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Abandon Ship: Inside Debt and Risk-Taking Incentives in Bad Times

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Non-Technical Summary

Inside debt (namely, managerial deferred compensation and pension plans) is traditionally viewed as a tool to align the incentives of managers with those of shareholders and, thus, to decrease the risk of corporate default. Naturally, this result holds only if inside debt provides managers with a debt-like payoff. For this reason, the beneficial effect of inside debt hinges on the way managers' contributions are invested. If a large fraction of inside debt is invested in the company's stock, inside debt may provide equity-like payoffs that intensify, rather than diminish, managerial risk-taking incentives.

We show that this is indeed the case. Moreover, the investment strategy of inside debt is time-varying: Managers tend to divest inside debt from their own firm's equity in bad times and invest it in assets that have low correlation with the firm's equity. This strategy allows the manager to hedge his/her wealth against default risk and induces him/her to take on more risk. It is worth emphasizing that the investment strategy of inside debt increases managerial risk taking incentives in bad times, exactly when creditors would need more protection.

We conclude that it would be improper to assume that inside debt unambiguously decreases managerial risk-taking incentives. Most importantly, it would be important to have information about the investment strategy of inside debt because this information can be used to build early warning indicators of distress. Unfortunately, the current regulation does not require companies to disclose information regarding the investment strategy of inside debt.

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Abandon Ship: Inside Debt and Risk-Taking Incentives in Bad Times*

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Abstract

We develop a model that endogenizes the manager's choice of firm risk and of inside debt investment strategy. Our model delivers two predictions. First, managers have an incentive to reduce the correlation between inside debt and company stock in bad times. Second, managers that reduce such a correlation take on more risk in bad times. Using a sample of U.S. public firms, we provide evidence consistent with the model's predictions. Our results suggest that the weaker link between inside debt and company stock in bad times does not translate into a mitigation of debt-equity conflicts.

JEL Classification: G32, G34

Keywords: Inside Debt, Executive Compensation, Corporate Distress

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1 Introduction

Top executives of U.S. public firms receive an important fraction of their compensation in the form of retirement benefits. Such benefits are akin to debt-like claims on the firm and are often called "inside debt". As pointed out by Jensen and Meckling (1976) and Edmans and Liu (2011), inside debt can align the incentives of managers and creditors, thus making the former more conservative.[1]

Yet, several papers suggest a more nuanced view of inside debt incentives.[2] To align incentives of managers with those of creditors, inside debt has to indeed provide managers with debt-like payoff. As a result, the risk-reducing role of inside debt hinges on the way managers' contributions are invested. However, the investment strategy of inside debt has received little attention. An exception is Jackson and Honigsberg (2014), who show that a substantial fraction of inside debt is invested in the company's stock. Hence, inside debt may provide managers with equity-like payoff and intensify, rather than diminish, managerial risk-taking incentives in bad times, exactly when debt-related agency conflicts are most severe. Such a result would depend on how the manager's investment strategy of inside debt varies throughout time. However, the literature is silent as to the time-varying investment strategy of inside debt.

We fill this gap in the literature. We start by developing a model that endogenizes the manager's risk choice and inside debt investment strategy. Our model provides two novel predictions. First, we expect CEOs to divest inside debt from their own firm's equity in bad times. Second, in bad times, CEOs with a smaller fraction of inside debt invested in their own firm's equity will take on more risk.

We test our model's predictions on a large sample of 1,740 U.S. public firms over the period 2006-2015 by analyzing CEOs' compensation packages. First, we substantiate

[1]Several studies provide evidence consistent with this view. See, e.g., Sundaram and Yermack (2007) and Cassel, Huang, Sanchez, and Stuart (2012).

[2]See, e.g., Anantharaman, Fang, and Gong (2014) and Colonnello, Curatola, and Hoang (2016).

the suggestive evidence of Jackson and Honigsberg (2014) and show that inside debt is indeed significantly linked to company stock. Given that current disclosure rules do not require companies to reveal how inside debt contributions are invested, we measure the link between inside debt and company stock by means of the correlation between inside debt returns and stock returns. We find that this correlation is indeed positive, large, and statistically significant. This suggests that inside debt is generally similar to equity-like compensation, such as restricted shares and stock options.

However, the high correlation between inside debt returns and stock returns is not necessarily incompatible with creditors' interests. In fact, debt-related agency conflicts (e.g., risk-shifting) are more prevalent in periods of financial distress. In other words, inside debt, to be effective, should mitigate agency problems especially during distress periods. Thus, as a second step, we analyze the time-varying relation between inside debt returns and stock returns. In line with our model's prediction, we find that this correlation is much lower during distress periods. This suggests that, in bad times, the interests of shareholders and managers are less aligned through inside debt and inside debt may actually help reducing debt-related agency cost when it is needed the most.

To test the validity of the previous argument, we examine whether the decline in the correlation between inside debt and company stock is indeed the result of incentive realignment between managers and creditors or, instead, just reflects managers' desire to "abandon" the firm during bad times. To distinguish between these two possible causes of the decline in correlation, we explore patterns in firm risk. We find that asset risk is higher in distressed periods and especially so for firms characterized by a lower correlation between stock returns and inside debt returns. Indeed, as suggested by our model, the positive relation between asset risk and distress is significantly stronger for such firms. For those firms bond yield spreads are also higher, which is inconsistent with a mitigation of debt-related agency conflicts.

Taken together, our results point to a novel channel dampening the risk-reducing incentives of inside debt. If executives can decide how to invest their inside debt, they can hedge themselves against default risk, for instance by investing inside debt in assets weakly or negatively correlated with company stock in distress periods. This strategy provides executives with an insurance that induces risk-shifting behavior and thus exposes long-term creditors to increased risk.

Our paper contributes to the literature studying the risk-taking incentives of inside debt. A substantial body of work provides evidence compatible with the risk-reducing role of inside debt suggested by Jensen and Meckling (1976) and Edmans and Liu (2011). Sundaram and Yermack (2007) find a negative relation between the ratio of inside debt to inside equity and default risk. Wei and Yermack (2011) show that, after firms' initial disclosure of top executive retirement plans, bond prices rise while stock prices decrease. Liu, Mauer, and Zhang (2014) illustrate that inside debt helps protect creditors by favoring cash hoarding behavior. Srivastav, Armitage, and Hagendorff (2014) focus on the banking sector and document that inside debt limits managerial risk-shifting through a reduction of incentives to divert cash to shareholders. Cassel, Huang, Sanchez, and Stuart (2012) report evidence of a negative relation between executives' inside debt holdings and the volatility of stock returns. Anantharaman, Fang, and Gong (2014), however, show that inside debt is effective at reducing the cost of private loans only when it is effectively exposed to default risk. Colonnello, Curatola, and Hoang (2016) extend this result to public debt and illustrate that low-seniority debt can interact with equity incentives in making CEOs less conservative. Such an unintended increase in managerial risk-taking is concentrated in bad times (Inderst and Pfeil, 2013). Jackson and Honigsberg (2014) show that executives invest inside debt in their own firm's equity.[3] We complement this

[3] Jackson and Honigsberg (2014) also show that executives tend to receive inside debt payments before retirement. In other words, if managers can accelerate inside debt payments, it is unlikely that inside debt can be effective in aligning managers' and creditors' interests.

literature by developing and testing a model of managerial risk-taking that takes into account the manager's time-varying inside debt investment strategy.

2 Model

To study the relation between the investment strategy of inside debt and risk-taking incentives, we extend the one-period model of Bolton, Mehran, and Shapiro (2015) to account for deferred compensation.[4] We consider a company characterized by separation between ownership and control. The risk-neutral manager, hired by shareholders, takes operating decisions under a compensation package consisting of a fixed component (i.e., salary), a share of equity, and inside debt. We consider a benchmark contract that does not allow the manager to modify the composition of inside debt and we compare the results with those of a contract that does allow the manager to decide the investment strategy of inside debt.

2.1 Investment technology and managerial compensation

The manager can invest an amount I and obtain a random gross return $\tilde{x}$ per unit of investment that can take three values:

- A high return $x + (1 + \mu)\Delta$ with probability q;
- A medium return x with probability $(1 - 2q)$;
- A low return $x - \delta$ with probability q.

Given that there are three possible states of the world, the probability $q < \frac{1}{2}$ represents tail risk and is the choice variable for the manager. In other words, the manager controls the riskiness of the company by choosing the variance of the investment technology of

[4] In the remainder of the paper, we use the terms "inside debt" and "deferred compensation" interchangeably. Indeed, as discussed below, while inside debt consists of deferred compensation and pension plans, we can reliably measure only the returns on the former component.

the firm. $\mu \in (0,1)$ represents idiosyncratic profitability: The higher is μ the higher are expected returns on investment. The manager can change q at the cost $c(q) = \frac{1}{2}aq^2$.

To finance investments, the firm raises external funds at the rate R under the constraint that risk-neutral external creditors obtain a total return $1+R$ at least equal to the risk-free return, which is assumed to be 1 for simplicity. Under the additional assumption that the firm defaults only when the investment return is low, the return promised to creditors has to satisfy

$$(1-q)(1+R) + q(x-\delta) \geq 1. \tag{1}$$

R is chosen so that the previous constraint holds with equality, which implies that

$$1 + R = \frac{1 - q(x-\delta)}{(1-q)}, \tag{2}$$

with the additional assumptions $x < 1 + \delta$ and $x > 2 + \delta$. These assumptions, in conjunction with the fact that R is strictly increasing in q, ensure that default only occurs when the return is low.

The investment technology and borrowing conditions above are similar to those described by Bolton, Mehran, and Shapiro (2015). Our extension is related to the manager's compensation package. The manager total pay W is given by

$$W = \bar{w} + S_E P_E + S_D D, \tag{3}$$

where $\bar{w}$ represents the fixed salary, S_E the share of equity, P_E the price of equity, S_D the loading on inside debt, and D the expected value of deferred compensation.[5] The price

[5]More precisely, Bolton, Mehran, and Shapiro (2015) assume that the compensation package of the manager depends on salary, equity and the company's credit spread. Thus the first two components of our compensation package are the same as those in Bolton, Mehran, and Shapiro (2015). The novelty of our approach relies therefore on the third component.

of equity is given by the present value of cash flows net of operational costs:

$$P_E = q(x + (1+\mu)\Delta) + (1-2q)x - (1-q)(1+R) - \frac{1}{2}aq^2. \tag{4}$$

We consider two types of inside debt management. The first is the traditional scheme where inside debt is represented by a fixed amount of money that the manager obtains only if the company is solvent, that is with probability $1-q$. Under this scheme, the expected value of inside debt is given by $D = (1-q)\bar{D}$, where $\bar{D}$ is some positive constant decided at the time the contract is signed.

The second scheme, instead, allows for managerial discretion in deciding the inside debt investment strategy. We conjecture that the manager may have an incentive to link his/her deferred compensation to company stock or to assets with low/negative correlation with company stock depending on the company's expected profitability. Hence, we consider an additional compensation contract with a payoff of inside debt given by

$$D = \beta P_E + (1-\beta)q\bar{C}, \tag{5}$$

where $\bar{C}$ represents the payoff of assets that have negative correlation with company stock. Those assets are negatively correlated with company stock because they pay the amount $\bar{C}$ only when the return on investment is low, which happens with probability q. The manager can modify the composition of his/her deferred compensation by changing β at the cost $c(\beta) = \frac{1}{2}b\beta^2$. To implement this compensation contract, we modify the stock price P_E by subtracting also the cost of changing β from the firm's cash flows.

In summary, under the benchmark inside debt contract our manager only selects the risk of investment and thus solves the following problem

$$\max_q \bar{w} + S_E P_E + S_D D, \tag{6}$$

where

$$P_E = q(x + (1+\mu)\Delta) + (1-2q)x - (1-q)(1+R) - \frac{1}{2}aq^2, \tag{7}$$

$$D = (1-q)\bar{D}. \tag{8}$$

Under the "discretionary" contract, our manager can also choose the composition of his/her deferred compensation and thus solves

$$\max_{q,\beta} \bar{w} + S_E P_E + S_D D, \tag{9}$$

where

$$P_E = q(x + (1+\mu)\Delta) + (1-2q)x - (1-q)(1+R) - \frac{1}{2}aq^2 - \frac{1}{2}b\beta^2, \tag{10}$$

$$D = \beta P_E + (1-\beta)q\bar{C}. \tag{11}$$

The first order conditions of these problems are reported in Appendix *A*. We now analyze the optimal solution.

2.2 Empirical predictions

To compute the optimal managerial risk choices, we calibrate our model. First, we normalize the initial investment I to 1, so that salary and inside debt compensation parameters can be expressed as a percentage of initial firm's assets. We choose realistic parameters for salary-to-assets ($w = 0.001$), inside debt-to-assets ($\bar{D} = 0.002$), and equity ownership ($S_E = 0.03$) that are consistent with the mean values in our sample. The cost of changing asset composition and that of modifying inside debt investment strategy are difficult to measure but we argue that modifying the risk characteristics of physical assets should be more expensive than changing the composition of a portfolio of financial assets and therefore we set $a = 1 > b = 0.5$. Our goal is to study the implications of inside debt for risk-taking incentives and therefore we consider different values of the loading on inside debt, that is $S_D = [0.5, 1, 2, 3]$. The parameters of the investment technology are chosen as follows: $x = 1.08$, $\Delta = 0.35$ and $\delta = 0.1$. This parameterization endogenously generates a realistic pattern of return on investments. In the case of the standard inside debt contract, the expected return on investment is always in the range $(7\%, 29\%)$, while under the discretionary contract, the expected return on investment is in the range $(6\%, 16\%)$, depending on the idiosyncratic profitability μ. Finally, we set $\bar{D} = \bar{C}$ to avoid unnecessary differences in the monetary incentives of the two contracts.

In Figure 1, we plot the optimal risk choice of the manager for different expected profitability values and for different loadings on inside debt. First, we observe that the optimal choice of β increases with the firm's profitability. This means that while in good times the manager desires to link the value of his/her deferred compensation to the company's stock price, in bad times the incentive to link the deferred compensation to the company's stock prices is reduced. In fact, in bad times, the manager prefers to link the deferred compensation to assets that are negatively correlated with company stock to protect his/her wealth against the risk of default. This insurance strategy implies that the optimal amount of risk that the manager takes under the discretionary contract is larger than the optimal amount of risk taken under the standard inside debt contract. Most importantly, the bigger is the loading on inside debt (S_D) the higher is the incremental risk induced by the discretionary contract. This result suggests that increasing the importance of deferred compensation in the manager's compensation package may increase, rather than decrease, risk-taking if the compensation contract allows the manager to modify the investment strategy of inside debt over time.

In summary, the simple model proposed in this section suggests that a discretionary contract allowing the manager to decide the investment strategy of inside debt induces the manager to take on more risk than a standard inside debt contract, especially during times in which the company's expected profitability is low. This is so because the standard inside debt contract exposes the manager to the same default risk faced by creditors. By contrast, the possibility to modify the composition of inside debt allows the manager to hedge his/her wealth against default risk and, as a result, induces him/her to take on more risk. Note that creditors cannot easily increase the return on debt in reaction to managerial discretion over inside debt, because the current regulation does not require companies to disclose information regarding the investment strategy of inside debt.

In conclusion, the model delivers two testable hypotheses.

HYPOTHESIS 1:

The positive link between inside debt and company stock is weaker in bad times.

HYPOTHESIS 2:

In bad times, CEOs with a weaker link between inside debt and company stock take on more risk.

3 Empirical approach and data

3.1 Empirical approach

Our empirical approach, rather than establishing causality, goes in the direction of capturing endogenous patterns between inside debt investment strategy and managerial risk-taking that are consistent with the model (see, e.g., Danis, Rettl, and Whited, 2014). These variables are endogenous in our model, so the tests below are concerned with the relation among equilibrium quantities.

Our empirical analysis needs to deal with one important difficulty, namely, that we do not observe how CEOs invest their inside debt plans. As a consequence, we use the approach suggested by Jackson and Honigsberg (2014) and look at the correlation between returns on inside debt and stock returns. This is an admittedly indirect way to infer the actual CEO investment strategy, but it still provides insights about CEO time-varying incentives from inside debt.

To test Hypothesis 1, we analyze the relation between inside debt returns and stock returns in normal and distressed times by estimating the following specification:

$$\begin{aligned} \textit{Inside debt return}_{i,t} = & \beta_1 \cdot \textit{Distress}_{i,t} \cdot \textit{Stock return}_{i,t} \\ & + \beta_2 \cdot \textit{Distress}_{i,t} + \beta_3 \cdot \textit{Stock return}_{i,t} \\ & + \theta \cdot \textit{Control variables}_{i,t} + \upsilon_i + \nu_t + \epsilon_{i,t}. \end{aligned} \tag{12}$$

The subscripts i and t indicate firm and year, respectively. $\textit{Inside debt return}_{i,t}$ is the CEO annual return on inside debt over the fiscal year. $\textit{Distress}_{i,t}$ is an indicator variable for financial distress. $\textit{Stock return}_{i,t}$ is the annual stock return over the fiscal year. We always first estimate regressions without control variables to limit concerns about "bad controls", namely about selection bias due to the inclusion of control variables that are outcome variable themselves (Angrist and Pischke, 2009). For the same reason, we choose a parsimonious set of control variables. $\textit{Control variables}_{i,t}$ include CEO characteristics (age, tenure, and the relative debt-to-equity ratio) and firm size. Given that our hypotheses relate to the time-varying risk-taking incentives of inside debt, we focus on the time-series variation by including firm fixed effects, υ_i. To control for changing aggregate economic conditions, we include fiscal year fixed effects, ν_t. Standard errors are clustered at the firm-level.

Hypothesis 1 concerns the relation between inside debt returns and stock returns in distress, so the parameter of interest in equation (12) is β_1. We expect it to be negative.

To shed light on how the link between inside debt and stock returns relates to debt agency conflicts, we investigate firm riskiness. Rather than directly examining risk-shifting, we verify whether patterns in firm risk are consistent with this phenomenon. We analyze firm risk by estimating this specification:

$$\begin{aligned} y_{i,t} =& \beta_1 \cdot Distress_{i,t} \cdot Low\ correlation_{i,t} + \beta_2 \cdot Distress_{i,t} + \beta_3 \cdot Low\ correlation_{i,t} \\ &+ \theta \cdot Control\ variables_{i,t} + \upsilon_i + \nu_t + \epsilon_{i,t}. \end{aligned} \tag{13}$$

$y_{i,t}$ is the outcome variable of interest (asset risk, yield spread). $Distress_{i,t}$ is defined as above. $Low\ correlation_{i,t}$ is an indicator variable equal to one if the absolute value of the residual from regressing $Inside\ debt\ return_{i,t}$ on $Stock\ return_{i,t}$ is in the top quartile for a given firm-year. Such a measure captures weakened correlation between inside debt and stock returns and is consistent with our specification (12). $Low\ correlation_{i,t}$ thus proxies for periods in which inside debt is divested from the firm's own equity. $Control\ variables_{i,t}$ include the variables listed for equation (12).

The parameter of interest in equation (13) is β_1. Based on Hypothesis 2, we expect it to be positive.

3.2 Data and summary statistics

We consider a sample of U.S. public firms from 2006 through 2015 that have available executive compensation information in the Standard and Poor's Execucomp database. We start our analysis in 2006, because the U.S. Securities and Exchange Commission (SEC) enhanced disclosure requirements about executive pensions and deferred compensation were enforced starting in 2006. We obtain accounting data and daily stock return data from the CRSP-Compustat merged database. We require each firm to have traded ordinary shares (CRSP share code 10 or 11). We obtain corporate bond yield data from the Financial Industry Regulatory Authority's Trade Reporting and Compliance Engine (TRACE), and Treasury yield data from Federal Reserve Economic Data (FRED), St.

Louis Federal Reserve Bank. We exclude financial institutions, utilities, subsidiaries and firm-years with negative assets or sales. We also exclude firm-years with missing assets, sales, number of outstanding shares, and stock price at fiscal year-end. Throughout our analysis, we focus on CEOs.

Using these data sources, we compute the following variables.

Returns. For our empirical analysis, we need to compute returns both on the firm's stock and on inside debt. The case of stock returns poses no difficulties. We measure them as the total market return on the firm's stock over the fiscal year.

The measurement of inside debt returns is more challenging. Inside debt is composed of deferred compensation plans (defined contribution plans) and pension plans (defined benefit plans). The returns on deferred compensation plans are the most likely to reflect CEOs' investment choices. Indeed, as pointed out by Wei and Yermack (2011): "Deferred compensation may often be invested either at a fixed rate of return, or in the company's stock, or in a menu of stock or bond mutual funds chosen by the firm. Many companies allow managers to make frequent changes in how their deferred compensation is invested". The returns on deferred compensation plans can be computed by using information on each CEO's annual earnings from investing defined contributions. We use two different measures of deferred compensation returns. The first measure relies on the earnings a CEO receives on his/her plans relative to the beginning-of-year balance. The beginning-of-year balance is obtained from subtracting CEO's and firm's contributions and CEO's annual earnings from the end-of-year balance (Jackson and Honigsberg, 2014). The second measure of returns is computed similarly but relies on the previous year's end-of-year balance.

By contrast, the returns on pension plans can hardly be measured precisely. CEOs usually have little power to decide how to invest these plans, which "usually accrue to managers under company-wide formulas established by each firm" (Wei and Yermack, 2011). The value of pension plans depends on many factors, such as years of service, cash compensation, and the firm's cost of debt (Sundaram and Yermack, 2007).[6] Hence, by making a simplifying assumption, we focus on deferred compensation plans as a proxy for inside debt returns while neglecting pension plans. We use the first measure of deferred compensation returns described above for our baseline tests.

Finally, we compute *Low correlation*, an indicator variable equal to one if the absolute value of the residual from a firm fixed effect regression of deferred compensation returns on stock returns is in the top quartile for a given firm-year. We compute residuals both including the estimated firm fixed effect and excluding it. *Low correlation* is aimed at capturing periods of weakened correlation between inside debt and stock returns.

Distress. We proxy for default risk by using the Altman's Z-score. In our main analysis, we classify a firm-year as distressed if it belongs to the top quartile of the Altman's Z-score. We compute Altman's Z-score quartiles over the Compustat universe. It should be stressed that by using such a broad definition of distress we do not only capture highly distressed firms but also firms that experience a deterioration in their performance. We believe that this way of defining distress is particularly suitable to study the problem at hand, because it allows us to examine the whole period before potential default in which a CEO may divest his/her inside debt from the firm's stock.

Firm risk. We use the naïve asset volatility measure by Bharath and Shumway (2008) as a proxy for asset risk. As an alternative measure of firm risk, we use yield spreads on senior unsecured straight bonds whose trades are reported in TRACE. For each bond, we compute the yield spread as the difference between the yield and the yield on the Treasury security with closest residual maturity at the end of the year similarly to Badoer,

[6]The measurement of changes in the value of pension plans, indeed, is generally viewed as problematic. For instance, Wei and Yermack (2011), to compute their relative incentive ratio measure, proxy for the change in CEO inside debt relative to firm debt, $\Delta D_{CEO}/\Delta D_{FIRM}$, by means of the CEO inside debt to firm debt ratio (D_{CEO}/D_{FIRM}).

Demiroglu, and James (2016). We also construct a firm-level measure of yield spread by computing the mean yield spread across a firm's different bond issues at each date.

Other variables. The variables for which we control in our regressions include CEO age and tenure, the CEO relative debt-to-equity ratio (Edmans and Liu, 2011), and size.

Table 1 presents summary statistics for the variables used in our tests. The final sample includes 1,740 unique firms. Stock returns are higher and more volatile than deferred compensation returns. The fraction of distressed firm-years in our sample is 11.9%.

All variables are winsorized at the 1% and 99% levels. Only deferred compensation returns are winsorized at the 2.5% and 97.5% levels, as their distribution is more prone to outliers (arguably because of measurement error). Detailed definitions of the variables are given in Table A.1. All dollar amounts are expressed in 2010 dollars.

4 Results

4.1 Deferred compensation returns and stock returns

Figure 2 shows the correlation between stock returns and our two measures of deferred compensation returns. Looking at our baseline measure (left graph), we observe that for a large fraction of CEOs (i.e., 189 out of 779), returns on deferred compensation and stock returns correlate almost perfectly (i.e the correlation between the two is larger than 0.9). This correlation pattern is even more pronounced for our alternative measure of deferred compensation returns (right panel). This suggests that these CEOs invest nearly all of their deferred compensation plans in company stock as pointed out by Jackson and Honigsberg (2014). As explained above, managers' have indeed discretion over the investment strategy of deferred compensation plans.

We now study the dynamics of these correlations over different states of the world.

We aim to understand whether the incentives to invest inside debt in company stock change with the firm's financial conditions. Hypothesis 1 suggests that if the manager is able to decide the investment strategy of inside debt, he/she would prefer to dampen the link between inside debt and company stock in bad times. Therefore, we expect to observe a lower correlation between inside debt and company stock returns when the firm approaches distress. Figure 3 confirms the model's intuition. We plot the linear relation between deferred compensation returns and stock returns distinguishing between distressed and non-distressed firm-years. In distressed periods, this relation is indeed weaker.

In Table 2, we confirm this prima facie evidence. In Panel A, we regress our two measures of returns on deferred compensation plans on stock returns (columns 1 and 4). Again, we find a positive and significant (at 1% level) relation. This result is robust to the inclusion of selected control variables (columns 2 and 5). One may be concerned that the observed positive relation is driven by firms whose stocks have a high correlation with the market. In other words, our result may be due to CEOs investing their plans in index funds tracking the market (or the industry) rather than in their own company's stock. To address this issue, in columns 3 and 6, we distinguish between idiosyncratic stock return and market-adjusted industry stock return (see, e.g., Peters and Wagner, 2014). We find that, while market-adjusted industry returns enter significantly, the idiosyncratic component of stock returns is still positively and significantly associated with deferred compensation returns. Hence, CEOs appear to be indeed investing deferred compensation plans in their own firm's stock.

In Panel B, we distinguish between distressed and non-distressed firm-years. In distressed periods, the correlation between stock returns and deferred compensation returns is significantly lower than in non-distressed periods as indicated by the negative and significant estimated coefficient of *Distress* × *Stock return* (columns 1 and 4). Again, this result is robust to the inclusion of control variables (columns 2 and 5) and to using the idiosyncratic component of stock return (columns 3 and 6). Figure 4 plots the estimated density of the absolute value of the residuals from estimating a regression of deferred compensation returns (baseline measure) on stock returns. The distribution outside of distress is more peaked around zero than in distress. These results support Hypothesis 1 and suggest that indeed CEOs divest inside debt from company stock in bad times.

What are the implications of these results for the conflict of interest between shareholders, creditors, and managers? In normal times, inside debt tends to be invested in company stock and therefore provides managers with equity-like incentives, rather than debt-like incentives. However, the observed decreased correlation between inside debt returns and stock returns in distressed periods may point toward a re-alignment of interests between managers and creditors that happens exactly when creditors would benefit the most from enhanced managerial alignment. A natural question then is whether the decreased correlation between deferred compensation returns and stock returns in distressed periods is associated with lower debt-related agency conflicts. Below, we address this question.

4.2 Debt-related agency conflicts

The decline in the correlation between inside debt and company stock in bad times can have different consequences. On the one hand, a lower correlation may signal a re-alignment of interests between creditors and managers. On the other hand, the decline in correlation may reflect the managers' desire to "abandon" the firm in distressed periods, i.e., managers may invest inside debt in assets that are weakly or negatively correlated with company stock in an effort to protect their inside debt. The latter is not necessary a good signal for creditors and may actually lead to an increase in debt-related agency conflicts.

We estimate different specifications of equation (13) using asset risk and yield spreads as dependent variables. Our goal is to verify whether patterns in the firm risk and investment policy in low-correlation distressed firm-years are consistent with debt-related agency conflicts, such as the risk-shifting problem (Jensen and Meckling, 1976).

Table 3 focuses on asset risk. We test Hypothesis 2, that, in bad times, CEOs with a weaker link between inside debt and company stock take on more risk. To this end, we use three different proxies for low correlation: i) An indicator variable equal to one if the absolute value of the residual from regressing deferred compensation returns (baseline measure) on stock returns is in the top quartile for a given firm-year (columns 1 and 2), ii) the absolute value of the residual as a continuous variable (column 3), and iii) the same as measure i) but removing the firm fixed effect from the residual (column 4). In each case, we observe that asset risk is significantly higher in distress and especially so for low-correlation firm-years, consistent with our Hypothesis 2.

We now examine yield spreads. Yield spreads not only provide us with an alternative proxy for firm risk, but they allow us to gain insights on debt value. Therefore, while asset risk mainly speaks to the risk-shifting problem, debt valuations reflect all types of debt-related agency conflicts that may negatively affect creditors, such as the underinvestment problem (Myers, 1977). In Table 4, we conduct tests similar to those on asset risk using yield spreads as dependent variable. Panel A studies yield spreads at the firm level. Panel B studies yield spreads at the bond level, which allows us to control also for coupon rate, residual maturity, and bond fixed effects.[7] All specifications, besides year fixed effects, include issuer rating fixed effects. Consistent with the results above, we find that yield spreads are generally significantly higher for distressed firm-years characterized by low correlation between deferred compensation and stock returns.

These results cast doubts on the traditional view that inside debt serves as a tool

[7]Bond fixed effects absorb coupon rate in Panel B.

to discipline managerial risk-taking behavior especially during distress. We complement the analysis of Lee, Murphy, Oh, and Vance (2016), who find that risky investments are positively related to inside debt for financially constrained firms and that such a positive relation is stronger in distress. Taken together, these findings suggest that the negative effect of inside debt on risk-taking found in other studies (see references in Lee, Murphy, Oh, and Vance, 2016) may actually hinge on inside debt characteristics: The investment strategy (as suggested in this paper), seniority (Anantharaman, Fang, and Gong, 2014; Colonnello, Curatola, and Hoang, 2016), and financial constraints (Lee, Murphy, Oh, and Vance, 2016). Such a negative effect may also hinge on managers' characteristics, as we show below.

4.3 The role of CEO age

The evidence reported in the previous sections indicates that in distressed periods the correlation between inside debt returns and stock returns decreases. We now check whether the incentive to decrease the correlation between inside debt and stock returns is influenced by the personal characteristics of the CEO. Given that payments of inside debt are received upon retirement, the CEO's age is expected to play an important role in shaping managerial incentives to change the link between inside debt and stock returns.

To shed more light on the effect of CEO's age on the time-varying correlation between inside debt and stock returns, we regress deferred compensation returns (baseline measure) on stock returns and their interactions with CEO age groups (unreported but available upon request). In Figure 5, we report the average marginal effect of stock returns on deferred compensation returns as a function of CEO age (upper graph) and the conditional effect of CEO age differentiating between normal periods and distressed periods (lower graph). In the upper graph, we observe that the correlation between deferred compensation returns and stock returns tends to decline as CEO age increases but the changes are not statistically significant. The lower graph shows that the correlation between inside debt returns and stock returns across CEO age groups follows a similar pattern in distressed and non-distressed firm-years. The difference in correlation between distressed and non-distressed firm-years is negative across all CEO age groups, but statistically significant only for CEOs that are particularly likely to retire (aged between 60 and 64). These CEOs also exhibit the largest difference. Intuitively, CEOs close to retirement may be particularly interested in protecting their deferred compensation plans and shy away from investing them in their own company stock when in distress. Interestingly, the difference is economically large, though statistically insignificant, also for young CEOs (below 50 years of age).

5 Conclusion

The recent literature on executive compensation suggests that inside debt induces managers to behave more conservatively and, in this way, helps protect creditors from the risk of default. However, to serve this purpose, inside debt has to provide managers with debt-like payoffs and expose managers and creditors to the same default risk. But what happens if managers can invest the inside debt with the goal of hedging themselves against the risk of default? The theory and the empirical evidence provided in our paper suggests that in this case inside debt may act as an insurance increasing, rather than decreasing, risk-taking incentives. This insurance is most important in distress periods and thus induces managers to increase risk-taking exactly in those periods in which creditors would require a more prudent behavior.

These results have implications for the ongoing policy debate. First of all, it would be inadequate to assume that inside debt, and deferred compensation in particular, would unambiguously successfully decrease risk-taking incentives. Second, it would be important to have information not only about the investment strategy of the inside debt, as already suggested by Jackson and Honigsberg (2014), but also about its development and changes over time. Those changes may be useful early warning indicators of distress.

References

Anantharaman, D., Fang, V.W., Gong, G., 2014. Inside debt and the design of corporate debt contracts. Management Science 60, 1260–1280.

Angrist, J.D., Pischke, J.S., Mostly harmless econometrics: An empiricist's companion, Princeton University Press, NJ, 2009.

Badoer, D.C., Demiroglu, C., James, C.M., 2016. Ratings quality and borrowing choice. Working paper, University of Florida.

Becker, B., Ivashina, V., 2015. Reaching for yield in the bond market. Journal of Finance 70, 1863–1902.

Bharath, S.T., Shumway, T., 2008. Forecasting default with the Merton distance to default model. Review of Financial Studies 21, 1339–1369.

Bolton, P., Mehran, H., Shapiro, J., 2015. Executive compensation and risk taking. Review of Finance 59, 1–42.

Cassel, C., Huang, S., Sanchez, J., 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.

Colonnello, S., Curatola, G., Hoang, N. G., 2016. Direct and indirect risk-taking incentives of inside debt. Working paper, SAFE.

Core, J., Guay, W., 2002. Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. Journal of Accounting Research 40, 613–630.

Danis, A., Rettl, D.A., Whited, T.M., 2014. Refinancing, profitability, and capital structure. Journal of Financial Economics 114, 424–443.

Dick-Nielsen, J., 2009. Liquidity biases in TRACE. Journal of Fixed Income 19, 43–55.

Edmans, A., Liu, Q., 2011. Inside debt. Review of Finance 15, 75–102.

Himmelberg, C.P., Hubbard, G., 2000. Incentive pay and the market for CEOs: An analysis of pay-for-performance sensitivity. Working paper, Columbia University.

Inderst, R., Pfeil, S., 2013. Securitization and compensation in financial institutions. Review of Finance 4, 1323–1364.

Jackson, R.J., Honigsberg, C., 2014. The hidden nature of executive retirement pay. Virginia Law Review 100, 479–1819.

Jensen, M., Meckling, W., 1976. Theory of the firm: Managerial behavior, agency costs and ownership structure. Journal of Financial Economics 3, 305–360.

Lee, J., Murphy, K. J., Oh, P. SH., Vance, M. D., 2016. Inside debt and corporate investment. Working paper.

Liu, Y., Mauer, D.C., Zhang, Y., 2014. Firm cash holdings and CEO inside debt. Journal of Banking & Finance 42, 83–100.

Myers, S.C., 1977. Determinants of corporate borrowing. Journal of Financial Economics 5, 147–175.

Peters, F.S., Wagner, A.F., 2014. The executive turnover risk premium. Journal of Finance 69, 1529–1563.

Srivastav, A., Armitage, S., Hagendorff, J., 2014. CEO inside debt holdings and risk-shifting: Evidence from bank payout policies. Journal of Banking & Finance 47, 41–53.

Sundaram, R.K., Yermack, D., 2007. Pay me later: Inside debt and its role in managerial compensation. Journal of Finance 62, 1551–1588.

Wei, C., Yermack, D., 2011. Investor reactions to CEOs' inside debt incentives. Review of Financial Studies 24, 3813–3840.

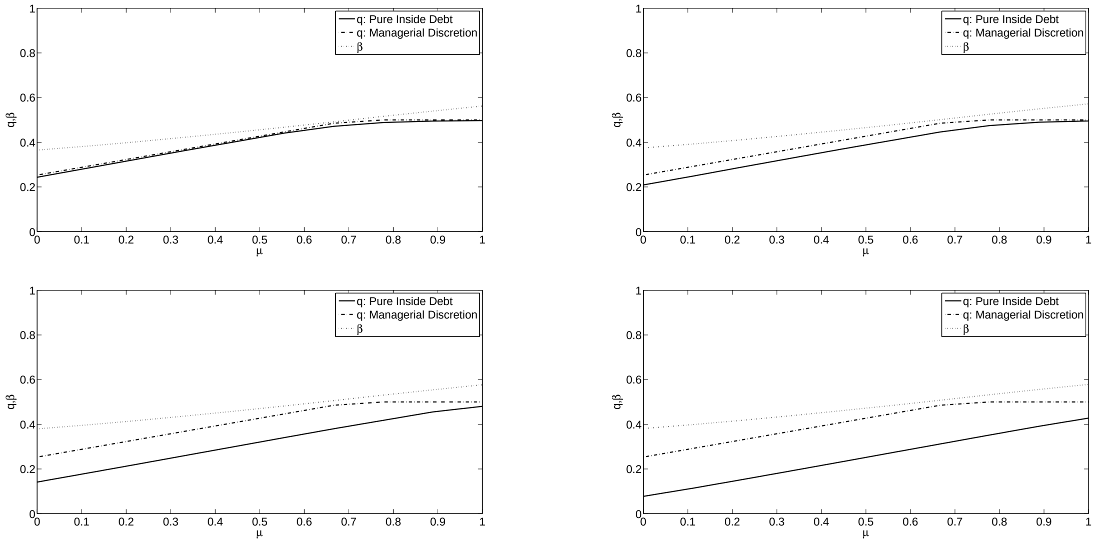

Figure 1: Risk-taking dynamics as a function of firm's profitablity
This figure plots optimal choices of asset volatility and the optimal composition of inside debt for different levels firm's profitability and under the two compensation contracts considered. Left side, upper panel: $S_D = 0.5$. Right side, upper panel: $S_D = 1$. Left side, lower panel: $S_D = 2$. Right side, lower panel: $S_D = 3$.

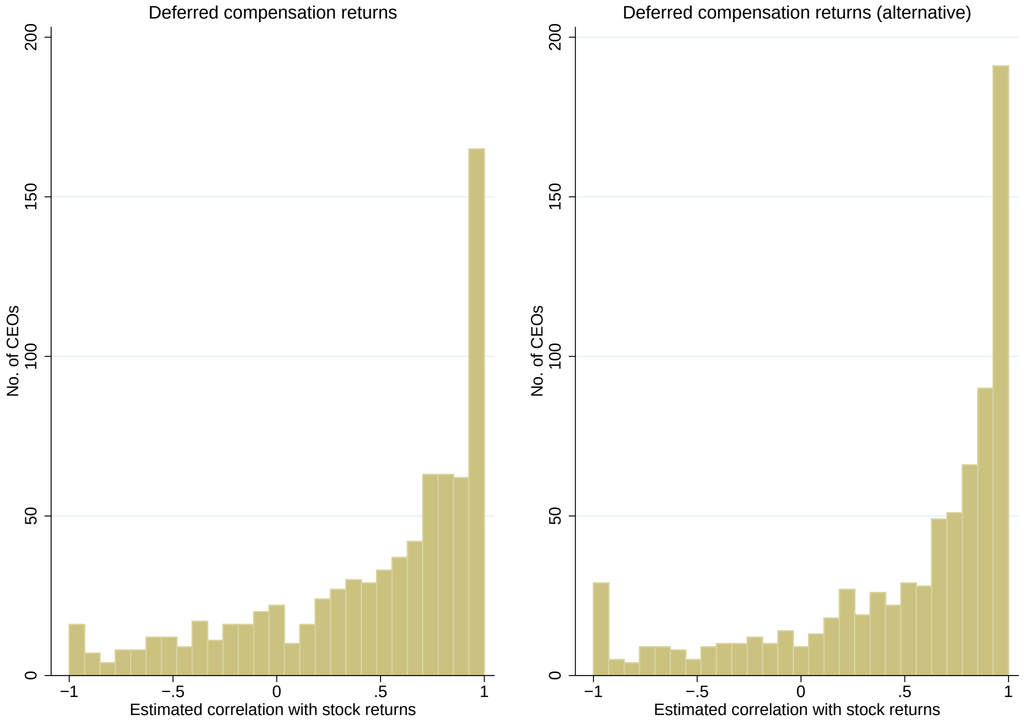

Figure 2: Correlation between stock returns and deferred compensation returns
This figure shows the distribution of correlation between deferred compensation returns and stock returns across CEOs. Correlation is computed for CEOs with at least four observation available. The same correlation is computed for two different measures of deferred compensation returns. Left panel shows the correlation between stock returns and the return measure based on earnings relative to beginning-of-year balance of deferred compensation plans. Right panel shows the correlation between stock returns and the return measure based on earnings relative to previous year's end-of-year balance of deferred compensation plans.

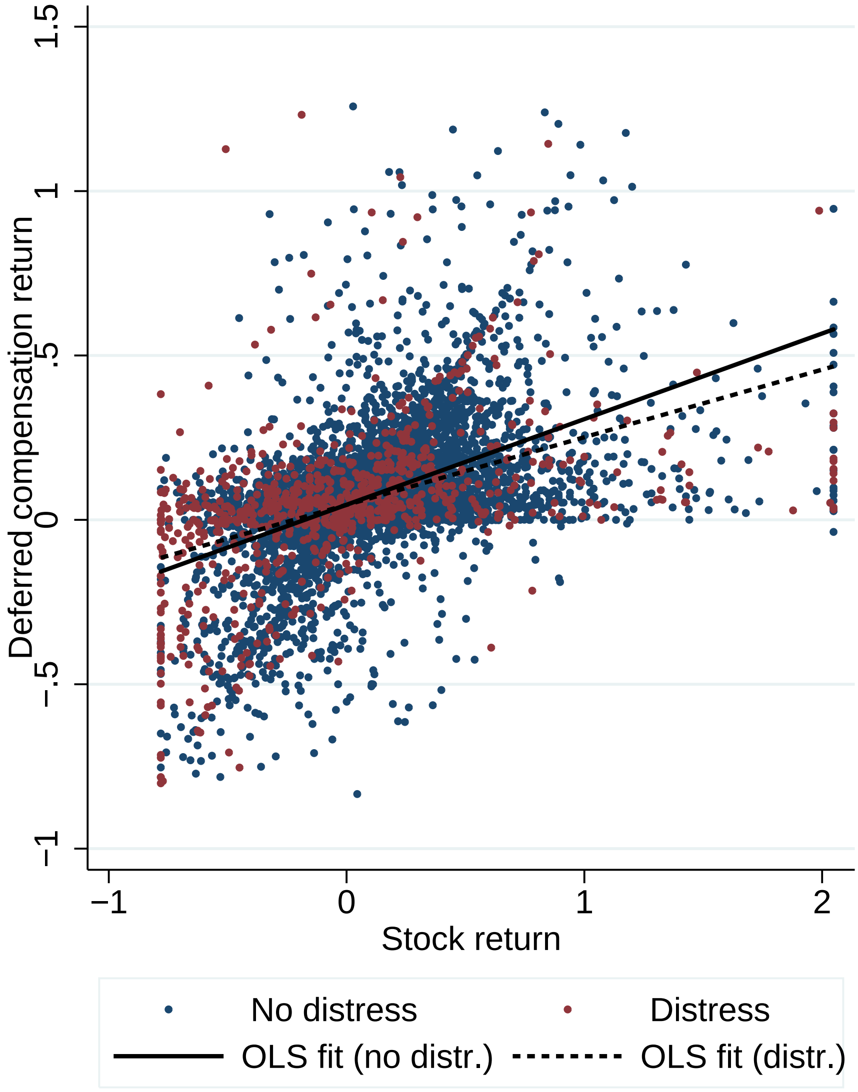

Figure 3: Relation between stock returns and deferred compensation returns
This figure shows CEO deferred compensation returns (baseline measure) and stock returns. The fitted lines are estimated using an OLS regression of deferred compensation returns on stock returns distinguishing between non-distressed and distressed firm-years. Outliers are omitted.

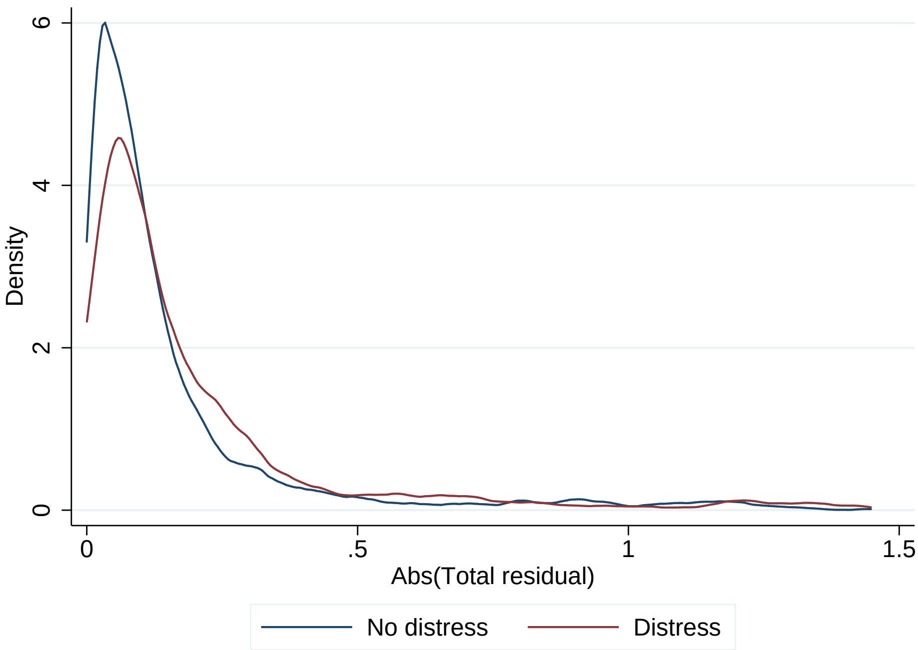

Figure 4: Distribution of residuals
This figure plots the density of the absolute value of residuals (inclusive of firm fixed effects) from estimating a regression of deferred compensation returns (baseline measure) on stock returns distinguishing between non-distressed and distressed firm-years (Epanechnikov kernel function).

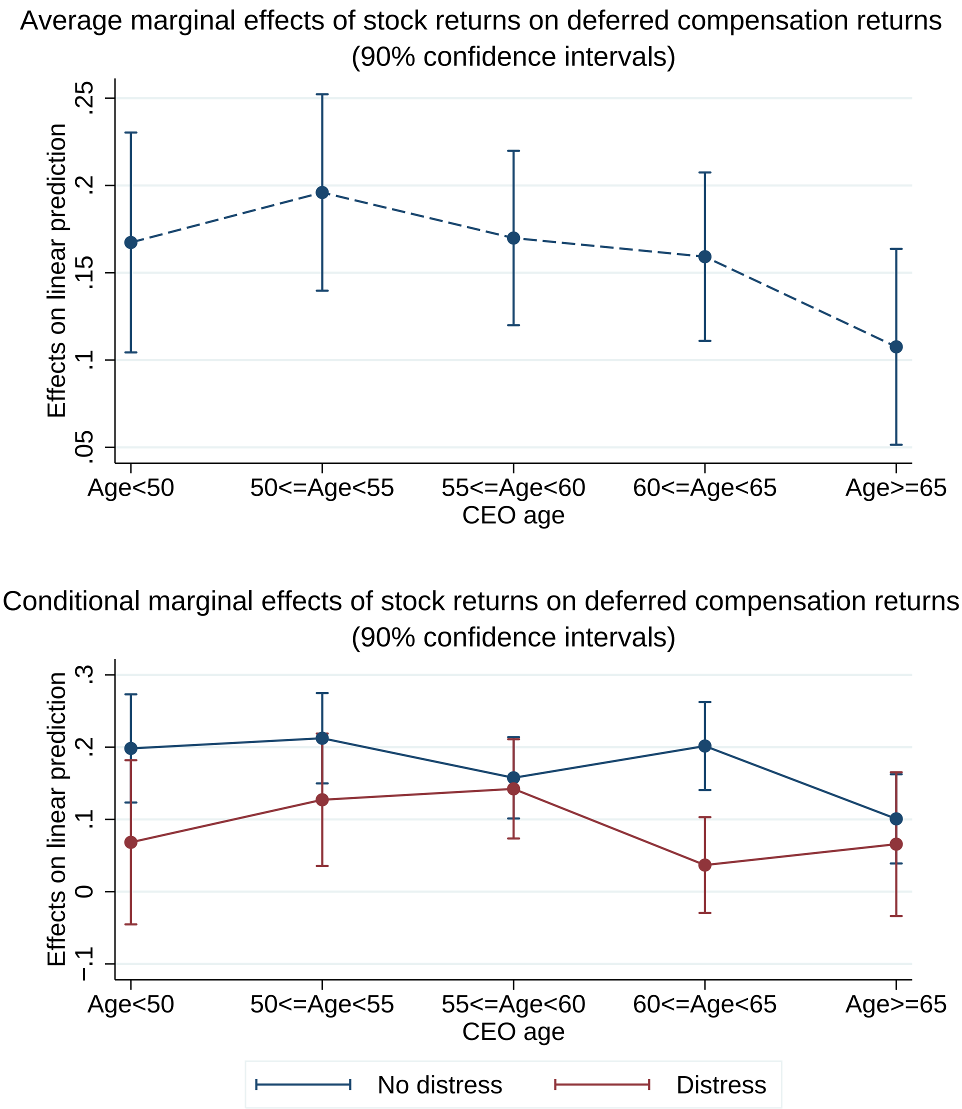

Figure 5: Average of managerial effect of stock returns on inside debt
This figure plots the average marginal effect of stock returns on deferred compensation returns (baseline measure) conditioning on the CEO age quintile. In the upper graph, the average marginal effects are estimated by using a regression of deferred compensation returns on stock returns and their interactions with CEO age groups, controlling for *Size*, *CEO relative D/E ratio*, *CEO tenure*, firm fixed effects, and year fixed effects. In the lower graph, the average marginal effects are computed by estimating the same specification separately over the non-distressed subsample and the distressed subsample.

Table 1: Summary statistics

This table reports summary statistics of all variables employed in the paper. The sample includes 1,740 U.S. firms over the period 2006-2015. We obtain executive compensation data from Execucomp, accounting and stock market data from the CRSP-Compustat merged database, and bond market data from TRACE. All dollar amounts are in 2010 constant dollars. Refer to Table A.1 for variable definitions.

	Mean	Std.Dev.	Q1	Med.	Q3	Obs.
Returns						
Deferred compensation return	0.082	0.312	0.000	0.065	0.160	6097
Deferred compensation return (alt.)	0.065	0.189	0.000	0.057	0.146	4975
Stock return	0.117	0.415	-0.127	0.095	0.312	6042
Idiosyncratic stock return	0.000	0.350	-0.185	-0.005	0.183	6012
Market-adj. industry stock return	0.027	0.172	-0.065	0.007	0.102	6010
Distress measures						
Z-score	-3.761	2.882	-4.770	-3.291	-2.159	5947
Distress	0.119	0.324	0.000	0.000	0.000	5947
Risk measures						
Asset risk	0.342	0.157	0.231	0.305	0.413	6097
Firm-level yield spread	0.028	0.037	0.011	0.018	0.033	2522
CEO characteristics						
CEO age	56.280	6.491	52.000	56.000	60.000	6097
CEO tenure	6.694	6.506	2.000	5.000	9.000	6097
CEO relative D/E ratio	3.598	12.580	0.149	0.530	1.687	5670
Firm characteristics						
Size	8.093	1.431	7.013	7.970	9.074	6097
Tobin's q	1.806	0.895	1.223	1.561	2.105	6097
Cash flow	0.650	1.508	0.215	0.445	0.890	6028
Rated	0.579	0.494	0.000	1.000	1.000	6097
Investment grade	0.347	0.476	0.000	0.000	1.000	6097

Table 2: Deferred compensation returns and stock returns

This table reports panel regressions of CEO deferred compensation returns on stock returns over the period 2006-2015. Panel A analyzes the relation between deferred compensation returns and stock returns. Panel B interacts stock returns with a distress indicator equal to one if a firm-year belongs to the top quartile of the Altman's Z-score. In both panels, the same specifications are estimated for two different measures of deferred compensation returns. Columns 1 through 3 use the return measure based on earnings relative to beginning-of-year balance of deferred compensation plans. Columns 4 through 6 use the return measure based on earnings relative to previous year's end-of-year balance of deferred compensation plans. Columns 1 and 4 estimate the baseline specification. Columns 2 and 5 control also for size, CEO age, CEO tenure, and the CEO relative D/E ratio. Columns 3 and 6 distinguish between idiosyncratic stock returns and market-adjusted industry stock returns. All specifications include firm fixed effects and year fixed effects. The t-statistics are calculated with robust standard errors clustered by firm. Significance at the 10%, 5%, and 1% levels are indicated by *, **, ***, respectively. Refer to Table A.1 for variable definitions.

Panel A: Baseline relation

	Deferred comp.			Deferred comp. (alt.)		
	(1)	(2)	(3)	(4)	(5)	(6)
Stock return	0.166***	0.169***		0.147***	0.149***	
	(9.43)	(9.25)		(12.92)	(12.55)	
Idio. stock return			0.133***			0.106***
			(6.87)			(8.49)
Market-adj. ind. stock return			0.174***			0.188***
			(5.43)			(8.64)
Size		-0.003	-0.005		-0.022**	-0.024**
		(-0.16)	(-0.28)		(-2.06)	(-2.22)
CEO age		0.002	0.002		0.001	0.001
		(1.59)	(1.42)		(0.67)	(0.70)
CEO tenure		-0.003**	-0.004**		-0.001	-0.001
		(-2.34)	(-2.39)		(-1.29)	(-1.48)
CEO relative D/E ratio		0.000	0.001		0.000	0.000
		(0.92)	(1.55)		(1.45)	(1.46)
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6042	5618	5541	5092	4764	4696
Adjusted R^2	0.20	0.20	0.18	0.43	0.43	0.41

Panel B: Distressed vs. non-distressed firms						
	Deferred comp.			Deferred comp. (alt.)		
	(1)	(2)	(3)	(4)	(5)	(6)
Distress × Stock return	-0.096***	-0.086***		-0.076***	-0.084***	
	(-3.14)	(-2.84)		(-3.02)	(-4.45)	
Stock return	0.180***	0.181***		0.154***	0.165***	
	(9.05)	(8.61)		(12.33)	(12.54)	
Distress × Idio. stock return			-0.103***			-0.080***
			(-2.74)			(-3.61)
Idio. stock return			0.145***			0.118***
			(6.49)			(8.41)
Distress × Market-adj. ind. stock return			-0.181***			-0.119***
			(-2.74)			(-2.76)
Market-adj. ind. stock return			0.199***			0.207***
			(5.51)			(8.60)
Distress	-0.003	-0.013	-0.031	0.022	-0.015	-0.027**
	(-0.11)	(-0.56)	(-1.26)	(1.39)	(-1.16)	(-2.02)
Size		-0.001	-0.003	-0.017	-0.016	-0.018
		(-0.04)	(-0.15)	(-1.52)	(-1.50)	(-1.63)
CEO age		0.003	0.002	0.000	0.001	0.001
		(1.60)	(1.44)	(0.58)	(0.63)	(0.68)
CEO tenure		-0.003**	-0.004**	-0.001	-0.001	-0.001
		(-2.29)	(-2.33)	(-1.09)	(-1.27)	(-1.42)
CEO relative D/E ratio		0.000	0.001	0.000	0.000	0.000
		(0.91)	(1.55)	(1.56)	(1.47)	(1.54)
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5893	5471	5396	4639	4639	4573
Adjusted R^2	0.19	0.19	0.18	0.43	0.44	0.41

Table 3: Asset risk and correlation between deferred compensation returns and stock returns in distress
This table reports panel regressions of asset risk over the period 2006-2015. The dependent variable is the naïve asset volatility measure by Bharath and Shumway (2008). Column 1 estimates a regression of asset volatility on the interaction of *Distress* and *Low correlation (total resid.)*. *Distress* is an indicator equal to one if a firm-year belongs to the top quartile of the Altman's Z-score. *Low correlation (total resid.)* is an indicator variable equal to one if the absolute value of the residual from regressing deferred compensation returns on stock returns is in the top quartile for a given firm-year. We use the deferred compensation returns based on earnings relative to beginning-of-year plan balance. Column 2 controls also for size, CEO age, CEO tenure, and the CEO relative D/E ratio. Column 3 interacts *Distress* with the absolute value of the total residual. Column 4 interacts *Distress* with *Low correlation (resid. w/o firm FE)*, an indicator defined in the same way as *Low correlation (total resid.)* but removing the firm fixed effect from the residual. All specifications include firm fixed effects and year fixed effects. The *t*-statistics are calculated with robust standard errors clustered by firm. Significance at the 10%, 5%, and 1% levels are indicated by *, **, ***, respectively. Refer to Table A.1 for variable definitions.

	Asset risk			
	(1)	(2)	(3)	(4)
Distress × Low correlation (total resid.)	0.027*	0.024*		
	(1.95)	(1.85)		
Low correlation (total resid.)	0.012***	0.012***		
	(2.83)	(2.82)		
Distress × Low correlation (total resid.)			0.041*	
			(1.76)	
Total resid.			0.016*	
			(1.69)	
Distress × Low correlation (resid. w/o firm FE)				0.024*
				(1.79)
Low correlation (resid. w/o firm FE)				0.009**
				(2.30)
Distress	0.018**	0.020***	0.020**	0.019**
	(2.30)	(2.70)	(2.48)	(2.58)
Size		-0.057***	-0.056***	-0.057***
		(-8.58)	(-8.55)	(-8.61)
CEO age		0.000	0.000	0.000
		(0.91)	(0.93)	(0.85)
CEO tenure		-0.000	-0.000	-0.000
		(-0.48)	(-0.50)	(-0.55)
CEO relative D/E ratio		-0.000	-0.000	-0.000
		(-0.20)	(-0.16)	(-0.16)
Firm F.E.	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes
Observations	5893	5471	5471	5471
Adjusted R^2	0.58	0.59	0.58	0.58

Table 4: Yield spreads and correlation between inside debt returns and stock returns in distress
This table reports panel regressions of yield spreads over the period 2006-2015. The dependent variable is the yield spread on senior unsecured straight bonds. The yield spread is computed as the difference between the bond yield and the yield on the Treasury security with closest residual maturity. Panel A reports firm-level regressions of yield spreads. Column 1 estimates a regression of yield spreads on the interaction of *Distress* and *Low correlation (total resid.)*. *Distress* is an indicator equal to one if a firm-year belongs to the top quartile of the Altman's Z-score. *Low correlation (total resid.)* is an indicator variable equal to one if the absolute value of the residual from regressing deferred compensation returns on stock returns is in the top quartile for a given firm-year. We use the deferred compensation returns based on earnings relative to beginning-of-year plan balance. Column 2 controls also for size, CEO age, CEO tenure, and the CEO relative D/E ratio. Column 3 interacts *Distress* with the absolute value of the total residual. Column 4 interacts *Distress* with *Low correlation (resid. w/o firm FE)*, an indicator defined in the same way as *Low correlation (total resid.)* but removing the firm fixed effect from the residual. All specifications in Panel A include firm fixed effects. Panel B reports bond-level regressions of yield spreads. Columns 1 and 2 control for coupon rate, residual maturity, and firm fixed effects. Columns 3 through 5 control for residual maturity and bond fixed effects. Column 1 estimates a regression of yield spreads on the interaction of *Distress* and *Low correlation (total resid.)*. Columns 2 and 3 control also for size, CEO age, CEO tenure, and the CEO relative D/E ratio. Column 4 interacts *Distress* with the absolute value of the total residual. Column 5 interacts *Distress* with *Low correlation (resid. w/o firm FE)*. All specifications include issuer rating fixed effects and year fixed effects. The t-statistics are calculated with robust standard errors clustered by firm. Significance at the 10%, 5%, and 1% levels are indicated by *, **, ***, respectively. Refer to Table A.1 for variable definitions.

Panel A: Firm-level analysis

	Yield spread			
	(1)	(2)	(3)	(4)
Distress × Low correlation (total resid.)	0.017**	0.017**		
	(2.16)	(2.17)		
Low correlation (total resid.)	-0.003**	-0.003**		
	(-1.99)	(-2.00)		
Distress × Low correlation (total resid.)			0.016	
			(1.37)	
Total resid.			-0.003	
			(-1.02)	
Distress × Low correlation (resid. w/o firm FE)				0.015*
				(1.86)
Low correlation (resid. w/o firm FE)				-0.002
				(-1.42)
Distress	0.012***	0.012***	0.014***	0.013***
	(2.88)	(2.83)	(2.74)	(2.94)
Size		0.003	0.003	0.003
		(1.20)	(1.13)	(1.15)
CEO age		0.000	0.000	0.000
		(0.15)	(0.18)	(0.17)
CEO tenure		0.000	0.000	0.000
		(0.25)	(0.30)	(0.32)
CEO relative D/E ratio		0.000	0.000	0.000
		(1.16)	(1.12)	(1.11)
Firm F.E.	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes
Rating F.E.	Yes	Yes	Yes	Yes
Observations	2092	2087	2087	2087
Adjusted R^2	0.39	0.39	0.38	0.39

Panel B: Bond-level analysis					
	Yield spread				
	(1)	(2)	(3)	(4)	(5)
Distress × Low correlation (total resid.)	0.016*	0.016*	0.017*		
	(1.70)	(1.72)	(1.72)		
Low correlation (total resid.)	-0.003**	-0.003**	-0.003***		
	(-2.27)	(-2.31)	(-2.66)		
Distress × Low correlation (total resid.)				0.025*	
				(1.92)	
Total resid.				-0.002	
				(-0.78)	
Distress × Low correlation (resid. w/o firm FE)					0.019*
					(1.94)
Low correlation (resid. w/o firm FE)					-0.001
					(-1.31)
Distress	0.011**	0.011**	0.011**	0.012*	0.010**
	(2.12)	(2.15)	(2.12)	(1.82)	(2.07)
Maturity	-0.000	-0.000	-0.000	-0.000	-0.000
	(-1.17)	(-1.08)	(-1.35)	(-1.54)	(-1.45)
Coupon rate	0.002***	0.002***			
	(6.42)	(6.48)			
Size		0.003	0.001	0.001	0.001
		(0.86)	(0.17)	(0.19)	(0.22)
CEO age		0.000	0.001	0.001	0.001
		(1.02)	(1.07)	(1.07)	(1.08)
CEO tenure		-0.000	-0.000	-0.000	-0.000
		(-0.77)	(-0.64)	(-0.61)	(-0.60)
CEO relative D/E ratio		0.000	0.000	0.000	0.000
		(0.23)	(0.47)	(0.52)	(0.56)
Firm F.E.	Yes	Yes	No	No	No
Time F.E.	Yes	Yes	Yes	Yes	Yes
Rating F.E.	Yes	Yes	Yes	Yes	Yes
Bond F.E.	No	No	Yes	Yes	Yes
Observations	7972	7955	7955	7955	7955
Adjusted R^2	0.60	0.61	0.33	0.33	0.34

Appendix for

"Abandon Ship: Inside Debt and Risk-Taking Incentives in Bad Times"

A Optimal policies

Under the standard inside debt contract the manager solves

$$\max_{q} \bar{w} + S_E P_E + S_D D,$$

where

$$P_E = q(x + (1+\mu)\Delta) + (1-2q)x - (1-q)(1+R) - \frac{1}{2}aq^2,$$
$$D = (1-q)\bar{D}.$$

The objective function of the manager is concave and therefore the optimal solution is completely determined by the first order order condition

$$S_E((1+\mu)\Delta - x + (1+R) - aq) - S_D\bar{D} = 0,$$

where R has to be such that creditors hold the bond, that is $R = \frac{1-q(x-\delta)}{1-q} - 1$.

Under the discretionary contract the manager solves

$$\max_{q,\beta} \bar{w} + S_E P_E + S_D D, \tag{A.1}$$

where

$$P_E = q(x + (1+\mu)\Delta) + (1-2q)x - (1-q)(1+R) - \frac{1}{2}aq^2 - \frac{1}{2}b\beta^2, \tag{A.2}$$
$$D = \beta P_E + (1-\beta)q\bar{C}. \tag{A.3}$$

Note that in this case the objective function may not be globally concave because the quantity βP_E contains a third order term with respect to β, that is $-\frac{1}{2}b\beta^3$. Therefore, in this case we solve for the optimal managerial policy numerically.

B Definition of variables

See Table A.1.

Table A.1: Definition of variables

Variable	Definition
Deferred compensation return	Return on deferred compensation plans computed by using information on each CEO's annual earnings from investing defined contributions in Execucomp. The annual return is computed by dividing the CEO's annual earnings by beginning-of-year deferred compensation plans' balance. The beginning-of-year balance is obtained from subtracting CEO's and firm's contributions and CEO's annual earnings from the end-of-year balance (Jackson and Honigsberg, 2014).
Deferred compensation return (alt.)	Defined as *Deferred compensation return* but using the previous year's end-of-year balance rather than the beginning-of-year balance.
Stock return	Total stock return over the fiscal year defined as `trs1yr` in Execucomp.
Idiosyncratic return	*Stock return* minus equally weighted industry return based on Fama-French 48 industry classification.
Market-adjusted industry return	Equally weighted industry return based on Fama-French 48 industry classification minus equally weighted market return.
Z-score	Altman's Z-score defined as `−3.3 × (pi/at) − (saleq/at) − 1.4 × (re/at) − 1.2×(act−lct)/at) − 0.6×(prcc_f·csho)/lt)` in Compustat.
Distress	Distress indicator equal to one if a given firm-year if it belongs to the top quartile of the Altman's Z-score. We compute Altman's Z-score quartiles over the Compustat universe.
Low correlation (total residual)	Indicator variable equal to one if the absolute value of the residual from regressing inside debt returns on stock returns is in the top quartile for a given firm-year.
Low correlation (residual w/o firm FE)	Defined as *Low correlation (total residual)*, but excluding the firm fixed effect from the residual.
Asset risk	Standard deviation of asset returns defined as in the naïve approach by Bharath and Shumway (2008). We measure equity volatility as the annualized standard deviation of stock returns over the last fiscal year.
Bond-level yield spread	Yield spread on senior unsecured straight bonds in TRACE. We follow Dick-Nielsen (2009) and filter duplicate, corrected, canceled and reversed trades. Similarly to Becker and Ivashina (2015), for each bond, we compute the median yield across trades on a given trading day. We compute the yield spread at annual frequency as the difference between the yield and the yield on the Treasury security with closest residual maturity from FRED on the last trading day of the fiscal year.
Firm-level yield spread	Average *Bond-level yield spread* across a firm's bond issues at a given date.
Maturity	Bond residual maturity (in months) in TRACE.
Coupon rate	Coupon rate in TRACE.
CEO age	CEO's age defined as `age` in Execucomp. If missing, we replace it with `page`−(Current year− `year`). If missing, we replace it with the CEOs' median age.
CEO tenure	Number of years since the executive was appointed as CEO based on `becameceo` in Execucomp. The Execucomp indicator variable `ceoann` does not identify a CEO for each firm-year. Indeed, as pointed out by Himmelberg and Hubbard (2000), it is often missing in the first year the firm enters the sample. Because of this, we construct an indicator for CEOs by using Execucomp variables `becameceo` and `leftofc` that allows us to detect some additional CEOs.
CEO relative D/E ratio	Defined as in Cassel, Huang, Sanchez, and Stuart (2012). Inside debt holdings defined as the sum of `defer_balance` and `pension_value` from Execucomp. We set missing values to zero. Equity holdings are adjusted for the CEO's option holdings. As we work on the 2006-2014 period, we use the full-information method - as opposed to the one-year approximation method by Core and Guay (2002) - to compute the CEOs' option portfolio delta, thanks to the enhanced SEC disclosure requirements introduced in 2006. We assume that CEOs with missing data about inside debt/equity holdings have zero inside debt/equity holdings.
Size	Natural logarithm of real total assets (`at`) in Compustat.
Tobin's q	Tobin's q defined as `(at−ceq+prccf×csho)/at` in Compustat.
Cash flow	Internal cash flow defined as `(ib+dp)/ppent(t−1)` in Compustat.
Rated	Indicator variable equal to one a firm has a long-term issuer rating, `splticrm`, from Compustat.
Investment grade	Indicator variable equal to one if a firm has investment grade rating (`splticrm` at least BBB) from Compustat.

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