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Capital structure, executive compensation, and investment efficiency

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ABSTRACT

This paper examines how the similarity between the executive compensation leverage ratio and the firm leverage ratio affects the quality of the firm's investment decisions. A larger leverage gap (i.e., a bigger difference between these two ratios) leads to more investment distortions. Managers with more debt-like compensation components tend to under-invest, whereas managers with larger equity-based compensation engage more in over-investment. Furthermore, investment distortion is likely to increase the equity (debt) value when compensation leverage is lower (higher) than firm leverage. These findings suggest that managers can deviate from an optimal investment policy to increase the value of their portfolio, and that a lower leverage gap can reduce agency costs.

1. Introduction

The connection between the firm's leverage ratio and management's compensation leverage ratio has been the subject of several theoretical and empirical studies. Jensen and Meckling (1976) was the first study to observe that one method to mitigate the agency cost of outside debt is having the manager hold debt and equity in the same ratio as they appear in the firm's capital structure. While Jensen and Meckling focus on the asset substitution (risk-shifting) problem, their argument can be applied to any investment related bondholder–shareholder conflict. The rationale is that by setting the compensation leverage equal to the firm leverage, stockholders ensure that the value of the compensation package perfectly depends on the firm value. Thus, the manager has the incentive to take only projects that increase the value of the firm's total assets, and is less likely to engage in under- or over-investment activities. Dybvig and Zender (1991), for example, show that paying the manager according to firm value can overcome Myers and Majluf (1984) under-investment problem.

Along this line, the theoretical model of John and John (1993) predicts a positive relationship between firm leverage and executive compensation leverage. Empirical evidence in support of this prediction has been found by Bryan et al. (2000) and Ortiz-Molina (2004). Further evidence on how the discrepancy between firm capital structure and executive compensation affects managerial behavior is provided by Sundaram and Yermack (2007). They sample 237 Fortune 500 companies over a 7-year period, and find evidence for the proposition that if the executive debt-equity ratio exceeds that of the firm, then CEOs adopt a conservative management style in order to reduce debt default risk. In a related recent paper, Cassell et al. (2012) document that CEOs with high inside debt holdings seek to reduce the risk level of the firm. Anantharaman et al. (2010) find that a higher CEO's relative leverage is associated with lower cost of debt financing and fewer restrictive covenants. Wang et al. (2010) find that bank loans spreads are significantly lower for firms with larger CEO pension benefits and deferred compensation.

While the current literature primarily focuses on the effect of high inside debt on risk level, we aim to take the empirical evidence a step forward and provide a general set of results on the effect of leverage gap on agency behavior. We provide empirical evidence on whether any difference between compensation leverage and firm leverage (positive or negative) motivates managers to engage in any investment-related type of agency behavior (not only risk-driven behavior). Furthermore, we evaluate the effect of these investment distortions on the market value of the firm's equity and debt. To the best of our knowledge, this is the first direct empirical examination of the relation between leverage gap and the quality of investment decisions.

To estimate compensation leverage we manually collected data on pension plans for 260 of the largest firms listed on the US stock exchanges over a ten-year period between 2000 and 2009. Instead

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of a CEO-only database used in previous studies, all firm executives (typically five per firm year) are used to compute inside debt in this study. To assess the quality of investments we measure the extent to which firms deviate from their expected investment policy.

We begin our empirical analysis by looking at the absolute values of leverage gap and excess investment. We find that larger differences (positive or negative) between the compensation leverage and firm leverage lead to larger deviations from the optimal investment policy. We show that the investment distortion is not affected by endogeneity bias (the possibility that firms with greater prior potential for agency conflicts are more likely to adopt a compensation leverage close to firm leverage). This finding provides empirical support for the propositions of Jensen and Meckling (1976) and John and John (1993), suggesting that the similarity between executive compensation leverage and firm leverage can mitigate investment-related agency problems.[1]

We next focus on the raw values of leverage gap and excess investment in order to characterize the investment distortion. We find that firms with higher raw leverage gap display lower investment intensity; that is, managers tend to under-invest (over-invest) when their interests are more aligned with those of the bondholders (shareholders). This result is consistent with the agency theory prediction that managers with more debt-like components in their compensation package will prefer a more conservative investment policy (see, e.g., Jensen and Meckling, 1976; Sundaram and Yermack, 2007; Cassell et al., 2012).

Lastly, we investigate the impact of compensation-based investment distortion on the value of the firm's claims. We find that when the compensation leverage is lower than firm leverage, investment distortion in general – and especially over-investment – is more likely to increase the value of equity. Similarly, when compensation leverage exceeds firm leverage, investment distortion in general – and especially under-investment – is likely to increase the value of debt. This evidence indicates that managers have personal incentives to deviate from an optimal investment policy in order to increase the value of their compensation package. Thus, we provide further support for the proposition that setting the compensation leverage close to firm leverage can reduce agency costs.

The paper proceeds as follows. The next section states our hypotheses. Section 3 describes the data and variable estimation. Section 4 tests the hypotheses, and Section 5 concludes.

2. Hypotheses

Conventional financial theory suggests that managers should accept only projects that increase firm value. In practice, however, managers can have incentives to deviate from that policy. First, management represents the interests of shareholders, and thus should take actions that increase the value of equity, and not necessarily the value of total assets. Second, managers often have their own set of interests that affect their investment decisions. These include reputation concerns, empire-building interests, and risk-aversion. We focus on compensation-based managerial incentives; specifically, we analyze how managers' investment decisions affect the value of their compensation package, and the implications with respect to the quality of investments.

A typical management compensation package can be viewed as a portfolio of a debt-like component (pension and deferred compensation), and an equity-like component (stocks and stock-options). Agency theory suggests that if the compensation's debt-equity ratio is different from the firm's leverage ratio, then the value of the firm and the value of the compensation package may not necessarily move in the same direction. When the manager's compensation leverage is lower than firm leverage, the manager's interest is more aligned with that of the shareholders. This could lead to investments in less-than-optimal projects that decrease firm value, while increasing the equity value. Similarly, when the compensation leverage is higher than firm leverage, the manager's interest tends to be aligned more with the interest of the bondholders, and this could also lead to an investment distortion. If, however, the compensation leverage ratio is identical to the firm leverage ratio, the value of the compensation package solely depends on the firm value, assuring that the managers will have incentives to accept only value-increasing projects.

Note that although the shareholders control the executive compensation policy, it is in their interest to align the compensation's value to the firm's value. That is, on the one hand, setting the managers' pensions and deferred salaries as their main compensation component (relative to the firm leverage) will create managerial incentives to increase the value of debt, rather than the value of the equity or the value of the firm in general. On the other hand, compensating managers mainly by stocks and stock-options in a levered firm will deter potential creditors and thus can increase the cost of debt financing, especially among firms with high expected costs associated with investment-related bondholder-shareholder conflicts.

The importance of the similarity between compensation leverage and firm leverage has several implications for corporate investment policy, and these prompt two sets of hypotheses. The first set deal with the effect of compensation leverage on the extent to which firms deviate from their optimal investment policy, while the second set relate to the impact of executive compensation packages on the values of the firm's debt and equity.

We predict that a larger difference (positive or negative) between compensation leverage and firm leverage leads to more investment distortion in general. In particular, because managers with more debt-like compensation components are more likely to prefer a conservative management policy, we predict a negative relation between the actual leverage gap and the extent of investment intensity.

H1a. A larger absolute difference between compensation leverage and firm leverage leads to more investment distortions.

H1b. The difference between compensation leverage and firm leverage is negatively related to the firm's investment intensity.

The second set of hypotheses predict that investment distortions that are motivated by executive compensation considerations should be reflected in the values of the firm's equity and debt.

H2a. When the compensation leverage is lower (higher) than the firm leverage, an investment distortion is likely to increase (decrease) the equity value, and to decrease (increase) the debt value.

H2b. When the compensation leverage is lower (higher) than the firm leverage, an over-investment (under-investment) is likely to increase (decrease) the equity value, and to decrease (increase) the debt value.

3. Data and variable estimation

Testing these two sets of hypotheses requires an estimation of compensation leverage, firm leverage, the extent of investment distortion, a set of control variables that can potentially affect

[1] Other theoretical studies that analyze the ability of executive compensation to mitigate bondholder-shareholder conflicts include Brander and Poitevin (1992), Harikumar (1996), and Subramanian (2003).

investment distortion, and stock and bond return data. Information on executive compensation is obtained from hand-collected data, and is combined with the ExecuComp database. Firm-specific accounting variables are drawn from Compustat, whereas stock returns are taken from CRSP.

3.1. Compensation leverage

The estimate of a firm's compensation leverage is based on managers' inside debt and inside equity. Inside debt typically includes the present values of the manager's pension and deferred compensation. We follow Sundaram and Yermack (2007) and focus on pensions because the disclosure for deferred compensation is extremely limited. Inside equity includes the value of equity and the estimated value of the stock-options held by the manager. To estimate inside debt and inside equity we combine hand-collected data with data obtained from ExecuComp and CRSP.

3.1.1. Pension value

Sundaram and Yermack (2007) explain the calculation of pension data in great detail. Using a database of 237 Fortune 500 CEOs over a seven-year period (1996–2002), they demonstrate the significant role of pensions as a form of debt-based compensation. Our database extends Sundaram and Yermack's prior work by using hand-collected data for 260 firms drawn from the 700 largest companies by market capitalization over a ten-year period (2000–2009). Instead of a CEO-only database, all firm executives (typically five per firm-year) are used to compute inside debt in this study. The resulting sample includes three additional years and approximately six times more firm-year data points than the original Sundaram and Yermack's sample.

Pensions refer to Supplemental Executive Retirement Plans, or SERPs. SERPs allow executives to receive retirement benefits far greater than they would be normally entitled to under federal insurance guidelines. These pension benefits represent unfunded and unsecured debt claims against the firm, and in the event of insolvency, have equal standing with other unsecured creditors. The disclosure for pension valuation became significantly more transparent in 2006; prior to this period, some calculation was needed to evaluate executive pensions.

The SEC statements require the summary compensation information for the CEO, CFO, and three other executives. Frequently, more than five executives have information available due to changes in management, or as a function of corporate reporting policy. Prior to July 2006, the SEC required that pension values be expressed in a tabled matrix of the form given in Table 12 in the Appendix. Firms were not required to disclose the actual present value of the benefit. Nevertheless, the value could be inferred by an investor using the procedure outlined in the next paragraphs. Firms with fiscal years on or after December 15, 2006 were required to adopt a new presentation, which included a computation of formal present value calculations.

The sample period encompasses both systems: prior to 2006, hand-calculation was used; after 2006, present values were used where available. Since both calculations employed identical (or nearly identical) calculation methodologies, the sample years are considered directly comparable and contiguous. The established method for computing pension values is the actuarial present value method, detailed and explained in the two equations below. A guided example using ConocoPhillips is provided in the Appendix to clarify the calculation procedure.

The present value of a pension annuity is expressed as:

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

where X is defined as the amount of the annual pension, A is the current age of the executive, R is the minimum retirement age to achieve full retirement benefit, K is the final year of the pension, and $P(n)$ is the probability that the executive will be alive in n years. Using the 'Period Life Table,' an actuarial life table available from the Social Security administration, the mortality probabilities for an executive of age A can be projected. While it is hypothetically possible an executive can receive a pension benefit indefinitely, the mortality projections of the Social Security administration end at 119 years, so K is for practical purposes set at 120 following Sundaram and Yermack (2007).

The discount rate, d, is defined as the annualized Moody's Seasoned Aaa bond-rating for a given year, taken from the Federal Reserve Board's H.15 release.[2] Firms maintaining pensions tend to be larger and older than average, thus many of them have established a comparable bond rating. Furthermore, firms that volunteered present value data of pensions prior to 2006 used either the ten-year Treasury bond yield or Aaa bond-rating for that year.

The most difficult portion of this calculation involves the computation of X, the annual pension benefit. Companies offering executive pensions will typically report defined pension annuities in the form of a generic table relating final average earnings with years of credit service. Final average earnings reflect the executives' highest annual average salary and bonus over a specified number of years. In this study, we assume that the most recent years' of executive compensation are also the highest.

We compute the annual pension benefit by:

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

Where C_t refers to the cash salary and bonus compensation to each executive for year t, P refers to the number of prior years whose compensation is averaged together, and S refers to the executives' years of service. The years of service figure may relate to date of first hire, years of total work experience, or a number of methodologies employed by the firm. This information is provided in the same section as the pension plan table. M refers to the multiplicative factor that describes the pension plan table, and is best interpreted as the amount of pension benefit earned per year of service. For most firms, this figure is between 1.5% and 2.0% of average compensation per year of service.

The net combination of these two equations produces the actuarial present value for the executive pension for that year. Some firms will deduct anticipated social security benefits from the annual pension award; since these are far smaller than the annual benefits entitled to most executives, no deduction is made here.

3.1.2. Stocks and stock-options value

The market value of common equity of a manager is estimated by the number of shares held by the manager multiplied by the share price. To estimate the value of the unexercised stock-options held by the manager we employ the procedure developed by Core and Guay (2002) (also used by Sundaram and Yermack (2007)). The options' value is estimated by Black and Scholes (1973) model, with the following inputs' estimates.

The exercise price of the unexercised stock-options is measured in two steps. Using ExecuComp data we first compute the ratio of the realizable value of in-the-money exercisable options to the number of unexercised exercisable options; we then estimate the exercise price by subtracting this ratio from the firm's stock price at the end of its fiscal year. Following Sundaram and Yermack (2007) the maturity of all outstanding stock-options is set to six

[2] Information is taken directly from the FRB archive of historical interest rate data, available at http://www.federalreserve.gov/releases/h15/data.htm.

years. Stock price volatility is measured by the standard deviation of the stock return in the previous 60 months. The dividend yield is taken over a three-year period, estimated by Fama and French (1988) procedure. The risk-free rate is estimated using the one-year T-bill yield.

Given the values of pension, stocks, and stock-options of the individual manager, the compensation leverage at the firm level is defined as:

$$\frac{\frac{1}{J}\sum_{j=1}^{J} Pension_j}{\frac{1}{J}\sum_{j=1}^{J}(Pension_j + Stocks_j + Options_j)} \tag{3}$$

where J represents the number of top managers (typically five) in each firm in each year.

This measure of compensation leverage at the firm level weighs the compensation leverage ratios of the firm's top executive according to the value of their compensation components. Using this measure therefore implies that the decision making power over investment decisions is distributed among the top managers in proportion to their total compensation. To cover situations where the corporation decisions are made mainly by the CEO, we perform all tests by comparing firm leverage with the compensation leverage of the firm's CEO only.

3.2. Firm leverage

Following Sundaram and Yermack (2007) we use the firm's book leverage and not the market leverage to avoid the mechanical relation between compensation leverage and firm leverage that resulted from the variation in equity market value. We define book leverage as the ratio of the book value short- and long-term debt to the book value of total assets. In addition, since executive pension plans typically represent long-term compensation, in the empirical analysis we use also the leverage ratio that includes only long-term debt (referred to as long-term leverage).

3.3. Investment distortion

We measure the extent to which a firm deviates from its optimal investment policy by the difference between actual and expected investment.[3] We estimate a firm's actual investment by gross capital expenditures divided by book value of total assets at the beginning of the year.[4] We estimate a firm's expected investment by the median investment in the industry in a given year.[5] For robustness, we use two alternative proxies for expected investment, and because all three proxies are highly correlated and produce similar results, we report only those based on our main proxy.[6]

3.4. Control variables

We consider five factors that indicate the potential of a firm to deviate from the optimal investment policy. (1) Size. Large firms are usually less exposed to agency conflicts; they are less likely to default because they have access to a wider variety of financing channels, and also have a better reputation in the debt market (see Diamond, 1993). Large firms also typically attract more attention in the financial markets than small firms, which reduces their flexibility to deviate from the optimal investment policy. (2) Investment opportunity set. Investment-related agency conflicts are more likely to occur when firms have more investment opportunities (see Smith and Watts, 1992; Barclay and Smith, 1995a, 1995b). (3) Financial distress. Incentives to deviate from optimal investment policy are more likely to arise when firms experience financial distress. This is because debt and equity values are more uncertain the closer they are to bankruptcy (see, e.g., Jensen and Meckling, 1976; Myers, 1977; Eisdorfer, 2008). We measure the extent of financial distress using Altman's (1968) Z-score, a widely used model of bankruptcy prediction.[7] (4) Regulation. Smith (1986) argues that managers of regulated firms have less discretion over investment decisions than managers in unregulated firms. This implies that deviation from optimal investment policy is less likely to occur in regulated firms. Following Hermalin and Weisbach (1988), we consider public utilities (SIC code 49), airlines and railroads (SIC codes 40–47), and financial institutions (SIC codes 60–69) as regulated industries. (5) Industry homogeneity. Managers have less operational flexibility in more homogeneous industries, and hence, are less likely to invest in poor projects than in heterogeneous industries. In addition, it would be easier for the bondholders to detect changes in the firm's investment policy in homogeneous industries. We use Parrino's (1997) proxy for industry homogeneity to classify industries as homogenous or heterogeneous.[8]

3.5. Bond return

We measure the annual return on the firm's bonds by comparing the market values of the firm's total debt in the current year and the previous year. We use the two-equation contingent-claim method of Ronn and Verma (1986) to estimate the market value of the firm's debt. The first equation, based on Merton (1974), expresses the value of the firm's equity as the value of a call option on the firm's total asset, using the Black and Scholes (1973) formula:

$$V_E = V_A N(d_1) - Fe^{-rT} N(d_2) \tag{4}$$

where V_E is the equity value; V_A is the asset value; $N(\cdot)$ is the cumulative function of a standard normal distribution; $d_1 = [\ln(V_A/F) + (r + \sigma_A^2/2)T]/[\sigma_A\sqrt{T}]$; $d_2 = d_1 - \sigma_A\sqrt{T}$; σ_A is the asset volatility; F is the face value of debt; r is the risk-free rate; and T is the time to maturity of debt. The second equation, which is derived from Ito's lemma, represents the relation between equity volatility (σ_E) and asset volatility:

$$\sigma_E = \frac{V_A N(d_1)\sigma_A}{V_E} \tag{5}$$

[3] Recent studies that also measure investment distortions by the difference between actual and expected investment are, for example, Titman et al. (2004), Richardson (2006), and Eisdorfer (2011).

[4] Most studies measure firm-specific investment intensity by capital expenditures scaled by either total assets (see Kaplan and Zingales, 1997; Mayers, 1998; Korkeamaki and Moore, 2004) or property, plant, and equipment (see Fazzari et al., 1988; Hoshi et al., 1991).

[5] The industry median is based on the four-digit SIC code. If the four-digit category contains fewer than five observations, we use a three-digit code, and if that new category contains fewer than five observations, we use a two-digit code. See Lang et al. (1996) for a similar procedure.

[6] The first alternative proxy is the fitted value from industry-year cross-sectional regressions (using all two-digit SIC codes with at least 20 observations in a given year) of the firms' actual investment on Tobin's Q ratios (measured by the market-to-book equity ratio as of the beginning of the year). The second alternative proxy is the fitted value from a pooled regression of the firms' actual investment on a set of variables that have been found to explain investment in prior studies: size, market-to-book ratio, leverage (all as of the beginning of the year), lagged cash flow from operations, stock return in the previous year, industry dummy, and year dummy (see, for example, Fazzari et al., 1988; Lang et al., 1996).

[7] Altman's *Z*-score model for predicting bankruptcies is: *Z-score* = 1.2*(Working capital/Total assets)*+1.4*(Retained earnings/Total assets)*+3.3*(Earnings before interest and taxes/Total assets)*+0.6*(Market value of equity/Book value of total liabilities)*+0.999*(Sales/Total assets)*.

[8] This measure is based on the average of the correlations between the firm-specific returns and the industry-index return. Industries included in the most homogeneous quintile are, for example, metal mining, and oil and gas extraction, while those included in the least homogeneous quintile are, for example, wholesale trade, and industrial and commercial machinery and computer equipment. For details, see Parrino (1997).

The unobservable V_A and σ_A are calculated using estimates of the remaining inputs. V_E is measured by the stock price multiplied by the number of shares outstanding. F is measured by the total liabilities of the firm. r is measured by the one-year Treasury bill yield. T is measured by the weighted-average maturity of the short- and long-term debt, and σ_E is measured by the realized monthly stock return volatility in the subsequent year.

Solving simultaneously Eqs. (4) and (5) for each firm in each year generates firm-level time series estimates of asset value and asset volatility. As there are no closed-form solutions to V_A and σ_A, we solve the two-equation system numerically (the initial values used are $V_E + F$ and σ_E). The market value of debt is therefore given by V_A - V_E.

3.6. Sample statistics

Combining our hand-collected pension data with the data obtained from CRSP/Compustat results in a final sample of 2011 firm-year observations representing data on the 260 firms over the period 2000–2009. Table 1 provides descriptive statistics and correlations of the main variables. The mean compensation leverage is 0.21 including all top executives, and 0.18 for the CEO only. These ratios are slightly higher than the estimates reported in Sundaram and Yermack (2007), and more importantly, are fairly close to the book leverage estimates of 0.27 and 0.23. Yet, on average, there is a significant difference in absolute terms between compensation leverage and firm leverage (absolute leverage gap of 0.17–0.18). As expected, the compensation leverage ratios of all executives and CEO-only are highly correlated (coefficient of 0.94). A similar result applies to firm total and long-term leverage ratios (correlation of 0.92); thus, the corresponding leverage gap measures are highly correlated (coefficients of 0.97 and 0.90). Lastly, some of the proxies of investment distortion are correlated, especially industry regulation and homogeneity (correlation of 0.73).

4. Empirical tests

4.1. The relation between compensation leverage and firm leverage

We first examine whether our data sample supports the positive connection between compensation leverage and firm leverage, as implied by the theories of Jensen and Meckling (1976) and John and John (1993), and as empirically found by Bryan et al. (2000) and Ortiz-Molina (2004). We run the following pooled regression on a sample of firm-year observations:

$$Comp.\ Leverage_{i,t} = \alpha + \beta\ Firm\ Leverage_{i,t} + Controls + \varepsilon_{i,t} \qquad (6)$$

where i is the firm index, t is the year index, *Comp. Leverage* is the management's compensation leverage, *Firm Leverage* is the firm's book leverage ratio. The control variables are firm size, defined as the natural log of the firm's equity value (in millions of dollars); market-to-book ratio, measured by equity market value divided by equity book value; and Z-score, regulation dummy and homogeneity dummy variables, as described in Section 3.4. Both *Comp. Leverage* and *Firm Leverage* are used in raw, market-adjusted, and industry-adjusted data (calculated by subtracting the marketwide and industrywide medians of the measures from the firm's raw figures). As this regression (and others below) relies on time series cross-sectional data, we use the Newey and West (1987) procedure, modified for panel data, to correct for heteroskedasticity and serial correlation.

Table 2 reports the results of regression (6). The coefficients of firm leverage are significantly positive in all regressions (t-statistics between 2.92 and 7.62) and are similar under total and long-term leverage ratios (using compensation leverage of CEO yields similar relation). This result strongly supports the theory initiated by Jensen and Meckling (1976), suggesting a positive relation between compensation leverage and firm leverage.

Note also that across models, the only variable that is consistently significant other than firm leverage is market-to-book ratio, which is negatively related to compensation leverage. This may simply be a mechanical relationship; as share price raises, both market-to-book and the value of executive stocks and stock-options increase. Higher market-to-book could also signal higher expected equity values, which might induce executives to seek greater equity compensation relative to debt compensation, lowering compensation leverage.

The table further shows that industry regulation has a significantly positive effect on compensation leverage in raw and market-adjusted terms. This is expected as incentive-based compensations (stocks and stock-options) are less effective in a more regulated environment. This effect however is controlled in the industry-adjusted models, where the negative coefficient may simply reflect the properties of the compensation leverage distribution.

Another interesting result is that the effect of Z-score is negative for the raw and industry-adjusted models (i.e., financially sound firms grant managers with more equity-based compensation), while the effect is positive for the market-adjusted compensation leverage. The intercept change in sign – in the opposite direction of the Z-score, provides a hint that this may be due to low variability in the market adjustment. Specifically, the regression results in column B are based on the raw data minus a market adjustment; however, the market variable displays much less variation across firms than the industry adjustment. This is almost like subtracting a constant from the raw data. Thus, the estimated coefficient on the Z-score from the raw data (column A) is roughly equivalent to the coefficient on the Z-score estimated from the market-adjusted data plus a "constant." The intercept now acts like a buffer. The intercept in column A is similar to the one from (B) minus a constant.

4.2. Hypotheses 1a and 1b

The first set of hypotheses concerns the effect of the difference between compensation leverage and firm leverage on investment distortion. We first test whether any difference between compensation leverage and firm leverage leads to investment distortion (hypothesis 1a) using the following regression:

$$Abs(Excess\ investment)_{i,t} = \alpha + \beta Abs(Leverage\ gap)_{i,t} + Controls + \varepsilon_{i,t} \qquad (7)$$

where *Abs*(*Excess investment*) is the absolute value of the difference between the firm's actual investment and industry-year median investment, and *Abs*(*Leverage gap*) is the absolute value of the difference between compensation leverage and firm leverage.

Table 3 (and others below) presents regression results for compensation leverage ratios of all executives and CEO only, and for firm total leverage and long-term leverage ratios. The coefficient of *Abs*(*Leverage gap*) is always positive and significant (t-statistics between 2.18 and 3.14) where the results under the total leverage ratio are somewhat stronger. This finding supports our hypothesis, suggesting that a larger gap between compensation leverage and firm leverage can lead to deviation from optimal investment policy.

The results are also significant in economic terms. A one standard deviation increase in the absolute difference between compensation leverage and firm leverage increases the extent of the investment distortion by 0.004–0.006, which accounts for 17–24% of the unconditional average of investment distortion.

Table 1
Descriptive statistics and correlations. For all variables, observations outside the top and the bottom percentiles are excluded. P25, P50, and P75 indicate the 25th, 50th, and 75th percentiles, respectively, of each variable. Compensation leverage of all executives is the present value of the pension of the firm's top managers divided by the present value of the pension and the values of the stocks and stock-options held by the managers, as defined in Eq. (3). Compensation leverage of the CEO is the same ratio for the compensation components of the CEO only. Firm leverage is the ratio of book value of debt to the book value total assets. Firm long-term leverage is the ratio of book value of long-term debt to the sum of book values of long-term debt and common equity. Leverage gap is the difference between compensation leverage of all executives and firm leverage, and leverage gap long-term is the difference between compensation leverage of all executives and firm long-term leverage, where 'abs' indicates the absolute value of these measures. Excess investment is the difference between the firm's actual investment in a given year (measured by gross capital expenditures divided by book value of total assets at the beginning of the year) and the median investment in the industry in that year (where 'abs' indicates absolute value). Firm size is the natural log of the firm's equity value (in millions of dollars), measured by the stock price multiplied by the number of shares outstanding. Market-to-book ratio is the equity market value divided by the equity book value. Z-score is the Altman (1968) model's measure of bankruptcy prediction. Industry regulation is a dummy variable that equals one if the firm is regulated, and zero otherwise, where public utilities (SIC code 49), airlines and railroads (SIC codes 40–47), and financial institutions (SIC codes 60–69) are considered as regulated industries. Industry homogeneity is a dummy variable that equals one if the firm operates in an homogeneous industry, based on Parrino's (1997) proxy. Stock return is presented in annual terms, and bond return is the annual percentage change in the market value of debt, measured by the contingent-claim method outlined in Section 3.5. The results are based on 2,011 firm-years representing data on 260 firms over the period 2000–2009.

	Mean	StdD	P25	P50	P75												
Panel A. Descriptive statistics																	
Compensation leverage: All executives	0.208	0.188	0.061	0.160	0.299												
Compensation leverage: CEO only	0.184	0.184	0.041	0.128	0.271												
Firm leverage	0.270	0.149	0.167	0.253	0.360												
Firm leverage: Long-term	0.225	0.141	0.123	0.202	0.310												
Leverage gap	−0.062	0.225	−0.200	−0.075	0.065												
Leverage gap: Long-term	−0.017	0.219	−0.152	−0.032	0.104												
Abs(Leverage gap)	0.181	0.148	0.071	0.147	0.249												
Abs(Leverage gap: Long-term)	0.166	0.144	0.059	0.133	0.223												
Excess investment	0.008	0.043	−0.008	0.001	0.019												
Abs(Excess investment)	0.024	0.036	0.005	0.013	0.027												
Size	16.276	1.168	15.493	16.193	16.965												
Market-to-book ratio	3.884	4.208	1.768	2.788	4.382												
Z-score	3.419	2.147	1.918	3.085	4.378												
Industry regulation	0.302	0.459	0.000	0.000	1.000												
Industry homogeneity	0.437	0.496	0.000	0.000	1.000												
Stock return	0.113	0.376	−0.097	0.106	0.289												
Bond return	0.050	0.243	−0.085	0.005	0.146												
	Comp. lvg.	Comp lvg. CEO	Firm lvg.	Firm lvg. LT	Lvg. gap	Lvg. gap LT	Abs(Lvg. gap)	Abs(Lvg. gap LT)	Ex. Inv.	Abs(Ex. Inv.)	Size	MB	Z	Ind. reg.	Ind. homog.	Stock return	Bond return
Panel B. Correlations																	
Compensation leverage	1.00	0.94	0.12	0.13	0.75	0.77	0.14	0.36	−0.06	−0.09	−0.16	−0.15	−0.25	0.04	0.06	−0.19	0.01
Compensation leverage: CEO only		1.00	0.09	0.10	0.72	0.74	0.15	0.36	−0.06	−0.09	−0.14	−0.15	−0.22	0.05	0.06	−0.19	0.02
Firm leverage			1.00	0.92	−0.56	−0.49	0.44	0.33	−0.03	−0.02	−0.16	0.12	−0.46	0.01	−0.03	0.06	−0.01
Firm leverage: Long-term				1.00	−0.50	−0.53	0.39	0.36	−0.03	0.02	−0.25	0.10	−0.48	−0.06	−0.06	0.07	0.00
Leverage gap					1.00	0.97	−0.18	0.08	−0.03	−0.06	−0.03	−0.21	0.08	0.03	0.07	−0.20	0.02
Leverage gap: Long-term						1.00	−0.13	0.08	−0.03	−0.09	0.03	−0.19	0.08	0.08	0.09	−0.21	0.01
Abs(Leverage gap)							1.00	0.90	−0.03	−0.03	−0.07	0.04	−0.17	0.08	0.04	−0.01	0.05
Abs(Leverage gap: Long-term)								1.00	−0.04	−0.03	−0.14	−0.01	−0.19	0.06	0.05	−0.06	0.04
Excess investment									1.00	0.52	−0.01	0.05	0.11	0.02	−0.07	−0.03	−0.06
Abs(Excess investment)										1.00	−0.04	0.02	0.04	−0.11	0.08	0.01	0.01
Size											1.00	0.17	0.23	0.07	0.07	0.01	0.08
Market-to-book ratio												1.00	0.42	−0.23	−0.26	0.16	0.05
Z-score													1.00	−0.39	−0.29	0.05	0.03
Industry regulation														1.00	0.73	−0.04	−0.01
Industry homogeneity															1.00	0.01	0.02
Stock return																1.00	0.34
Bond return																	1.00

Table 2
Regressions of compensation leverage on firm leverage. The table shows the results of regression (6). In column A the dependent variable is compensation leverage, and the independent variables are firm leverage (total book leverage in Panel A and long-term book leverage in Panel B), firm size (in logs), market-to-book ratio, Z-score, and industry regulation and homogeneity dummy variables. Columns B and C show similar regressions where the compensation leverage and firm leverage are adjusted to the market and industry medians in a given year. The table presents regression coefficients and *t*-statistics (in parentheses), based on Newey-West standard errors. The sample contains 2,011 firm-years representing data on 260 firms over the period 2000–2009.

	A Raw data	B Market-adj data	C Industry-adj data
Panel A. Total leverage			
Intercept	0.3440	−0.0026	0.0655
	(4.35)	(−0.03)	(0.91)
Firm leverage	0.1911	0.5815	0.1746
	(4.68)	(7.62)	(3.96)
Size	−0.0096	−0.0015	−0.0020
	(−2.06)	(−0.30)	(−0.45)
Market-to-book	−0.0044	−0.0058	−0.0027
	(−3.16)	(−4.22)	(−2.44)
Z-score	−0.0046	0.0062	−0.0047
	(−1.90)	(2.22)	(−2.57)
Regulation	0.0587	0.0456	−0.0295
	(3.21)	(2.53)	(−1.89)
Homogeneity	−0.0100	−0.0004	0.0001
	(−0.82)	(−0.04)	(0.01)
R-square	0.084	0.013	0.015
Panel B. Long-term leverage			
Intercept	0.3931	−0.0703	0.0468
	(4.92)	(−0.78)	(0.62)
Firm long-term leverage	0.1251	0.6346	0.1891
	(2.92)	(7.40)	(3.93)
Size	−0.0110	0.0010	−0.0012
	(−2.35)	(0.19)	(−0.26)
	(−2.71)	(−4.07)	(−2.39)
Z-score	−0.0063	0.0082	−0.0043
	(−2.54)	(2.68)	(−2.26)
	(3.48)	(2.94)	(−1.71)
Homogeneity	−0.0124	−0.0068	0.0019
	(−1.02)	(−0.55)	(0.19)
R-square	0.076	0.073	0.005

The investment distortion is also significantly related to some of the control variables. As expected, the coefficient of market-to-book ratio is positive, suggesting that investment distortions are more likely to arise when firms have more investment opportunities (see Smith and Watts, 1992; Barclay and Smith, 1995a, 1995b). The effect of the Z-score is positive as well, indicating that financially distressed firms are less likely to distort optimal investments. This finding is counter-intuitive on the one hand, as higher bankruptcy risk typically increases the extent of agency problems; but on the other hand, it can be explained by the lower flexibility of managers in distressed firms. These managers have fewer opportunities to engage in agency behavior because of the high degree of monitoring and restrictions on managers' actions.

We recognize that the relation between leverage gap and investment distortion could involve endogeneity bias. That is, it is possible that firms with a greater potential to deviate from the optimal investment policy are more likely to adopt compensation leverage similar to firm leverage (i.e., a negative relation). On the other hand, a smaller difference between compensation leverage and firm leverage should reduce investment distortion (i.e., a positive relation).

To address the endogeneity concern, we employ a two-stage least squares (2SLS) regression. In the first stage we run a regression of leverage gap on two instrumental variables (IV) that are expected to affect leverage gap, but are not associated with investment distortion. The first IV is tax-loss carry forward, scaled by firm's size. Barclay et al. (1995) argue that firms with tax-loss carry forward are likely to have a low marginal corporate tax rate, and thus might choose a relatively low leverage ratio. Moreover, marginal tax rates also affect the extent of managerial stock-options grants. This is because high future corporate tax rates increase the future tax deduction from deferred compensation relative to the immediate tax deduction received from cash compensation (see Yermack, 1995; Matsunaga, 1995; Dechow et al., 1996).

The second IV is associated with the quality of the firm. As discussed by Barclay et al. (1995), high-quality (or undervalued) firms are likely to choose high leverage ratios for signaling consideration. We follow their study and classify firms as high-quality in a given year if their net income before extraordinary items increases in the following year, and use the corresponding dummy variable as the

Table 3
Regressions of absolute excess investment on absolute leverage gap**.** The table shows the results of regression (7). The dependent variable is the absolute value of excess investment (the absolute difference between the firm's investment and the industry-year median investment). The main independent variable is the absolute value of leverage gap. Leverage gap is measured by the difference between compensation leverage (of all executives and CEO only) and firm leverage (total book leverage and long-term book leverage). The remaining independent variables are firm size (in logs), market-to-book ratio, Z-score, and industry regulation and homogeneity dummy variables. The table presents regression coefficients and *t*-statistics (in parentheses), based on Newey-West standard errors. The sample contains 2,011 firm-years representing data on 260 firms over the period 2000–2009.

	All executives		CEO	
	Total leverage	Long-term leverage	Total leverage	Long-term leverage
Intercept	0.0156	0.0143	0.0129	0.0125
	(1.18)	(1.09)	(0.94)	(0.92)
Abs(Leverage gap)	0.0384	0.0280	0.0392	0.0251
	(2.81)	(2.28)	(3.14)	(2.18)
Size	−0.0007	−0.0005	−0.0005	−0.0003
	(−0.74)	(−0.53)	(−0.54)	(−0.38)
Market-to-book	0.0007	0.0006	0.0007	0.0007
	(2.19)	(2.33)	(2.04)	(2.25)
Z-score	0.0022	0.0022	0.0022	0.0021
	(3.62)	(3.64)	(3.49)	(3.44)
Regulation	−0.0099	−0.0099	−0.0087	−0.0101
	(−1.77)	(−1.78)	(−1.53)	(−1.83)
Homogeneity	0.0255	0.0259	0.0242	0.0249
	(7.54)	(7.71)	(7.21)	(7.45)
R-square	0.085	0.085	0.080	0.082

Table 4
2SLS regression of absolute excess investment on absolute leverage gap. The table shows the results of a two-stage least squares (2SLS) procedure. In the first stage (Panel A) we run a regression of absolute leverage gap on two instrumental variables: tax-loss carry forward and a dummy variable that equals one if the net income before extraordinary items is increasing in the following year, and zero otherwise. The control variables are the same as in Table 3. In the second stage (Panel B) we run a regression of absolute excess investment on the fitted values of absolute leverage gap from the first-stage regression (and the control variables). The table presents regression coefficients and *t*-statistics (in parentheses), based on Newey-West standard errors. The sample contains 2,011 firm-years representing data on 260 firms over the period 2000–2009.

	All executives		CEO	
	Total leverage	Long-term leverage	Total leverage	Long-term leverage
Panel A. First-stage regression				
Intercept	0.4124	0.3796	0.3889	0.3711
	(6.49)	(5.54)	(5.97)	(5.34)
Tax-loss carry forward	0.1910	0.2550	0.1728	0.2303
	(2.36)	(3.05)	(2.09)	(2.69)
Net income dummy	−0.0105	−0.0196	−0.0104	−0.0186
	(−1.22)	(−2.23)	(−1.17)	(−2.09)
Size	−0.0137	−0.0122	−0.0114	−0.0111
	(−3.37)	(−2.80)	(−2.73)	(−2.50)
Market-to-book	0.0029	0.0016	0.0041	0.0029
	(2.44)	(1.51)	(3.36)	(2.55)
Z-score	−0.0101	−0.0086	−0.0124	−0.0108
	(−4.19)	(−3.60)	(−5.00)	(−4.42)
Regulation	−0.0131	−0.0231	−0.0118	−0.0150
	(−0.66)	(−1.18)	(−0.60)	(−0.78)
Homogeneity	−0.0055	0.0038	−0.0083	−0.0021
	(−0.48)	(0.32)	(−0.71)	(−0.17)
R-square	0.094	0.103	0.097	0.101
Panel B. Second-stage regression				
Intercept	−0.0354	−0.0245	−0.0355	−0.0248
	(−1.45)	(−1.24)	(−1.44)	(−1.25)
Fitted abs(Leverage gap)	0.0941	0.0741	0.0990	0.0772
	(1.85)	(1.85)	(1.84)	(1.86)
Size	0.0021	0.0017	0.0020	0.0017
	(1.97)	(1.79)	(1.92)	(1.77)
Market-to-book	0.0002	0.0004	0.0000	0.0003
	(0.92)	(1.76)	(0.13)	(1.21)
Z-score	0.0011	0.0008	0.0015	0.0010
	(1.56)	(1.34)	(1.73)	(1.49)
Regulation	0.0081	0.0086	0.0081	0.0080
	(0.70)	(0.74)	(0.70)	(0.69)
Homogeneity	0.0276	0.0268	0.0278	0.0273
	(6.63)	(6.55)	(6.51)	(6.61)
R-square	0.132	0.132	0.130	0.132

Table 5
Regressions of excess investment on leverage gap. The table shows the results of regression (8). The dependent variable is excess investment, measured by the difference between the firm's investment and the industry-year median investment. The main independent variable is leverage gap, measured by the difference between compensation leverage (of all executives and CEO only) and firm leverage (total book leverage and long-term book leverage). The remaining independent variables are firm size (in logs), market-to-book ratio, Z-score, and industry regulation and homogeneity dummy variables. The table presents regression coefficients and *t*-statistics (in parentheses), based on Newey-West standard errors. The sample contains 2,011 firm-years representing data on 260 firms over the period 2000–2009.

	All executives		CEO	
	Total leverage	Long-term leverage	Total leverage	Long-term leverage
Intercept	0.0162	0.0158	0.0155	0.0150
	(1.15)	(1.13)	(1.09)	(1.06)
Leverage gap	−0.0103	−0.0115	−0.0104	−0.0116
	(−2.06)	(−2.31)	(−2.19)	(−2.45)
Size	−0.0017	−0.0017	−0.0017	−0.0017
	(−1.91)	(−1.88)	(−1.88)	(−1.83)
Market-to-book	0.0004	0.0004	0.0004	0.0004
	(1.59)	(1.60)	(1.55)	(1.56)
Z-score	0.0052	0.0052	0.0052	0.0053
	(8.14)	(8.14)	(8.24)	(8.24)
Regulation	0.0393	0.0395	0.0393	0.0395
	(6.90)	(6.94)	(6.89)	(6.93)
Homogeneity	−0.0189	−0.0190	−0.0189	−0.0190
	(−4.49)	(−4.54)	(−4.50)	(−4.55)
R-square	0.103	0.104	0.103	0.104

second IV in the first-stage regression. The first-stage regression results (reported in Panel A of Table 4) confirm that the instrumental variables are associated with the absolute leverage gap. We also verify that the instrumental variables are not affected by the absolute excess investment (not reported).

In the second stage we run a regression of investment distortion on the fitted values of absolute leverage gap generated by the first-stage regression. The results of the second-stage regression (Panel B of Table 4) show that the effect of the fitted *Abs*(*leverage gap*) on investment distortion is slightly weaker in comparison to Table 3, but remains significant (t-statistics between 1.84 and 1.86). These findings suggest that the positive effect of leverage gap on investment distortion is not driven by endogeneity.

The results in Tables 3 and 4 indicate that a gap between compensation leverage and firm leverage could lead to investment distortion in general. We now attempt to provide a more specific characterization of this relation, as posited by hypothesis 2a. We examine whether relatively high compensation leverage tends to be associated with under-investment, while relatively low compensation leverage is more likely to be associated with over-investment. We run a similar regression to that in Eq. (7), but now use raw values of excess investment and leverage gap:

$$Excess\ investment_{i,t} = \alpha + \beta Leverage\ gap_{i,t} + Controls + \varepsilon_{i,t} \tag{8}$$

Table 5 presents the regression results. The coefficient of *Leverage gap* is negative and significant in all regressions (t-statistics between −2.06 and −2.45). Thus, the results support our hypothesis; managers that are compensated more by debt-like components show a lower investment activity, whereas managers with more equity-based compensation components tend to adopt a more intensive investment policy.

The table further indicates that size has a significantly negative effect on excess investment, and market-to-book ratio has a significantly positive effect. These relations are expected, as small and growth firms tend to invest more than large, mature firms with fewer growth opportunities. The effect of the Z-score is significantly negative, which is also expected; firms that experience financial distress often have less of an ability to exercise investment opportunities due to high monitoring and restrictions in these firms, and moreover, often have incentives to forgo profitable investments (see Myers, 1977).

For the same considerations applied to Table 3, we reexamine the results in Table 5 using a 2SLS procedure. We find however that the two instrumental variables used above (tax-loss carry forward and the net income dummy) are not strongly associated with the raw leverage gap. We therefore use a different instrumental variable: the present value of the managers' pension (the sum of pension values of all executives and the pension value of the CEO, both scaled by firm size). The reason for choosing this variable is straightforward: while pension is obviously correlated with leverage gap (i.e., it is one of the components of compensation leverage), it is unlikely to be affected by the firm's excess investment (as the firm's leverage and other compensation components, such as stock-options).

The first-stage results (reported in Panel A of Table 6) show, as expected, that pension is strongly associated with leverage gap, and we also verify that pension is not affected by excess investment (not reported). The second-stage regression results (Panel B of Table 6) show that the effect of the fitted leverage gap on excess investment is still strongly significant for the CEO's compensation leverage (t-statistics of −2.22 and −2.23), but still significant – al-

Table 6
2SLS regressions of excess investment on leverage gap. The table shows the results of a two-stage least squares (2SLS) procedure. In the first stage (Panel A) we run a regression of leverage gap on an instrumental variable: the present value of pension (of all executives and CEO only) scaled by firm size. The control variables are the same as in Table 5. In the second stage (Panel B) we run a regression of excess investment on the fitted values of leverage gap from the first-stage regression (and the control variables). The table presents regression coefficients and t-statistics (in parentheses), based on Newey-West standard errors. The sample contains 2,011 firm-years representing data on 260 firms over the period 2000–2009.

	All executives		CEO	
	Total leverage	Long-term leverage	Total leverage	Long-term leverage
Panel A. First-stage regression				
Intercept	−0.8579	−0.8541	−0.8928	−0.8881
	(−10.15)	(−10.26)	(−10.46)	(−10.45)
Pension	0.0290	0.0294	0.0588	0.0595
	(8.05)	(8.67)	(7.04)	(7.21)
Size	0.0448	0.0464	0.0451	0.0467
	(8.68)	(9.14)	(8.66)	(9.02)
Market-to-book	−0.0100	−0.0092	−0.0105	−0.0097
	(−7.09)	(−6.91)	(−7.46)	(−7.25)
Z-score	0.0178	0.0189	0.0204	0.0215
	(6.33)	(6.84)	(7.17)	(7.69)
Regulation	0.0376	0.0545	0.0334	0.0502
	(2.20)	(3.13)	(1.97)	(2.91)
Homogeneity	0.0012	−0.0104	0.0002	−0.0114
	(0.10)	(−0.83)	(0.02)	(−0.91)
R-square	0.188	0.188	0.197	0.198
Panel B. Second-stage regression				
Intercept	0.0090	0.0099	0.0016	0.0019
	(0.66)	(0.74)	(0.11)	(0.14)
Fitted leverage gap	−0.0250	−0.0228	−0.0366	−0.0360
	(−1.60)	(−1.65)	(−2.23)	(−2.22)
Size	−0.0014	−0.0014	−0.0010	−0.0010
	(−1.56)	(−1.58)	(−1.16)	(−1.10)
Market-to-book	0.0003	0.0003	0.0001	0.0002
	(0.94)	(1.07)	(0.45)	(0.51)
Z-score	0.0054	0.0054	0.0057	0.0057
	(7.46)	(7.60)	(7.64)	(7.65)
Regulation	0.0399	0.0402	0.0401	0.0407
	(6.89)	(6.98)	(6.97)	(7.03)
Homogeneity	−0.0192	−0.0194	−0.0193	−0.0197
	(−4.54)	(−4.64)	(−4.58)	(−4.71)
R-square	0.101	0.102	0.103	0.103

beit weaker – for all executives' compensations (t-statistics of −160 and −1.65). These results thus provide further indication that the effect of leverage gap on investment distortion cannot be attributed to endogeneity.

4.3. Hypotheses 2a and 2b

To test the second set of hypotheses, we first define a dummy variable (*Leverage dummy*) that equals one if the compensation leverage ratio is lower than the firm leverage ratio, and zero otherwise. We then run the following regressions:

$$Stock\ Rtrn._{i,t} = \alpha + \beta Abs(Ex.\ inv)_{i,t} + \gamma Abs(Ex.\ inv)_{i,t} Lvg.\ dummy_{i,t} + Controls + \varepsilon_{i,t} \quad (9)$$

$$Bond\ Rtrn._{i,t} = \alpha + \beta Abs(Ex.\ inv)_{i,t} + \gamma Abs(Ex.\ inv)_{i,t} Lvg.\ dummy_{i,t} + Controls + \varepsilon_{i,t} \quad (10)$$

where *Stock Rtrn* is the annual returns of the firm's stock, and *Bond Rtrn* is the annual percentage change in the market value of the firm's total debt, estimated by the contingent-claim method outlined above. Hypotheses 2a is consistent with positive γ in regression (9) and negative γ in regression (10).

We add two managerial control variables to these regressions: a governance index and an entrenchment index; both are relevant to this analysis. To the extent that executives can influence their own compensation structures (see Bebchuk et al., 2002), it seems plausible that when investment distortions lead to increases in equity (debt) values, executive compensation leverage is lowered (raised) in response. To control for this potential possibility, we include in the regressions the following managerial variables. The first is the governance index ("G-index"), established by Gompers et al. (2003), and the second is the entrenchment index ("E-index"), established by Bebchuk et al. (2009); both are frequently used in the literature as broad indicators of corporate governance characteristics. We construct these two variables following the procedures outlined in Gompers et al. (2003) and Bebchuk et al. (2009) using the RiskMetric database.

Table 7 shows the results of regression (9). The coefficient of the interaction term between the leverage dummy variable and the absolute excess investment is significantly positive (t-statistics between 2.30 and 3.34). This result supports the hypothesis, suggesting that an investment distortion is more likely to increase the value of the firm's equity in cases where the proportion of the equity-like component in the managers' compensation is larger than the proportion of the firm's assets that are financed by equity.

Table 8 shows the results for bond returns (regression (10)). The coefficient of the interaction term is significantly negative (t-statistics between −2.22 and −4.32), which is also consistent with our hypothesis; managers with a relatively high debt-like components in their compensation package are more likely to follow an investment policy that increases debt value.

Hypothesis 2b posits that managers with more equity-based compensation increase equity value through over-investment, while managers with more debt-like compensation increase debt value through under-investment. Therefore, we test the hypothesis using similar regressions to those in Eqs. (9) and (10), with actual excess investment:

$$Stock\ Rtrn._{i,t} = \alpha + \beta Ex.\ inv_{i,t} + \gamma Ex.\ inv_{i,t} Lvg.\ dummy_{i,t} + Controls + \varepsilon_{i,t} \quad (11)$$

$$Bond\ Rtrn._{i,t} = \alpha + \beta Ex.\ inv_{i,t} + \gamma Ex.\ inv_{i,t} Lvg.\ dummy_{i,t} + Controls + \varepsilon_{i,t} \quad (12)$$

Hypotheses 2b suggests a positive γ in regression (11) and a negative γ in regression (12). The results of these regressions are consistent with the hypothesis. The coefficient of the interaction term in regression (11) (reported in Table 9) are significantly positive (t-statistics between 1.97 and 3.25), suggesting that when managers' compensation relies more on equity-based components, over-investment benefits the shareholders. And similarly, the coefficients of the interaction term in regression (12) (reported in Table 10) are all negative, and especially strongly significant when all executives' compensation is used (t-statistics of −3.52 and −3.92). That is, when managers' compensation contains more debt-like components, under-investment benefits the bondholders. The results in

Table 7

Regressions of stock return on the interaction between leverage gap and absolute excess investment. The table shows the results of regression (9). The dependent variable is the firm annual market-adjusted stock return. The independent variables are: the absolute value of excess investment (the absolute difference between the firm's investment and the industry-year median investment); a leverage dummy variable that equals one if the compensation leverage (of all executives and CEO only) is lower than the firm leverage (total book leverage and long-term book leverage), and zero otherwise; an interaction term between the leverage gap dummy and absolute excess investment; firm size (in logs); market-to-book ratio; Z-score; industry regulation and homogeneity dummy variables; G-index, based on Gompers et al. (2003); and E-index, based on Bebchuk et al. (2009). The table presents regression coefficients and t-statistics (in parentheses), computed for a sample of 260 firms with 2,011 firm-years over the period 2000–2009.

	All executives		CEO	
	Total leverage	Long-term leverage	Total leverage	Long-term leverage
Intercept	0.8375	0.8140	0.8541	0.8429
	(5.40)	(5.22)	(5.43)	(5.32)
Abs(Excess investment)	−1.4869	−1.4595	−1.8372	−1.4397
	(−2.79)	(−2.91)	(−2.50)	(−2.13)
Leverage dummy	0.0578	0.0445	0.0487	0.0351
	(2.32)	(1.87)	(1.75)	(1.35)
Lvg. dummy *Abs(Ex. inv)	1.9119	1.9237	2.0760	1.6592
	(3.17)	(3.34)	(2.67)	(2.30)
Size	−0.0425	−0.0413	−0.0436	−0.0428
	(−4.77)	(−4.62)	(−4.86)	(−4.74)
Market-to-book	−0.0046	−0.0045	−0.0045	−0.0043
	(−2.01)	(−1.94)	(−1.96)	(−1.84)
Z-score	−0.0005	0.0016	0.0002	0.0017
	(−0.11)	(0.33)	(0.04)	(0.33)
Regulation	−0.0335	−0.0309	−0.0331	−0.0328
	(−1.02)	(−0.94)	(−1.01)	(−0.99)
Homogeneity	0.0534	0.0556	0.0529	0.0553
	(2.04)	(2.12)	(2.01)	(2.09)
G-index	−0.0138	−0.0128	−0.0130	−0.0124
	(−2.61)	(−2.41)	(−2.45)	(−2.32)
E-index	0.0148	0.0141	0.0131	0.0128
	(1.41)	(1.35)	(1.24)	(1.21)
R-square	0.084	0.081	0.075	0.068

Table 8
Regressions of change in debt value on the interaction between leverage gap and absolute excess investment. The table shows the results of regression (10). The dependent variable is the annual percentage change in the market value of debt (measured by the contingent-claim method outlined in Section 3.5), adjusted to the market average. The independent variables are: the absolute value of excess investment (the absolute difference between the firm's investment and the industry-year median investment); a leverage dummy variable that equals one if the compensation leverage (of all executives and CEO only) is lower than the firm leverage (total book leverage and long-term book leverage), and zero otherwise; an interaction term between the leverage gap dummy and absolute excess investment; firm size (in logs); market-to-book ratio; Z-score; industry regulation and homogeneity dummy variables; G-index, based on Gompers et al. (2003); and E-index, based on Bebchuk et al. (2009). The table presents regression coefficients and *t*-statistics (in parentheses), computed for a sample of 260 firms with 2,011 firm-years over the period 2000–2009.

	All executives		CEO	
	Total leverage	Long-term leverage	Total leverage	Long-term leverage
Intercept	0.1441	0.1153	0.1022	0.1299
	(0.74)	(0.59)	(0.52)	(0.66)
Abs(Excess investment)	3.7646	3.8106	3.4313	3.3424
	(5.88)	(6.32)	(3.74)	(3.97)
Leverage dummy	0.1174	0.1346	0.1240	0.0938
	(3.84)	(4.61)	(3.62)	(2.91)
Lvg. dummy *Abs(Ex. inv)	−2.8007	−3.0099	−2.0620	−1.9965
	(−3.84)	(−4.32)	(−2.13)	(−2.22)
Size	−0.0220	−0.0208	−0.0199	−0.0203
	(−1.98)	(−1.87)	(−1.78)	(−1.81)
Market-to-book	−0.0006	−0.0009	−0.0010	−0.0008
	(−0.21)	(−0.29)	(−0.33)	(−0.27)
Z-score	0.0288	0.0297	0.0285	0.0286
	(4.54)	(4.68)	(4.47)	(4.45)
Regulation	0.0176	0.0249	0.0208	0.0227
	(0.43)	(0.61)	(0.51)	(0.56)
Homogeneity	0.0249	0.0223	0.0177	0.0172
	(0.77)	(0.70)	(0.55)	(0.53)
G-index	−0.0037	−0.0032	−0.0037	−0.0035
	(−0.56)	(−0.49)	(−0.56)	(−0.53)
E-index	−0.0027	−0.0035	−0.0029	−0.0022
	(−0.21)	(−0.27)	(−0.22)	(−0.17)
R-square	0.083	0.089	0.077	0.073

Table 9
Regressions of stock return on the interaction between leverage gap and excess investment. The table shows the results of regression (11). The dependent variable is the firm annual market-adjusted stock return. The independent variables are: firm excess investment, measured by the difference between the firm's investment and the industry-year median investment; a leverage dummy variable that equals one if the compensation leverage (of all executives and CEO only) is lower than the firm leverage (total book leverage and long-term book leverage), and zero otherwise; an interaction term between the leverage gap dummy and absolute excess investment; firm size (in logs); market-to-book ratio; Z-score; industry regulation and homogeneity dummy variables; G-index, based on Gompers et al. (2003); and E-index, based on Bebchuk et al. (2009). The table presents regression coefficients and *t*-statistics (in parentheses), computed for a sample of 260 firms with 2,011 firm-years over the period 2000–2009.

	All executives		CEO	
	Total leverage	Long-term leverage	Total leverage	Long-term leverage
Intercept	0.8175	0.7865	0.8310	0.8156
	(5.32)	(5.08)	(5.35)	(5.20)
Excess investment	−1.5972	−1.3971	−1.9170	−1.2849
	(−3.61)	(−3.38)	(−3.32)	(−2.43)
Leverage dummy	0.0896	0.0788	0.0805	0.0632
	(4.34)	(3.99)	(3.63)	(3.02)
Lvg. dummy *Ex. inv	1.6220	1.4083	1.8160	1.1236
	(3.25)	(2.97)	(2.95)	(1.97)
Size	−0.0429	−0.0413	−0.0440	−0.0428
	(−4.84)	(−4.64)	(−4.93)	(−4.76)
Market-to-book	−0.0045	−0.0043	−0.0045	−0.0042
	(−1.95)	(−1.87)	(−1.93)	(−1.81)
Z-score	0.0009	0.0034	0.0017	0.0033
	(0.19)	(0.68)	(0.34)	(0.65)
Regulation	−0.0219	−0.0180	−0.0203	−0.0204
	(−0.65)	(−0.54)	(−0.61)	(−0.60)
Homogeneity	0.0476	0.0496	0.0456	0.0487
	(1.86)	(1.94)	(1.78)	(1.89)
G-index	−0.0136	−0.0124	−0.0127	−0.0120
	(−2.57)	(−2.34)	(−2.38)	(−2.24)
E-index	0.0140	0.0129	0.0118	0.0116
	(1.33)	(1.24)	(1.13)	(1.10)
R-square	0.086	0.082	0.078	0.069

Table 10
Regressions of change in debt value on the interaction between leverage gap and excess investment. The table shows the results of regression (12). The dependent variable is the annual percentage change in the market value of debt (measured by the contingent-claim method outlined in Section 3.5), adjusted to the market average. The independent variables are: firm excess investment, measured by the difference between the firm's investment and the industry-year median investment; a leverage dummy variable that equals one if the compensation leverage (of all executives and CEO only) is lower than the firm leverage (total book leverage and long-term book leverage), and zero otherwise; an interaction term between the leverage gap dummy and absolute excess investment; firm size (in logs); market-to-book ratio; Z-score; industry regulation and homogeneity dummy variables; G-index, based on Gompers et al. (2003); and E-index, based on Bebchuk et al. (2009). The table presents regression coefficients and *t*-statistics (in parentheses), computed for a sample of 260 firms with 2,011 firm-years over the period 2000–2009.

	All executives		CEO	
	Total leverage	Long-term leverage	Total leverage	Long-term leverage
Intercept	0.2971	0.2669	0.2627	0.2832
	(1.55)	(1.38)	(1.36)	(1.46)
Excess investment	3.1754	3.1875	2.5933	2.7716
	(5.96)	(6.40)	(3.63)	(4.23)
Leverage dummy	0.0712	0.0865	0.0915	0.0671
	(2.80)	(3.57)	(3.37)	(2.61)
Lvg. dummy *Ex. inv	−2.1280	−2.2572	−1.2144	−1.4509
	(−3.52)	(−3.92)	(−1.60)	(−2.06)
Size	−0.0259	−0.0246	−0.0245	−0.0248
	(−2.35)	(−2.23)	(−2.22)	(−2.23)
Market-to-book	−0.0003	−0.0006	−0.0005	−0.0004
	(−0.10)	(−0.22)	(−0.18)	(−0.14)
Z-score	0.0257	0.0264	0.0255	0.0257
	(4.02)	(4.12)	(3.98)	(3.96)
Regulation	−0.0455	−0.0388	−0.0433	−0.0427
	(−1.10)	(−0.94)	(−1.04)	(−1.02)
Homogeneity	0.0836	0.0802	0.0777	0.0786
	(2.65)	(2.55)	(2.45)	(2.48)
G-index	−0.0067	−0.0065	−0.0070	−0.0070
	(−1.03)	(−0.99)	(−1.07)	(−1.06)
E-index	−0.0020	−0.0019	−0.0025	−0.0014
	(−0.16)	(−0.15)	(−0.19)	(−0.11)
R-square	0.088	0.094	0.084	0.080

Table 11
Robustness tests. Panels A and B replicate the regression results in Tables 3 and 5, respectively (referred to as "base results") using three alternative estimation methods. The first is feasible generalized least squares (FGLS) regression, allowing for a heteroskedastic and firm-specific autocorrelation variance-matrix of the errors. The second is fixed industry effects regression (based on two-digit SIC code). Finally, the third is Fama–MacBeth (1973) regressions with 10 annual cross-sections. The Fama–MacBeth coefficients are the average coefficients in the cross-section regressions, and the *t*-statistics are the average coefficients divided by their time series Newey-West standard errors. The table reports only the coefficients and *t*-statistics of the absolute leverage gap (in Panel A) and leverage gap (in Panel B). The results are computed for a sample of 260 firms with 2,011 firm-years over the period 2000–2009.

	All executives		CEO	
	Total leverage	Long-term leverage	Total leverage	Long-term leverage
Panel A. Replication of Table 3 regressions				
Base results	0.0384	0.0280	0.0392	0.0251
	(2.81)	(2.28)	(3.14)	(2.18)
FGLS	0.0213	0.0185	0.0245	0.0170
	(1.84)	(1.58)	(2.12)	(1.45)
Industry fixed effects	0.0228	0.0207	0.0273	0.0165
	(1.89)	(1.71)	(2.24)	(1.37)
Fama–MacBeth	0.0362	0.0241	0.0406	0.0298
	(7.18)	(6.55)	(3.56)	(4.62)
Panel B. Replication of Table 5 regressions				
Base results	−0.0103	−0.0115	−0.0104	−0.0116
	(−2.06)	(−2.31)	(−2.19)	(−2.45)
FGLS	−0.0080	−0.0095	−0.0093	−0.0104
	(−2.05)	(−2.44)	(−2.38)	(−2.66)
Industry fixed effects	−0.0181	−0.0197	−0.0173	−0.0190
	(−3.39)	(−3.72)	(−3.24)	(−3.57)
Fama–MacBeth	−0.0082	−0.0104	−0.0094	−0.0116
	(−2.21)	(−3.14)	(−2.21)	(−2.87)

Tables 7–10 thus provide further support for the prediction that managers have a personal rationale to deviate from an optimal investment policy in order to increase the value of their portfolio.

4.4. Robustness tests

We examine the robustness of the effect of leverage gap on investment distortion to the estimation method. We replicate the regressions reported in Tables 3 and 5 using three alternative procedures. The first is a feasible generalized least squares (FGLS) regression, which allows for a heteroskedastic and firm-specific autocorrelation variance–covariance matrix of the errors. The second is an industry fixed effects regression that eliminates potential effects of industry-specific properties on investment distortion. This regression includes dummy variables for each two-digit SIC code in the sample that contains at least five firm-year observations. The third is a Fama and MacBeth (1973) regression that controls for cross-sectional correlation.

Table 11 reports the robustness tests. For the effect of absolute leverage gap on absolute excess investment (Panel A), the FGLS and industry fixed effects yield somewhat weaker results than those in Table 3, yet remain mostly significant. The Fama–MacBeth regressions, however, show stronger results (t-statistics between 3.56 and 7.18). For the raw values regressions (Panel B), all three procedures show a significant negative effect of leverage gap on excess investment, whereas under the industry fixed effect and Fama–MacBeth regressions the results are even stronger than those reported in Table 5 (t-statistics between −2.21 and −3.72). The results in Table 11 therefore suggest that the main findings of this study are robust to the estimation procedure.

5. Conclusions

This paper addresses the similarity between the debt-to-equity ratio in the firm's capital structure and the debt-to-equity ratio in the manager's compensation package. Building on the theory originated by Jensen and Meckling (1976), we predict that a larger gap between compensation leverage and firm leverage increases the likelihood that managers will deviate from the optimal investment policy in order to increase the value of their compensation package.

Using an extensive hand-collected data on top executives' pension plans in large companies, we find empirical support for our prediction. First, the absolute difference between compensation leverage and firm leverage increases the extent of the investment distortion. Further examination reveals that managers that are compensated with more debt-like components (relative to firm leverage) tend to under-invest, while managers with more equity-based compensation components tend to over-invest.

We also show that investment distortion, and particularly over-investment, is more likely to increase the value of the firm's equity when the proportion of the equity-like component in the manager's compensation is larger than the proportion of the firm's assets that are financed by equity. Similarly, with respect to the value of debt, when managers' compensation leverage ratio exceeds firm leverage ratio, investment distortion, and particularly under-investment, is likely to increase the value of the firm's debt.

These findings indicate that the connection between the manager's compensation package and the firm's capital structure plays an important role in the firm's investment policy. Firms may be able to mitigate agency costs by setting the compensation leverage of top managers as close as possible to the firm's leverage ratio.

Appendix An. example of the pension value estimation procedure

Using ConocoPhillips as an example firm, we can establish how the pension computation is performed for each executive. In this case, James J. Mulva, the President and CEO of ConocoPhillips in 2002, provides the example representation.

In Table A1, we have produced the same pension table disclosure available to investors of ConocoPhillips in fiscal year 2002. While investors may reference annual reports to access these tables, they are presented more conveniently in Definitive 14A statements. The table records years of service in five-year increments on the horizontal axis, and final average earnings in $500,000 increments on the vertical axis. Final average earnings are defined as the average of the three highest years of salary and bonus awards in the ten years prior to retirement. We assume the most recent three years of Mr. Mulva's compensation are his three highest years of compensation in the last ten years, yielding a three-year average of $4.487 million in earnings credited towards retirement.

For each executive firm-year, a sufficient historical salary and bonus level of each executive was computed. To begin the sample at 2000, firms requiring three years of historical compensation needed SEC data beginning in 1998, and for firms requiring five years, 1996 was the first year of hand-collection. For many executives, especially those requiring five or more years of averaged compensation to compute their earnings, historical data was unavailable for as much time as was needed. To compute average compensation for these executives, salaries and bonuses were 'downwardly weighted' to the oldest year. For example, if five years of data was required to average an executive's compensation and four years were available, the most recent three years were weighted equally and the most distant year double-weighted to generate a 5-year proxy.

Mr. Mulva's widely-available birth year of 1946 establishes his age at the end of 2002 at 56; for other executives, age information was obtained from 10-Ks (when available), and from a variety of other sources including old news articles, obituaries, and public records indexing services. Retirement age to achieve full benefit is 65.

Table A1
Pension Plan Disclosure for ConocoPhillips, FY 2002. The pension benefit table is taken directly from the FY 2002 DEF-14A statement filed by ConocoPhillips on April 4, 2003, p.24.

Final Average Earnings	Years of Credited Service at Normal Retirement				
	20	25	30	35	40
750,000	240,000	300,000	360,000	420,000	480,000
1,250,000	400,000	500,000	600,000	700,000	800,000
1,750,000	560,000	700,000	840,000	980,000	1,120,000
2,250,000	720,000	900,000	1,080,000	1,260,000	1,440,000
2,750,000	880,000	1,100,000	1,320,000	1,540,000	1,760,000
3,250,000	1,040,000	1,300,000	1,560,000	1,820,000	2,080,000
3,750,000	1,200,000	1,500,000	1,800,000	2,100,000	2,400,000
4,250,000	1,360,000	1,700,000	2,040,000	2,380,000	2,720,000
4,750,000	1,520,000	1,900,000	2,280,000	2,660,000	3,040,000
5,250,000	1,680,000	2,100,000	2,520,000	2,940,000	3,360,000
5,750,000	1,840,000	2,300,000	2,760,000	3,220,000	3,680,000
6,250,000	2,000,000	2,500,000	3,000,000	3,500,000	4,000,000
6,750,000	2,160,000	2,700,000	3,240,000	3,780,000	4,320,000
7,250,000	2,320,000	2,900,000	3,480,000	4,060,000	4,640,000
7,750,000	2,480,000	3,100,000	3,720,000	4,340,000	4,960,000

The Pension Plan Table section of the Definitive 14A provides the following information: "*The Pension Plan Table below shows the maximum estimated straight-life annual benefits payable at age65 for the final average earnings indicated, prior to reductions required by the companies' plans for Social Security benefits. The current years of service, as of December 31, 2002 for the Named Executive Officers for retirement benefit purposes are: Mr.Mulva, 31years; Mr.Dunham, 36years; Mr.McKee, 35years; Mr.Nokes, 32years; and Mr.Harrington, 23years.*"

The multiplicative factor M can be determined algebraically from Table 12: the addition of every \$1,000,000 in final average earnings generates \$320,000 of additional pension compensation for 20 years of service; this corresponds to 0.32 for 20 years, or 0.016 (1.6%) of final average earnings for each year of service. Mulva, as of 2002, has 31 years of service credit towards retirement.

We can assume that Mulva will work through his 65th year, at which point he will retire with 40 years of service.[9] Following Eq. (2), we can calculate his annual pension entitlement credited upon retirement as $0.016 \times 40 \times \$4.487 = \$2.872$ million.

To complete Eq. (1), we require Mulva's age, A (56); R, the company's retirement age (65); d, the cost of long-term debt; and $P(n)$, the probability that Mulva will be alive and receiving pension disbursements n years into the future. The cost of long term debt, determined from the Federal Reserve Statistical Release H15 for Moody's Aaa rated bonds was $d = 0.0649$ for 2002. Using the statistical tables provided by the US Social Security Administration, we can infer that Mulva has an 88.3% chance of being alive to receive his first payment at the age of 66, 86.7% chance of surviving until age 67, and so forth until age 120.[10]

The summation of each year's actuarial present value contribution establishes our present value of Mulva's pension benefit at the end of 2002: \$13.673 million.

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[9] Mr. Mulva was 56 with 31 years of service in 2002; he was eligible to achieve full retirement benefits in 2011, at which point he would have had 40 years of service $(31 + (65 - 56))$.

[10] The odds of Mulva surviving even to age 111 are so minimal, that no additional present value is added beyond this age. Thus, the age 120 truncation is appropriate based on current longevity estimates.