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Inside debt and the maturity structure of corporate debt

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Abstract

Theory posits that providing CEOs with debt-like compensation such as defined benefit pensions and deferred compensation aligns managerial interests with the interests of debtholders and reduces agency costs of debt. Prior theoretical predictions also suggest that short-maturity debt is able to reduce agency costs of debt. I investigate whether inside debt compensation and short-maturity debt are substitute mechanisms to mitigate agency costs of debt. After controlling for previously known determinants of debt maturity, I find an inverse relation between CEO inside debt compensation and the use of short-maturity debt. This inverse relation is stronger when the payoff of inside debt compensation to CEOs more closely resembles the payoff of risky debt to external creditors.

Declaration

This essay is the sole work of the author whose name appears on the title page. It contains no material which the author has previously submitted for assessment at the University of Melbourne or elsewhere. To the best of the author's knowledge, the essay contains no material previously written or published by another person except where reference is made in the text of the essay.

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Signature of Student

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Contents

1 Introduction

Defined benefit pension plans and deferred compensation schemes often form a part of the firm-specific wealth of chief executive officers (CEOs) of U.S. companies. These amounts accrue to CEOs through their compensation contracts and usually represent obligations of the firm to pay fixed amounts to the CEO in the future.[1] Executive pensions and deferred compensation balances are generally unsecured and unfunded obligations of the firm, and in nearly all cases have equal priority in payment with external debtholders in bankruptcy.[2] Hence, the payoff to CEOs from these aspects of compensation resembles the payoff of risky debt held by external creditors. It is in this sense that executive pensions and deferred compensation constitute "inside debt." By affecting both the level and composition of CEO compensation, inside debt potentially alters managerial incentives.

The recent turmoil experienced globally in financial markets underscores the indefensibility of certain components of CEO pay when their firms face financial distress. It is intuitive that the wealth of CEOs is eroded as the share price of the firm falls and bonuses are forfeit. Perhaps less obvious, however, is the effect of financial distress on the value of the CEO's inside debt. As the payoff of inside debt can be characterized as the payoff of risky debt, CEOs with large inside debt holdings may manage the firm in a more conservative manner to preserve the value of their inside debt holdings.[3] This behavior is perhaps consistent with the objectives of external debtholders. That is, inside debt represents a potential mechanism that aligns the incentives of CEOs with that of debtholders.

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[1] Executive pensions are typically characterized by defined benefit pension schemes and entail a stream of fixed payments to the employee after retirement based on tenure and age; deferred compensation arrangements are typically characterized by defined contribution pension schemes, whereby the CEO defers current cash compensation and invests this into a retirement plan usually controlled by the firm.

[2] For further detail on the priority of executive pensions and deferred compensation in bankruptcy, see Sundaram and Yermack (2007) and Gerakos (2010).

[3] Two recent high-profile cases highlight the vulnerability of inside debt. Rick Wagoner, former CEO of General Motors, lost $20 million of his pension benefits when GM filed for bankruptcy (Sterne (2009)). Chrysler's bankruptcy meant it would no longer have an obligation to pay its former CEO, Lee Iacocca, a substantial portion of his pension benefits as the claim was unsecured (Chasan (2009)).

Jensen and Meckling's (1976) agency theoretic framework posits conflicts of interest between the principals (shareholders and debtholders) and agents (CEOs) of the firm. Agency costs of debt arise from CEOs reallocating wealth to shareholders at the expense of debtholders, typically through implementing investment and financing policies that increase overall firm risk. The maturity structure of corporate debt offers a channel through which the agency costs of debt can be minimized. Leland and Toft (1996) argue that short-maturity debt can reduce agency costs of debt arising from asset substitution since its value is less sensitive to the riskiness of the firm's assets than longer-term debt.

Barnea, Haugen, and Senbet (1980) propose that in a rational expectations framework, debtholders are fully aware of CEO incentives to alter overall firm risk arising from the compensation structure and incorporate this information in the pricing of debt contracts. Jensen and Meckling (1976) and, more recently, Edmans and Liu (2011) theorize that because the payoff structure of inside debt resembles risky debt, CEOs have weaker incentives to engage in risk-shifting behavior in order to preserve the value of their inside debt holdings. An important, yet unanswered, question arises from the confluence of the inside debt and debt maturity literatures. Do external debtholders perceive CEOs with larger inside debt holdings as having less incentive to pursue risky strategies, and hence is inside debt a substitute for short-maturity debt in mitigating the agency costs of debt? This issue is of particular importance, given that it is shareholders that ultimately bear the costs of agency suffered by other stakeholders. The main purpose of this paper is to investigate the relation between CEO inside debt holdings and the maturity structure of corporate debt to provide insight on this issue.

Though pension benefits and deferred compensation both constitute inside debt, several differences exist beyond this salient characteristic. Wei and Yermack (2011) document that while pension benefit values are normally accumulate to CEOs based on their tenure and cash compensation, deferred compensation balances accrue due to the CEO voluntarily foregoing current period cash compensation in return for fixed payments at a later date. The value of the CEO's deferred compensation depends on the rate at which it is invested. In most cases, CEOs are able to invest their deferred compensation at a fixed rate, in the company's own stock, or a portfolio of stocks and

bonds. As a consequence of this investment choice, the payoff from deferred compensation may depend on the value of the firm's equity if the CEO is credited with the rate of return earned on common stock. This suggests that deferred compensation may be less debt-like than pension benefits and provide a lower level of incentive alignment with debtholders than defined benefit pensions. In addition to this, Wei and Yermack (2011) note that CEOs may have greater flexibility as to the payment schedule of their deferred compensation arrangements. In some cases, CEOs are able to withdraw from their deferred compensation balances prior to retirement. These distinguishing characteristics are thus expected to render deferred compensation as less debt-like than pension benefits in the eyes of external debtholders. Edmans and Liu (2011) argue that the extent to which inside debt potentially mitigates agency costs of debt depends on how closely its payoff resembles that of risky debt. Since pension benefits are potentially more debt-like than deferred compensation, pension benefits are expected to provide CEOs with greater incentive alignment with debtholders than deferred compensation. The empirical results of my paper provide evidence consistent with this perspective.

I examine the relationship between the CEO's inside debt and the proportion of short-maturity debt in the firm's debt structure using a sample of 6,518 firm-year observations during the fiscal years 2006 to 2011. I employ alternative definitions of debt maturity and measures of inside debt incentives that have been empirically and theoretically motivated by the literature. After controlling for previously known determinants of debt maturity, I find an inverse relation between the use of short-maturity debt and CEO inside debt holdings, consistent with theoretical predictions. Additional analysis reveals that this inverse relation is primarily driven by CEO pension benefits, as opposed to deferred compensation. This observation supports Edmans and Liu's (2011) hypothesis that the mechanism through which inside debt reduces agency costs of debt is dependent on the extent to which inside debt is debt-like. Finally, I re-test my main hypotheses using a sample of 1,867 new public debt issues during the fiscal years 2007 to 2011 and find results consistent with the main analysis. Overall, the findings suggest inside debt aligns the incentives of CEOs with the incentives of debtholders and is a substitute for short-maturity debt in mitigating the agency costs of debt.

This paper advances the literature in several ways. First, my study extends the literature which explores the incentive effects of executive compensation structure. In particular, my paper contributes to a nascent literature on inside debt by providing empirical evidence on the role of inside debt in aligning CEO interests with that of debtholders. My paper complements extant research (see, e.g., Chava, Kumar, and Warga (2010), Anantharaman, Fang, and Gong (2010) and Chen, Dou, and Wang (2010)) that find a negative relation between inside debt incentives and the use of loan covenants, an alternative to short-maturity debt in alleviating agency costs of debt.

Second, my study contributes to the literature on the determinants of the maturity structure of corporate debt. To date, research on the interaction between compensation structure and debt maturity has focused on equity-based compensation. Datta, Iskandar-Datta, and Raman (2005) provide empirical evidence on the interaction between compensation structure and debt maturity by documenting a negative association between managerial stock ownership and debt maturity. Brockman, Martin, and Unlu (2010) extend Datta et al.'s (2005) analysis by showing that equity-based CEO incentives are also determinants of corporate debt maturity. I depart from this line of research by investigating the role of debt-based components of executive compensation in the determination of debt maturity structure. By documenting an inverse relation between inside debt holdings and short-maturity debt, I contribute to the understanding of the interaction between executive compensation and debt maturity.

The remainder of the paper is organized as follows. In section 2, I provide a review of the literature. Section 3 develops the hypotheses that relate inside debt and corporate debt maturity structure. Section 4 describes the sample and data. I present my empirical findings in section 5, and conclude the paper in section 6.

2 Literature review

Agency costs of equity and agency costs of debt are considered in Jensen and Meckling's (1976) framework. Equity is awarded to CEOs to induce effort, but this incentivizes CEOs to take excessive risks with respect to firm strategies from the viewpoint of external debtholders. Shareholders' incentives to increase overall firm risk increases in cases where the firm is highly levered and in cases where the firm is approaching financial distress. Jensen and Meckling (1976) suggest that compensating CEOs with debt in the firm potentially counteracts the risk-shifting problem. They propose the following argument: When the CEO's ratio of personal holdings in the firm's debt and equity equals the ratio of debt and equity of the firm, the CEO's incentive to alter the overall risk of the firm is eliminated since any risk-shifting does not affect the CEO's wealth.

Edmans and Liu (2011) build on Jensen and Meckling's (1976) theoretical prediction that providing debt compensation to CEOs can alleviate agency costs of debt and show that agency costs of debt are strictly decreasing in the CEO's inside debt holdings when effort and risk-shifting concerns are jointly considered. This insight is important given that it is shareholders who ultimately bear the costs of agency. Further, the optimal level of inside debt in the CEO's compensation structure is strictly positive. However, counter to Jensen and Meckling's initial hypothesis, they show that granting CEOs debt and equity in the firm in a ratio that equals the firm's debt-to-equity ratio is typically suboptimal in minimizing deadweight losses from agency. A debt bias (i.e., granting CEOs debt and equity in the firm in a ratio that exceeds the firm's debt-to-equity ratio) is optimal when the probability of bankruptcy is high, or when the CEO's influence on liquidation values is high since inside debt renders the CEO sensitive to the incidence of bankruptcy and the liquidation value of the firm in bankruptcy. Edmans and Liu also show that the payoff of inside debt compensation must closely resemble the payoff to risky debt in order for it to be effective in mitigating agency costs of debt. Departures in the payoff structure from risky debt is conjectured to reduce the effectiveness of inside debt compensation in mitigating agency costs of debt, or perhaps, induce excessive risk-shifting behavior in CEOs.

Though the use of inside debt in executive compensation in U.S. firms is not a recent phenomenon, systematic empirical research on the economic consequences of inside debt has been hindered by poor disclosure requirements relative to equity-based (e.g., stock and stock options) and cash-based (e.g., salary and bonuses) compensation. The U.S. Securities Exchange Commission (SEC) introduced more stringent disclosure requirements relating to executive compensation in 2006. Following the SEC's regulatory reform, firms are required to disclose the actuarial present value of pension benefits and the deferred compensation balances of their top five executives in their annual proxy statements.[4] Sundaram and Yermack (2007) provide the pioneering step in this field of research in a broad empirical analysis of CEO pension arrangements. Using a hand collected sample of executive compensation data for 237 large capitalization firms, Sundaram and Yermack document that CEOs' defined benefit pensions comprises a substantial portion of CEOs' firm-specific wealth. They document that CEOs with large inside debt holdings relative to equity holdings manage their firms more conservatively; Merton's (1974) Distance-to-Default measure, their proxy for default risk, is 0.4 standard deviations higher for CEOs whose firm-specific debt-to-equity ratio exceeds the firm's debt-to-equity ratio. Furthermore, they conjecture, but do not test, that firms whose CEOs have large inside debt holdings may utilize less short-maturity debt due to external creditors' perception of lower risk-shifting incentives, which is the focus of this paper.

Cassell et al. (2012) show that inside debt holdings directly affect the riskiness of firm policy choices of CEOs. Among the authors' findings, firms whose CEOs have large inside debt holdings relative to equity holdings have less R&D expenditures, lower leverage, greater diversification of the firm's operating segments, and greater asset liquidity. Taken together, Cassell et al. conclude that CEOs' incentives are altered by their inside debt holdings and that CEOs holding large amounts of inside debt implement more conservative investment and financing policies, consistent with theoretical predictions on the incentive effects of inside debt.

[4] Gerakos (2010) provides a detailed discussion regarding the SEC's 2006 compensation disclosure reform and its implications for firms' reporting requirements of inside debt.

The branch of corporate finance research on debt covenants is related to my study on inside debt and the use of short-maturity debt. Rajan and Winton (1995) argue that the use of loan covenants and short-maturity debt are substitutes in minimizing agency costs of debt. Chava et al. (2010) document that publicly traded debt securities are less likely to contain covenants when the CEO receives large pension benefits as part of the compensation structure. The negative relation between CEOs' pension benefits and the probability of inclusion of covenants is particularly evident for covenants restricting investment activities that raise default risk. Similarly, Chen et al. (2010) find that the restrictiveness of covenants are decreasing in CEO inside debt levels. Anantharaman et al. (2010) complement Chava et al. (2010) and Chen et al.'s (2010) studies by investigating the debt covenants of private loan contracts. Similarly, they conclude that covenant usage in private settings is decreasing in the inside debt holdings of the CEO. Anantharaman et al. (2010) note that private loans provide a unique insight into the influence of inside debt on perceived risk from creditors' perspectives as private lenders are usually privy to proprietary firm information during the contracting process.

Several studies turn their attention to the market implications of CEOs' inside debt holdings. Bolton, Mehran, and Shapiro (2011) study a sample of financial institutions and find significantly positive abnormal credit default swap (CDS) returns for CEOs of financial firms that have higher than median defined benefit pensions and deferred compensation balances. The lower CDS spread implies investors' expectations of the probability of the financial firm's default is lower when the CEO has large inside debt holdings. Tung and Wang (2010) document that CEOs of banks with large inside debt holdings were less involved in risky investment activities during the recent financial crisis. Importantly, Bolton et al. (2011) and Tung and Wang's (2010) analyses relate to financial institutions, which typically have highly leveraged capital structures. Therefore, risk-shifting concerns may be of first-order importance in this setting. Wei and Yermack (2011) study the effect of the revelation of CEOs' inside debt holdings following the SEC's executive compensation disclosure reform in 2006 on stock and bond prices for non-financial firms in the Standard and Poor's 1500 index. They find that stocks experienced significantly negative abnormal returns, and corporate bonds experienced significantly positive abnormal returns around the time of announcement of the CEO's inside debt holdings. This effect is more pronounced for CEOs whose ratio

of holdings of debt and equity in the firm is greater than the debt-to-equity ratio of the firm. For firms whose CEOs have sizeable inside debt holdings relative to equity holdings, the authors also document that the volatility of returns for both stocks and bonds and implied volatilites of exchange-traded options are lower in the period following the disclosure reform compared to the pre-reform period. Collectively, investors' reactions appear to be consistent with the expectation that large inside debt holdings potentially give CEOs incentives to implement more conservative, lower risk operating strategies (as in Cassell et al. (2012)) that shift the alignment of CEO interests towards that of debtholders.

An extensive and rich literature examines the determinants of the maturity structure of corporate debt. The literature provides an extensive set of theoretical frameworks that hypothesizes the factors that affect the debt maturity choices of firms. Briefly, these are the tax hypothesis of Brick and Ravid (1985), the signaling hypothesis ofFlannery (1986), the liquidity risk hypothesis of Diamond (1991) and Sharpe (1991), and Myers (1977) and Barnea et al.'s (1980) agency costs frameworks. Myers (1977) proposes that shareholders have incentives to reject profitable projects under certain conditions where the debtholders are able to capture enough of the benefits of the project such that shareholders do not earn a normal return. This deadweight loss from agency (i.e., the underinvestment problem) can be eliminated through the firm issuing short-maturity debt to fund projects. When short-term debt matures before the firm's growth options expire, the firm is able to re-price debt so that the benefits of positive net present value projects do not accrue to debtholders. Barnea et al. (1980) argue that short-maturity debt can also reduce the asset substitution problem, whereby shareholders, and by extension, CEOs acting in shareholders' interests, have incentives to substitute investment into high-risk projects following the issuance of debt. Barnea et al. (1980) take the position that, with rational expectations, debtholders recognize the incentive problem and discount the value of debt accordingly and thus shareholders ultimately bear the costs of agency suffered by debtholders. Short-maturity debt is less sensitive to changes in risk of the firm's projects, hence reducing the incentive for shareholders to engage in risk-shifting behavior to reallocate wealth from debtholders to themselves. Taken together, Myers (1977) and Barnea et al.'s (1980) agency cost perspectives on the maturity structure of debt suggests issuing short-maturity debt is an effective mechanism to

minimize the agency costs of debt that would otherwise be borne by the firm's shareholders.[5]

Given the importance of the debt maturity choice in minimizing agency costs of debt, and that this decision is at the discretion of top managers of the firm, the role of executive compensation in altering managerial incentives becomes of particular interest. There is considerable empirical evidence in support of the agency cost perspectives that debtholders recognize the incentive problem arising from CEO compensation structure (see, e.g., Coles, Daniel, and Naveen (2006) and Billett, Mauer, and Zhang (2010), among others). To date, the literature on debt maturity and executive compensation has focused on managerial incentives stemming from equity-based compensation. The focus of my study is on the incentives provided by inside debt. Rajan and Winton (1995) and Stulz (1990) comment that short-maturity debt allows debtholders to subject CEOs to greater monitoring frequency and hence limit managerial discretion. Datta et al. (2005) provide evidence of an inverse relation between the equity stake of the firm's top five managers and the proportion of short-maturity debt in the firm's debt structure. They argue that a stronger manager-shareholder interest alignment means managers are more willing to commit to more frequent monitoring by issuing short-maturity debt. An alternative interpretation of Datta et al. is that because managers are more strongly aligned with shareholders, agency costs of debt are higher. In order to reduce the losses from debt-related agency, more short-maturity debt is issued as theorized by Myers (1977) and Barnea et al. (1980). Brockman et al. (201) show that short-maturity debt can mitigate agency costs of debt due to executive compensation risk. They find a positive relation between short-maturity debt and CEOs' risk appetites as measured by CEO delta and vega.[6]

[5] Though the theoretical predictions of Brick and Ravid (1985), Flannery (1986), Diamond (1991), and Sharpe (1991) are not the main focus of my paper, I control for the factors that are predicted to influence debt maturity in their models in my empirical analysis.

[6] Delta (vega) is the sensitivity of the CEO's firm-specific wealth to changes in the stock price (stock volatility). To the extent that CEOs are underdiversfied with respect to their wealth, a high delta is expected to decrease the CEO's appetite for risk. A high vega is expected to increase risk appetites due to the convex payoff structure of executive stock options.

3 Hypotheses

I begin by investigating the implications of CEO inside debt holdings on the debt maturity structure of the firm. CEO defined benefit pensions and deferred compensation balances typically represent unfunded, unsecured obligations of the firm that have equal priority in payment as risky debt in the event of bankruptcy. Prior empirical research shows that inside debt compensation influences CEOs' incentives and hence behavior. Cassell et al. (2012) provide evidence that CEOs implement less risky investment and financing policies when they have large inside debt holdings. Their results are consistent with the notion that because inside debt holdings are sensitive to the event of bankruptcy and the liquidation value of the firm, CEOs manage the firm in a more conservative manner to preserve the value of their inside debt holdings. Therefore, CEOs with large inside debt holdings are expected to have reduced incentive to engage in risky asset substitution, thereby potentially reducing debt-related agency costs. Further, due to the concave payoff structure of risky debt, holders of risky debt (i.e., external creditors) generally prefer the firm to engage in low-risk strategies that minimize the probability of bankruptcy. Hence, inside debt compensation is expected to shift CEOs' interests towards that of debtholders.

Previous theoretical research on debt maturity structure argues that short-maturity debt is able to mitigate agency costs of debt. The value of short-maturity debt is less sensitive to changes in the riskiness of the firm's projects, hence incentives for CEOs acting in the interests of shareholders to transfer wealth from debtholders to shareholders by shifting investment into high-risk projects is reduced. Short-maturity debt also provides debtholders greater ability to monitor management and limit managerial discretion that would harm their interests due to increased refinancing frequency. Inside debt compensation and short-maturity debt are therefore potential substitute mechanisms to minimize agency costs of debt that would otherwise be borne by shareholders of the firm. Based on the preceding arguments, I therefore expect a negative association between CEO inside debt holdings and the proportion of short-maturity debt in the firm's debt structure. This is the central hypothesis of my study.

I also examine whether the relation between CEO inside debt holdings and debt maturity is influenced by the composition of CEO inside debt holdings. Edmans and Liu (2011) posit that the effectiveness of inside debt compensation in mitigating agency costs of debt hinges on the extent to which the payoff to CEOs of inside debt holdings resembles risky debt held by external creditors. Two characteristics of deferred compensation potentially render this amount as less debt-like in nature than defined benefit pensions. Firstly, prior empirical research (e.g., Wei and Yermack (2011)) document that deferred compensation arrangements sometimes allow, or indeed require, the CEO's deferred compensation to be invested in the company's own stock, implying the payoff depends on equity values. Secondly, the payment schedule is more flexible, with CEOs able to withdraw from their deferred compensation balances prior to retirement in some cases. Therefore, deferred compensation is expected to reduce agency costs of debt to a lesser extent than defined benefit pensions. Hence, the relation between defined benefit pensions and short-maturity debt is predicted to be stronger than the relation between deferred compensation and short-maturity debt.

To summarize, my hypotheses on the relation between CEO inside debt holdings and debt maturity can be stated as follows:

H1: There is a negative relation between CEO inside debt holdings and the proportion of short-maturity debt.

H2: The negative relation between CEO defined benefit pensions and short-maturity debt is stronger than the relation between deferred compensation and short-maturity debt.

4 Data and variables

4.1 Data sources and sample selection

CEO compensation data are collected from the Execucomp database. Firm specific financial accounting data are obtained from Compustat annual files. Stock return and price data are obtained from CRSP monthly files. I start with compensation data from the Execucomp database. Execucomp provides the compensation data for executives of firms in the S&P 500, S&P MidCap 400, and S&P SmallCap 600. Given that the SEC's increased disclosure requirements relating to executive compensation came into effect in 2006, this provides a natural starting period for the sample. I collect compensation data for executives identified as CEOs for the fiscal years 2006 to 2011. I require that CEOs' data on the actuarial present value of their pension benefits and deferred compensation are available to compute their inside debt holdings. The initial sample is then matched to Compustat and CRSP. Following prior studies on debt maturity (e.g., Johnson (2003), Datta et al. (2005), and Brockman et al. (2010)), I discard firm-year observations that have potentially erroneous debt maturities (i.e., less than 0% or greater than 100% of total debt maturing within a specified period). I require that firm-year observations have non-missing data to construct the variables used in the study (discussed in Section 4.2) to be included in the sample. Finally, I trim continuous variables at the 1^{st} and 99^{th} percentiles of the empirical distribution to eliminate the potential effect of outliers. The preceding procedures result in the final sample of 6,518 firm-year observations, based on 1,009 unique firms in the Standard and Poor's 1500 index over the fiscal years 2006 to 2011. Panel A of Table I provides the sample reconciliation.

Table I

Sample reconciliation and distribution

This table provides the sample reconciliation (Panel A), the sample distribution by year (Panel B), and the sample distribution by 2-digit SIC code (Panel C). The sample consists of 6,518 firm-year observations based on 1,009 unique firms and covers the fiscal years 2006 to 2011.

Panel A: Sample reconciliation		
Total number of observations in Execucomp from 2006 to 2011	11,108	
Less number of observations for which debt maturity is missing	(3,032)	
Less number of observations for which debt maturity is potentially erroneous	(254)	
Less number of observations for which data on inside debt is missing	(321)	
Less number of observations trimmed at 1st and 99th percentiles	(983)	
Final sample	6,518	
Panel B: Sample distribution by year		
Year	*N*	*Percent*
2006	1,090	16.7%
2007	1,080	16.6%
2008	1,007	15.4%
2009	1,151	17.7%
2010	1,149	17.6%
2011	1,041	16.0%
Total	6,518	100.0%
Panel C: Sample distribution by 2-digit SIC code		
Industry	*2-digit SIC code*	*N*	*Percent*
Oil & gas extraction	13	198	3.0%
Food & kindred products	23	168	2.6%
Papers & allied products	26	81	1.2%
Chemicals & allied products	28	371	5.7%
Primary metal industries	33	103	1.6%
Fabricated metal products	34	76	1.2%
Machinery & computer equipment	35	257	3.9%
Electronic & other equipment	36	1,241	19.0%
Transportation equipment	37	586	9.0%
Measuring, analyzing & controlling instruments	38	391	6.0%
Air transportation	45	986	15.1%
Communications	48	85	1.3%
Electric, gas & sanitary services	49	381	5.8%
Wholesale: durable goods	50	103	1.6%
Eating & drinking places	58	77	1.2%
Miscellaneous retail	59	70	1.1%
Business services	73	213	3.3%
Health services	80	83	1.3%
Other (<1% representation)		1,048	16.1%
Total		6,518	100.0%

4.2 Variable descriptions

4.2.1 Dependent variable: Debt maturity

My predictions focus on the use of short-maturity debt in the firm's debt structure. Compustat reports the amount of long-term debt due in 1 year through to 5 years at the end of the fiscal year.[7] I measure the debt maturity as the proportion of the firm's total debt that matures in 3 years or less as *DEBT3*. Following the Johnson (2003) and Brockman et al. (2010), I calculate *DEBT3* for each firm as the sum of current liabilities, debt due in 2 years, and debt due in 3 years as a proportion of the sum of current liabilities and long-term debt at the end of the fiscal year. As an alternative, *DEBT5*, debt maturity is measured as the proportion of the firm's total debt that matures in 5 years or less, and is calculated as the sum of current debt and debt due in 2 through to 5 years as a proportion of the sum of current liabilities and long-term debt.[8]

4.2.2 Variable of interest: Inside debt compensation

Jensen and Meckling (1976) and, more recently, Edmans and Liu (2011) provide the theoretical prediction that CEO inside debt holdings potentially provide incentives to CEOs to manage the firm in a more conservative manner, simultaneously reducing agency costs of debt. I define *CEO inside debt holdings* for each CEO as the sum of the actuarial present value of their pension benefits and deferred compensation as reported in Execucomp in thousands of dollars at the fiscal year end. This measure of inside debt holdings is consistent with recent empirical studies including Anantharaman et al. (2010), Wei and Yermack (2011), and Cassell et al. (2012), among others. Due to the concave payoff structure of inside debt compensation, CEOs with large inside debt holdings are expected to be rendered more sensitive to the incidence of bankruptcy and hence manage the firm in a more conservative manner consistent with debtholders' incentives, all else equal. Therefore, I expect there to be a negative relation between *CEO inside debt holdings* and *DEBT* and *DEBT5*.

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[7] Beyond 5 years, Compustat aggregates the total amount of long-term debt due into a single value.

[8] Other studies on debt maturity (e.g., Barclay and Smith (1995), Barclay, Marx, and Smith (2003), and Datta et al. (2005)) use the complement of my measures (i.e., 1–*DEBT3* or 1–*DEBT5*) as the measure of debt maturity.

The proportions of debt and equity compensation (i.e., the compensation structure) may be important in capturing the incentive effects of inside debt compensation on the CEO. Specifically, Jensen and Meckling (1976) argue that when the CEO's personal holdings of debt and equity in the firm is equal to the firm's debt-to-equity ratio, the incentive for the CEO to risk-shift is eliminated, since risk-shifting would not increase the value of the CEO's total holdings of debt and equity in the firm. Motivated by this argument, I include as an alternative variable of interest the *CEO to firm debt-to-equity ratio*. I follow recent empirical applications of this variable (e.g., Sundaram and Yermack (2007), Wei and Yermack (2011), and Cassell et al. (2012)) in calculating *CEO to firm debt-to-equity ratio* as

$$CEO\ to\ firm\ debt-to-equity\ ratio = \frac{(CEO's\ inside\ debt\ holdings\ /\ CEO's\ equity\ portfolio\ holdings)}{(Book\ value\ of\ firm\ debt/Market\ value\ of\ firm\ equity)} \quad (1)$$

where the CEO's inside debt holdings is as previously defined; the CEO's equity portfolio holdings is the value of stock (including restricted stock) and options (including unvested options) in the firm as reported by Execucomp. Book value of firm debt is the sum of current and long-term debt, and the market value of firm equity is the number of shares outstanding in the firm multiplied by the stock price at the fiscal year end. Similarly, I hypothesize an inverse relation between *CEO to firm debt-to-equity ratio* and *DEBT3* (*DEBT5*).

4.2.3 Control variables

I control for determinants of debt maturity that have been theoretically motivated in the prior literature and the empirical findings of previous debt maturity studies. The construction of the control variables discussed below are largely consistent with prior empirical debt maturity studies including Johnson (2003), Datta et al. (2005), Brockman et al. (2010), Barclay and Smith (1995), Billett, King, and Mauer (2007), and Guedes and Opler (1996), among others.

Datta et al. (2005) provide evidence that there is a negative association between managerial stock ownership and short-maturity debt. This is consistent with the notion that in the presence of strong manager-shareholder incentive alignment managers will

not be averse to frequent monitoring by debtholders associated with short-maturity debt. An agency cost perspective interpretation is that high managerial ownership increases agency costs of debt, hence more short-maturity debt is issued to minimize debt-related agency costs. As in Brockman et al. (2010), I calculate the proportion of shares in the firm owned by the CEO (*Ownership*) as the number of shares owned by the CEO divided by the number of common shares outstanding in the firm.

The nature of a firm's assets is theorized to be related to the nature of its liabilities. Johnson (2003) argues that firms with greater asset return volatility (*Asset std. dev.*) have a lower probability of repaying debt and hence have a preference for long-term debt over short-term debt. Consistent with Johnson (2003) and Brockman et al. (2010), I measure *Asset std. dev.* as the ratio of the market value of equity to the market value of the firm multiplied by the monthly stock return standard deviation over the fiscal year, where the market value of assets is the market value of equity plus the book value of debt less the book value of assets.

Myers (1977) argues that firms are able to reduce agency costs of debt associated with incentives for shareholders to forgo profitable projects by matching the maturities of assets (*Asset maturity*) and liabilities. This suggests that firms with longer asset maturities have longer debt maturities, hence there is expected to be a negative relation between *Asset maturity* and short-maturity debt. I follow Guedes and Opler (1996), Johnson (2003), and Datta et al. (2005) in calculating *Asset maturity* as the book value-weighted maturity of the firm's assets, where the maturity of long-term assets is gross property, plant and equipment scaled by depreciation expense. The maturity of short-term assets is calculated as current assets divided by cost of goods sold.

Myers (1977) also theorizes that the underinvestment problem is of greater concern for firms with greater growth opportunities. Myers proposes that shareholders' disincentives to accept positive net present value projects can be eliminated by issuing short-term debt that matures before growth options expire. Hence, I expect a positive relation between growth opportunities and short-maturity debt. I proxy for growth opportunities using the firm's market-to-book ratio (*M/B*), which is measured as the ratio of the market value of assets to the book value of total assets of the firm.

Diamond (1991) argues that there is a positive relation between leverage and debt maturity as highly levered firms seek to reduce their liquidity risk. I define *Leverage* as the ratio of the book value of debt to the market value of assets of the firm, consistent with Barclay and Smith (1995), Johnson (2003) and Datta et al.'s (2005) papers. Diamond (1991) further predicts a non-linear relationship between the credit quality of a firm and the proportion of short-term debt. In Diamond's model, high credit quality borrowers prefer short-term debt to refinance debt more frequently as favorable future prospects are revealed, while low quality borrowers are more likely to prefer long-term debt to avoid liquidity risk. Very low credit quality firms, however, can only issue short-maturity debt. I follow Barclay, Marx, and Smith (2003), Billett, King, and Mauer (2007) in using firm size, measured as the market value of equity plus the book value of assets minus the book value of equity, to proxy for credit quality. Specifically, I include the natural logarithm of size (*Size*) and its squared value ($Size^2$) as control variables in my empirical analysis. According to Diamond's prediction, the use of short-maturity debt is negatively related to *Size* and positively related to $Size^2$. Similarly, Flannery's (1986) signaling hypothesis of debt maturity suggests short-maturity debt is issued by high quality firms given that it is too costly for low quality firms to replicate. Therefore, I follow Barclay and Smith (1995) and Datta et al. (2005) in including as a control and measuring *Abnormal earnings* as difference between earnings per share in year t and year t–1 divided by the share price in year t–1. To the extent that high *Abnormal earnings* signals to investors high future cash flows, the signaling hypothesis implies the coefficient on *Abnormal earnings* is expected to be positive.

I further proxy for credit quality by including a zero-one dummy variable set equal to one if the firm has a long-term debt S&P credit rating, and zero otherwise (*Rating dummy*). I also include a zero-one dummy variable set equal to one if the firm has an Altman's (1968) Z-score greater than 1.81, and zero otherwise (*Z-score dummy*). Firms with a long-term debt credit rating and high Z-scores (i.e., further away from financial distress) are likely to be able to access long-term debt funding more easily than firms limited to private debt or closer to financial distress. Therefore, there is an expected negative relation between short-maturity debt and *Rating dummy* and *Z-score dummy*.

The existence of other market frictions such as industry regulations and taxes might also affect the debt maturity structure of a firm. Barclay and Smith (1995) propose that CEOs of firms in regulated industries might face greater restrictions with respect to their investment choices and thus have less incentive to issue short-maturity debt to mitigate agency costs of debt. Regulated firms are defined as in Barclay and Smith and previous studies (e.g., Datta et al. (2005) and Brockman et al. (2010)) as firms with 4-digit Standard Industrial Classification (SIC) codes between 4900 and 4939 (i.e., utility firms). *Regulation dummy* is a dummy variable set equal to one if the firm is in a regulated industry and zero otherwise. According to Brick and Ravid's (1985) tax hypothesis of debt maturity, when the term structure of interest rates is upward sloping, the use of long-term debt increases firm value as higher long-term interest rates accelerate the receiving of interest tax shields. I follow Brockman et al. (2010) in calculating *Term* as the difference between the yields on 10-year government bonds and 6-month government bonds. Yields on government bonds are obtained from the St. Louis Federal Reserve Bank economic database.

4.3 Sample distribution and descriptive statistics

Panel A of Table I provides the sample reconciliation. Panel B and Panel C of Table I provide the distribution of observations over the sample period and across industries classified by 2-digit SIC codes, respectively. Sample firms appear to be distributed relatively evenly over the sample period and represent a diverse range of industries.

Table II provides descriptive statistics for the variables used in the main analysis. The proportion of debt maturing in 3 years or less as measured by the dependent variable *DEBT3* is 39% for sample firms. The proportion of debt maturing in 5 years or less (*DEBT5*) is 60%. These values are similar to the debt maturities reported by Datta et al. (2005) and Brockman et al. (2010). The proportion of debt maturing in 3 years or less in Johnson's (2003) study is 55%. The mean inside debt holding of sample CEOs is $4.1 million. The mean value of CEOs' pension benefits ($2.4 million) is greater than the mean value of deferred compensation ($1.7 million). The CEO to firm debt-to-equity ratio has a mean of 0.969 and a median of 0.004, suggesting the CEO's debt-to-

Table II

Summary statistics

This table shows the summary statistics for sample observations. The sample consists of 6,518 firm-year observations based on 1,009 unique firms and covers the fiscal years 2006 to 2011. *DEBT3* is the sum of current liabilities, debt due in 2 years, and debt due in 3 years as a proportion of the sum of current debt and long-term debt. *DEBT5* is the sum of current liabilities, and debt due in years 1 through 5 as a proportion of the sum of current debt and long-term debt. *Pension benefits* is the CEO's actuarial present value of pension benefits as reported in Execucomp. *Deferred compensation* is the CEO's deferred compensation balance as reported in Execucomp. *Inside debt holdings* is calculated as the sum of *Pension benefits* and *Deferred compensation*. *Inside equity* is measured as the value of stock, restricted stock, options, and unvested options as reported in Execucomp. *CEO to firm debt-to-equity ratio* is calculated as (*Inside debt holdings* ÷ *Inside equity holdings*) / (book value of debt ÷ market value of equity). *CEO vega* is the dollar change in CEO wealth for a 1% change in stock volatility. *Ownership* is defined as the proportion of shares outstanding in the firm owned by the CEO. *Size* is measured as (market value of equity + book value of assets – book value of equity). *Leverage* is defined as the ratio of the book value of debt to the market value of the firm. *Asset maturity* is (gross property, plant and equipment ÷ depreciation) × (gross property, plant and equipment ÷ total assets) + (current assets ÷ total assets) × (current assets ÷ cost of goods sold). *Asset std. dev.* is measured as monthly stock return standard deviation × (market value of equity ÷ market value of assets). *M/B* is computed as (market value of assets ÷ book value of assets). *Abnormal earnings* is calculated as (earnings per share at t – earnings per share at t–1) / share price at t–1. *Term* is measured as the difference in yield on 10-year government bonds and 6-month government bonds. *Rating dummy* is a zero-one dummy set equal to one if the firm has an S&P credit rating, and zero otherwise. *Z-score dummy* is a zero-one dummy set equal to one if the firm has an Altman's (1968) Z-score greater than 1.81, and zero otherwise. *Regulation dummy* is a zero-one dummy set equal to one for firms with 4-digit SIC codes between 4900 and 4939, and zero otherwise.

Variable	N	Mean	Std. Dev	25%	50%	75%
DEBT3	6,518	0.39	0.29	0.19	0.32	0.51
DEBT5	6,518	0.60	0.29	0.38	0.59	0.93
Pension benefits($000's)	6,518	2,398	6,277	0.00	0.00	1,138
Deferred compensation ($000's)	6,518	1,708	6,192	0.00	0.00	898
Inside debt holdings ($000's)	6,518	4,107	10,151	0.00	33.22	3,682
Inside equity holdings ($000's)	6,518	76,315	825,142	4,122	13,665	35,154
CEO to firm debt-to-equity ratio	6,518	0.97	2.60	0.00	0.00	0.78
CEO vega	4,766	1.97	2.85	0.37	0.94	2.55
Ownership	6,518	0.02	0.05	0.00	0.01	0.02
Size ($000,000's)	6,518	10,306	20,179	1,811	3,966	9,336
Leverage	6,518	0.18	0.13	0.09	0.15	0.27
Asset maturity	6,518	11.04	9.41	3.91	8.45	16.51
Asset std. dev.	6,518	0.07	0.04	0.04	0.06	0.09
M/B	6,518	1.79	1.25	1.12	1.40	1.91
Abnormal earnings	6,518	-0.06	0.30	-0.02	0.00	0.02
Term (%)	6,518	2.03	1.25	1.65	2.11	3.25
Rating dummy	6,518	0.50	0.50	0.00	1.00	1.00
Z-score dummy	6,518	0.89	0.32	1.00	1.00	1.00
Regulation dummy	6,518	0.06	0.23	0.00	0.00	0.00

equity is lower than the firm's debt-to-equity ratio for the majority of firms. The average inside debt holdings and CEO to firm debt-to-equity ratio is smaller than those reported by Cassell et al. (2012) ($7.0 million and 2.322, respectively), though their sample excludes observations for which the CEO has zero inside debt.

The sample firms are relatively large with a mean (median) firm value of $10.3 billion ($4.0 billion). The mean (median) leverage for sample firms is 18.2% (14.9%). These values and the descriptive statistics for the remaining control variables are similar to those reported by Datta et al. (2005) and Brockman et al. (2010) in their studies on debt maturity.

5 Multivariate results

5.1 Inside debt compensation

I estimate the following pooled ordinary least squares (OLS) model to test hypothesis H1 that there is a negative relation between inside debt and the proportion of short-maturity debt in the firm's debt structure:

$$DEBT3_{i,t}\left(DEBT5_{i,t}\right) = \beta_0 + \beta_1 CEO's\ inside\ debt\ holdings_{i,t} + \delta' X_{i,t} + industry\ fixed\ effect + year\ fixed\ effect + \epsilon_{i,t} \quad . \tag{2}$$

The dependent variable is the proportion of debt that matures in 3 years or less, or the proportion of debt that matures in 5 years or less. The key variable of interest is the *CEO's inside debt holdings*. Alternatively, in place of *CEO's inside debt holdings* I include *CEO to firm debt-to-equity ratio* as the variable of interest in the regression. In total, this yields four specifications, one for each combination of the dependent variable and inside debt variable of interest. The regression models include a vector of control variables $X_{i,t}$ discussed in Section 4.2. Each specification includes industry (2-digit SIC) fixed effects to control for unobserved cross-sectional heterogeneity in the determinants of debt maturity at the industry level.[9] Year fixed effects are included to capture time-series variation in the data. The error term $\epsilon_{i,t}$ is potentially serially correlated and heteroskedastic.

[9] In unreported results, I include firm fixed-effects instead of industry fixed-effects in my specification and find that all variables become insignificant at conventional levels, suggesting that there is little variation in the included explanatory variables within individual firms. This is potentially explained by the relatively short sample period as a result of CEO inside debt data only being available for the fiscal year 2006 onwards.

Columns 1 and 2 of Table III provide the estimation results where the dependent variable is *DEBT3*. According to H1, there is a negative relation between the CEO's inside debt holdings and the proportion of short-term debt. I find evidence in support of this main hypothesis. In column 1, the variable of interest is *CEO's inside debt holdings*. The regression results suggest that when the proportion of short-maturity debt in the firm's debt structure is lower when the CEO has greater inside debt holdings. This is consistent with the argument that inside debt compensation is able to reduce agency costs of debt, and hence is a substitute for short-maturity debt. The results for the model with *CEO to firm debt-to-equity ratio* as the variable of interest is shown in column 2. The estimated coefficient on *CEO to firm debt-to-equity ratio* is negative, as predicted, but lacks explanatory power. In the specifications in columns 3 and 4, I replace *DEBT3* with *DEBT5* as the measure of debt maturity. Similar to the results in column 1, the coefficient on *CEO's inside debt holdings* (column 3) is negative and highly significant. Again, this finding is consistent with the main hypothesis that inside debt incentives reduce agency costs of debt. The estimated coefficient on *CEO to firm debt-to-equity ratio* (column 4) is negative, but marginally insignificant at the 5% level. Collectively, the results in Table III provide evidence that suggests inside debt is a substitute for short-maturity debt in mitigating agency costs of debt.

Though the coefficient estimates on *CEO to firm debt-to-equity ratio* are both negative as predicted, they are weaker in terms of statistical significance than the corresponding coefficients on *CEO's inside debt holdings*. However, these results are consistent with the perspective that the *CEO to firm debt-to-equity ratio* also implicitly takes into account incentive effects arising from the CEO's stock and options in the firm. Indeed, all sample firm CEOs hold some form of inside equity and this holding is, on average, of substantial value. Hence, when a CEO holds both inside debt and equity, CEO incentives stemming from inside debt to reduce firm risk is potentially partially mitigated by incentives arising from inside equity. Nonetheless, when the ratio of the CEO's personal debt and equity holdings in the firm increases relative to the firm's debt-to-equity ratio, the CEO appears to exhibit stronger alignment with debtholders' incentives. I further control for finer measures of equity-based compensation incentives by controlling for CEO vega in Section 5.2.

Table III

Relation between debt maturity and inside debt incentives

This table shows the pooled OLS regression estimates for the four specifications. In columns 1 and 2 (3 and 4), the dependent variable is *DEBT3* (*DEBT5*). The sample consists of 6,518 firm-year observations based on 1,009 unique firms and covers the fiscal years 2006 to 2011. All variables are defined in Table II. Each model includes industry (2-digit SIC) fixed effects and year fixed effects. Statistical significance is based on robust standard errors clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

		Dependent Variables							
		DEBT3				*DEBT5*			
		(1)		(2)		(3)		(4)	
Independent Variables	Predicted Signs	Coefficient Estimate	*p*-value	Coefficient Estimate	*p*-value	Coefficient Estimate	*p*-value	Coefficient Estimate	*p*-value
CEO's inside debt holdings	–	–0.0011**	0.041			–0.0020***	0.002		
CEO to firm debt-to-equity ratio	–			–0.0018	0.513			–0.0055*	0.054
Ownership	+	0.2527*	0.078	0.2498*	0.083	0.1308	0.365	0.1179	0.418
Size	–	–0.2507***	0.000	–0.2400***	0.000	–0.1490***	0.000	–0.1314***	0.002
Size^2	+	0.0132***	0.000	0.0123***	0.000	0.0069***	0.005	0.0055**	0.028
Leverage	–	–0.1956	0.257	–0.2099	0.236	–0.0518	0.717	–0.0925	0.539
Asset maturity	–	–0.0009	0.514	–0.0009	0.541	–0.0025*	0.059	–0.0023*	0.077
Asset std. dev.	+	–0.0700	0.910	–0.0680	0.914	0.8358	0.152	0.8172	0.164
M/B	+	0.0369***	0.000	0.0377***	0.000	0.0322***	0.000	0.0335***	0.000
Abnormal earnings	+	–0.0678***	0.003	–0.0689***	0.002	0.0064	0.741	0.0040	0.838
Term	–	–0.0263**	0.048	–0.0264**	0.046	–0.0122	0.380	–0.0125	0.368
Rating dummy	–	–0.1324***	0.000	–0.1323***	0.000	–0.1074***	0.000	–0.1065***	0.000
Z-score dummy	–	0.0070	0.814	0.0043	0.886	0.0048	0.855	–0.0002	0.993
Regulated dummy	–	0.1252***	0.010	0.1159**	0.022	0.1474**	0.022	0.1313*	0.052
Intercept		1.5450***	0.000	1.5155***	0.000	1.2811***	0.000	1.2404***	0.000
Industry fixed effects		Yes		Yes		Yes		Yes	
Year fixed effects		Yes		Yes		Yes		Yes	
N		6,518		6,518		6,518		6,518	
Adjusted R^2		0.2713		0.2705		0.3672		0.3658	

To gauge the economic significance of incentives arising from inside debt compensation, I calculate the effect on the proportion of short-maturity debt in the firm's debt structure for a one standard deviation increase in the respective inside debt variables. I focus on the *DEBT5* regressions shown in columns 2 and 4 of Table III. The slope coefficients on *CEO's inside debt holdings* and *CEO to firm debt-to-equity ratio* are -0.0020 and -0.0054, respectively. For a one standard deviation increase in the CEO's inside debt holdings, the firm's use of short-maturity debt decreases by 2.1% points. The same computation applied to the CEO's relative debt-to-equity ratio leads to a 1.4% point decrease in the use of short-maturity debt. The effect of inside debt compensation appears to be moderately economically significant.

Besides the coefficients on the variables of interest, the coefficients on the control covariates are generally consistent and as predicted across all specifications. Consistent with Datta et al.'s (2005) prediction and empirical results, I find that managerial stock ownership (*Ownership*) is positively related to proportion of short-maturity debt. Though, this relation is not statistically significant in the *DEBT5* regressions. The regression results strongly suggest a non-linear relation between the debt maturity choice of a firm and firm size, in support of Diamond's (1991) liquidity risk theory. I obtain insignificant results for the coefficient on *Leverage*, though it is reliably negative across all specifications, as is found in prior studies. The negative coefficients on *Asset maturity* implies firms have a preference for longer maturity debt when asset maturities are longer.

Contrary to the findings of Brockman et al. (2010), I find a strong positive relation between the firm's growth opportunities (*M/B*) and the use of short-maturity debt. This result supports the view that firms with more valuable growth opportunities issue more short-maturity debt to minimize agency costs related to underinvestment and asset substitution. The signs of the coefficients on *Abnormal earnings* are counter to expectations and significant in the *DEBT3* specifications, and have the expected signs though are insignificant in the *DEBT5* specifications. It is not immediately clear why this is the case. As expected, firms with credit ratings (*Rating dummy* equal to 1) have less short-term debt presumably because it is less costly for them to issue long-maturity debt relative to unrated firms. Although the coefficients for the remaining controls are

either inconsistent across specifications or the signs on estimated coefficients contrary to theory, prior studies also document such results (e.g., Johnson (2003), Datta et al. (2005), and Brockman et al. (2010)).

After controlling for previously known theoretical and empirical determinants of debt maturity, I find an empirical negative relationship between CEO inside debt holdings and the use of short-maturity debt. I interpret the results to be consistent with the theoretical argument advanced by Jensen and Meckling (1976) and Edmans and Liu (2011) that inside debt reduces the agency cost of debt.

5.2 CEO vega incentives

In the previous section, I control for CEO inside equity incentives explicitly through *Ownership*, and implicitly through *CEO to firm debt-to-equity ratio*. Recent empirical studies (e.g., Coles et al. (2006), Brockman et al. (2010), and Cassell et al. (2012)) argue that, with respect to equity-based compensation, managerial incentives to pursue riskier investment and financing policies are better measured by the CEO's vega. That is, the sensitivity of CEO wealth to changes in stock volatility (*Vega*). Due to the asymmetric payoff of options, CEOs with larger vega are expected to implement riskier investment and financing policies to increase the value of their firm-specific equity portfolio holdings. Vega is expected to be positively related to short-maturity debt.

I calculate *Vega* as the sum of partial derivatives of the option price with respect to stock return volatility based on the Black and Scholes (1973) option pricing model adjusted for dividends divided by 100.[10] This gives the interpretation of the dollar value change in the CEO's wealth for a 1% change in the annualized standard deviation of stock returns. The mean (median) *Vega* is $196,700 ($93,500), implying that a 1% increase in stock volatility increases the average CEO's firm-specific equity portfolio holdings by $196,700.

[10] Prior empirical studies including Coles et al. (2006), Brockman et al. (2010), and Cassell et al. (2012) estimate CEO vega following the methodology of Core and Guay (2002) due to data on the strike price and time to maturity of executive stock options not being available in the Execucomp database. In the current study, Execucomp provides data on these inputs, thus I do not estimate these values based on Core and Guay's methodology.

I re-estimate the regression models in Table III with the inclusion of *Log of vega* as an additional covariate.[11] Table IV displays the regression results; the columns in Table IV correspond to the columns in Table III. Only CEO-specific variables are displayed for brevity, though the coefficient estimates for the controls not shown are qualitatively similar to those in Table III. Similar to the results shown in Table III, both *CEO's inside debt holdings* and *CEO to firm debt-to-equity ratio* are negatively related to the proportion of short-maturity debt across all specifications. Contrary to Brockman et al. (2010), I do not document a significantly positive relation between *Log of vega* and short-maturity debt. This finding is potentially explained by the difference in inputs used to calculate *Vega*.

5.3 Heterogeneity of inside debt holdings

Edmans and Liu (2011) argue that the incentive alignment effect of inside debt hinges on the extent to which the payoff of inside debt resembles the payoff of risky debt. Pension benefits and deferred compensation both offer fixed payoffs when the firm is solvent and are generally unsecured and unfunded. However, as discussed in previous sections, the CEO's deferred compensation may depend on the value of the firm's equity, as well as having more flexible payment schedules. This potentially renders deferred compensation as less debt-like than defined benefit pensions. Based on this perspective, the effect of deferred compensation in attenuating agency costs of debt is expected to be less than the effect of an equal dollar holding of defined benefit pensions. Indeed, deferred compensation could exacerbate CEO's incentives for risky asset substitution since this amount could depend on equity values.

To address the potentially offsetting effects of pension benefits and deferred compensation on debt-related agency costs, I disaggregate the *CEO to firm debt-to-equity ratio* into a pension-based variable (*Pension relative debt-to-equity*) and a deferred compensation-based variable (*DC relative debt-to-equity*). The construction of each covariate is analogous to the construction of *CEO to firm debt-to-equity ratio* except CEOs' inside debt holdings are replaced by the actuarial present value of their

[11] Specifically, *Log of vega* is computed as the natural logarithm of 1+*Vega*.

Table IV

Relation between debt maturity, CEO vega incentives, and inside debt incentives

This table shows the pooled OLS regression estimates for the four specifications. In columns 1 and 2 (3 and 4), the dependent variable is *DEBT3* (*DEBT5*). The sample consists of 4,719 firm-year observations based on 814 unique firms and covers the fiscal years 2006 to 2011. All control variables are included in each regression but are not displayed for brevity. The control variables not displayed are *Size*, *Size*^{2}, *Asset maturity*, *Asset std. dev.*, *M/B*, *Abnormal earnings*, *Term*, *Rating dummy*, *Z-score dummy*, and *Regulated dummy*. All variables are defined in Table II. Each model includes industry (2-digit SIC) fixed effects and year fixed effects. Statistical significance is based on robust standard errors clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

		Dependent Variables							
		DEBT3				*DEBT5*			
		(1)		(2)		(3)		(4)	
Independent Variables	Predicted Signs	Coefficient Estimate	*p*-value	Coefficient Estimate	*p*-value	Coefficient Estimate	*p*-value	Coefficient Estimate	*p*-value
CEO's inside debt holdings	–	–0.0013*	0.066			–0.0019**	0.023		
CEO to firm debt-to-equity ratio	–			–0.0026	0.384			–0.0048*	0.095
Log of vega	+	0.0256	0.322	0.0186	0.444	0.0059	0.779	–0.0039	0.847
Ownership	+	0.5055***	0.007	0.5006***	0.007	0.4260***	0.005	0.4136***	0.006
Intercept		1.7435***	0.000	1.7102***	0.000	1.4586***	0.000	1.4201***	0.000
Control variables		Yes		Yes		Yes		Yes	
Industry fixed effects		Yes		Yes		Yes		Yes	
Year fixed effects		Yes		Yes		Yes		Yes	
N		4,719		4,719		4,719		4,719	
Adjusted R^2		0.3292		0.3283		0.4361		0.4349	

pension benefits and deferred compensation, respectively. Based on H2, I expect *Pension relative debt-to-equity* to be negatively related to the use of short-maturity debt, while the relation between *DC relative debt-to-equity* and short-maturity debt is expected to be comparatively weaker, or perhaps, positive.

The results, based on the full sample, are displayed in Table V. The coefficient on *Pension relative debt-to-equity* is negative for both measures of debt maturity, though only statistically significant in the *DEBT5* regression (column 2). Conversely, the results show there is no statistically significant relation between *DC relative debt-to-equity* and the use of short-maturity debt.[12] Interestingly, the estimates for *Pension relative debt-to-equity* are larger (in absolute terms) than the corresponding coefficients on *CEO to firm debt-to-equity ratio* in Table III. This can be accounted by the fact that *CEO to firm debt-to-equity ratio* captures the potentially countervailing effects of pensions and deferred compensation on inside debt incentives; by construction, *CEO to firm debt-to-equity ratio* includes incentive effects from both pension benefits and deferred compensation.

Overall, the results in Table V indicate that pensions provide a stronger CEO-debtholder incentive alignment effect than deferred compensation, in support of the proposition that the strength of CEO inside debt incentives is contingent on the extent to which the inside debt is debt-like. The findings are complementary to Anantharaman et al.'s (2010) study, which also documents that debtholders recognize the extent to which CEOs' inside debt holdings resemble risky debt in setting loan covenants, which are an alternative mechanism to short-maturity debt in mitigating agency costs of debt.

[12] The mean value of pension benefits ($2.4 million) is higher than the mean value of deferred compensation ($1.7 million). Nonetheless, CEOs on average have substantial deferred compensation balances. This potentially alleviates the concern that the results of a stronger relation between debt maturity and pension benefits (compared to deferred compensation) is driven by CEOs having economically small deferred compensation balances.

Table V

Disaggregation of *CEO to firm debt-to-equity ratio*

This table shows the pooled OLS regression estimates when *CEO to firm debt-to-equity ratio* is disaggregated into *Pension relative debt-to-equity* and *DC relative debt-to-equity*. In column 1 (2), the dependent variable is *DEBT3* (*DEBT5*). The sample consists of 6,518 firm-year observations based on 1,009 unique firms and covers the fiscal years 2006 to 2011. *Pension relative debt-to-equity* is calculated as (*Pension benefits ÷ Inside equity holdings*) / (book value of debt ÷ market value of equity). *DC relative debt-to-equity* is calculated as (*Deferred compensation ÷ Inside equity holdings*) / (book value of debt ÷ market value of equity). All other variables are defined in Table II. Each model includes industry (2-digit SIC) fixed effects and year fixed effects. Statistical significance is based on robust standard errors clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

		Dependent Variables			
		DEBT3		*DEBT5*	
		(1)		(2)	
Independent Variables	Predicted Signs	Coefficient Estimate	*p*-value	Coefficient Estimate	*p*-value
Pension relative debt-to-equity	–	–0.0055	0.120	–0.0077**	0.030
DC relative debt-to-equity	– / +	0.0012	0.789	–0.0036	0.445
Ownership	+	0.2406*	0.094	0.1123	0.434
Size	–	–0.2393***	0.000	–0.1310***	0.003
$Size^2$	+	0.0123***	0.000	0.0055**	0.029
Leverage	–	–0.2079	0.239	–0.0913	0.543
Asset maturity	–	–0.0008	0.572	–0.0022*	0.082
Asset std. dev.	+	–0.0767	0.903	0.8120	0.167
M/B	+	0.0376***	0.000	0.0334***	0.000
Abnormal earnings	+	–0.0686***	0.002	0.0041	0.832
Term	–	–0.0262**	0.048	–0.0124	0.372
Rating dummy	–	–0.1319***	0.000	–0.1063***	0.000
Z-score dummy	–	0.0056	0.850	0.0006	0.982
Regulated dummy	–	0.1169**	0.018	0.1319**	0.048
Intercept		1.5115***	0.000	1.2380***	0.000
Industry fixed effects			Yes		Yes
Year fixed effects			Yes		Yes
N			6,518		6,518
Adjusted R^2			0.2710		0.3659

5.4 New debt issues

The previous analysis is useful in examining the relation between inside debt incentives and firms' existing debt maturity structure. However, Guedes and Opler (1996) propose that the determinants of debt maturity structure are better examined using an incremental approach rather than a balance sheet approach when the relative importance of the determinants are subject to changes over time. Focusing on new debt issues also explicitly characterizes Barnea et al.'s (1980) framework in which potential creditors rationally incorporate CEO incentives to risk-shift in the pricing and negotiation of new debt contracts.

I obtain data on the debt maturities of public bonds issued between 2007 and 2011 from the Fixed Income Securities Database (FISD). The data are then matched to CEO and firm characteristics in the fiscal year prior to the new debt issue. This yields a sample of 1,867 new debt issues by 543 firms.

FISD reports the time to maturity of new debt issues in months. I define the dependent variable as the natural logarithm of the debt maturity in months (*Log maturity*). According to my central hypothesis, debt maturity is expected to be positively related to inside debt (or, equivalently, a negative relation between the use of short-maturity debt and inside debt). Columns 1 and 2 of Table VI display the results for the two inside debt compensation measures. As predicted by theory, and consistent with the findings of my main analysis, the coefficients on *CEO's inside debt holdings* and *CEO to firm debt-to-equity ratio* are positive, albeit insignificant at conventional levels. In column 3, *CEO to firm debt-to-equity ratio* is disaggregated into the component pension- and deferred compensation-based measures. The coefficient on *Pension relative debt-to-equity* is significantly positive, whereas the estimated coefficient for *DC relative debt-to-equity* is insignificant. The results are similar to those tabulated in Section 5.3, in that pension benefits provide stronger attenuation of agency costs of debt than do deferred compensation. Collectively, the results provide evidence in favor of my central hypothesis, the perspective that differing forms of inside debt provide different inside debt incentives, and that potential creditors are able to perceive this heterogeneity.

Table VI

Relation between debt maturity and inside debt incentives: New debt issues

This table shows the pooled OLS regression estimates for the new debt issues sample. The dependent variable is the natural logarithm of debt maturity in months (*Log of maturity*). The sample consists of 1,867 observations based on 543 unique firms and covers the fiscal years 2007 to 2011. *Pension relative debt-to-equity* is calculated as (*Pension benefits ÷ Inside equity holdings*) / (book value of debt ÷ market value of equity). *DC relative debt-to-equity* is calculated as (*Deferred compensation ÷ Inside equity holdings*) / (book value of debt ÷ market value of equity). All other variables are defined in Table II. Statistical significance is based on robust standard errors clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

		Dependent Variable: *Log of maturity*					
		(1)		(2)		(3)	
Independent Variables	Predicted Signs	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value
CEO's inside debt holdings	+	0.00135	0.138				
CEO to firm debt-to-equity ratio	+			0.0093*	0.084		
Pension relative debt-to-equity	+					0.0279***	0.008
DC relative debt-to-equity	– / +					–0.0049	0.562
Ownership	–	–0.2973	0.298	–0.2915	0.311	–0.2846	0.318
Log of size	+	0.4512***	0.003	0.4412***	0.003	0.4362***	0.003
(Log of size)^2	–	–0.0242***	0.002	–0.0234***	0.003	–0.0230***	0.003
Leverage	+	–0.6522***	0.001	–0.5848***	0.003	–0.5716***	0.004
Asset maturity	+	–0.0014	0.590	–0.0017	0.504	–0.0020	0.439
Asset std. dev.	–	0.1550	0.819	0.2186	0.747	0.2574	0.705
M/B	–	–0.0729**	0.013	–0.0761***	0.010	–0.0729**	0.012
Abnormal earnings	–	0.0361*	0.066	0.0367	0.062	0.0353*	0.073
Term	+	–0.0074	0.884	–0.006*	0.908	–0.0065	0.900
Rating dummy	+	–0.0460	0.556	–0.0484	0.539	–0.0594	0.445
Z-score dummy	+	–0.0859	0.127	–0.0749	0.189	–0.0778	0.174
Regulated dummy	+	–0.2348*	0.056	–0.2206*	0.069	–0.2271*	0.060
Intercept		3.0311***	0.000	3.0401***	0.000	3.0533***	0.000
Industry fixed effects			Yes		Yes		Yes
Year fixed effects			Yes		Yes		Yes
N			1,867		1,867		1,867
Adjusted R^2			0.0445		0.0449		0.0469

6 Summary and conclusions

I analyze the role of inside debt in mitigating the agency costs of debt by examining the relationship between inside debt incentives and the use of short-term debt. Prior studies suggest short-term debt can reduce the agency costs of debt by constraining managerial risk preferences. Inside debt exposes CEOs to the same risks as external holders of risky debt. Theory posits that inside debt compensation shifts the alignment of CEOs' interests towards that of debtholders and attenuates the agency cost of debt.

My main empirical analysis based on a sample of 6,518 firm-year observations during the fiscal years 2006 to 2011 finds support for this hypothesis. The use of short-term debt in firms is decreasing in CEO inside debt holdings. This relationship is robust to different measures of debt maturity and the inclusion of previously known determinants of debt maturity. To lend further support to this finding, I re-test my main hypothesis using a sample of new public debt issues and find consistent results.

I also find that the negative relation between inside debt incentives and short-term debt is driven by the defined benefit pension component of CEO inside debt holdings, as opposed to deferred compensation. This result is consistent with Edmans and Liu's (2011) extension of Jensen and Meckling's (1976) theoretical prediction that the degree to which CEOs are aligned with debtholders is dependent on the extent to which inside debt resembles risky debt.

My study extends the literatures on executive compensation, debt maturity, and agency costs. I provide evidence on the role of inside debt in the determination of debt maturity structure and how inside debt can alleviate risk-shifting incentives of CEOs. A fruitful area for future research could, for example, involve sharper identification of the extent to which CEO inside debt truly resembles risky debt to gain further insights into the role of inside debt in mitigating agency costs of debt.

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