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Pay Me Later: Inside Debt and Its Role in Managerial Compensation

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ABSTRACT

Though widely used in executive compensation, inside debt has been almost entirely overlooked by prior work. We initiate this research by studying CEO pension arrangements in 237 large capitalization firms. Among our findings are that CEO compensation exhibits a balance between debt and equity incentives; the balance shifts systematically away from equity and toward debt as CEOs grow older; annual increases in pension entitlements represent about 10% of overall CEO compensation, and about 13% for CEOs aged 61–65; CEOs with high debt incentives manage their firms conservatively; and pension compensation influences patterns of CEO turnover and cash compensation.

IN THE THREE DECADES SINCE THE PUBLICATION of Jensen and Meckling (1976), a vast academic literature has emerged on executive compensation. This literature focuses predominantly on equity-based compensation, paid in the form of restricted stock, stock options, and other instruments whose value is tied to future equity returns. Empirically, the growing role of equity-based compensation is widely documented in the research examining pay versus performance. On the theoretical front, the literature seeks to identify both a justification for linking managerial pay to equity and the potential consequences of such a link for managerial incentives and other issues.

Implicit in virtually all of this research is the assumption that managerial compensation consists of only two components, namely, cash and equity-linked instruments. For example, Dewatripont and Tirole (1994, p. 1027) ask:

> Why are managers' monetary incentives ... traditionally correlated with the value of equity rather than the value of debt? That is, why does compensation meant to maximize firm value have managers paid in stocks rather than as a function of firm value?

Overlooked almost entirely is the widespread practice of paying top managers with debt. Many executives in the United States work in exchange for promises

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from their firms to pay them fixed sums of cash in the future. The most common form of these intracompany IOUs ("inside debt" in the language of Jensen and Meckling (1976)) are defined benefit pensions and deferred compensation. As we document in this paper, the amounts involved are significant in many firms, especially the largest and oldest.

For firms that use pensions and deferred compensation, the implications of substantial inside debt holdings by executives are numerous. By affecting both the overall level of compensation and its composition, inside debt alters managerial incentives and in turn the size of the firm's payouts, the composition of these payouts (dividends vs. share repurchases), the firm's cost of debt and its capital structure, the choice of new securities to be issued (debt vs. equity), project choice, capital expenditure choice, and the incentive to pursue diversifying mergers, among many other things. From a theoretical standpoint, inside debt also raises the question of whether and under what conditions such debt holdings could be part of an optimal compensation package.

This paper takes a first, largely empirical, step in exploring the nature and implications of debt-based compensation for CEOs of large U.S. companies. Because disclosure for deferred compensation plans is limited, out of necessity most of our analysis focuses on CEO pension plans. (Even for pensions, information is not readily available as we explain later in the paper.) We begin with an example that illustrates and motivates the material to come.

A Case Study: Jack Welch of General Electric

Table I presents annual pension and deferred compensation data for perhaps the most famous CEO in American business, John F. Welch Jr. of General Electric Co. The data reflect the last 9 years of Welch's career and include information about his direct compensation and equity ownership.

Welch's debt-based compensation was a significant part of his overall pay. Incremental yearly increases in his pension entitlement, when valued using standard actuarial methods, ranged as high as $15.3 million during the period shown, very close to his cash salary and bonus compensation in each of his last 5 working years. By the time Welch retired, General Electric owed him $109 million, the present value of his pension and deferred compensation.

The growth of Welch's pension value accelerated in his final years of office. This pattern is directly linked to the service-based defined benefit formula underlying most CEOs' pensions. This formula provides clear incentives for CEOs to remain working until the minimum age for pension payout and also to manage the firm in their latter years in a way that preserves the value of the pension. In particular, one might expect CEOs to reduce firm risk as they accumulate seniority and the value of their pension grows.

Welch's cash compensation also grew substantially after he turned 60 in 1995; he received a very large equity award that year as well. General Electric permits retirement at age 60 with full pension benefits. To provide incentives

Table I

John F. Welch's Compensation as CEO of General Electric

Variables related to the compensation of John F. Welch Jr., CEO of General Electric Co., between 1993 and 2002. Equity awards represents the sum of the value of stock option and restricted stock awards, as reported by the ExecuComp database. The total value of Welch's pension is based upon a formula for the annual pension value disclosed in the company's proxy statement, which is assumed to be paid in a life annuity whose actuarial value is calculated based upon Welch's age and the company's cost of debt. The pension increment is the present value of the change in Welch's annual pension amount. The total pension value can change each year by more or less than the value of the pension increment due to changes in market interest rates, the life expectancy of the CEO, or the underlying pension formula. The value of deferred compensation is inferred from above-market interest income to Welch that is reported in the proxy statement. Total inside debt equals the value of Welch's pension plus deferred compensation. Total inside equity equals the market value of stock owned plus the Black–Scholes estimated value of options held. The debt/equity ratio for the CEO equals the value of inside debt divided by inside equity. The company's debt/equity ratio equals the book value of short- and long-term debt divided by the market capitalization of common stock. All values are reported in millions of dollars as of December 31 of each year. Welch retired in September of 2001, thus his compensation that year is not for a full 12 months.

Year	Age	Cash Salary + Bonus	Equity Awards	Pension Increment	Total Value of Pension	Value of Deferred Comp.	Total Inside Debt	Total Inside Equity	CEO's Debt-to-Equity Ratio	Company's Debt-to-Equity Ratio
1993	58	$4.0	$4.5	$3.9	$15.3	$0.8	$16.1	$120.0	0.13	1.81
1994	59	$4.4	$4.9	$4.3	$15.5	$1.2	$16.7	$129.9	0.13	1.09
1995	60	$5.3	$15.8	$3.2	$23.3	$3.7	$27.0	$223.1	0.12	0.96
1996	61	$6.3	$6.6	$4.4	$29.6	$5.6	$35.2	$331.2	0.11	0.80
1997	62	$8.0	$7.3	$7.0	$37.3	$8.6	$45.9	$632.6	0.07	0.60
1998	63	$10.0	$37.1	$9.2	$47.0	$10.2	$57.2	$850.2	0.07	0.52
1999	64	$13.3	$24.7	$12.0	$53.4	$12.7	$66.1	$1,263.1	0.05	0.40
2000	65	$16.7	$106.1	$15.3	$70.4	$18.9	$89.3	$1,155.0	0.08	0.42
2001	66	$16.0	$0.0	$11.1	$84.3	$24.8	$109.1	$639.4	0.17	0.59

for managers to keep working beyond that age, one would expect the company to increase compensation in order to make them whole for the pension benefits sacrificed by not retiring. This appears to have been the case with Welch.

Welch's "debt-to-equity ratio"—the ratio of his inside debt holdings to his equity (stock and option) holdings—ranged between 0.05 and 0.17 during the period shown, well below the company's overall debt-to-equity ratio during the same period. While having the CEO invested in both debt and equity claims against the company may mitigate the agency costs of debt (Jensen and Meckling (1976)), very large CEO holdings of inside debt may lead to an overly conservative management style. It is possible that the large equity awards Welch received in his final years in office were partly intended to counteract the incentives for conservative management that would otherwise have arisen from his large pension value.

Welch's pension structure and holdings of inside debt are not exceptional.[1] This paper investigates CEO pensions in the United States and finds that

[1] The level of Welch's compensation is not typical of most CEOs—his pension is by far the highest in our sample—but the balance between his inside debt and equity holdings and their evolution

the above patterns are generally present in the data. The rest of this section elaborates.

This Paper's Contribution

Our sample consists of compensation data for 237 Fortune 500 companies' CEOs over the 7-year period between 1996 and 2002. Following a discussion of the related literature in Section I, Section II describes the common rules used to determine CEO pensions.

Our analysis opens in Section III by describing our sample and highlighting the importance of pensions in the compensation structure of CEOs for our sample companies. Of the many features we find, two bear particular emphasis. First, we show that increases in the actuarial value of pensions constitute a significant component of overall compensation for many CEOs. For example, for the sample CEOs in the 61–65 age group, the pension component of overall compensation is on average 40% larger than the base salary and is 23% of the size of equity compensation. Second, the importance of the pension component of compensation increases monotonically with age. As a consequence, the balance between debt and equity incentives for CEOs shifts in a clear pattern away from equity and toward debt as they grow older. For instance, only 7% of the CEOs in our sample who are between the ages of 51 and 55 have debt-to-equity ratios exceeding their company's debt-to-equity ratios, but for CEOs in the 61–65 age group, this rises to 21%.

Though our sample is dominated by large capitalization firms with long, successful histories, we believe our results about the importance of CEO pensions apply to a much wider circle of firms. Tabulations from the ExecuComp database (see Section III) indicate that service-based, defined benefit pensions are held by about one-fourth of the CEOs of small capitalization firms, about one-third of the CEOs of mid-sized firms, and more than half the CEOs of firms in the Standard & Poor's 500 (S&P 500) Index. These statistics underestimate the frequency of pension compensation, since other CEOs have pensions negotiated separately in employment contracts or derived from different types of formulas. In light of the importance of the pension component of executive compensation, we find it surprising that companies in the United States (unlike their U.K. counterparts) are not required to report pension values explicitly and in greater detail. We comment further on this issue in Section III.

Section IV looks to identify important variables that determine or correlate with (a) the value of a CEO's earned pension, and (b) the CEO's ratio of debt to equity holdings. We consider a large set of variables suggested by contracting theory and intuition, including the firm's leverage, growth opportunities, tax

over time are quite typical among CEOs. Probably the most valuable pensions among active CEOs today are held by Lee R. Raymond of ExxonMobil Corp. and Edward E. Whitacre Jr. of SBC Communications Inc., each of whose pension has an actuarial present value between $50 million and $60 million. Raymond also holds about $350 million worth of shares and options in his company, while Whitacre's equity holdings are considerably lower, not too far from parity with his pension value.

status, and liquidity position. We find that the firm's leverage is positively related to the CEO's pension value. The CEO's tenure with the firm also exhibits a positive association with both the pension value and ratio of debt to equity pay, as does the age of the firm and an indicator variable for whether the CEO was hired from outside.

Section V turns to a topic that has received considerable coverage in the compensation literature, CEO turnover (e.g., Warner, Watts, and Wruck (1988) and Huson, Malatesta, and Parrino (2004)). Examining the role of the payout schedule for pensions in this context, we find that it acts as a critical determinant of turnover. In particular, holding constant age and other variables, we find that CEOs are much more likely to retire once their pensions become fully payable. Though the results are strongest in the year in which CEOs turn 65, when mandatory retirement policies go into effect for many firms, we find evidence that pension availability increases CEO turnover at every age above 60. Moreover, for CEOs who do not retire when pensions become payable, we find that they collect additional cash compensation that leaves them almost exactly whole for each dollar of forgone pension income. These results have special significance since the role of pensions has not thus far been highlighted in the literature on CEO turnover.

Finally, in Section VI, we study the agency costs of debt stemming from the "asset-substitution" or "risk-shifting" incentives of CEOs that hold equity. Because such incentives are dampened when the CEO holds debt in the company, debt-based compensation should, ceteris paribus, reduce the riskiness of the firm's external debt. We test for this implication. As our metric of risk, we use the firm's "distance-to-default," which, loosely speaking, is the number of standard deviation decreases in the firm's value that are required for the firm to default. (A higher distance-to-default indicates a lower likelihood of default.) The notion that distance-to-default captures default risk was popularized in Moody's KMV implementation of Merton's (1974) model and is now widely accepted as a good ordinal proxy for default risk. We find that the data support the theory. As the CEO's pension value increases relative to his equity value, risk-taking as measured by distance-to-default declines. A firm's distance-to-default is 0.3 to 0.4 standard deviations higher when the CEO's personal debt-to-equity ratio exceeds his company's debt-to-equity ratio.

We believe our paper is the first to highlight the importance of debt-based compensation as an element of top management contracts, and also the first to call attention to the underlying incentive and governance implications of these schemes. Our concluding remarks in Section VII point to a number of open questions, both theoretical and empirical, beyond those addressed in this paper.

I. Literature Review

The large theoretical literature on managerial compensation and agency problems offers a number of models that justify the use of equity in a manager's

compensation package. Yet, the role of debt instruments in management compensation has received little attention.

In general, the impact of debt and equity holdings on the manager's incentives depends on the capital structure of the firm itself. Beginning with Jensen and Meckling (1976), several papers examine the optimal design of a firm's "ownership structure," defined as the combination of the firm's capital structure and management compensation structure. The canonical model involves an "owner-manager" who seeks to raise outside financing (outside debt and/or equity) to fund a project. The objective is to choose these components optimally to minimize deadweight losses from agency. We discuss some of these papers in this section.

Jensen and Meckling (1976) consider an owner-manager who retains an equity interest in the firm. This equity interest constitutes the manager's sole compensation. They note that outside equity finance creates moral hazard concerns: The manager bears the full cost of the effort expended in generating returns but receives only a part of the rewards, thus he does not have adequate incentives to expend optimal effort. Outside debt, on the other hand, creates risk-shifting problems: The manager, as a holder of a convex residual claim on the firm, has an incentive to suboptimally increase the riskiness of the firm's cash flows. In either case, deadweight costs result, precluding first-best outcomes.

For the most part, Jensen and Meckling do not consider including debt in the manager's compensation, except for a brief section in which they note that having the manager hold debt and equity in the same ratio as they appear in the firm's capital structure eliminates the risk-shifting problems associated with outside debt.[2]

Jensen and Meckling consider the problems of outside debt and outside equity separately—their framework does not encompass effort-avoidance and risk-shifting possibilities simultaneously—so they do not discuss the optimality of debt compensation in general or its impact on the moral hazard problem. Hellwig (1994) studies a generalization of the Jensen–Meckling framework that simultaneously admits both shirking and risk-shifting.

Matters are much more complex in Hellwig's model; for example, the manager can hide a low-effort choice behind a high-risk choice. Hellwig finds that under certain conditions, the optimal contract involves the issuance of outside debt and outside equity; the manager holds the residual equity but still does not hold debt. Other more complex (and less reasonable) outcomes are possible in Hellwig's model, but none are discussed that involve the manager holding debt.

The Jensen–Meckling and Hellwig frameworks focus on the different income streams generated by different securities (and their consequent incentive effects), but they do not pay much attention to the control rights conferred by

[2] Controlling the problems of risk-shifting leads to an empirical prediction that the amount of equity pay for a manager should vary inversely with firm leverage. See the model of John and John (1993) and empirical evidence in numerous papers such as Bryan, Hwang, and Lilien (2000) and Ortiz-Molina (2004).

these securities. In practice, a specific correlation obtains: Equity holders, the holders of junior convex claims, control the firm in good states of the world, while debt holders, the holders of senior concave claims, control the firm in bad states. Motivated by this observation, Dewatripont and Tirole (1994) describe a model in which multiple outside investors hold diverse securities (outside debt and outside equity) and there is control by debt holders in bad states and by equity holders in good states.[3] In the optimal contract in the Dewatripont–Tirole model, managerial compensation is tied to equity value rather than to firm value; debt is once again not a part of the compensation package. Loosely put, under the optimal incentive scheme, because managers should be punished when they take low-effort levels, control in this event should pass to debt holders who have an incentive to choose actions that hurt the manager.

It is possible that the literature's focus on rationalizing a congruence of interests between the manager and equity holders stems from the widely held belief that compensation schemes in practice exhibit such alignment. However, the empirical evidence we present in this paper indicates that senior managers' interests are more closely tied to debt holders than is commonly acknowledged, and that at least in some firms, managers hold more inside debt than inside equity. This suggests that a reappraisal of the literature may be in order. It also points to the need to develop new theoretical frameworks that can address the possible optimality of inside debt—in particular, pensions—in managerial compensation.[4]

A notable first step in this direction is Edmans (2006). In cases in which risk-shifting is the only concern, Edmans shows, echoing Jensen and Meckling, that inside debt can address this problem; that it can do so more fully than debt covenants; and, perhaps most interestingly, that inside debt continues to form a part of optimal compensation even in the presence of such considerations as bonuses or private benefits.[5] When shirking is also a concern, the role of inside debt becomes more intricate. On the one hand, it continues to moderate risk-shifting incentives. Inside equity is required to improve managerial incentives to exert effort, but this exacerbates risk-shifting; inside debt works to

[3] Other relevant papers in this context include Zender (1991) and Aghion and Bolton (1992), who also address the point that income streams and control rights have a specific relationship, but who do not have multiple outside investors, and Bolton and Scharfstein (1990), who have multiple claimholders but no outside equity.

[4] In this context, Dybvig and Zender (1991) show that a priori restrictions on the set of compensation schemes in a theoretical model can lead to biased results. The context of their paper is very different from ours: Their aim is to show that allowing for information asymmetries does not overturn the Modiglian–Miller irrelevance results if compensation mechanisms are not limited.

[5] Fixed bonuses and private benefits are debt-like in that they involve a given payoff in the event of the firm remaining solvent; however, they are also insensitive to the value of the firm in bankruptcy, and so are more like binary options than debt. Previous literature (e.g., John and John (1993)) suggests that such considerations could resolve risk-shifting problems, but Edmans notes that these results are contingent on the special forms assumed in these papers for firm value in bankruptcy, and that, indeed, under different assumptions, private benefits may even *exacerbate* risk-shifting.

mitigate this impact. On the other, it performs an important alignment role. Inside equity aligns managers with equity holders in good states, but inside debt aligns managers with debt holders in bad states. The latter becomes important if one assumes that managerial effort can improve not only the value of the firm when solvent, but also its liquidation values. In particular, if bankruptcy is likely or if the marginal impact of managerial effort on liquidation values is high, managerial effort may actually be *improved* by substituting inside debt for inside equity. This indicates, curiously, that suboptimal managerial effort may arise, in some cases, because of too much equity. More generally, it suggests that inside debt may be important in highly levered companies in which risk-shifting considerations are of first-order importance.

Virtually no previous study examines the role of pensions in top executives' compensation. When CEOs' pensions are mentioned in academic journals, the discussion occasionally includes references to the annual amount due to a CEO upon retirement, but almost never to the actuarial present value of the lifetime entitlement. A recent exception is Bebchuk and Jackson (2005), who tabulate the pension values for 51 current or recently retired CEOs of S&P 500 companies and conclude that pensions represent a significant component of those CEOs' compensation.[6]

An extensive literature in labor economics deals with workers' pension plans (see, e.g., the survey paper by Gustman, Mitchell, and Steinmeier (1994)), and some of the conclusions of this research appear to have relevance for executive pensions as well. Much of the labor economics pension literature concerns the fundamental question of why companies offer pension plans at all, particularly defined benefit plans. Explanations proposed in the literature include:

- encouraging worker-firm "bonding," that is, reducing labor mobility by creating a high opportunity cost in lost benefits if the worker leaves the firm voluntarily;
- mitigating shirking, particularly near the end of a labor contract, since having employment terminated before retirement generates a substantial cost in lost retirement pay (e.g., Lazear (1979)); and
- enabling firms to control retirement flows by providing a sharp benefit increase to workers who retire around the company's chosen retirement age (Lazear (1979, 1983)).

There are obvious analogies between these hypotheses and some of the hypotheses we examine in this paper—for example, the incentives provided by pensions to the CEO in terms of risk-taking or the relation between CEO turnover and the date pensions become payable. Whether defined benefit plans

[6] To calculate pension values, Bebchuk and Jackson use life annuity price quotes from a commercial web site affiliated with *Annuity Shopper* magazine. For CEOs who have not yet reached retirement age, these values are discounted back to the executive's current age using a constant discount factor of 5%. This approach has an important shortcoming, in that it does not derive the discount factor from the credit rating of the company granting the pension. Our computations, which utilize the credit-ratings of the firms, result in discount factors varying in our sample from 4.92% to 15.25%.

facilitate CEO-firm "bonding" by discouraging voluntary turnover is also of obvious interest.[7] However, because there are important differences between the roles of the CEO and the workers in a firm, their respective pension plans may exist for separate reasons.[8]

Two additional branches of corporate finance research are also related to our work. One line of relevant research concerns the "horizon problem" of CEOs approaching retirement. Evidence indicates that these CEOs tend to reduce investment and R&D spending in their final years in order to maximize accounting earnings and thereby reap larger annual cash bonuses (see Dechow and Sloan (1991)). We also predict that CEOs behave more conservatively as they grow old, but the motivation in our paper involves not the maximization of annual bonus income, but instead the safeguarding of the value of their pensions and deferred compensation. The means by which CEOs achieve such safeguarding may involve some mix of reducing investment spending, selecting less risky projects, unlevering the firm's capital structure, or lengthening the maturity of the firm's debt.

A separate, rich literature considers the role of defined benefit pension plans as an aspect of corporate finance generally. Pension plans have important effects upon corporate taxation, funds available for investment, mergers and acquisitions, and especially in recent years, earnings management. A notable recent example of this research is Rauh (2006). However, to date this literature does not consider the importance of pensions in the compensation of individual managers, which is our focus in this paper.

II. CEO Pensions

The inside debt compensation owed by firms to their CEOs can take the form of either pension obligations or deferred compensation. Because disclosure is extremely limited for deferred compensation,[9] we must restrict the analysis in

[7] In the labor economics literature, evidence on bonding appears mixed. Ippolito (1991) and Allen, Clark, and McDermed (1993) find a negative relationship between defined benefit pension plans and labor turnover, but Gustman and Steinmeier (1993) find that defined contribution plans have an equally strong negative association with labor mobility, indicating that the relationship between defined benefits and reduced labor mobility may not be causal.

[8] For example, there is an analogy between the unsecured nature of CEO pension plans and underfunded worker pension plans. Ippolito (1985) offers the suggestion that leaving workers' pension plans underfunded may weaken unions' bargaining or holdup power, but this line of reasoning would appear inapplicable to top managers.

[9] Nearly every company has a deferred compensation plan for its executives, but disclosure is only required of "above-market interest" earned on the deferred compensation account balance. Above-market interest occurs only if the company credits the executive with a fixed rate of interest and this fixed rate exceeds 110% of the Internal Revenue Service's "applicable federal rate" that was in effect at the time of establishment of the plan. Using this information, one can convert the amount of above-market interest paid during a year to an executive into an average annual balance in their deferred compensation account. Most firms do not pay a fixed rate of interest but instead permit deferred compensation balances to be invested in diversified index funds, bond funds, or synthetic shares of company stock, and in these cases no disclosure of executive earnings is required.

this paper to pensions only. In the minority of cases in which deferred compensation values can be inferred (less than 15% of the sample), this form of inside debt is usually far less than the value of pensions, so the omission of deferred compensation from our analysis may not be serious.

Pensions for CEOs are usually called supplemental executive retirement plans, or SERPs, since their payouts far exceed the maximum federally insured amounts available to most workers under ordinary tax-qualified pension plans. (CEOs usually participate in a company's ordinary plan up to the maximum amount, but the vast majority of their pension entitlements are covered by a SERP.) SERP pension liabilities represent unsecured, unfunded debt claims against the firm, and should the firm become insolvent, SERP pension beneficiaries would stand in line with other unsecured creditors.[10] A firm generally does not receive a tax deduction until pension payments are made to a retired executive, and the executive does not face an income tax liability until payments are received. For at least some firms, pensions therefore offer the possibility for net tax savings between the company and an executive by shifting compensation from the present to the future, when one party or the other might expect to have different marginal tax rates compared to the present.

We calculate the actuarial present value of each CEO's pension as of the end of each fiscal year. The large majority of CEO pensions are defined benefit plans that pay a fixed amount per year upon retirement. Typically the pension is payable as a life annuity, although some companies disclose pension values based upon different annuity types.[11] All companies specify a minimum retirement age, which is the earliest age that an executive can leave the company and obtain 100% of the earned pension benefit (most companies will pay a reduced amount in the event of early retirement). If the CEO chooses to work beyond the minimum retirement age, he forfeits the right to pension benefits that he would otherwise have collected by retiring. The

[10] About 15% of the sample companies disclose funding executives' pensions with so-called "rabbi" trust funds or similar devices such as insurance policies. Rabbi trusts are irrevocable, meaning that the firm cannot withdraw contributions once they are made, but in the event of bankruptcy these trusts can be reached by the firm's creditors. A separate and much rarer device, a "secular" trust fund, can be used to secure an executive's pension in a bankruptcy-proof form, but these trusts have adverse income tax consequences and are extremely controversial with creditors and other employees. The CEOs of both Delta Air Lines, Inc. and AMR Corp. (the parent of American Airlines) lost their jobs in 2003 and 2004 after disclosing that they had created such trusts for the benefit of themselves and other top managers. See Bachelder (1995, 2003) as well as www.401kpsp.com/rabbitrust.htm.

[11] Two popular alternatives are a life annuity with a guaranteed minimum term, and a joint life annuity payable for the longer of the life of the CEO and his or her spouse. Calculations for the values of other annuities require only straightforward modifications to equation (1). In cases of joint spousal annuities, we assume that the CEO is married with a spouse of the same age. Many firms give executives the option of choosing among several payout schemes, with the annual amount adjusted in an actuarially fair way so that the overall value of the pension does not change.

formula for the actuarial present value of a CEO's pension in most cases is

$$\sum_{n=\max(0,R-A)}^{K-A} \frac{p(n)X}{(1+d)^n}, \tag{1}$$

where X is the annual pension amount, R is the minimum retirement age, A is the CEO's current age, $p(n)$ is the probability that the CEO is alive n years in the future, d is the firm's cost of long-term debt, and K is the terminal year of the pension. We obtain the mortality probabilities by age, $p(n)$, separately for male and female CEOs using actuarial tables published by the U.S. Social Security Administration. In theory K can increase without limit; however, for simplicity we set $K = 120$ and assume that all CEOs die with certainty by age 120, so that $p(120 - A) = 0$, because the Social Security mortality tables do not extend beyond age 119.

The CEO's current age and the company's minimum pension retirement age are disclosed in company proxy statements. The company's cost of debt is based upon Moody's or S&P's historical bond ratings, and Salomon Smith Barney's historical corporate yield curves for different rating; we use the 7-year U.S. Treasury bond yield plus an appropriate markup for each rating class, because 7 years approximates the duration of cash flows that most CEOs expect from their pension entitlements. When no bond rating is available, we estimate a company's debt rating based upon comparable companies. A majority of the observations without bond ratings correspond to firms with little or no long-term debt outstanding; we therefore classify most of these observations as Aaa credits. Within the range of different rating classes of investment grade debt, small changes in assumptions about discount rates do not lead to material changes in estimated pension values.

The most difficult part of the calculation arises in estimating X, the annual pension amount that each CEO is entitled to receive upon retirement. In some cases companies disclose this value directly, but more often it must be inferred from other information published in the proxy statement, a process that requires time-consuming research for each company. In practice, the annual pension entitlement is usually calculated according to

$$\sum_{k=1}^{P} \frac{C_{t-k}}{P} \times M \times S, \tag{2}$$

where C_t is the cash salary and bonus compensation for year t, P is a number of past years (usually either 3 or 5) whose compensation is averaged together as part of the formula, M is a multiplier factor that usually lies in a neighborhood between 0.015 and 0.020, and S is the executive's number of years of service. Often the formula is modified so that the product MS is capped at a value of perhaps 0.50 or 0.60. Therefore, for many long-serving executives the pension payment will equal 60% of the average pay received in their final

3 years in office.[12] The structure of the formula effectively serves as a multiplier on the value of current cash compensation, since a CEO who receives a pay increase will see that increase feed into the pension formula and increase his retirement pay as well. This effect intensifies as the CEO gets older, since the present value of future pension income grows larger as he nears retirement. Under a reasonable set of assumptions,[13] an extra dollar of cash compensation received in one year adds about 48 cents to the actuarial present value of a pension when a CEO is 55 years old, and about $1.10 when he is 65. Since this multiplicative effect exerted by pension plans upon salary and bonus income tends to strengthen as CEOs near retirement, it resembles the optimal life-cycle compensation scheme derived by Gibbons and Murphy (1992), who argue that executives near retirement require the strongest pay–performance incentives.

The Securities and Exchange Commission (SEC) requires companies to disclose annual pension payments in a matrix format, whereby years of service S are tabulated on one axis, and final average compensation C is tabulated on the other. The pension formula itself is not directly disclosed, but it can be inferred for any single executive by locating his position on the matrix and comparing the values of bordering cells. Many companies reduce the pension payout by the amount of an executive's Social Security entitlement, but because this sum is trivial for most CEOs (perhaps 1% to 3% of their pensions), we do not take account of this adjustment. In the Appendix, we present an example of the calculations required to derive the actuarial present value of a pension for one CEO, along with a copy of the company's disclosure table that serves as a basis for the derivation.

An issue arises concerning the life expectancy figures used in our calculations of CEOs' pension values. Our mortality data from the U.S. Social Security Administration are derived from the entire U.S. population, rather than just the population of CEOs. To the extent that CEOs have longer life expectancies than ordinary people due to their affluence and access to superior health care, our calculated values of their lifetime pensions represent underestimates. However, a counterargument is that CEOs may face unusually high mortality risks due to the stress of their jobs, the lack of time for exercise, the constant disruption of sleeping and eating routines due to travel, and the frequent use of light aircraft. Indeed, the incidence of unexpected deaths of CEOs while in office has been high enough to spawn several academic studies, beginning with Johnson et al. (1985).

[12] Equation (2) is written so that the pension payout is based on compensation received in the most recent P years in office. Some firms instead use the highest P-year average achieved in any P consecutive years in office, while still others use the highest any P individual years, whether consecutive or not. In practice, because cash compensation tends to increase almost monotonically over an executive's career, all of these formulas yield the same value for most executives. To keep the data collection and calculations tractable for this paper, we use the formula in equation (2) as the default for all observations unless better information is readily available.

[13] Assume that the number of years average $P = 5$, the multiplier $M = 0.016$, years service $S = 20$ at age 55, and $S = 30$ at age 65, and the real discount rate $d = 0.03$. If we instead assume $P = 3$, the totals would be .80 and $1.84, respectively.

No systematic data are available on the mortality rates of CEOs or top business executives, but two forms of related data are informative: studies of the life expectancies of annuity purchasers, and studies of the life expectancies of other public figures. Our examination of these studies below suggests that our CEO lifetime pension value numbers would not perhaps be very different were better data on CEO life expectancy available.

Defined benefit pensions are life annuities, and a number of authors explore the value of life annuity contracts when the population of annuitants is not randomly selected. Mitchell et al. (1999) study the effects of adverse selection in a group of voluntary purchasers of annuities, who exhibit lower death rates and longer life expectancies than the general population. Using discount rates based on corporate bond yields, for males aged 55 the authors find an 8.7% premium for the value of annuities issued to voluntary purchasers compared to annuities issued to the general population. For males aged 65 the premium for voluntary annuitants rises to 12.8%, and it increases further for older holders of annuities, since the differential death rates of annuity holders compared to the general population become more economically meaningful in old age.

Most of the CEOs in our sample lie between the ages of 55 and 65, suggesting that the value of their pensions should be adjusted upward by perhaps 10% if their mortality rates are similar to those of voluntary annuitants. However, the CEOs in our sample are not genuine voluntary annuitants, since most participate by default in company-wide, service-based defined benefit plans that pre-date their careers with the firm. As such, our CEOs belong to a class known as "compulsory annuitants," rather than voluntary annuitants. Mitchell and McCarthy (2002) find lower longevity differentials for compulsory annuitants compared to the general population than for voluntary annuitants. This suggests that any adjustment to the value of CEOs' lifetime pensions to account for differential life expectancy might be relatively small, probably on the order of 5% of pension value.

The most relevant academic study of the mortality of public figures appears in Redelmeier and Singh (2001), who find that Academy Award–winning actors and actresses live almost 4 years longer on average than a matched sample of movie performers who never win the Oscar. The authors label this longevity differential the "status effect." A similar pattern might apply to CEOs, who by definition are more successful in their careers than most people. However, when we try to replicate the Redelmeier–Singh study for two other populations for which data are readily available, we find very little to no effect.[14] These

[14] The two populations we examine are U.S.-born Major League Baseball players and members of the U.S. House of Representatives. In the former case, we look at two possible status effects: whether a player had ever been chosen to play in the annual All-Star game (about 13% of the sample of 8,567 players) or had been chosen Most Valuable Player (less than 1% of the sample). For the Congressional group, we look at the subgroup that had served in the U.S. Senate (644 out of a total sample size of 10,367). Even after numerous cuts of the data related to career dates and length, we find no status effect for baseball players based on either being chosen for the All-Star game or being chosen most valuable player. Among the politicians, we find a slightly higher (roughly 1 year)

findings suggest that the status effect for Oscar winners found by Redelmeier and Singh may be sample specific, and that a similar effect may not exist for the population at large.

III. Descriptive Statistics

Data for our study come from 237 firms drawn from the 2002 Fortune 500 ranking of the largest U.S. companies. From the initial list of 500 companies, we exclude all private firms as well as those public companies that do not have a history on the ExecuComp compensation database extending at least 10 years back to 1993. This results in a sample of 237 firms. For these firms, we retain observations for the 7-year period 1996 to 2002, yielding a final sample of 1,659 firm-year observations. Because of the sample design, the data set includes some over-representation of larger firms with longer operating histories, since firms must have qualified for the ExecuComp database continuously since 1992. An historical sample selection rule is necessary for this research, because pension values are calculated based upon as many as 5 years of lagged data for past compensation, and we reserve data for the years 1993 to 1995 to use in these computations. In some cases we must retrieve company proxy statements as far back as 1991 from Internet sources in order to collect the necessary compensation history.

Due to our historical selection rule, our sample includes an over-representation of large, older firms with successful track records of at least a decade of strong performance. The sample includes many of the most famous names in American business, such as General Electric, Microsoft, Disney, Coca Cola, Intel, and IBM, and the 237 firms we study have an aggregate market capitalization of $5.4 trillion as of the end of 2002. Casual observation suggests that these older, large capitalization firms are among the most likely to offer pensions to their employees.

Table II presents data comparing our 237 sample firms to the 274 companies in the S&P's 500 index at year-end 2002 that are not part of our study (11 of our Fortune 500 sample companies are not S&P 500 members, so Table II analyzes a total of 511 firms). Compared to other S&P 500 firms, those in our sample are larger and older, but they have similar profitability and returns to shareholders (over a 5-year horizon). Our sample firms are more likely to belong to manufacturing industries and less likely to be technology companies. CEOs in our sample firms earn higher cash salary and bonus compensation compared to those in the rest of the S&P 500, but less compensation from stock option awards. As expected, the incidence of CEO pension plans, which we

life expectancy for those Representatives who were also Senators at some point, compared to those who never were. Even this small difference may simply reflect a form of survivorship bias rather than a status effect since longevity in the House of Representatives may provide a candidate with visibility that leads to election to the Senate. Moreover, Representatives who move up to the Senate may have above-average financial affluence, since personal financial resources may be needed to win election to the Senate.

Table II

Comparison of Sample Companies with Other S&P 500 Companies

Descriptive statistics for 237 firms used in a study of CEO pension plans compared with statistics for other firms in the Standard & Poor's 500 Index at year-end 2002. All data are sample means for the year 2002, and dollar values are in millions. The right column shows the p-value of a t-test for the difference in sample means. The sample of 237 firms includes all public companies in the 2002 Fortune 500 ranking of the largest U.S. firms that have a complete history of data on the ExecuComp database from 1993 to 2002. Because the sample of 237 firms includes 11 that do not belong to the S&P 500 Index, the total number of companies studied in this table equals 511. All information in the table is obtained from ExecuComp or company proxy statements. Stock option award values are based upon ExecuComp's Black–Scholes method. The indicator variable for CEO pay/service pension equals 1 if ExecuComp reports a positive value for the variable measuring years service accrued for pension. A small number of observations have missing values for certain variables.

Variable	Sample Firms	Rest of S&P 500	p-value of t-test
Observations	237	274	
Annual sales	\$14,479	\$10,283	0.03**
Sales growth (1 year)	1.1%	−0.5%	0.47
Market capitalization	\$22,978	\$10,110	0.00***
Return on assets (EBITDA)	12.0%	11.6%	0.66
Return to shareholders (1 year)	−9.9%	−19.5%	0.00***
Return to shareholders (5 years)	2.1%	1.9%	0.87
Firm age (years since IPO)	41	27	0.00***
Manufacturing industry	40%	24%	0.00***
Financial industry	16%	16%	0.99
Technology industry	9%	21%	0.00***
Healthcare industry	8%	12%	0.13
CEO age	56	55	0.07*
CEO years tenure	7	8	0.14
CEO salary and bonus	\$2.58	\$1.81	0.00***
CEO option award value	\$2.79	\$5.12	0.08*
CEO pay/service pension indicator	0.62	0.44	0.00***

Significant at 1% (***), 5% (**), and 10% (*) levels.

ascertain from ExecuComp,[15] is significantly higher for our sample firms than for other S&P 500 companies. These data suggest that our results below must be interpreted with some care, since our research design yields a sample in which pension compensation for CEOs is more widespread than usual.

[15] One variable tabulated by ExecuComp is the years service accrued for pension, if any, for each CEO. This variable has a nonzero value only if the company's proxy statement includes the SEC's required pension matrix reporting the annual lifetime pension benefit for an individual as a joint function of his average income and his years of service. We create an indicator variable and set it equal to one if the years service for pension purposes is nonzero. It is important to point out that this variable will understate (perhaps substantially) the true incidence of CEO pensions, since it will not indicate pensions negotiated by contract or calculated according to a method other than the common pay-and-service formula. In our sample, for instance, 13% of CEOs—a sixth of the total number who had pension plans—had pension plans that are outside the pay-and-service formula (see Table V), so they were not picked up by this indicator.

Table III
Descriptive Statistics

Descriptive statistics for variables related to CEO and firm characteristics for a sample of 1,659 observations from 237 Fortune 500 companies over 1996 to 2002. Pension actuarial values are calculated based upon assumptions given in the text. Equity value equals the value of common stock plus stock options, calculated according to Black–Scholes methodology. Cash compensation is the value of annual salary and bonus. Leverage equals total debt, both short- and long term, divided by total debt plus either the book value or market value of equity. Distance-to-default is the number of standard deviations' decrease in firm value that would be required for a firm to default on its debt, according to assumptions given in the text. Distance-to-default is not calculated for firms with market leverage below 1%.

	Mean	*SD*	25th Percentile	Median	75th Percentile
CEO variables					
Age	57.2	6.9	53	58	62
Pension indicator	0.78				
Pension actuarial value (mm.)	$4.2	$6.1	$0.3	$2.6	$5.6
Equity ownership value (mm.)	$416.3	$3,192.9	$16.0	$38.2	$104.8
Pension value/equity value	0.17	0.34	0.01	0.07	0.19
Annual cash compensation (mm.)	$2.3	$2.2	$1.2	$1.8	$2.7
Annual pension increment (mm.)	$0.9	$1.7	$0.0	$0.2	$1.0
CEO's years as CEO	6.61	7.07	2	4	9
CEO's years employed with firm	22.16	12.10	13	23	32
CEO outside hire indicator	0.18				
CEO in founding family indicator	0.14				
CEO percent ownership	1.19%	4.27%	0.05%	0.11%	0.31%
Firm variables					
Total assets (bn.)	$36.5	$88.9	$4.8	$12.0	$29.3
Net sales (bn.)	$12.4	$14.2	$4.3	$7.5	$14.5
Return on assets (EBITDA)	16.1%	10.6%	9.0%	15.1%	22.1%
Equity market capitalization (bn.)	$24.8	$46.5	$4.8	$9.5	$22.8
Equity volatility	0.372	0.147	0.277	0.346	0.435
Leverage (market value of equity)	0.267	0.212	0.092	0.211	0.421
Leverage (book value of equity)	0.565	0.278	0.361	0.566	0.790
Research & development/sales	0.023	0.047	0	0	0.025
Distance-to-default	3.15	1.10	2.39	2.97	3.72
Tax loss carry-forward indicator	0.211				
Negative operating income indicator	0.007				
Years since date of founding	91.95	45.33	61	94	120
Number of industry segments	2.54	1.97	1	2	3
Board size	12.10	3.46	10	12	14
Percent of outside directors	79.2%	11.0%	73.3%	81.8%	87.5%
Institutional investor ownership	61.1%	14.9%	51.0%	62.6%	72.1%

For the 237 companies in our sample, Tables III to V and Figure 1 present information concerning CEO pensions and other aspects of CEO compensation. Table III shows that for most CEOs, equity value is far higher than pension value, and the median ratio between these two quantities is 0.07. However, as we show below, this ratio increases markedly as CEOs grow older.

To understand the importance of pension increases in yearly CEO compensation for our sample companies, the first step is to measure the annual increment

Table IV
Mean Values of Elements of CEO Compensation, by Age

Descriptive statistics for variables related to CEO compensation and pensions for a sample of 1659 observations from 237 Fortune 500 companies over 1996 to 2002. Increments to pension actuarial values are calculated based upon assumptions given in the text. Stock options awards are valued according to Black–Scholes methodology as reported by ExecuComp. All dollar values are in millions. In each column the annual pension increment is calculated based upon fewer observations than the other variables, since it requires the use of year-over-year differences in certain variables.

	All CEOs	Age 46–50	Age 51–55	Age 56–60	Age 61–65	Age 66+
Observations	1,656	175	385	509	423	104
Salary	\$0.9	\$0.8	\$0.9	\$1.0	\$1.0	\$1.0
Bonus	\$1.4	\$1.2	\$1.3	\$1.5	\$1.6	\$1.8
Stock option awards	\$5.8	\$6.1	\$6.0	\$4.9	\$5.1	\$7.0
Restricted stock awards	\$0.9	\$1.0	\$0.7	\$0.9	\$0.9	\$1.2
Long-term incentive payouts	\$0.5	\$0.5	\$0.4	\$0.5	\$0.8	\$0.3
Annual increment to pension value	\$0.9	\$0.3	\$0.6	\$0.9	\$1.4	\$0.6
Total compensation	\$10.4	\$9.8	\$9.9	\$9.7	\$10.7	\$11.8
Change in pension/total comp.	0.11	0.05	0.08	0.11	0.16	0.11
Pension value/equity value	0.18	0.05	0.14	0.22	0.26	0.04
Fraction of CEOs for whom (pension value/equity value) > firm's (debt value/equity value)	0.13	0.05	0.07	0.17	0.21	0.03

to CEO pensions. We calculate this as the present value of the difference between the stream of cash flows to which the CEO is currently entitled using (2) and the stream to which the CEO was entitled a year ago, that is

$$\frac{M}{P}\left([C_{t-1} - C_{t-(P+1)}]S + \sum_{k=1}^{P} C_{t-k}\right). \tag{3}$$

Conceptually, this is the inside-debt analog of new equity grants. One could think of the corporation issuing a new bond to the CEO each year, representing a lifetime annuity with a face value equal to the difference in (3).

The present value of the mean annual increment across our sample equals \$0.9 million. This sample mean value, as well as the sample mean values for subgroups of CEOs reported in Table IV, is somewhat understated because our calculations essentially rely on first differences in compensation, forcing us to discard the observation for each CEO's first year in the data set if he has a nonzero pension;[16] this process causes a disproportionately large number of zero-valued observations to enter the calculations.

[16] The pension increment is missing for about one-fifth of the sample observations. These cases include new CEOs hired from outside the firm, CEOs with insufficient disclosed compensation histories to permit computations, and companies using certain patterns of disclosure that do not permit us to decode the underlying pension formula. These computational problems do not prevent us from obtaining the year-end value of each CEO's pension entitlement.

Table V
Form and Structure of CEO Pensions

Incidence and structure of CEO pensions in a sample of 1,659 observations from 237 Fortune 500 companies over 1996 to 2002. The data come from annual company proxy filings. The presence of workforce-defined benefit plans is based upon whether Compustat reports a nonzero value for assets held in a defined benefit pension plan. CEO retirement ages are tabulated within the subsample of 1,286 observations for firms whose CEOs have accrued nonzero pensions. Data in the right column are based upon the 1,076 observations for which pensions are calculated according to the widely used pay/service formula, which is the product of average compensation times years employed times a multiplier factor. The final section of the table reports the payout currently accrued by each CEO, not the payout that a CEO might expect to receive if he worked until normal retirement age.

Incidence of CEO pensions, tabulated by type of plan	
Pay-and-service formula	65%
Cash balance	7%
Negotiated by contract	6%
Pension frozen from defunct plan	<1%
No pension	22%
Incidence of CEO pensions, tabulated by incidence of workforce-defined benefit plans	
Firms with workforce plans	90%
Firms without workforce plans	20%
Minimum CEO retirement age to obtain full pension benefits	
55	3%
60	11%
62	9%
65	76%
Other	1%
Items included in calculation of average compensation	
Salary	100%
Bonus	94%
Restricted stock awards	4%
Long-term incentive plans	4%
Years of compensation averaged to calculate annual payout	
1	5%
3	39%
4	3%
5	54%
Fraction of final average compensation in annual payout	
Less than 20.1%	9%
20.1–30.0%	9%
30.1–40.0%	12%
40.1–50.0%	23%
50.1–60.0%	31%
60.1–70.0%	14%
More than 70.0%	2%

A second figure of interest is the annual change in the present value of total pension entitlement, that is, the difference between the present value of the pension entitlement calculated today and the present value of the pension entitlement calculated a year ago. (This is the inside-debt analog of the change in the value of total equity held by the CEO.) This change could be negative

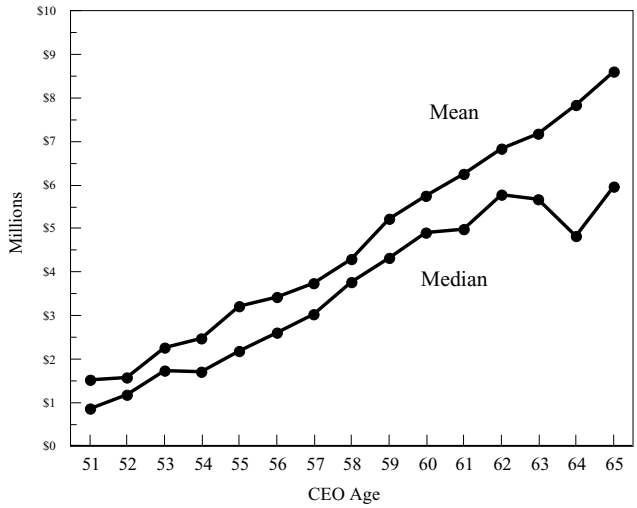

Figure 1. Mean and median actuarial present values for CEO pensions by age. Mean and median actuarial present values for pensions held by CEOs in a sample of 237 Fortune 500 companies over 1996 to 2002, including zero-valued observations, which comprise 23% of the 1,659 CEO-year observations. Pension values are calculated based upon assumptions given in the text, using information disclosed in company proxy statements.

if the company's cost of debt has risen over the last year, if the company has changed its pension formula, if the pension increment this year was negative because the CEO took a cut in his cash compensation, or if the CEO is working past the normal retirement age and has failed to draw down his pension when it became available.

Pension values decline on an objective actuarial basis for about 6% of the CEO-year observations in the sample, and a significant number of these observations occur due to market-wide increases in interest rates that reduce the value of all pensions across the board. However, in the vast majority of cases, CEO pension values rise each year. Even if there is no change in basic compensation, the CEO's years of service (the variable S in equation (2)) will increase each year, his life expectancy will increase so long as he has not died, and the discounted value of future pension entitlements will increase as well.

CEO pension values are highly sensitive to age. Figure 1 illustrates mean and median actuarial pension values for all CEOs in the sample between ages 51 and 65. As the graph shows, the mean lifetime pension entitlement has a present value of just $1.5 million for 51-year-old CEOs, but this rises to $8.6 million for 65-year-old CEOs; the median values increase from $0.8 million to $6.0 million over the same range. The convex shape of the top graph shows that the rate of pension growth accelerates as CEOs age. Data on the graph are likely subject to some self-selection bias, as those CEOs with the most valuable pensions may be inclined to retire earlier and drop out of the sample.

Table IV reports mean values for all sources of CEO compensation, including the annual increment to pension value, for the entire sample and separately for

subsamples of CEOs arranged according to age. The sum of total compensation from all categories is almost invariant to age, averaging right around $10 million per CEO per year, but the importance of pension value as part of overall compensation change increases monotonically up to age 65. For CEOs in the 46 to 50 age group, the annual pension increment averages $400,000, representing about 4% of total compensation. In the 61 to 65 age group, in contrast, the average pension increment is $1.4 million annually, representing about 13% of total compensation. Beyond age 65, pensions begin to lose their importance; many members of this group are sacrificing the right to draw down their pensions by continuing to work, which makes the net change in pension value lower than for those younger than 65. One can also assume that many CEOs with the most lucrative pensions retire by age 65 and exit the sample.

Data near the bottom of Table IV present the ratio between pension value and equity value for CEOs in different age groups. The data indicate that this ratio also increases monotonically, rising from about 0.05 for CEOs in the 46 to 50 age bracket to 0.21 for CEOs aged 61 to 65, until it too falls off for CEOs aged 66 and above. In other words, pension values tend to rise more rapidly than the value of equity owned as CEOs grow older, giving managers increasing incentives to run the firm more in the interests of debt holders and less in the interests of equity holders. The last line of the table shows the fraction of CEOs for whom the personal debt-to-equity ratio (pension value divided by share plus option value) exceeds the firm's overall debt-to-equity ratio (short- and long-term debt divided by market value of equity). This group of CEOs has clear incentives to pursue policies that favor debt more than equity. Thirteen percent of all CEOs fall into this group, with the fraction again rising monotonically by age.[17]

We find that a significant amount of variation exists both between firms and within firms in the design of pension plans. Sixty-seven firms, or 28% of those in the sample, change either the form of their pension plan or the underlying formula at some point during the 7-year sample period, not counting several dozen firms that negotiate one-time pension enhancements with CEOs in their final year of service (see Yermack (2006)).

Table V presents details about the frequency and structure of CEO pensions within the sample. Pensions are held by CEOs in all but 22% of the firm-year observations, and the majority of these pensions are awarded based on the pay-and-service formula in equation (2) above. A minority of CEOs negotiate their pensions directly as part of their employment contracts,[18] or participate in cash balance pension plans that are generally quite modest in value. A large

[17] Our calculations here are conservative. We have taken no account of deferred compensation as part of the CEO's inside debt holdings. In addition, one could argue that the CEO's fixed salary represents a form of pseudo-debt that the executive expects to collect up until retirement age, and taking account of that claim would increase the CEO's debt-to-equity ratio further. Also, the firm's debt-to-equity ratio would decrease if one counted convertible debt as part of equity capital instead of debt capital.

[18] The table indicates that 6% of CEOs negotiate fixed pension amounts in their employment contracts. However, a larger number negotiate modifications to the pay-and-service formula to make it more generous for themselves than the formula used for regular company employees. For example, while serving as the CEO of CSX Corp., John W. Snow had an employment contract calling for his pension to be calculated including the value of restricted stock grants as part of his annual

overlap occurs between whether a firm awards pensions to its CEO and the presence of a defined benefit pension plan for other workers in the firm, according to Compustat's disclosure of whether the firm has nonzero assets held in a defined benefit plan,[19] but the overlap is not complete: About 10% of firms with defined benefit workforce pensions do not award pensions to their CEOs, and about 20% of firms with no defined benefit workforce plan do provide for CEO pensions. Within the subsample of CEOs that receive pensions, the retirement age at which full pension benefits become available is usually 65, though a minority of firms pay full pensions at earlier ages, some as young as age 55. Most CEO pensions are based upon final average compensation, which always includes salary and also includes bonuses 94% of the time. A small minority of firms take into account other forms of compensation, such as restricted stock awards or long-term incentive plans when making these calculations. Final average compensation is nearly always based upon either 3 years' pay (39% of all observations) or 5 years' pay (54%).

Data in Tables III to V indicate that pensions are an important part of overall CEO compensation in our sample firms. No broad-based data about the size and frequency of CEO pension plans are available for other firms throughout the economy. However, we are able to obtain some information about the broad-based distribution of CEO pensions from ExecuComp. As we discussed, we assume that when ExecuComp reports a nonzero value for a CEO's years' service for pension purposes, the company must be maintaining a SERP and reporting it in the proxy statement. For the entire ExecuComp sample, we construct a binary variable for pay-and-service CEO pensions and code it one if the CEO has positive years of service for pension purposes, and zero otherwise. For 2003, the most recent ExecuComp year with complete data, the incidence of defined benefit pensions according to this method is 24.0% in the Standard and Poor's index of 600 small capitalization firms, 32.7% in its index of 400 mid cap firms, and 52.0% in the S&P 500 Index of large cap firms.[20] As the data in Table V indicate, the incidence of pay-and-service pensions for CEOs in our sample is somewhat higher at 65% for the entire 1996 to 2002 period, and it was 61% for the subsample of 2002 observations.

Despite the evident importance of CEO pensions as part of overall compensation, especially in large capitalization companies, current SEC regulations require only complex and somewhat opaque disclosures about pensions, and financial acumen is required to convert the reported data into estimates of the fair value of any executive's pension. Disclosure practices in certain other

income, an enhancement of the company's ordinary formula that took account of only salary and bonus; while serving as the CEO of Alcoa Inc., Paul H. O'Neill had an employment contract that awarded him 2 years of service time for pension purposes for every 1 year worked.

[19] These data for workforce pension plans are somewhat misleading for two reasons. Some of the firms with assets held in defined benefit plans may have discontinued their plans for current or future workers. In addition, some firms may provide workforce pensions based upon a defined contribution or cash balance formula, instead of the more traditional defined benefit structure.

[20] We compare the true incidence of pay-and-service CEO pensions in our sample with the frequency estimated by this ExecuComp variable and find that the overall totals are quite close, although the ExecuComp variable suffers from modest coding errors whereby the false positive observations are netted out almost exactly by a similar number of false negatives.

countries such as the United Kingdom provide far more illuminating reports of pension values and their annual changes. Moreover, disclosure requirements are non-existent in the United States for most aspects of deferred compensation, as well as post-retirement transactions involving pension rights such as "SERP swaps" that are understood to be available to many top executives but never disclosed.

IV. Cross-Sectional Determinants of CEO Debt versus Equity Holdings

We analyze the distribution of CEOs' inside debt and equity ownership within our sample of 237 firms. We measure the value of inside debt as the actuarial present value of CEO pension holdings and the value of equity as the market value of stock and options, with option portfolios valued according to standard Black-Scholes assumptions.[21] As we discuss above, the absence of deferred compensation from our analysis will lead to estimates of CEO debt values somewhat below the true level. Since we are assessing the relative strength of debt and equity ownership for our sample CEOs, the key dependent variable in our regression analysis equals the ratio of pension (or debt) value divided by stock plus option (or equity) value.

We test several well-known theories of compensation that appear in the literature on equity incentives (Yermack (1995)), in addition to the theories of debt-based compensation discussed above. These include:

- *Leverage:* Because debt-based compensation reduces the agency costs of debt, we should observe a positive association between the CEO's debt-to-equity ratio and the firm's leverage (see Edmans (2006) for a theoretical framework making this point). We measure leverage as long-term debt over the sum of long-term debt and stockholders' equity, as reported by Compustat. We use the book value instead of the market value of equity to avoid a mechanical negative association between the leverage variable and the market value of CEOs' equity holdings.
- *Liquidity:* Equity compensation provides a means for firms to pay executives without the use of cash. (Pension compensation does not require immediate cash, but will require the use of cash at some point.) We therefore expect a negative association between measures of liquidity and CEOs' debt-to-equity ratios. We measure liquidity constraints with an indicator variable that equals one if the firm has negative operating cash flow.

[21] We obtain information about the number of options held and their average exercise prices from ExecuComp. We then estimate option portfolio values by applying a "representative option" approach that has become widely used in the compensation literature. Core and Guay (2002) provide empirical validation of this approach. We assume all outstanding options have 6-year lives and use the prevailing firm volatilities, dividend rates, and risk-free rates to value them on a Black–Scholes basis. If all of a CEO's outstanding options are out of the money, we cannot calculate an average exercise price for the representative option. In these cases we read older proxy statements until we can obtain enough information about the options' exercise prices in order to use the representative option method.

- *Growth opportunities:* Equity pay is expected to be used when a firm has many valuable investment opportunities that are best understood by managers instead of outside shareholders or directors. Accordingly, we expect a negative association between measures of growth opportunities and the CEO's debt-to-equity ratio. We use the ratio of research and development expense over sales as a proxy for growth opportunities. We avoid other measures that rely on the company's stock price, such as the market-to-book ratio or Tobin's Q, because these will exhibit mechanical positive correlations with the value of the CEO's equity holdings.
- *Tax status:* Taxation plays a role in both stock option and pension compensation. Each provides opportunities for income deferral to future years, which could result in a net tax savings for the firm and executive depending on the marginal tax rates of each. Stock options have additional favorable tax treatment under certain conditions, although CEO stock option awards are generally too large to qualify for these benefits. We include as a regression control an indicator variable for whether the firm has net operating loss carry-forwards on its balance sheet as a proxy for its tax status. However, we cannot make an unambiguous prediction about the sign of the estimate for this variable, since compensation in both the numerator and denominator of the CEO's debt-to-equity ratio delivers certain types of tax benefits.

We estimate our regressions in a Tobit framework due to the significant number of zero-valued observations for the CEO pension variable. All regressions include control variables for firm size (the log of total assets) and a range of governance variables including the log of board size, the percentage of outside directors on the board, the CEO's years in office (tenure), a dummy for whether the CEO belongs to the firm's founding family, and the percentage ownership by institutional investors as reported by Thomson/CDA. Most importantly among these controls for CEO tenure is years of service, because the formula for the accumulation of pension value will mechanically increase a CEO's debt incentives based upon his years with the firm, as discussed above. We also include a dummy variable for CEOs who are hired from outside the firm. Casual observation suggests to us that these CEOs are likelier to negotiate employment contracts with special pension provisions. This could occur for at least two reasons. First, the firm may have to make the CEO whole if he sacrificed unvested pension benefits at his previous employer when he changed jobs. Second, as noted above, pension compensation can have the effect of bonding a worker to the firm, and companies may feel more of a need for a bonding mechanism when a complete outsider, who has already changed companies at least once, is brought in as CEO.

Table VI presents the regression estimates, with some of the control variables untabulated in order to save space. In the left column, estimates are based upon the value of the CEO's pension alone; these estimates are reported so that the reader can assess whether the results for the CEO's debt-to-equity ratio, in the right column, are influenced by its numerator or denominator. In

Table VI
Determinants of CEO's Inside Debt Holdings

Tobit regression estimates of the actuarial present value of a CEO's pension, shown unadjusted in the left column, scaled by salary and bonus in the center column, and scaled by the value of the CEO's ownership of shares and options in the right column. Pension values are estimated using actuarial assumptions given in the text. Stock option values are based upon Black–Scholes calculations. Leverage equals total debt over total debt plus stockholders' equity. The dummy variable for liquidity constrained firms equals 1 if the firm has negative operating income. The dummy variable for tax status equals 1 if the firm has an operating loss carry-forward. *t*-statistics based upon standard errors clustered at the firm level appear in parentheses below each estimate. The dependent variables are multiplied by 10^6 and 10^1 in the center and right columns, respectively, to improve display of the estimates. Industry dummy variables are based upon the Fama–French definitions of industry portfolios provided in Kenneth French's asset pricing data library.

Dependent Variable	Pension Value	Pension Value ÷ (Salary + Bonus)	Pension Value ÷ (Stock + Options)
CEO's years employed by firm	0.223***	0.099***	0.084***
	(5.83)	(9.14)	(4.96)
CEO hired from outside firm dummy	3.043***	1.300***	1.043**
	(3.46)	(4.31)	(2.36)
			(1.38)
Firm size (log of total assets)	1.430**	−0.045	−0.201
	(2.38)	(0.37)	(1.38)
Leverage (book value)	3.333**	1.193***	1.697***
	(2.46)	(2.72)	(2.63)
Liquidity constraint dummy	−2.395*	−0.225	0.130
(negative operating income)	(1.70)	(0.45)	(0.44)
Growth opportunities (R&D/sales)	−14.449	−2.030	−4.147
	(1.26)	(0.59)	(1.06)
Tax status (carry-forward dummy)	−0.042	0.095	0.130
	(0.07)	(0.46)	(0.44)
Years since founding of firm	0.026***	0.012***	0.014***
	(2.91)	(3.70)	(3.49)

Other regression controls: institutional ownership (%), log of board size, percent of outside directors, CEO membership in founding family, year indicator variables, industry indicator variables.
Significant at 1% (***), 5% (**), and 10% (*) levels.

the center column we provide estimates for the CEO's pension value divided by the magnitude of the CEO's cash salary and bonus, again for comparison purposes. Because we have a 7-year panel and expect persistence in the pension variable's value from year to year, we cluster the standard errors by firm (Petersen (2006)). As Table VI shows, the sign and significance of coefficients for the explanatory variables are extremely similar across all three dependent variables, with the exception of the firm size variable. Larger firms pay more pension compensation, as indicated by the positive coefficient in the left column, but they do not exhibit significantly different mixes of pension versus cash compensation or pension versus equity pay, as indicated by the insignificant estimates in the other two columns.

The firm's leverage ratio, the key explanatory variable in the model, has a positive and significant association with the CEO's pension value, whether measured in isolation or scaled by cash compensation or equity ownership. These estimates are consistent with firms using inside debt compensation to mitigate the agency costs of debt.

Among other control variables, the CEO's years employed by the firm exhibits a positive association with the CEO's pension value as expected, although interpretation of the direction of causation in this association is somewhat difficult since pensions are structured to encourage executives to stay with the firm. CEOs hired from outside the firm appear to have larger pensions than CEOs promoted internally, and each of these results is significant in all three models. Older firms also pay larger pensions than younger firms, holding all else constant. Except in one case, we do not obtain significant estimates for the variables measuring liquidity, growth opportunities, or tax status, though none has an unexpected sign.

V. Pensions and CEO Turnover

A substantial literature examines the determinants of executive turnover, but none with reference to pension payout patterns. Inside debt compensation such as pensions offers incentives for the CEO to leave his position once the debt becomes payable, since ordinarily the debt is collectible only after the CEO retires or passes age 70.5. We therefore study the interaction between pension compensation and patterns of CEO turnover, using logistic regressions presented in Table VII.

The dependent variable in Table VII equals one if the CEO leaves his position in the last half of the current fiscal year or in the first half of the subsequent fiscal year. We separate the cases of CEO turnover into forced and planned based upon searches of news stories and disclosures in company proxy statements; about one-quarter of the turnover events are involuntary according to our research. We omit several dozen observations involving unusual cases of CEO turnover, including those negotiated in connection with acquisitions or spinoffs, acting CEOs, and cases in which the CEO cedes the CEO title to someone else but does not retire or begin to transition out of top management, remaining as the full-time, permanent Chairman of the Board with compensation equal to or exceeding the CEO. (Bill Gates of Microsoft would be a representative example.)

The first three columns of Table VII present logit estimates with the dependent variable equal to one for all turnover, forced turnover only, and planned turnover only, from left to right. For our purposes, the key explanatory variables in Table VII are two indicator variables for whether the CEO's pension is currently payable. The first variable, labeled "pension start age indicator," equals one if the CEO's age, as disclosed in the annual proxy statement, is within one year of the age at which he has the right to payout of 100% of his earned pension benefits, if any. (Many firms permit CEOs to retire but collect reduced pension benefits before this age.) The second variable, labeled "pension past payable

Table VII
Logit Estimates for CEO Turnover as a Function of Pension Compensation

This table presents logistic regression estimates for the probability of CEO turnover. The sample includes observations for a panel of 237 Fortune 500 companies over 1996 to 2002. The dependent variable equals 1 if the CEO leaves his position during the last half of the fiscal year or the first half of the subsequent fiscal year. The pension start age indicator equals 1 if the CEO's reported age is within 1 year of the age at which he has the right to immediate payout of his full pension, if any. The pension past payable indicator equals 1 if the CEO's age exceeds by more than 1 year the age at which he had the right to immediate payout of his full pension, if any. Excess stock return equals the difference between the raw stock return and the CRSP value-weighted index, compounded continuously. *t*-statistics robust to serial correlation and heteroskedasticity appear below each estimate in parentheses.

	All Turnover	Forced Turnover	Planned Turnover	Planned Turnover
Pension start age indicator	0.950**	0.896	1.229**	−0.001
	(3.27)	(1.60)	(4.09)	(0.001)
Pension start age indicator × indicator for start age = 65				2.836.
				(3.46)
Pension past payable indicator	1.151***	−0.548	1.558***	1.529***
	(3.57)	(0.47)	(4.94)	(4.23)
Pension past payable indicator × indicator for CEO age 64, 65, or 66				1.774**
				(2.31)
Excess stock return, prior 2 years	−0.849***	−1.867***	0.230	0.295
	(3.34)	(5.53)	(0.79)	(0.97)
Member of founding family	−0.989**	−0.496	−1.209**	−1.079**
	(2.17)	(0.71)	(2.36)	(2.09)
CEO percentage ownership	−3.093	4.484	−3.141	−1.993
	(0.84)	(1.02)	(0.72)	(0.52)
Years tenure as CEO	0.013	0.011	0.028*	0.026*
	(0.84)	(0.31)	(1.76)	(1.66)
Observations	1,616	1,616	1,616	1,616
CEO age dummy variables	Yes	Yes	Yes	Yes
Year dummy variables	Yes	Yes	Yes	Yes
Mean of dependent variable	0.106	0.0229%	0.077	0.077
% classified correctly	89.5%	97.0%	92.7%	93.2%

Other regression controls: institutional ownership (%), log of board size, percent of outside directors, leverage (book value), market-to-book ratio.
Significant at 1% (***), 5% (**), and 10% (*) levels.

indicator," equals one if the CEO's full pension start date has already passed by one year or more. Both variables equal zero if the CEO's right to receive his full pension has not yet vested or if the CEO has no pension. Other explanatory variables in the regressions include the range of controls found in many studies of CEO turnover: company performance, measured as the 2-year, net-of-market stock return over the current and prior year; CEO variables including age, percent ownership, tenure in office, and membership in the company's founding family; leverage; market-to-book ratio; and governance variables including log of board size, percentage of outside directors on the board, and percentage ownership by institutional investors. All regression estimates include standard errors robust to serial correlation and heteroskedasticity.

Estimates in Table VII show that the existence of a currently payable pension is associated with a significant increase in the incidence of CEO turnover, after holding constant CEO age and other factors. The economic magnitude of the estimates is substantial; the logit marginal effect for the pension start age indicator implies that when this variable equals 1, CEO turnover rises by 4.0 percentage points, a very large magnitude compared to the unconditional voluntary turnover rate of 7.7%. The estimated marginal effect for the pension past payable indicator is even larger, at 5.1 percentage points.

Both the pension start age and pension past payable indicators have significant estimates only in the models for all turnover and for voluntary turnover, but not for forced turnover. This pattern of estimates makes intuitive sense, since the CEO controls his departure decision only in voluntary turnover cases, and the payout status of his pension should not be expected to influence the board's decision about whether to dismiss an underperforming CEO.

Annual turnover frequencies plotted in Figure 2 reinforce the economic significance of Table VII's regression estimates. The figure depicts voluntary turnover frequencies by age for CEOs who are at or beyond the age at which their pensions are 100% payable, compared to turnover frequencies for CEOs who are younger than the full pension age. The graph excludes CEOs who do not have pensions and also omits cases of forced CEO turnover. Large disparities exist in turnover rates for CEOs of the same age according to whether or not their pensions have become fully payable; for example, for the group of 63-year-old CEOs, the voluntary turnover rate is 17% in companies whose pensions are not yet payable in full, while the rate increases to 50% in firms in which the pension payable age equals the CEO's current age, and lies in between these two numbers, at 31%, for CEOs who are already beyond their firm's pension payout age. This pattern of turnover rates holds for all CEO ages except 62, even as turnover rates increase with age in all three categories for the age range shown on the graph.

A concern arises in interpreting the results in Table VII due to the possibility that mandatory retirement policies in some firms may be synchronized with pension payout ages, creating illusory causation between CEOs' pension payout and retirement dates. The U.S. Age Discrimination in Employment Act, as amended in 1986, prohibits mandatory retirement for most U.S. workers, but an exception exists for "high policymaker" executives such as CEOs and their management teams. Top managers can be required by their firms to retire at a certain date, but no earlier than age 65. Notwithstanding the potential importance of mandatory retirement policies, the differential retirement rates shown in Figure 2 for CEOs between the ages of 60 and 64 provide evidence of the importance of pension payouts in influencing retirements, since all of these CEOs are too young to be subject to mandatory retirement. In addition, those firms that do have mandatory retirement policies are permitted to waive them and sometimes do for strong performing CEOs (two recent examples occurred at ExxonMobil for Lee Raymond and General Electric for Jack Welch).

Ideally, we would like to test directly for the strength of mandatory retirement effects by compiling data about the policies of our sample firms. However,

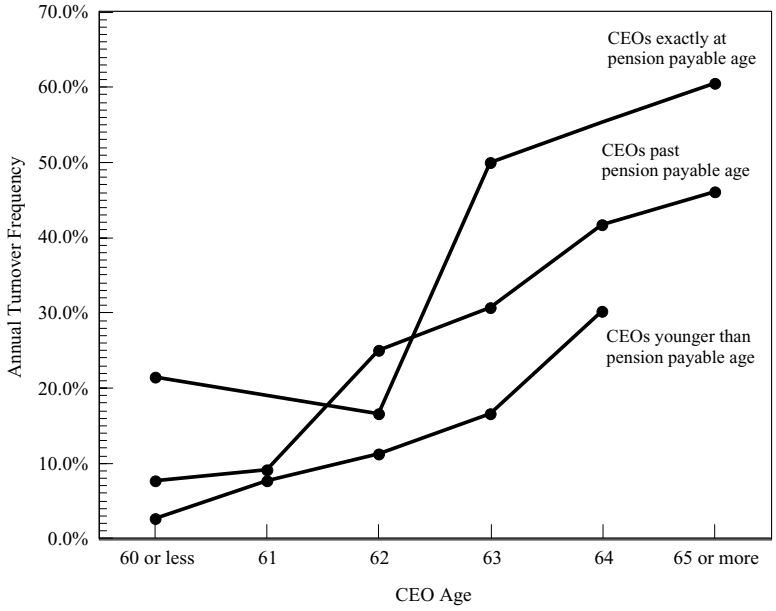

Figure 2. Annual CEO turnover rates by age, as a function of pension availability. Annual frequencies of voluntary CEO turnover at different ages within a sample of 237 Fortune 500 companies over 1996 to 2002. The entire sample includes 1,659 annual observations, but the chart is drawn for a subsample of 1,264 observations, excluding those CEO-years for which no pension plan was in effect and also excluding cases of involuntary turnover. The top line shows turnover rates for CEOs who are exactly at the age at which their pensions become fully payable, comprising a total of 61 observations (no CEOs have pension start ages of 61 or 64). The middle line shows turnover rates for CEOs who are past the pension start age, a total of 124 observations. The bottom line shows turnover rates for CEOs who are younger than the pension start age, a total of 1,079 observations.

to our knowledge such policies are not disclosed in a formal or systematic way. As an alternative, we focus on the importance of age 65 as a retirement point for many CEOs, conjecturing that if mandatory retirement policies are in effect, the large majority of them probably occur at this age due to the controlling law. We estimate a logit regression of planned turnover in which the two indicator variables for pension payability are interacted with indicators based upon the CEO's age. As the rightmost column of Table VII shows, we interact the pension start age indicator with a dummy variable that equals one if the company's pension start year is age 65. We also interact the pension past payable indicator with a dummy variable that equals one if the CEO's current age is 64, 65, or 66. Both interaction terms have powerful effects upon the estimates, consistent with mandatory retirement policies influencing CEO turnover. Almost the entire impact of the pension start age indicator occurs at companies with payout ages equal to 65, but the pension past payable indicator has positive size and statistical significance regardless of whether the CEO is near age 65. This enables us to conclude that certain CEOs aged 64 or younger retire due to the

availability of their full pensions; regressions using alternative specifications of the interaction terms (not tabulated to save space) lend further support to this conclusion. This pattern of CEO retirements due to pension availability appears to be consistent with Lazear's (1979, 1983) conjecture about ordinary workforce pension plans, in which the payout is structured in a way to elicit voluntary retirement of workers at certain ages.

In further analysis, we study whether firms adjust the compensation of CEOs who do not retire and claim their lifetime pensions in the first possible year. We estimate a regression with the dependent variable equal to the annual salary plus bonus cash compensation of each CEO. The key explanatory variable equals the pension payments, if any, that certain CEOs forgo when they continue in office past the age at which full pension benefits would be available for payout. This variable equals zero for all CEOs who are below the pension payout age or who work for companies with no pensions. Control variables in the regression include the excess stock return over the current and prior years, firm size, and CEO characteristics including age, percentage ownership, tenure, founding family membership, and fixed effects for each unique CEO-company pair. Regression estimates, which are untabulated to save space, indicate that CEOs receive close to 50 cents on the dollar in immediate compensation for forgone pension benefits. In addition, this incremental compensation feeds into the calculation of the CEO's future pension benefits when he ultimately retires. According to the multiplier estimates discussed in Section III above, the net increase in the CEO's wealth will be quite close to one dollar for each dollar of forgone pension income, almost exactly compensating him for the opportunity cost of not drawing his pension earlier.

We conclude that CEO pension plans, when present, influence CEO succession in important ways. We close this section with two related conjectures. First, we would expect the pension holdings of a retiring CEO to play a role in the choice of his successor. An exiting CEO with a large pension that is scheduled to be paid out over many years would prefer that his successor avoid risk, limit payouts to investors, and otherwise manage the firm conservatively. We therefore would expect these CEOs to be succeeded by older executives from inside the firm, perhaps with significant pension entitlements of their own.[22] Second, we observe earlier in the paper that CEO pension values sometimes fall, for instance, in cases in which current-year salary and bonus compensation drop below the level of the past 3 or 5 years (depending on the firm's pension formula). Boards of directors are notoriously reluctant to dismiss mediocre CEOs except in cases of exceedingly poor performance (see, e.g., Warner et al. (1988)). However, one way for the board to induce the retirement of an underperforming CEO would be to cut his current-year compensation. Faced with a pay cut, the CEO would have to retire immediately to keep the value of his pension from falling.

[22] This prediction would not necessarily hold if CEOs can obtain lump-sum distributions of their pension values after retirement, as permitted by some companies (although sometimes only with discounts to the fair actuarial value). We thank Kevin Murphy for this observation.

VI. Inside Debt and Risk Reduction

When top executives receive part of their compensation in debt and part in equity, we would expect them to manage the firm in a way that considers the interests of both debt and equity investors. Classic agency cost of debt problems related to risk-shifting and excessive payouts should diminish in importance when managers hold large pensions or deferred compensation.

We use the simple framework of Merton (1974) to develop our hypotheses in this context. Consider a firm with two securities outstanding, namely, zero-coupon debt with face value F and maturity T, and equity. If the value V_T of the firm's assets on date T exceeds F, the debt is paid off and the balance goes to the firm's equity holders. If $V_T < F$, the firm is liquidated. Assume liquidation is costless and absolute priority holds. Then the payoffs to debt- and equity holders on date T are, respectively,

$$\min(V_T, F) \text{ and } \max(V_T - F, 0). \tag{4}$$

Now suppose the firm's manager holds a fraction α of the firm's equity and a fraction β of its debt. The time T payoffs to the manager are

$$\alpha \max(V_T - F, 0) + \beta \min(V_T, F). \tag{5}$$

The value of the manager's portfolio and its sensitivity to various parameters can now be determined using standard option pricing theory. If $C(F)$ is the current value of a call option on the firm with strike price F, the current value of the manager's portfolio is

$$\alpha C(F) + \beta(V - C(F)) = \beta V + (\alpha - \beta)C(F). \tag{6}$$

The most obvious parameter of interest is risk, which enters the option pricing formula in the form of volatility. In the oft-analyzed case in which a manager holds equity, he has an incentive to increase the firm's risk beyond the level desired by debt holders. In our setting, since the manager holds both debt and equity, this incentive for risk-shifting is lessened; with enough inside debt compensation, the manager may even have an incentive to reduce volatility. From (6), the impact of a change in volatility on the value of the manager's portfolio is just

$$(\alpha - \beta) \times \text{ vega}(C(F)). \tag{7}$$

This impact is positive if $\alpha > \beta$, zero if $\alpha = \beta$, and negative if $\alpha < \beta$. In other words, if the debt-to-equity ratio of the manager's holdings is less than the firm's debt-to-equity ratio, the manager has an incentive to increase risk, and vice versa.

To test whether managers' inside debt holdings in the form of pensions have an impact upon the firm's riskiness, we utilize the concept of the distance-to-default statistic popularized by Moody's KMV and now widely accepted as a qualitatively reliable indicator of default likelihood. The distance-to-default (henceforth, DtD) is the number of standard deviation decreases in a firm's

asset value that it would take for the firm to default. KMV's operationalization of this notion requires converting a firm's debt structure into an "equivalent" zero-coupon form. Following their approach (see Crouhy, Galai, and Mark (2001) or Sundaram (2001)), we define the default point *DPT* to be equal to the sum of the face value of short-term debt (less than 1 year) plus half the face value of long-term debt (greater than 1 year)[23] and to have a maturity of 1 year. This simple approximation has been found to work well in practice. Thus the distance-to-default statistic is

$$\text{DtD} = \frac{V - DPT}{\sigma V}. \tag{8}$$

Here, V is the firm's asset market value, as above, and σ is the firm's asset value volatility. To estimate (8) we must obtain values for the unobserved variables V and σ. We do so as follows. Under the default point *DPT*, equity holders have a call option to buy the firm for *DPT* in 1 year's time. The value of this call—which depends on V and σ—is the value of equity that is observable. Since we have two unknowns, we need a second equation. For this we use equity volatility σ_E, which too is observed. Standard stochastic calculus arguments show that equity volatility and asset value volatility are related via

$$\sigma_E = \sigma \frac{V}{E} \Delta_E, \tag{9}$$

where E is the market value of equity and Δ_E is the derivative $\partial E/\partial V$ of the option value function with respect to firm value (i.e., it is the delta of the call option that equity holders own).

Using these two equations and information regarding the risk-free rate, we can now solve for V and σ for each firm-year observation and substitute the resulting values into (8) to obtain the estimated DtD. We conduct these DtD calculations using an iterative spreadsheet algorithm. We discard observations for which $DPT/V < 0.01$, assuming that firms with a trivial amount of debt would never default. This filter removes 81 firm-years, or about 5% of the sample. Descriptive statistics for the DtD statistic appear in Table III. The mean and median DtD are about three standard deviations of annual performance.

Table VIII presents our regression analysis of the DtD. In this analysis we use fixed effects panel data models with a separate intercept assigned to each unique CEO-company pair. In addition to variables related to CEO incentives, we control for several firm variables that should have obvious relations to the likelihood of default: firm size (the log of total assets), leverage (in a book value form), and diversification (the number of segments for which the firm reports line-of-business data). We also include a variety of other governance and financial controls listed in the table. Our key explanatory variables are (i) the ratio of the CEO's pension value divided by the value of his stock plus options equity holdings, and (ii) an indicator that takes the value of one if the CEO's

[23] We do not distinguish between bank debt and public debt, though the latter is arguably more likely to default due to difficulties of renegotiation.

Table VIII
Estimates of Default Risk as a Function of CEOs' Inside Debt and Equity Holdings

Fixed effects estimates of firms' default risk. Default risk is measured as the distance-to-default, which equals the number of standard deviations' decrease in the market value of the firm that would place it below the default barrier (a more complete definition appears in the text). The key explanatory variables utilize the CEO's personal debt-to-equity ratio, which comprises the pension's actuarial present value in the numerator and the market value of shares and options in the denominator. For the firm, the debt-to-equity ratio equals the book value of total debt over the market value of common stock. The CEO's pension value is calculated using assumptions given in the text. The number of industry segments, a measure of diversification, equals the number of business units for which the company reports disaggregated line-of-business data in its annual report. Fixed effects are specified by assigning a separate intercept to each unique CEO-firm pair. The sample includes 1,659 observations for 237 Fortune 500 firms over 1996 to 2002, and the regression omits firms with minimal amounts of debt outstanding. *t*-statistics appear below each estimate in parentheses.

Dependent Variable: Distance-to-Default	Estimate	Estimate	Estimate
Firm size (log of total assets)	0.122*	0.121*	0.122*
	(1.84)	(1.85)	(1.87)
Leverage (book value)	−0.399***	−0.197	−0.205
	(2.73)	(1.34)	(1.38)
Number of industry segments in firm	0.011	0.006	0.006
	(0.74)	(0.41)	(0.42)
CEO's pension value/	0.154**		0.028
CEO's stock and option value	(2.09)		(0.36)
Indicator for		0.427***	0.419***
CEO's pension/equity > firm's debt/equity		(6.10)	(5.73)
Firms	233	233	233
Firm-CEO pairs	405	405	405
Total observations	1,570	1,570	1,570
Year dummy variables	Yes	Yes	Yes
R^2	0.820	0.825	0.825

Other regression controls: institutional ownership (%), log of board size, percent of outside directors, market-to-book ratio.
Significant at 1% (***), 5% (**), and 10% (*) levels.

personal debt-to-equity ratio exceeds the firm's debt-to-equity ratio, calculated based upon the market value of equity. Under this condition the CEO will have incentives to manage the firm in ways that increase debt value relative to equity value.

Coefficient estimates in Table VIII are positive and significant for both specifications of the CEO's debt-to-equity ratio when either variable is used without the other. A unit increase in this ratio implies an increase in DtD close to 0.14 standard deviations, according to the estimate in the left column. The center column's estimates indicate that DtD is approximately 0.4 standard deviations higher when the CEO's debt-to-equity ratio exceeds the company's overall ratio, which occurs for about 13% of the observations in the data according to summary statistics in Table IV. The regression estimate therefore implies that these

CEOs take actions, such as accepting fewer risky investments, that reduce the likelihood of default and the risks to their own pension values. When both variables for the CEO's debt-to-equity ratio are included in the regression together, as shown in the right column, the estimate for the continuous variable becomes insignificant while the estimate for the indicator variable retains almost the same size and significance as when it is used in the model alone.

We find that firm size exhibits a positive association with DtD and leverage exhibits a negative association, both as expected, while the variable measuring diversification has estimates close to zero.

VII. Conclusions

In a sample of large U.S. firms we find that top managers receive significant compensation from "inside debt," that is, intracorporate IOUs such as pensions and deferred compensation. These compensation instruments have received very little attention in prior theoretical or empirical research into executive compensation. Debt-based compensation provides managers with interesting incentives to reduce the agency costs of debt. Managers holding large pensions, for example, should be expected to pursue strategies that reduce overall firm risk. These may include choosing fewer risky investment projects, unlevering the capital structure, reducing payouts to equity holders, or lengthening the average maturity of outstanding debt.

We study a sample of 237 large capitalization firms and find that CEOs hold a portfolio of incentives arising from both inside debt and inside equity compensation. This portfolio tends to shift in favor of the inside debt instruments as CEOs grow older. When a CEO's personal debt-to-equity ratio exceeds the firm's external debt-to-equity ratio, regression evidence indicates that CEOs manage more conservatively to reduce the probability of a debt default.

Inside debt in the form of pensions also exerts strong influence on patterns of CEO turnover and other types of compensation. We find that at any given age, the probability of a CEO retiring voluntarily is far higher if the CEO's pension has vested and is payable immediately. For CEOs who continue to work beyond the minimum retirement age, cash compensation is markedly higher, apparently to compensate them for forgone pension income.

We believe that the study of debt-based incentives for top managers is likely to be a fruitful area for further research. A top priority would appear to be the development of theory that illustrates conditions under which debt-based compensation (and, in particular, pensions) represents the solution to an optimal contracting problem; Edmans (2006) provides a useful first step in this direction. On the empirical side, further research should examine how debt-based pay affects the selection of investment projects and capital structure, as well as related areas such as security issuance decisions, mergers and acquisitions, recapitalizations, or the timing of bankruptcy filings. Do managers with large pensions prefer to issue equity rather than debt? Will they be more likely to exercise call provisions to force refinancing or conversion of outstanding debt? If they do borrow, will they be more likely to raise funds from a bank or from

the public markets? Do they favor a longer maturity structure? Do managers with large amounts of inside debt seek out diversifying mergers that reduce firm risk? Are they more or less likely to accept outside acquisition proposals, and does this decision depend on the capital structure of the bidding firm or the method of payment offered? If the CEO has earned a large pension, is a workout to avoid bankruptcy more likely to succeed if the firm becomes distressed? How will equity holders fare in such a transaction? Opportunities also exist to study the structure of individual companies' pension and deferred compensation arrangements. Why do some firms have more generous pension formulas than others? Why do some use 3 instead of 5 years of compensation in the calculation of the pension payout? Why do minimum retirement ages vary between 55 and 65 for different firms? Do we observe pension plans influencing decisions about CEO succession, especially in cases in which the exiting CEO has a large pension to protect? With respect to deferred compensation, how much pay do firms allow their executives to defer, and how do executives respond to these opportunities? How do they choose to invest their deferred sums? Historical research into executive compensation would also profit from greater attention to the role of inside debt. Investigators such as Jensen and Murphy (1990) argue that weak pay–performance incentives through much of the 20th century gave managers little reason to maximize equity value. Such arguments would become stronger if augmented with data showing that managers in the 1980s, 1970s, and earlier typically had much more invested in inside debt via pension rights than in equity via stock or options, which we believe may well be the case.

We also believe our research highlights the potential importance of improved public disclosure of both pension and deferred compensation schemes. Current SEC regulations require only complex and somewhat opaque disclosures about pensions, and financial acumen is required to convert the reported data into estimates of the fair value of any executive's pension. Disclosure practices in certain other countries such as the United Kingdom provide far more illuminating reports of pension values and their annual changes. In addition, disclosure requirements are nonexistent in the United States for most aspects of deferred compensation, as well as post-retirement transactions involving pension rights such as "SERP swaps" that are understood to be available to many top executives but never disclosed.

Appendix A: Derivation of a CEO's Pension Value

This appendix illustrates the data collection and calculation steps for deriving the actuarial present value of a CEO's lifetime pension entitlement. As a representative example we use Jeffrey Immelt, CEO of General Electric Co., and we calculate the value of his pension as of the end of 2004.

Table A1 reproduces the pension information disclosed in the company's proxy statement filed early in 2005; these disclosures provide most of the information needed for the pension value calculation. Adhering to the SEC's disclosure

guidelines, the company reports in matrix form the fixed annual lifetime pension payout that an executive would receive, as a function of his years of service at retirement, tabulated in 5-year increments along the horizontal axis, and his earnings credited for retirement benefits, tabulated in $500,000 increments along the vertical axis. A footnote to the table indicates that Immelt has accrued 22 years service, and his earnings credited for retirement equal the average salary and bonus earned in the highest consecutive 3-year period during his most recent 10 years of employment. We assume that Immelt's most recent 3 years represent his highest consecutive 3 years of compensation, which must certainly be true since he had not served as CEO prior to late 2001. From the summary compensation table earlier in the proxy statement (not reproduced to save space), we calculate that Immelt's earnings credited for retirement equal $7.5 million, the average salary and bonus he received over the 3-year period of 2002 through 2004.

To infer the formula for calculating Immelt's annual lifetime pension benefit, we use simple algebra to study relationships between the cells of the matrix bordering Immelt's age and compensation. This area is shaded gray in Table A1. It is apparent from the cells along this border that $M = 0.0175$ for equation (2), which is given in the text of the main body of the paper.[24] We already know that $S = 22$ and $P = 3$, and we have obtained C_{t-k} for $k = 1$, 2, and 3 from the summary compensation table. This information allows us to calculate the lifetime pension entitlement as $X = \$2.9$ million, to be used in equation (1), which is also introduced in the text above and gives the actuarial present value of the lifetime pension entitlement.[25]

Other information required for equation (1) includes A, Immelt's current age; R, the company's retirement age at which full pension payouts begin; d, the company's cost of long-term debt; and $p(n)$, the probabilities that Immelt will be alive and continuing to receive payouts at various ages (n years) into the future. The table gives $R = 60$, and from Immelt's biography earlier in the proxy statement we obtain $A = 49$. We make the conservative assumption that the executive works for the entire year in which he reaches retirement age, so that Immelt's first payment would be received at age 61. Estimates of the company's bond rating and associated cost of debt are available from a variety of outside sources; we know that General Electric is an Aaa-rated company, and for this example we use the yield to maturity on Moody's Aaa index of long-term corporate bonds for December 2004, as reported in Federal Reserve Statistical Release H15, which gives $d = 0.0547$. A footnote at the end of the table indicates that the annual retirement benefit is paid in the form of a life annuity with a 5-year certain term (executives can often elect different annuity payouts or

[24] A $1,000.00 increase in earnings credited for retirement equates to a $350.00 increase in the pension benefit for an executive with 20 years service and a $437.50 increase in the pension benefit for an executive with 25 years service; $350/20 = $437.50/25 = 0.0175.

[25] Close examination of the matrix in Table A1 indicates that equation (2) for Immelt should also include a fixed sum of about $12,000 per year, which appears to represent an expected Social Security entitlement. We ignore this sum.

Table A1
General Electric Co. Executive Pension Disclosure

The table shows information from the company's proxy statement filed on March 4, 2005, p. 35. Employees are generally eligible to retire with unreduced benefits under company retirement plans at age 60 or later, and with Social Security benefits at age 62 or later. The approximate annual retirement benefits provided under company retirement plans and Social Security for GE employees in higher salary classifications retiring directly from the company at age 62 or later are shown in the table below. Estimated total annual retirement benefits are under the GE Pension Plan, the GE Supplementary Pension Plan, and the GE Excess Benefit Plan and Social Security.

Earnings Credited for Retirement Benefits	Years of Service at Retirement				
	20	25	30	35	40
$3,000,000	$1,062,300	$1,323,570	$1,584,840	$1,800,000	$1,800,000
$3,500,000	$1,237,300	$1,542,320	$1,847,340	$2,100,000	$2,100,000
$4,000,000	$1,412,300	$1,761,070	$2,109,840	$2,400,000	$2,400,000
$4,500,000	$1,587,300	$1,979,820	$2,372,340	$2,700,000	$2,700,000
$5,000,000	$1,762,300	$2,198,570	$2,634,840	$3,000,000	$3,000,000
$5,500,000	$1,937,300	$2,417,320	$2,897,340	$3,300,000	$3,300,000
$6,000,000	$2,112,300	$2,636,070	$3,159,840	$3,600,000	$3,600,000
$6,500,000	$2,287,300	$2,854,820	$3,422,340	$3,900,000	$3,900,000
$7,000,000	$2,462,300	$3,073,570	$3,684,840	$4,200,000	$4,200,000
$7,500,000	$2,637,300	$3,292,320	$3,947,940	$4,500,000	$4,500,000
$8,000,000	$2,812,300	$3,511,070	$4,209,840	$4,800,000	$4,800,000
$8,500,000	$2,987,300	$3,729,820	$4,472,340	$5,100,000	$5,100,000
$9,000,000	$3,162,300	$3,948,570	$4,734,840	$5,400,000	$5,400,000

Note: The amounts shown above are applicable to employees retiring in 2005 at age 62 and assume the employee was first eligible to participate in the GE Pension Plan before January 1, 2005.

Amounts shown as "earnings credited for retirement benefits" in this table represent the average annual covered compensation paid for the highest 36 consecutive months out of the last 120 months prior to retirement. For 2004, covered compensation for the individuals named is the same as the total of their salary and bonus amounts. As of February 10, 2005, the GE executive officers listed had the following years of credited service with the company: Mr. Immelt, 22 years. The approximate annual retirement benefits provided under company retirement plans are payable in fixed monthly payments for life, with a guaranteed minimum term of 5 years.

even a lump-sum distribution). We therefore have $p(12) = \cdots = p(16) = 1.00$. For ages 66 and above, we infer $p(n)$ using mortality tables available from the U.S. Social Security Administration.[26] These calculations indicate that Immelt has an 83.0% chance of being alive at age 66, 81.2% chance of being alive at age 67, and so forth; we carry the calculations all the way to age 120, when it is necessary for us to assume zero probability of further survival (this assumption is inconsequential to the calculation but is necessary in order to truncate it).

[26] See http://www.ssa.gov/OACT/STATS/table4c6.html. This table gives the probability of death within 1 year at each age between 0 and 119 for males and females. Using this information, it is straightforward to calculate the probability of any person at age A surviving n years into the future. Note that the table is updated periodically, and the mortality probabilities used in our calculations exhibit minor differences from those currently posted.

Substituting all of this information into equation (1) gives an estimate of $16.7 million for the actuarial present value of Immelt's lifetime pension entitlement as of the end of 2004.

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