Human Capital and Investment Policy

Shuangshuang Ji
Department of Finance
Belk College of Business
University of North Carolina at Charlotte
9201 University City Blvd.
Charlotte, NC 28223
sji2@uncc.edu

Xinxin Li
Department of Finance
Belk College of Business
University of North Carolina at Charlotte
9201 University City Blvd.
Charlotte, NC 28223
xli25@uncc.edu

Current Version: September 2017

We thank Craig Depken, Dolly King, David Mauer, Rob McGregor, Rob Nash, Yilei Zhang, and seminar participants at University of North Carolina at Charlotte for helpful comments and suggestions.

Human Capital and Investment Policy

Abstract

The literature relates human capital costs to firm leverage (Berk, Stanton, and Zechner (2010) and Chemmanur, Cheng, and Zhang (2013)) and mergers and acquisitions (Lee, Mauer, and Xu (2017)). In this paper, we study the relation between a firm's human capital costs and investment policy. We first present a simple theoretical setting to illustrate the positive effects of risky investment on average employee pay. We then empirically examine the relation between firms' investment policies and human capital costs. Using two proxies for risky investment (cash flow volatility and unlevered stock return volatility), we find a significantly positive relation between risky investment and human capital cost (as measured by CEO compensation and average employee pay). The effect is stronger in low-pay firms than high-pay firms, and non-technology firms than technology firms. We further investigate four channels through which risky investment policy influences human capital costs: corporate diversification, R&D expenditures, advertising expenditures, and total value of acquisitions in a year. We find that while diversification negatively affects human capital cost, the rest of the three channels have positive effect on human capital costs. Our results are robust after accounting for the endogeneity of leverage, investment, and compensation of CEOs along with other robustness tests. Overall, our research contributes to the nascent but growing literature on the impact of human capital on firm investment and financing decisions.

JEL classification: G31, G32, E24, J24
Keywords: Investment policy, Firm risk, Human capital, Human capital costs

1. Introduction

Aggressive investment policy is often associated with high business risk: if they turn out to be successful, it benefits the firm in the long run; if they fail, it may hasten business failure. The literature identifies one of the causes of corporate failure, as summarized in Argenti (1976), is insufficient considerations for research and development costs. Dambolena and Khoury (1980) indicate that a substantial instability in firm ratios is associated with corporation failure. When large risky investments fail, a firm faces high possibility of operating at loss, which ultimately leads to plant shutdowns. The labor economics literature (e.g., Clark and Oswald (1994) and Clark, Georgellis, and Sanfey (2001)) shows that the fear of job loss for employees is a major worry, no matter whether employees can find a new replacement job. The more aggressive the firm's investment policy is, the riskier the firm, and the larger the likelihood the firm will encounter a business failure, thus higher risk of the huge human capital loss borne by employees. Therefore, rational employees will demand a higher wage to compensate for this additional risk. We illustrate this line of motivation using a simple theoretical setting in next section. In this sense, aggressive investment activities may associate with larger human capital costs. This is extremely important to the firm because if employees demand significantly higher pay to compensate for the large human capital risk associated with risky investments, firms will have a strong incentive to forego risky investment projects to reduce human capital costs. Moreover, when human capital costs increase (because of increased investment risk), discounted expected future cash flow decreases while initial cash outlay stays the same. This will lead to a lower project NPV than what it would be to have less risky investment. Our finding provides a potential explanation for underinvestment problem apart from the established agency theory. [1]

The relation between human capital costs and corporate policies is largely ignored in the previous corporate finance literature. Lee, Mauer, and Xu (2017) examine whether human capital relatedness is a key factor in mergers and acquisitions. They find that mergers are more likely, and merger returns and post-merger performance are higher when firms have higher related human capital. They argue that mergers with high human capital relatedness give firms greater ability to layoff low quality and/or duplicate employees and reduce human capital costs. Berk et al. (2010) and Chemmanur et al. (2013) study the relation between human capital costs and firm's financing policy. Berk et al. (2010) argue that employees become entrenched under an optimal labor contract for a levered firm, and therefore face large human capital costs in bankruptcy.[2] Chemmanur et al. (2013) empirically support the predictions of Berk et al. (2010)'s and find that wages have significant explanatory power for firm leverage.

In this paper, we argue that the risk of investment failures partly determines human capital costs, no matter the firm is levered or unlevered. Our results indicate that total human capital cost is significantly positive related to the level of investment riskiness, measured by cash flow volatility and unlevered stock return volatility. We further investigate four possible channels through which risky investments policy affects human capital costs: corporate diversification, R&D expenditures, advertising

[1] We find that firms have to pay more on compensation when they have risky investments. The additional labor costs reduce the expected future cash flow, and therefore the NPV of the project. In other word, it may be optimal for firms to forego the risky investments since the corresponding NPV may be negative after accounting for additional labor costs.
[2] The only friction is the inability of employees to insure their human capital. In their model, entrenchment is the efficient response to this friction rather than an exogenously imposed inefficiency.

expenditures, and total value amount of all acquisition deals in a year (acquisition amount, thereafter). During a corporate bankruptcy, Berk et al. (2010) denote that the press almost invariably focuses on the human capital costs of bankruptcy. This focus can be explained by research in psychology, which demonstrates that job security is one of the most important determinants of human happiness and that the detrimental effect on happiness of an involuntary job loss is significant. Yet human capital costs of bankruptcy have received minimal attention in corporate finance literature. We start on a similar note, that human capital cost is potentially large. However, we argue that the potentially large human capital loss is associated with risky investments rather than high leverage. Since Harris and Raviv (1991) find that, in general, leverage decreases with advertising expenditures and R&D expenditures, the positive relation between human capital costs and leverage found in Chemmanur et al. (2013) should not contribute to our results.

To proxy for risky investment, we use cash flow volatility and unlevered stock return volatility. [3] Kuppuswamy and Villalonga (2016) study whether diversification creates value in the presence of external financing constraints, and they control for cash flow volatility as a proxy for risk. Rajgopal and Shevlin (2001) use coefficient of variation of future cash flows as a proxy for exploration risk in a sample of oil and gas producers. Coles et al. (2006) study managerial incentives and risk taking. They find a strong causal relation between managerial compensation and investment policy, debt policy, and firm risk. They use stock return volatility as a proxy for firm risk. Guay (1999) establishes a positive relation between firms' stock-return volatility, as a measure of investment risk and the sensitivity of managers' wealth to equity risk. Cash flow volatility

[3] We use unlevered volatility variables because leverage also increases stock return volatility. We follow Childs, Mauer, and Ott (2005), and Schwert and Strebulaev (2014) for empirical measures of unlevered risk.

and stock return volatility are two commonly used measures for investment related firm risks. In particular, cash flow volatility measures operation management risk as well.

A line of research has examined and interpreted the direct relation between CEO compensation and firm's investment policy, proxied mainly by R&D expenditures. The results, however, are mixed. Clinch (1991), Smith and Watts (1992), Gaver and Gaver (1993, 1995), and Baber, Janakiraman, Kang (1996) and Ryan and Wiggins (2002), find positive relations between investment opportunity proxies and compensation tied to stock price performance. In contrast, Bizjak et al. (1993), Yermack (1995) and Lev and Sougiannis (1996) find negative relations associated with total compensation and cash compensation of CEO. Matsunaga (1995) finds no significant association between R&D expenditures and the value of employee stock option grants. One possible reason for these mixed findings, as Cheng (2004) points out, is that in general settings, it is unclear whether compensation committees should motivate more R&D expenditures, because of the possibility of overinvestment in R&D. These studies use R&D expenditures as a proxy for growth opportunities or information asymmetry. A few more studies examine the relation of CEO compensation and R&D expenditures for interpretations other than investment policy. For instances, Grundy and Li (2010) predict that corporate investment level increases with investors' optimism. The positive relation they find between investment level and executive compensation is insignificant and depends on the investor's sentiment and other parameters. Fauver et al. (2015) examine whether an employee-friendly corporate culture increases firm financial value and efficiency. They find evidence that better employee treatment (proxied by level of compensation) fosters innovation and technical efficiency (proxied by R&D expenditures and capital expenditures). Gray and Cannella (1997) argue that a CEO who receives compensation based on a longer time horizon has incentives to behave differently. She can maximize her total compensation by engaging in strategies that build long run profitability for the firm by maintaining high levels of investment in R&D expenditures, capital expenditures, and advertising expenditures. Although evidence for a positive impact of CEO compensation on R&D expenditures is plenty, we argue in this paper that the relation is not one-directional. Not only does CEO compensation affect investment policy, but CEOs with under-diversified human capital risk will also demand higher pay as additional compensation for risky investment policy.

On the other hand, not many studies have focused on non-executive employees. Among the few, Clinch (1991) claims that three well-known determinants of compensation practices are motivation-based concerns (moral hazard), information-based concerns (adverse selection), and tax issues. The results are difficult to interpret from the motivation-, information-, and tax-based perspectives, because there are various factors that can influence the compensation design in each setting. In many cases, particularly for large companies or administrative positions, non-executive employees may have little involvement in firm’s investment decisions. Clinch (1991) continues to argue that, if this is the case, it is not clear how to interpret any relation between risky investments (R&D expenditures) and features of observed compensation relations for the average employee. Our paper comes into play and provides a novel explanation from a human capital cost perspective. Not only will CEOs demand higher pay to compensate for high investment risk, but also will non-executive (average) employees. Consistently, we find a positive effect of investment riskiness on average employee pay. Finally, we investigate the possible channels through which risky investments have influences on human capital costs. We examine corporate diversification, R&D expenditures, advertising expenditures, and acquisition amount. As diversification reduces total firm risk, we find that the greater the number of business segments with different four-digit SIC code a firm has, the lower the human capital costs. On the other hand, R&D expenditures, advertising expenditure, and acquisition amount are considered as three channels for the level of risky investments. We observe a positive relation between each of the three channels and firm's human capital costs, which is consistent with our hypotheses. Results apply to both CEO sample and employee sample.

Our results also are robust to our best attempts to address endogeneity. Our baseline regressions include firm-year fixed effect to control for firm specific and time invariant biases. The biggest endogeneity concern would be whether the results are driven by employee skill. To address this problem, we first include high-tech dummy as a control for skill. We then use system GMM regressions to account for concerns of omitted variables. Last but not least, we separate our sample into low-pay firms and high pay-firms, and non-high-tech firms and high-tech firms. Subsample analysis results also support our hypothesis. Endogeneity could still rise in the CEO sample because of potential causal relation among CEO compensation, investment policy, and leverage. We further address this concern using Simultaneous Equations Model method. We continue to find results that are generally robust.

We contribute to the literature in the following ways. First, our study contributes to the nascent but growing literature on the impact of the human capital literature by establishing the importance of human capital costs for a firm's investment decisions, and provide an understanding of the determinants of employee wages. Second, we offer a novel explanation for the underinvestment problem apart from the established agency theory. We find that risky investments (as measured by cash flow volatility and unlevered stock return volatility) have a significantly positive impact on human capital costs (as measured by both CEO compensation and average employee pay). In other words, employees will demand higher pay to compensate for the large human capital risk associated with risky investments that their firm is taking. The additional labor costs could be sufficiently large to offset the positive NPV of the risky projects.[4] If managers consider the large additional labor costs in the estimation process of NPV, it could be optimal to pass on the risky projects.

The rest of the paper is organized as follows. Section 2 describes a theoretical setting that motivates our study and then testable hypotheses. Section 3 discusses variable construction, data collection, and sample descriptive statistics. Section 4 and 5 present our empirical results using a CEO sample and an employee sample, respectively. We first present baseline regressions and robustness tests associated with each, and then we conduct subsample analysis where we compare high-pay firms vs. low-pay firms, and non-high-tech firms vs. high-tech firms for the employee sample. Section 6 presents results for channel tests. Section 7 concludes and discusses avenues for future research.

2. The Conceptual Model and Hypotheses Development

---

[4] The impact of risky investments on labor costs is economically significant, as we will show in Section 4.1 and 5.1.

Under the setting of employees' inability to insure their own human capital, Berk, Stanton, and Zechner (2010) endogenously derive managerial entrenchment as an optimal response to labor market competition. Their model predicts an inverse relation between entrenchment and leverage and provides evidence that bankruptcy costs borne by employees are large enough to offset the tax benefits of debt. One important implication of their model is that employees should care about the firm's likelihood of bankruptcy or shut down. Some variable such as credit rating can explicitly provide a link between firm's characteristics and probability of bankruptcy or shut down and serve as a reference to employees.

Different from Berk, Stanton, and Zechner (2010), we focus on the risk arising from the firm's expenditure on risky investments rather than assuming the firm earns the risk-free rate on all invested capital.[5] In this section, following Harris and Holmstrom (1982) and Berk, Stanton, and Zechner (2010), we present a simple conceptual model to motivate the potential positive relation between expenditure on risky investments and labor cost.

Assume an employee has a minimum reservation wage W_R. If firm invests in risky-free investments only, then the equilibrium wage, W^*, must satisfy the condition

$$W^* = W_R$$

[5] The only source of risk in their model is the volatility of employees' output.

Consider a firm that makes risky investments, and assume the probability of failure (i.e., complete shutdown) is $P(I)$, where $P'(I) > 0$ and $P(0) = 0$.[6]

The equilibrium wage under these conditions must satisfy the condition:

$$E[\widetilde{W}] = P(0) + (1 - P)W^{**} = W_R$$

Or

$$W^{**} = \frac{W_R}{1 - P}$$

Using $P = P(I)$, we may compute that

$$\frac{\partial W^{**}}{\partial I} = \frac{W_R P'(I)}{(1 - P(I))^2} > 0$$

The equilibrium wage increases with expenditure on risky investments. Thus, the labor cost is relatively higher in the firm with risky investments.

The critical assumption in this model is that the employee has firm-specific human capital that is not easily transferable to another firm. This means when an employee loses her job and goes back to the job market, she would not be as highly compensated at another firm or would have to bear considerable expense re-tooling her human capital to match the needs of an alternative employer even if the new employer is willing to pay a similar wage as what she is making at the previous firm. For example, labor market frictions exist and will translate to costs that are borne by the employee. She will not be able to find the same job without bearing non-trivial search and/or relocation

[6] We assume the riskiness borne by the firm is positively related to the capital expenditure on risky investments. See section 2.1 in Grundy and Li (2010). If a firm does not have risky investments, it is free of any shocks to demand in our setting.

costs. When the firm invests on risky projects, it increases the riskiness borne by the firm. As a result, the potential significant loss on human capital prompts the employee to demand higher compensation. The firm in turn may have to adopt conservative investment policy because of large labor cost associated with risky investments. We next motivate our hypotheses 1 and 2 based on the theoretical work.

As discussed earlier, firms involved in large aggressive investment activities are often associated with high business risk. In particular, the failure of the large investment may associate with failure of the plant. Employee's fear of job loss has been shown in labor economics literature (e.g., Gerlach and Stephan (1996)) plays a key role in employee happiness. As investment risk increases, so does the likelihood of business failure. Employee's human capital loss naturally accompanies with business failure. As a result, employees may demand a higher wage to compensate for the risk their firm is taking. In this sense, aggressive investment activities may associate with large human capital costs. Based on our theoretical prediction discussed above, we have following testable hypotheses:

Hypothesis 1. CEO compensation increases with investment risk.

Hypothesis 2. Average employee pay increases with investment risk.

To further address the potential endogeneity of "pay for skills", we divide our sample into low-pay firms and high-pay firms, and non-technology firms and technology firms. We consider employees with higher pay or in technology firms as skilled workers. Since employees demand higher pay to compensate for the potential human capital loss induced by risky investments their firm's taking, employee's sensitivity towards unemployment risk would be a crucial factor in determining the relation between risky investment expenditure and average employee pay. Marginal utility of wealth decreases as wealth increases, and this view holds that the disutility from losing additional dollar would decrease with wealth. Thus, wealthy people tolerate risk significantly better others.[7] In the same sense, less skilled employees should be more sensitive to unemployment risk than skilled employees because the latter possess more resource and therefore would have more choices once unemployed. Thus, if our "pay for risk" argument is valid, we should observe similar or stronger effect of risky investment on employee pay in the sample of low-pay firms and non-technology firms than that of the high-pay firms and technology firms, respectively. We formalize above discussion with the following testable hypothesis.

Hypothesis 3. Lower (average) compensation levels accentuate the positive relation between average employee pay and investment risk.

To further study the impact of investment policy on human capital cost, we examine the channels through which risky investment affects average employee pay. Lewellen (1971) argues that the combined enterprise enhances lenders' safety and increases aggregate debt capacity. He attributes this additional debt capacity to a co-insurance effect, whereby combining firms' cash flows that are not perfectly correlated will, in general, reduce the overall variance of the combined firm's cash flows. Subsequent researchers, such as Berger and Ofek (1995) and Kuppuswamy and Villalonga (2016) find that diversified firms have higher leverage relative to comparable portfolios of stand-alone firms. We follow literature to argue that specialization (the

[7] See Shilon (2015)

opposite of diversification) level is a channel where risky investments operate, i.e., the higher specialization (lower diversification) a firm has, the riskier the firm's investments. We use number of business segments as a proxy for corporate diversification. R&D expenditure has long been established in literature as a popular measure for risky investment (e.g., Clinch (1991), Smith and Watts (1992), Gaver and Gaver (1993, 1995), and Baber, Janakiraman, Kang (1996) and Ryan and Wiggins (2002)). Harris and Raviv (1991) argue that R&D expenditures and advertising expenditures can be interpreted as measuring the extent to which assets are intangible. Miller and Bromiley (1990) develop taxonomy of strategic risk that deals with the level of investment in physical capital and in the intangible resources that accrue from research and development and advertising expenditures. Following the literature, we adopt R&D expenditures and advertising expenditures as additional risky investment channels. In addition, Lubatkin and O'Neill (1987) study how mergers influence capital market risk and find that all types of mergers are associated with significant increases in unsystematic risk. May (1995) studies whether managers consider personal risk when making decisions that affect firm risk. He finds that expenditures on diversifying acquisition decrease when CEOs have higher level of personal wealth vested in firm equity. We follow the literature and adopt another possible channel for risky investment as acquisition amount. In summary, we implement corporate diversification, R&D expenditures, advertising expenditures, and acquisition amount as four possible channels through which risky investments affect human capital costs. As diversification reduces investment risk while the other three are contributors to investment risk, we hypothesize as follows:

Hypothesis 4. Lower number of business segments, higher R&D expenditures, higher advertising expenditures, or higher acquisition amount increase human capital costs.

3. Variable construction, data, and descriptive statistics

In this section, we provide details of variable construction, sample selection, and the descriptive statistics of the variables.

3.1. Variable construction

Our two main measures for a firm's risky investments are cash flow volatility and unlevered stock return volatility. Ryan and Wiggins (2001) argue that firms with risky investments or volatile operating cash flows will use incentive compensation with non-linear payoffs to limit a manager's downside risk. They find that high R&D firms have a cash flow volatility measure of 0.50 vs. 0.24 for low R&D firms. Gilchrist and Himmelberg (1995) include cash flow as one of the observable fundamentals in the forecasting system used to predict future investment opportunities. The literature finds that cash flow volatility is closely related to stock return volatility (e.g., Campbell et al. (2001), Huang (2009) and Irvine and Pontiff (2009)). Therefore, we use both cash flow volatility and stock return volatility (unlevered) as proxies for risky investments. Following Kuppuswamy and Villalonga (2016), cash flow volatility is calculated as the standard deviation of the ratio of operating income after depreciation to assets over the eight quarters (two years) ending in each fiscal year. We follow Childs et al. (2005) and Schwert and Strebulaev (2014) to calculate the unlevered stock return. Then the volatility is calculated as the standard deviation of daily stock returns in past two years to be consistent with cash flow volatility.

For human capital costs, we adopt two measures: CEO compensation and average employee pay (Chemmanur et al., (2013)). CEO total compensation is the sum of salary, bonus, other annual, restricted stock grants, LTIP (long-term incentive plan) payouts, all other, and value of option grants. We further examine equity-based compensation and cash compensation separately. Cash compensation is calculated as the sum of salary and bonus, and equity-based compensation is computed as the total compensation minus salary, bonus, other annual pay, and LTIP. For average employee pay, ideally we would like to have detail information on job titles, wages, and education level. Unfortunately, such data is not publicly available at firm level. We therefore use Compustat data to estimate average employee pay. We adopt two methods: 1. Staff expenses divided by the number of employees (following Chemmanur et al. (2013)), and 2. Selling, general, and administrative expense (SGA) divided by the number of employees. We can use Compustat SGA as a proxy for wages since the correlation between SGA and staff expenses is very high 0.9, and 78.8% of the whole sample has SGA (447,216 out of 567,376 observations), while staff expenses only has 45.9% (260,571). All variable definitions are specified in detail in Appendix A.

3.2. Sample selection

To construct our CEO sample, we gather information on CEO compensation from ExecuComp database. We collect detailed information on the CEO characteristics and compensation from 1992 to 2015. We then merge ExecuComp with Compustat. Following Chemmanur, Cheng and Zhang (2013), we delete firm-years with non-positive book value of equity and exclude financial and utilities companies. We require non-missing cash flow volatility, stock return volatility information, compensation information, and CEO and firm characteristics. A total of 17,688 firm-year observations have all necessary information to be included in the regressions of CEO sample, covering 1992 to 2015. For average employee pay sample, we use information from Compustat database to calculate average employee pay. We exclude financial, utilities companies, and firms with fewer than one hundred employees. We drop firm-years with non-positive book values of equity. We require non-missing information on risky investment measures, SGA, and firm characteristics. A total of 72,427 firm-year observations have all necessary information to be included in our OLS regressions of average employee sample, covering 1976 to 2015.[8]

In addition, we use number of segments with different four-digit SIC codes as a measure of corporate diversification level. This information is obtained from the Compustat Business Segment data files. We exclude firm-years in which at least one segment is classified as being in the financial sector. We obtain acquisition amount information from mergers and acquisitions database in SDC platinum. This data is available since 1976. Corporate governance could play a role in CEO compensation, and it could matter in determining average employee pay (e.g., Cronqvist et al. (2009) and Chemmanur et al. (2013)). In unreported tables, we use G-index constructed by Gompers, Ishii, and Metrick (2003) as a measure of corporate governance and include G-index in our robustness tests. The data source is the Investor Responsibility Research Center

[8] Since data item "staff expenses" has very low reporting rate, we would like to start from a sample as large as possible. We start from all Compustat firms dating back from 1950. Since we use acquisition amount (collected from SDC platinum) as a channel for risky investment and this data availability starts from 1976, our final sample for average employee pay covers from 1976 to 2015.

(IRRC) database. Since IRRC only provides annual information on corporate antitakeover provisions for specific years (i.e., 1990, 1993, 1995, 1998, 2000, 2002, 2004, 2006, and 2008), we fill in observations in the missing years using information from the most recent year. A larger value of the G-index indicates weaker shareholder rights and/or stronger managerial power. All dollar amounts are adjusted to 1992 constant dollars using the consumer price index (CPI), which is collected from Bureau of Labor Statistics. Industry classifications are adopted from Fama-French 49 industry classification.

3.3. Descriptive Statistics

Table 1 presents descriptive statistics for the variables used in our baseline regressions. Detailed variable definitions are in Appendix A. Panel A and B report variables used in the analysis of CEO compensation and average employee pay, respectively.[9] The sample mean for total compensation is 3.75 million dollars. Following Chemmanur et al. (2013), cash compensation is calculated as the sum of salary and bonus with a mean value of 0.86 million dollars. Equity-based compensation is computed as the total compensation minus salary, bonus, other annual pay, and LTIP (long-term incentive plan) with mean value of 2.42 million dollars. To control for the firm size effect, we scale compensation variables by total sale in the regressions. The means of cash flow volatility and unlevered stock return volatility in our sample are 0.012 and 0.023 respectively. The standard deviations for the two volatility variables are both relatively large at 0.012 and 0.011 compared to their means. Number of segments, R&D expenditures, advertising

[9] ExecuComp provides two measures of total compensation: one includes the value of the options granted, and the other includes the value of options exercised. For CEO total compensation reported in Panel A, we use total compensation including the value of options granted reported in ExecuComp. Our results remain similar when the value of options exercised is considered.

expenditures, and acquisition amount are variables of interest for channel testing. On average, a firm-year has about 2 segments in our sample. We report the scaled values by total sale for the other three channels for risky investments. The one-year shareholders return is a measure of firm performance and has a mean of 9.7%. For other CEO characteristics, about 3% of the CEOs in our sample are female, and 55.7% serve as chairman of the board. The average CEO age is 56. Our CEO sample statistics are generally comparable with previous studies.

Panel B reports variables used in the analysis of average employee pay. We proxy average employee pay using two methods: 1. Staff expenses divided by the number of employees, and 2. SGA divided by the number of employees. Using staff expense leads to a much smaller sample of 6,710 firm-year observations with a mean average employee pay of $34,403, while using SGA increases sample size to 72,427 firm-years with a mean average employee pay of $51,134. We report all the scaled values (by total sales) at interest that are used in regressions. Similar to the CEO sample, the standard deviations of cash flow volatility and unlevered stock return volatility are relatively large (at 0.022 and 0.017 respectively) compared to their mean (at 0.020 and 0.030). Fixed asset ratio is computed as gross property, plant, and equipment scaled by total assets, and the sample mean is 24.9%.

Table 2 reports correlations between all variables at interest. We see that both of the scaled CEO compensation and scaled average employee pay variables are positively correlated with the risky investment measures, providing first evidence that there is a positive relation between human capital costs and risky investment. It also shows that the scaled CEO compensation and scaled average employee pay variables are negatively correlated with number of segments (corporate diversification), positively correlated with R&D expenditures, advertising expenditures, and acquisition amount, which is consistent with Hypothesis 4.

4. Empirical tests and results on investment policy and CEO compensation

In this section, we describe our empirical results of the impact of investment riskiness on CEO compensation. We start with our baseline regression of CEO compensation. We then perform robustness tests to address potential endogeneity problem using system GMM, and to further identify causality using simultaneous equations model.

4.1. Baseline regression

We model CEO compensation as:

$$CEOComp_{i,t} = \gamma_0 + \gamma_1 RiskyInvestment_{i,t} + \gamma_2 Size_{i,t} + \gamma_3 MktLev_{i,t} + \gamma_4 MtB_{i,t} + \gamma_5 Return_{i,t} + \gamma_6 Age_{i,t} + \gamma_7 Chair_{i,t} + \gamma_8 Male_{i,t} + \varepsilon_{i,t}$$

$CEOComp_{i,t}$ is the CEO compensation of firm *i* in year *t*, and it is measured in three ways: total, cash, and equity-based compensation. $RiskyInvestment_{i,t}$ is our measure for risky investments, i.e., cash flow volatility and unlevered stock return volatility, respectively. $Size_{i,t}$ is the logarithm of market capitalization. $MktLev_{i,t}$ is market leverage. $MtB_{i,t}$ is market to book ratio. $Return_{i,t}$ is the return to shareholders of firm *i* in year *t*. $Return_{i,t}$ is one-year return to shareholders. $Age_{i,t}$ is CEO age. $Chair_{i,t}$ is a dummy variable equal to one when the CEO serves as chairman of the board. $Male_{i,t}$ is a dummy variable equal to one when the CEO is male.

Table 3 reports the results of the baseline regression of CEO compensation. Panel A reports regression results with firm and year fixed effect controlled, and panel B as a robustness test, reports results with industry and year fixed effect in order to control for High-Tech dummy as a proxy for CEO talent. Across all regression models except for regression (2), we find positive significant results on risky investment measures. To be specific, both measures of risky investments are positively correlated with total compensation at 1% significance level. This is consistent with our Hypothesis 1. The coefficient of cash flow volatility in regression (1) indicates that one unit increase in cash flow volatility will cause a 1.784% increase in the scaled CEO compensation (ratio of CEO total compensation and firm sale).[10] Unlevered stock return volatility is significant at 1% level; the coefficient in regression (4) indicates that a one-unit increase in unlevered stock return volatility is associated with 7.226% increase in the scaled CEO compensation. Our result is also economically significant. If the cash flow volatility (unlevered stock return volatility) increases by one standard deviation (0.012 and 0.011, as reported in Table 1), total CEO compensation increases by 7.14% (26.50%), respectively. We find a similar pattern for cash compensation and equity-based compensation.[11] Therefore, starting at the average firm sale of $5,710.2 million, the additional costs on total CEO compensation would be $1.223 million ($4.539 million). On average, being the chair has a positive and significant effect on CEO pay. The results in Panel B remain robust where industry fixed effect is controlled instead. Corporate

[10] Coefficients are reported in percentage.
[11] One standard deviation increase on unlevered cash flow volatility (stock return volatility) will result in a 0.4% (6.55%) and 13.96% (51.73%) increase for cash compensation and equity-based compensation, respectively.

governance could play a role in CEO compensation. As an additional robustness test, we include G-index in the regressions and the results remain robust.[12]

4.2. System GMM

Coles et al. (2006), Yermack (1995), Smith and Watts (1992) suggest that the decision on CEO compensation is endogenous. The CEO compensation in a given firm could be driven by the risky investment level simply because the risky projects require highly skilled managers to operate, thus generating a positive correlation between the amount of risky investments and compensation. On the other hand, literature in agency theory (Childs, Mauer and Ott (2005) and Mauer and Sarkar (2005)) argue that the impact of agency conflicts over the timing of investments is different across firms with different financing decision. Moreover, Zhang (2009) finds that debt and executive stock options act as substitutes in attenuating a firm's free cash flow problem. In this section, we use system GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998) to account for any omitted variables concern. In our context, we use the lagged values of compensation, risky investment, as well as all other right-hand-variables (except for fixed dummies) as instruments for the current values of compensation and risky investment.

Table 4 reports the results of system GMM estimation for the effects of investment riskiness on CEO compensation. The regressions use one lag of compensation and deeper lags of all other right-hand-variables, except time and industry fixed dummies. All control variables are considered to be endogenous with the exception of the year and industry dummy variables. All regressions pass the AR(1) and AR(2) tests, along with the

[12] We did not report the results using G-index. It is available upon request.

Hasen *J*-test and the difference-in-Hansen *J*-test proposed by Eichenbaum, Hansen, and Singleton (1988). As reported in the table, all AR(1) tests are statistically significant and all AR(2) tests are not statistically significant. It supports our exogeneity assumption on the deeper lags of right-hand-variables. Further, the Hansen *J*-test of over-identification for the equation in differences and the difference-in-Hansen *J*-test of over-identification for the equation in levels are be rejected. This implies that we cannot reject the null hypothesis that the lagged level and lagged difference instruments are not correlated with the respective error terms.

We observe that except for cash compensation, both total compensation and equity-based compensation are positively correlated with investment risk proxied by cash flow volatility and unlevered stock return volatility. Overall, our results remain robust after accounting for possible omitted variable concern. Consistent with Hypothesis 1, firms with more risky investment have to pay more to CEO to compensate corresponding employment risk.

4.3. Simultaneous equations model

Despite our attempt above to address the endogeneity problem, the issue of causation may still be a concern. On one hand, our baseline regression provides evidence that risky investments have significantly positive effect on CEO compensation. On the other hand, previous studies have shown that CEO compensation has a significant effect on risky investment expenditures (e.g., Clinch (1991), Smith and Watts (1992), Gaver and Gaver (1993, 1995), Baber, Janakiraman, and Kang (1996), and Ryan and Wiggins (2002)). Furthermore, Chemmanur et al. (2013) show that firm leverage has a positive effect on CEO compensation. Since Harris and Raviv (1991) find that in general leverage decreases with advertising expenditures and R&D expenditures, which are our two channels for risky investments. The positive relation between human capital costs and leverage found in Chemmanur et al. (2013) should not contribute to our results. To formally address the potential causal relations among CEO compensation, risky investments, and leverage, we follow Coles et al. (2006) and adopt simultaneous equations model as an additional robustness test. To control for the potential endogeneity problem between leverage and CEO compensation, we follow Graham et al. (1998) and Chemmanur et al. (2013) to use marginal tax rates as one instrument for leverage. The marginal tax rates based on income before interest is deducted (MTRB) from the database of marginal tax rates provided by John Graham. We employ another instrument for leverage as industry median market leverage. As for instrumental variables for risky investments, we adopt industry median volatility measures, along with industry median R&D expenditures. The simultaneous equations are specified as below.

Equation 1.

$$CEOComp_{i,t} = \gamma_0 + \gamma_1 RiskyInvestment_{i,t} + \gamma_2 Size_{i,t} + \gamma_3 MktLev_{i,t} + \gamma_4 MtB_{i,t} + \gamma_5 Age_{i,t} + \gamma_6 Return_{i,t} + \gamma_7 Chair_{i,t} + \gamma_8 Male_{i,t} + \varepsilon_{i,t}$$

Equation 2.

$$RiskyInvestment_{i,t} = \alpha_0 + \alpha_1 CEOComp_{i,t} + \alpha_2 Industry\ median\ of\ RiskyInvestment_{i,t} + \alpha_3 Industry\ median\ of\ R\&D_{i,t} + \alpha_4 Size_{i,t} + \alpha_5 MktLev_{i,t} + \alpha_6 MtB_{i,t} + \alpha_7 Age_{i,t} + \alpha_8 Capex_{i,t} + \varepsilon_{i,t}$$

Equation 3.

$$MktLev_{i,t} = \beta_0 + \beta_1 CEOComp_{i,t} + \beta_2 Industry\ median\ of\ MktLev_{i,t} + \beta_3 MTRB_{i,t} + \beta_4 Size_{i,t} + \beta_5 MtB_{i,t} + \beta_6 Cash_{i,t} + \beta_7 Capex_{i,t} + \varepsilon_{i,t}$$

Equations 1 - 3 are estimated simultaneously using 3SLS. Results are presented in Table 5. Panel A, B, and C reports results of Equation 1, 2, and 3, respectively. As shown in Panel A, we find both risky investment measures are positive significantly related to all three CEO compensation measures, which indicates that our results are robust after accounting for the endogeneity of CEO compensation, investment and financing policy. We also find from Panel B that CEO compensation is positively correlated with our two measures of risky investments, which is consistent with previous literature. From Panel A and Panel B, we show that CEO compensation and R&D expenditures are simultaneously determined. Note that in Panel C, we observe mix results of total CEO compensation on market leverage. To be specific, total compensation and equity compensation is positively correlated with market leverage, which is consistent with what Chemmanur et al. (2013) find, but cash compensation is negatively correlated with market leverage. One of the possible explanations could be that the true relation between CEO compensation and leverage might be non-linear (Cadenillas et al. (2004)).

5. Empirical tests and results on investment policy and average employee pay

In this section, we describe our empirical results of the impact of investment riskiness on average employee pay.

5.1. Baseline regression

Our baseline regression for average employee pay sample is specified as followed. Our objective is to estimate the effect of risky investment on average employee pay.

$$
\begin{aligned}
EmployeePay_{it} &= \delta_0 + \delta_1 RiskyInvestment_{it} + \delta_2 Size_{it} + \delta_3 MtB_{it} + \delta_4 MktLev_{it} \\
&+ \delta_5 AvgSale_{it} + \delta_6 PPE_{it} + \delta_7 ROA_{it} + \delta_8 ROE_{it} + \delta_9 Cash_{it} \\
&+ \delta_{10} FirmAge_{it} + \varepsilon_{it}
\end{aligned}
$$

Where $AvgSale_{it}$ is average sale per employee, PPE_{it} is fixed assets ratio, and $Cash_{it}$ is ratio of cash and marketable securities to the book value of assets. Detailed definitions of each variable are in Appendix A.

Regression results are presented in Table 6. Panel A reports results with firm and year fixed effect; Panel B include high-tech dummy to control for employee skills, and industry and year fixed effect are included. Column 1 and 2 are regressions with our two risky investment measures along with staff expense per employee, and column 3 and 4 use SGA as a proxy for average employee pay, respectively. In model (1) and (2) where staff expense per employee is used to calculate average employee pay, we observe that cash flow volatility is positively significant at 5% level while unlevered stock return volatility is insignificant with firm and year fixed effect; with industry and year fixed effect, cash flow volatility remains at 5% significance level and unlevered stock return volatility is now positively significant at 10% level. When SGA is used to proxy for average employee pay in model (3) and (4), we observe both cash flow volatility and unlevered stock return volatility are significantly positive at 1% level for both panels. The results are consistent with Hypothesis 2. The coefficient on cash flow volatility in regression 1, for example, indicates that one unit increase in cash flow volatility will cause a 0.096% increase in scaled staff expenses per employee (ratio of staff expenses per employee and total sale). Economically, if the cash flow volatility increases by one standard deviation (0.022, as reported in Table1 panel B), average employee pay proxied by staff expenses per employee increases by 10.56%.[13] Therefore, starting with the average value of firm's sale at $2,308.94 million, the additional cost on staff expense per employee would be $49,000. With an average of 10,250 employees per firm, that is about $490 million increase in human capital cost, a tremendously significant amount economically.[14]

5.2. System GMM

The biggest endogeneity concern in the average employee sample would be whether the results are driven by employee skills. To be specific, firms that invest more in risky projects (for example, pharmaceutical companies, high technology firms, etc.) may hire more skilled workers, and skilled workers are better paid than unskilled workers. To address this problem, we first included high-tech dummy as a control for skill in our baseline regressions as showed in Panel B Table 6. In this section, we use system GMM regressions to further account for concerns of omitted variables.

Results are reported in Table 7. The regressions use one lag of average labor costs and deeper lags of all other right-hand-side variables. All regressions pass the AR(1) and AR(2) tests, along with the Hansen *J*-test and the difference-in Hansen *J*-test proposed by

[13] With SGA per number of employee as proxy for average employee pay, the economic effect is that every standard deviation increase in cash flow volatility (unlevered stock return volatility) is associated with 11.88% (9.54%) increase in human capital cost.

[14] One of the reasons for the large economic significance is that the standard deviations of the two volatility variables are almost as large as their mean, if not larger, as showed and discussed in table 1.

Eichenbaum, Hanse, and Singleton (1988). If our exogeneity assumptions are valid, then the residuals in first differences should be correlated, but the residuals in second differences should not be correlated. This is what is observed in the table. Further, the Hansen *J*-test of over-identification for the equation in differences and the difference-in-Hansen *J*-test of over-identification for the equation in levels are not rejected. This implies that we cannot reject the hypothesis that the lagged level and lagged difference instruments in the system GMM are exogenous. In all regression, there is a statistically significant positive relation between proxies for risky investments and average employee pay. This effect is also economically significant compared to the coefficient estimates in panel B of Table 6. In comparison, when SGA is the proxy for average employee pay, the significance level on coefficients of risky investments reduces to 10%. This suggests that the endogeneity concern is more of a problem when SGA serves as the proxy for average employee pay. This makes sense because SGA (Selling, general, and administration fees) is noisier when comes to proxy for average employee pay than stuff expenses, as we already discussed earlier.

Overall, we continue to find a strong positive relation between average employee pay and risky investments after accounting for unobserved omitted variable concerns.

5.3. Subsample analysis

In addition to the baseline regression and system GMM approach, we divide our sample into low-pay firms and high-pay firms, and non-high-tech firms and high-tech firms in hope to further address the potential endogeneity concern of "pay for skills". As discussed in the hypothesis section, if our "pay for risk" argument is valid, then employee's sensitivity towards unemployment risk should be a crucial factor in determining the relation between risky investment expenditure and average employee pay. Less skilled employees should be more sensitive to unemployment risk than skilled employees because the latter possess more resource and therefore would have more choices once unemployed. Our Hypothesis 3 is based on this notion. We consider firms that hire employees with lower pay, or non-technology firm as firms with less skilled workers. We classify high-pay firms as those whose average employee pay is higher than sample median grouped by each fiscal year, whereas low-pay firms as those whose average employee pay is lower than sample median grouped by each fiscal year. We follow Carpenter and Petersen (2002) to identify high-tech industries by using first three-digit SIC code of 283, 357, 361, 362, 366, 367, 382, 384, 386, and 387. Results are presented in Table 8. Panel A uses staff expenses per employee as dependent variable, and panel B uses SGA per employee. Regressions (1) to (4) report results of low-pay firms vs. high-pay firms while regressions (5) to (8) report results of non-technology firms vs. technology firms. Results are generally consistent with what we expected. To be specific, Panel A (staff expenses) shows that cash flow volatility only displays significance for low-pay firms and for non-technology firms, while it is insignificant in the high-pay firms and technology firms. Panel B (SGA) shows that similar results are found for both low-pay and high-pay subsamples, and non-technology and technology subsamples. To be specific, both risk measures are significantly positive at 1% level. Results are very much in line with our expectation.

6. Channel Tests

To further study the impact of investment policy on human capital costs, we continue to examine the possible channels through which risky investment affects average employee pay. Follow the literature we discussed before, we investigate four possible channels: corporate diversification, R&D expenditures, advertising expenditures, and acquisition amount. While R&D expenditures, advertising expenditures, and acquisition amount are perceived as contributors to investment risk, diversification, on the other hand, reduces total firm risk. Therefore, we expect to see that the higher diversification level a firm is, the less human capital costs associated with it while the higher level of R&D expenditures, advertising expenditures, or acquisition amount, the more human capital costs associated with it. Table 8 and table 9 report the results for each channel of the CEO sample and employee sample separately.

In table 8, columns 1-4 report CEO total compensation regressed on each channel. We observe that except for column 1, all other channels are consistent with our expectation. To be specific, R&D expenditures and acquisition amount are significantly positive at 1% level. Advertising expenditures is positively significant at 10% level. The results provide evidence that is consistent with Hypothesis 4. Column 1 presents results using diversification level as a channel. We included squared variable of number of segments in the regression because literature suggests the level of diversification could have a nonlinear relation with compensation (e.g., Rose and Shepard (1994) and Duru and Reeb (2002)). We see that the coefficient on number of segment is negative, but insignificant.

For employee sample in table 9, we report results in two panels. Panel A reports the results using staff expense per employee as the dependent variable. We observe that number of segments is significantly negative at 10%, and R&D expenditures are positively significant at 1%, which is consistent with Hypothesis 4. However, neither advertising expenditures nor acquisition amount show any significance. Panel B reports the results using SGA per employee as the dependent variable, and we observe significance in all four specifications. In particular, the coefficient on number of segments is negative significantly at 1% level, while coefficients on R&D expenditures, advertising expenditures, and acquisition amount are all positively significant at 1% level, which is consistent with Hypothesis 4.

7. Conclusion

Human capital costs have been largely ignored in corporate financing and corporate budgeting literature. A few recent studies start to pay attention to the role of human capital costs in capital structure decisions. Berk et al. (2010) and Chemmanur et al. (2013) find that firms with high leverage are associated with larger human capital costs. In this paper, we argue that employees bear large human capital loss because of the risky investments that the firm is taking. We consider the risk borne by the firm (so as employees) arisen from the decision on risky investments in our theoretical setting, and then conduct empirical tests on the relation between risky investments expenditure and human capital costs (measured by CEO compensation and average employee pay). Our results indicate that human capital costs increased by taking on risky investments can significantly discourage firms' decisions on valuable investments, resulting in potential underinvestment problem.

Using two measures for risky investment level: cash flow volatility and unlevered stock return volatility, we find a firm's risky investment level is significantly positive related to both CEO compensation and average employee pay. In a panel sample of CEO covers from 1992 to 2015, and a panel sample of firms with necessary employee information covers from 1976 to 2015, we show that the positive relation is both statistically and economically significant. For example, we document that one standard deviation increase in cash flow volatility, total compensation of CEO increases 7.14%, and average employee pay increases 10.56% using staff expense per employee. Our results are evident after we control for industry fixed effect. To account for the potential endogeneity of CEO compensation, investment and financial policy, we conduct system GMM and simultaneous equations model. The results remain robust.

We further test whether our results are robust in subsamples. By comparing high pay firms and low pay firms, and non-technology firms and technology firms, we are able to provide further evidence that alleviates the "pay for skill" concern. We document similar and stronger results between expenses on risky investments and average employee pay in low-pay firms than high-pay firms, and in non-technology firms than technology firms, indicating that employees who are more sensitive to unemployment risk, have stronger effect in the compensation and risk level relation.

Lastly, we further explore four possible channels for risky investments: corporate diversification, R&D expenditures, advertising expenditures, and acquisition amount. We find further support for the positive relation between risky investments and human capital costs. In particular, we find firm's R&D expenditures, advertising expenditures, and acquisition amount to be positively relate to human capital costs, while diversification level to have negative relation.

One shortcoming of this study is related to average employee pay. As discussed in previous section, we are only able to proxy for average employee pay using Compustat database, and both proxies suffer from their own limitations. We are currently in the application process for accessing detailed employee compensation data from Bureau of Labor Statistics. Once the application process is complete, we will be able to test our average employee pay hypotheses with real labor data and further strengthen the paper.

Appendix A: Variable Definitions

Variable	Description (source of data)
CEO characteristics	
Total compensation	Salary + Bonus + Other Annual + Restricted Stock Grants + LTIP Payouts + All Other + Value of Option Grants. (ExecuComp)
Total comp/sale	Total compensation divided by total sale. (ExecuComp/Compustat)
Cash compensation	Sum of salary and bonus. (ExecuComp)
Cash comp/sale	Cash compensation divided by total sale. (ExecuComp/Compustat)
Equity-based compensation	Total compensation − Cash compensation − Other Annual − LTIP payouts (ExecuComp)
Equity-based comp/sale	Equity-based compensation divided by total sale. (ExecuComp/Compustat)
Age	Age of the CEO. (ExecuComp)
Male	Dummy variable equal to one when the CEO is male. (ExecuComp)
Chairman	Dummy variable equal to one when the CEO serves as chairman of the board. (ExecuComp)
Employee characteristics	
Staff expense per employee	Total labor expense divided by number of employees. (Compustat)
Staff expense per employee/sale	Average employee pay divided by total sale. (Compustat)
SGA per employee	Selling, general, and administrative expense divided by number of employees. (Compustat)
Scaled SGA per employee/sale	SGA per employee divided by total sale. (Compustat)
Number of employees	Total number of employees in a firm-year. (Compustat)
Proxies for risky investments	
Cash flow volatility	Standard deviation of the ratio of operating income after depreciation to assets over the eight quarters ending in each fiscal year. (Compustat)
Unlevered stock return volatility	Standard deviation of unlevered daily stock returns in past 2 years. (CRSP/Compustat)
No. of segments	Number of segments with different four-digit SIC code. (Compustat/Segment)

R&D/sale	Ratio of research and development expense to total sale. (Compustat)
Advertisement/sale	Ratio of advertisement expenditure to total sale. (Compustat)
Acq. amount/sale	Ratio of total value of all acquisition deals in a year to total sale. (SDC/Compustat)
Control variables	
Firm size	Logarithm of market capitalization in constant dollars using the CPI with base year 1992. (Compustat)
Average sale per employee	Amount of total sale divided by number of employees. (Compustat)
Market capitalization	Market value of equity. (Compustat)
Market leverage	Total debt divided by the market value of assets (book value of assets – book value of equity + market value of equity). (Compustat)
Market-to-book ratio	Ratio of book assets plus the difference between the market and book values of equity to the book value assets. (Compustat)
Marginal tax rate	Present value of current and expected future taxes paid on an additional dollar earned today. Come from the database of marginal tax rates provided by John Graham.
CAPEX/sale	Ratio of capital expenditures to sale. (Compustat)
Fixed assets ratio	Ratio of net property, plant, and equipment to the book value of assets. (Compustat)
ROA	Ratio of operating income before depreciation to the book value of assets. (Compustat)
ROE	Ratio of operating income before depreciation to the book value of equity. (Compustat)
Cash	Ratio of cash and marketable securities to the book value of assets. (Compustat)
Firm age	Number of years from the first year recorded on the database to year t. (Compustat)
One-year return to stock price shareholder	Ratio of difference between stock price at year t plus dividend per share and at year t-1 to stock price at year t-1. (Compustat)
High-tech dummy	Defined as an indicator variable which takes a value of one if a firm is involved in high-tech industries, and zero otherwise. We follow Carpenter and Petersen (2002) to identify high-tech industries by using first three-digit SIC code of 283, 357, 361, 362, 366, 367, 382, 384, 386, and 387.
Governance index	Gompers, Ishii, and Metrick (2003) governance index.

Reference

Argenti, J. 1976. Corporate Collapse: The Causes and Symptoms (London, UK: McGraw-Hill Book Company (UK) Ltd.,).

Arellano, M. and Bover, O., 1995. Another look at the instrumental variable estimation of error-components models. *Journal of econometrics*, *68*(1), pp.29-51.

Baber, W.R., Janakiraman, S.N. and Kang, S.H., 1996. Investment opportunities and the structure of executive compensation. *Journal of Accounting and Economics*, *21*(3), pp.297-318.

Berger, P.G. and Ofek, E., 1995. Diversification's effect on firm value. *Journal of Financial Economics*, *37*(1), pp.39-65.

Berk, J.B., Stanton, R. and Zechner, J., 2010. Human capital, bankruptcy, and capital structure. *The Journal of Finance, 65*(3), pp.891-926.

Bizjak, J.M., Brickley, J.A. and Coles, J.L., 1993. Stock-based incentive compensation and investment behavior. *Journal of Accounting and Economics*, *16*(1-3), pp.349-372.

Blundell, R. and Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, *87*(1), pp.115-143.

Cadenillas, A., Cvitanić, J. and Zapatero, F., 2004. Leverage decision and manager compensation with choice of effort and volatility. *Journal of Financial Economics*, *73*(1), pp.71-92.

Campbell, J.Y., Lettau, M., Malkiel, B.G. and Xu, Y., 2001. Have individual stocks become more volatile? An empirical exploration of idiosyncratic risk. *The Journal of Finance*, *56*(1), pp.1-43.

Chan, S.H., Martin, J.D. and Kensinger, J.W., 1990. Corporate research and development expenditures and share value. *Journal of Financial Economics*, *26*(2), pp.255-276.

Chemmanur, T.J., Cheng, Y. and Zhang, T., 2013. Human capital, capital structure, and employee pay: An empirical analysis. *Journal of Financial Economics*, *110*(2), pp.478-502.

Cheng, S., 2004. R&D expenditures and CEO compensation. *The Accounting Review*, *79*(2), pp.305-328.

Childs, P.D., Mauer, D.C. and Ott, S.H., 2005. Interactions of corporate financing and investment decisions: The effects of agency conflicts. *Journal of financial economics*, *76*(3), pp.667-690.

Clark, A., Georgellis, Y. and Sanfey, P., 2001. Scarring: The psychological impact of past unemployment. *Economica*, *68*(270), pp.221-241.

Clark, A.E. and Oswald, A.J., 1994. Unhappiness and unemployment. *The Economic Journal*, *104*(424), pp.648-659.

Clinch, G., 1991. Employee compensation and firms' research and development activity. *Journal of Accounting Research*, pp.59-78.

Coles, J.L., Daniel, N.D. and Naveen, L., 2006. Managerial incentives and risk-taking. *Journal of Financial Economics*, *79*(2), pp.431-468.

Cronqvist, H., Heyman, F., Nilsson, M., Svaleryd, H. and Vlachos, J., 2009. Do entrenched managers pay their workers more?. *The Journal of Finance*, 64(1), pp.309-339.

Dambolena, I.G. and Khoury, S.J., 1980. Ratio stability and corporate failure. *The Journal of Finance*, *35*(4), pp.1017-1026.

Duru, A. and Reeb, D.M., 2002. Geographic and industrial corporate diversification: The level and structure of executive compensation. *Journal of Accounting, Auditing & Finance*, *17*(1), pp.1-24.

Eichenbaum, M.S., Hansen, L.P. and Singleton, K.J., 1988. A time series analysis of representative agent models of consumption and leisure choice under uncertainty. *The Quarterly Journal of Economics*, *103*(1), pp.51-78.

Fauver, L., McDonald, M.B. and Taboada, A., 2015. Does it Pay to Treat Employees Well? International Evidence on the Value of an Employee-Friendly Culture. Working paper

Gaver, J.J. and Gaver, K.M., 1998. The relation between nonrecurring accounting transactions and CEO cash compensation. *Accounting Review*, pp.235-253.

Gerlach, K. and Stephan, G., 1996. A paper on unhappiness and unemployment in Germany. *Economics Letters*, *52*(3), pp.325-330.

Gilchrist, S. and Himmelberg, C.P., 1995. Evidence on the role of cash flow for investment. *Journal of Monetary Economics*, *36*(3), pp.541-572.

Gompers, P., Ishii, J. and Metrick, A., 2003. Corporate governance and equity prices. *The Quarterly Journal of Economics*, 118(1), pp.107-156.

Graham, J.R., 1996, Debt and the marginal tax rate, *Journal of Financial Economics* 41, 41-73.

Graham, J.R., 1996, Proxies for the corporate marginal tax rate, *Journal of Financial Economics* 42, 187-221

Graham, J.R., 1996. Debt and the marginal tax rate. *Journal of Financial Economics*, 41(1), pp.41-73.

Graham, J.R., 1996. Proxies for the corporate marginal tax rate. *Journal of Financial Economics*, 42(2), pp.187-221.

Graham, J.R., Lemmon, M.L. and Schallheim, J.S., 1998. Debt, leases, taxes, and the endogeneity of corporate tax status. *The Journal of Finance*, 53(1), pp.131-162.

Gray, S.R. and Cannella, A.A., 1997. The role of risk in executive compensation. *Journal of Management*, *23*(4), pp.517-540.

Grundy, B.D. and Li, H., 2010. Investor sentiment, executive compensation, and corporate investment. *Journal of Banking & Finance*, *34*(10), pp.2439-2449.

Guay, W.R., 1999. The sensitivity of CEO wealth to equity risk: an analysis of the magnitude and determinants. *Journal of Financial Economics*, *53*(1), pp.43-71.

Harris, M. and Holmstrom, B., 1982. A theory of wage dynamics. *The Review of Economic Studies*, 49(3), pp.315-333.

Harris, M. and Raviv, A., 1991. The theory of capital structure. *The Journal of Finance*, *46*(1), pp.297-355.

Irvine, P.J. and Pontiff, J., 2008. Idiosyncratic return volatility, cash flows, and product market competition. *The Review of Financial Studies*, *22*(3), pp.1149-1177.

Jaggia, P.B. and Thakor, A.V., 1994. Firm-specific human capital and optimal capital structure. *International Economic Review*, pp.283-308.

Lee, K.H., Mauer, D.C., and Xu, Q.Y., 2017. Human Capital Relatedness and Mergers and Acquisitions. *Journal of financial Economics, 2017.*

Lev, B. and Sougiannis, T., 1996. The capitalization, amortization, and value-relevance of R&D. *Journal of Accounting and Economics*, *21*(1), pp.107-138.

Lewellen, W.G., 1971. A pure financial rationale for the conglomerate merger. *The Journal of Finance*, *26*(2), pp.521-537.

Lubatkin, M. and O'Neill, H.M., 1987. Merger strategies and capital market risk. *Academy of Management Journal*, *30*(4), pp.665-684.

Matsunaga, S.R., 1995. The effects of financial reporting costs on the use of employee stock options. *Accounting Review*, pp.1-26.

Mauer, D.C. and Sarkar, S., 2005. Real options, agency conflicts, and optimal capital structure. *Journal of banking & Finance*, *29*(6), pp.1405-1428.

May, D.O., 1995. Do managerial motives influence firm risk reduction strategies?. *The Journal of Finance*, *50*(4), pp.1291-1308.

Miller, K.D. and Bromiley, P., 1990. Strategic risk and corporate performance: An analysis of alternative risk measures. *Academy of Management Journal*, *33*(4), pp.756-779.

Rajgopal, S., Shevlin, T. and Venkatachalam, M., 2003. Does the stock market fully appreciate the implications of leading indicators for future earnings? Evidence from order backlog. *Review of Accounting Studies*, *8*(4), pp.461-492.

Rose, N.L. and Shepard, A., 1994. *Firm diversification and CEO compensation: Managerial ability or executive entrenchment?* (No. w4723). National Bureau of Economic Research.

Ryan Jr, H.E. and Wiggins III, R.A., 2002. The interactions between R&D investment decisions and compensation policy. *Financial Management*, pp.5-29.

Ryan, H.E. and Wiggins, R.A., 2001. The influence of firm-and manager-specific characteristics on the structure of executive compensation. *Journal of Corporate Finance*, *7*(2), pp.101-123.

Shilon, N., 2015. CEO Stock Ownership Policies-Rhetoric and Reality. Ind. LJ, 90, p.353.

Smith, C.W. and Watts, R.L., 1992. The investment opportunity set and corporate financing, dividend, and compensation policies. *Journal of Financial Economics*, *32*(3), pp.263-292.

Yermack, D., 1995. Do corporations award CEO stock options effectively? *Journal of Financial Economics*, *39*(2), pp.237-269.

Zhang, Y., 2009. Are debt and incentive compensation substitutes in controlling the free cash flow agency problem?. *Financial Management*, *38*(3), pp.507-541.

Table 1

Descriptive Statistics

We report descriptive statistics for both CEO sample (Panel A) and employee sample (Panel B). In the CEO sample, we require non-missing information on cash flow volatility, stock return volatility, and firm data. The full CEO sample covers period from 1992 to 2015. In the employee sample, we require firm-years to be on the Compustat database and have cash flow volatility, unlevered stock return volatility, SGA (Selling, General and Administrative expense), and firm data. The full employee sample covers period from 1976 to 2015. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. All variables are defined in the Appendix A.

	N	Mean	Std Dev	Min	Median	Max
Panel A. CEO sample						
Total Compensation $mm	17,688	3.750	4.303	0.193	2.334	25.680
Total comp./sale	17,688	0.003	0.005	0.000	0.001	0.032
Cash compensation $mm	17,688	0.865	0.762	0.051	0.624	4.716
Cash comp/sale	17,688	0.001	0.001	0.000	0.000	0.007
Equity-based compensation $mm	9,129	2.416	4.246	0.000	0.912	27.070
Equity-based comp/sale	9,129	0.002	0.005	0.000	0.001	0.037
Cash flow volatility	17,688	0.012	0.012	0.001	0.008	0.065
Unlevered stock return volatility	17,688	0.023	0.011	0.008	0.021	0.062
No. of segments	13,264	1.682	1.083	1.000	1.000	8.000
CAPEX/sale	17,586	0.072	0.118	0.002	0.038	0.809
R&D/sale	11,703	0.071	0.107	0.000	0.027	0.714
Advertisement/sale	7,022	0.030	0.037	0.000	0.015	0.194
Acq. amount/sale	17,688	0.048	0.177	0.000	0.000	1.264
Sale $mm	17,688	5,710	12,769	64.538	1,490	88,050
High_tech dummy	17,688	0.208				
Age	17,688	55.930	7.454	29.000	56.000	96.000
Male	17,688	0.976				
Chairman	17,688	0.557				
Firm size	17,688	7.275	1.568	4.021	7.098	11.567
Market leverage	17,688	0.139	0.133	0.000	0.111	0.563
Market to book	17,688	3.312	3.159	0.497	2.381	20.985
One year shareholders' return	17,688	0.097	0.438	-0.758	0.062	1.823
G-Index (Gompers, Ishii, Metrick)	14,604	9.179	2.601	1.000	9.000	17.000
Panel B. Employee sample						
Staff expense per employee $thousand	6,710	34.403	19.593	1.553	34.737	93.166
Staff expense per employee/sale	6,710	0.0002	0.0004	0.000	0.0002	0.003
SGA per employee $thousand	72,427	51.134	45.172	1.849	36.302	236.586
SGA per employee/sale	72,427	0.0008	0.002	0.000	0.0002	0.010
Cash flow volatility	72,427	0.020	0.022	0.002	0.013	0.128
Unlevered stock return volatility	72,427	0.030	0.017	0.008	0.026	0.090
No. of segments	61,042	1.498	0.996	1.000	1.000	10.000
CAPEX/sale	71,771	0.065	0.085	0.003	0.040	0.589
R&D/sale	72,427	0.126	4.933	0.000	0.026	976.500
Advertisement/Sale	32,516	0.031	0.042	0.000	0.016	0.256
Acq. amount/sale	72,427	0.037	0.167	0.000	0.000	1.285
Sale $mm	72,427	2,308	7,318	6.232	215.886	53,674
High-tech dummy	72,427	0.312				
Average sale per employee $thousand	72,427	173.063	147.578	20.433	134.491	967.888

Market leverage	72,427	0.148	0.153	0.000	0.105	0.629
Market capitalization	72,427	2167.310	7041.060	3.150	198.770	52232
Market-to-book	72,427	1.905	1.402	0.601	1.437	8.872
Fixed asset ratio	72,427	0.249	0.180	0.014	0.210	0.806
Firm size	72,427	5.440	2.108	1.147	5.292	10.863
ROA	72,427	0.103	0.137	-0.484	0.122	0.378
ROE	72,427	0.237	0.389	-1.451	0.250	1.908
Cash	72,427	0.181	0.191	0.001	0.108	0.794
Firm age	72,427	10.954	8.809	1.000	8.000	46.000
Number of employees thousands	72,427	10.250	25.064	0.107	1.520	165.000
Governance Index	15,243	9.093	2.694	1.000	9.000	17.000

Table 2

Correlations Matrix

We report Pearson correlation coefficients between human capital cost and proxies of risky investments for both CEO sample (Panel A) and employee sample (Panel B). In the CEO sample, we require firm-years to be on the ExecuComp database and have cash flow volatility, unlevered stock return volatility and firm data. The full CEO sample covers period from 1992 to 2015. In the employee sample, we require firm-years to be on the Compustat database and have cash flow volatility, unlevered stock return volatility, SGA (Selling, General and Administrative expense) and firm data. The full employee sample covers period from 1976 to 2015. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A. CEO sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Total comp/sale	1								
(2) Cash comp/sale	0.677***	1							
(3) Equity-based comp/sale	0.947***	0.465***	1						
(4) Cash flow volatility	0.201***	0.212***	0.200***	1					
(5) Unlevered Stock return volatility	0.393***	0.363***	0.413***	0.375***	1				
(6) No. of segments	-0.168***	-0.157***	-0.155***	-0.151***	-0.203***	1			
(7) R&D/sale	0.544***	0.473***	0.504***	0.251***	0.380***	-0.235***	1		
(8) Advertisement/sale	0.053***	0.057***	0.053***	0.185***	0.005	0.007	0.004	1	
(9) Acq. amount/sale	0.149***	0.100***	0.154***	0.022***	0.044***	-0.049***	0.132***	0.026**	1

Panel B. Employee sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Staff expense per employee/sale	1							
(2) SGA per employee/sale	0.758***	1						
(3) Cash flow volatility	0.329***	0.439***	1					
(4) Unlevered Stock return volatility	0.446***	0.468***	0.438***	1				
(5) No. of segments	-0.199***	-0.196***	-0.177***	-0.273***	1			
(6) R&D/sale	0.087***	0.077***	0.024***	0.015***	-0.010**	1		
(7) Advertisement/Sale	0.131***	0.207***	0.221***	0.098***	-0.027***	0.135***	1	
(8) Acq. amount/sale	0.023*	0.082***	0.055***	0.090***	-0.044***	0.002	0.064***	1

Table 3

Effect of Investments Risk on CEO Compensation

The dependent variables are three measures of CEO compensation: Total compensation/sale, Cash compensation/sale and Equity-based compensation/sale of CEO. Regressions in Panel A include firm fixed effects and year fixed effects, regressions in Panel B include industry fixed effects and year fixed effects. We use cash flow volatility and unlevered stock return volatility as two proxies for risky investments. The coefficients are reported in terms of percentage. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. *T*-statistics (in parentheses) are computed using robust standard errors corrected for clustering of observations at the firm level. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Total comp/sale (1)	Cash comp/sale (2)	Equity-based comp/sale (3)	Total comp/sale (4)	Cash comp/sale (5)	Equity-based comp/sale (6)
Panel A. Firm-year fixed effects						
Cash flow volatility	1.784***	0.033	2.327**			
	(2.70)	(0.23)	(2.02)			
Unlevered stock return volatility				7.226***	0.595***	9.406***
				(6.79)	(3.28)	(5.66)
Firm size	-0.024**	-0.021***	0.029*	-0.008	-0.020***	0.043***
	(-2.01)	(-8.69)	(1.77)	(-0.66)	(-8.17)	(2.64)
Market Leverage	-0.423***	-0.116***	-0.324***	-0.202***	-0.097***	-0.014
	(-6.90)	(-9.38)	(-3.04)	(-3.04)	(-7.64)	(-0.13)
Market-to-book	0.014***	0.002***	0.012**	0.012***	0.002***	0.012**
	(5.34)	(4.67)	(2.57)	(5.00)	(4.27)	(2.51)
One-year return to shareholders	0.003	0.013***	-0.036**	-0.002	0.013***	-0.039***
	(0.40)	(9.78)	(-2.47)	(-0.24)	(9.51)	(-2.73)
Age	-0.003***	-0.000	-0.003***	-0.003***	0.000	-0.003***
	(-4.33)	(-0.03)	(-2.82)	(-4.19)	(0.08)	(-2.65)
Chairman	0.023**	0.005***	0.034**	0.021**	0.005***	0.033**
	(2.50)	(3.01)	(2.43)	(2.36)	(2.94)	(2.36)
Male	-0.041	-0.008	-0.124*	-0.048	-0.009	-0.128*
	(-0.89)	(-1.13)	(-1.75)	(-1.10)	(-1.23)	(-1.79)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.614	0.781	0.557	0.620	0.782	0.562
Number of observations	17,688	17,688	9,129	17,688	17,688	9,129

Panel B. Industry-year fixed effects						
Cash flow volatility	3.862***	0.678***	4.283***			
	(5.64)	(4.68)	(4.44)			
Unlevered stock return volatility				13.974***	1.803***	18.649***
				(12.48)	(7.77)	(11.37)
Firm size	-0.084***	-0.036***	-0.049***	-0.059***	-0.033***	-0.015**
	(-16.75)	(-25.82)	(-7.80)	(-12.22)	(-25.24)	(-2.55)
Market Leverage	-0.396***	-0.140***	-0.317***	-0.045	-0.098***	0.225***
	(-9.43)	(-10.68)	(-5.65)	(-0.95)	(-7.18)	(3.32)
Market-to-book	0.019***	0.003***	0.020***	0.019***	0.003***	0.017***
	(8.49)	(7.90)	(5.45)	(8.67)	(8.08)	(5.16)
One-year return to shareholders	0.017*	0.014***	-0.019	-0.000	0.012***	-0.030**
	(1.86)	(8.18)	(-1.22)	(-0.04)	(6.69)	(-2.03)
Age	-0.004***	0.000	-0.006***	-0.003***	0.000*	-0.004***
	(-4.41)	(1.27)	(-5.38)	(-3.30)	(1.82)	(-3.98)
Chairman	0.032***	0.008***	0.031*	0.033***	0.008***	0.033**
	(2.87)	(2.93)	(1.88)	(3.10)	(3.01)	(2.11)
Male	-0.042	-0.010	-0.062	-0.046	-0.010	-0.111
	(-1.16)	(-0.85)	(-0.72)	(-1.29)	(-0.95)	(-1.34)
High-tech dummy	0.054	0.007	0.052	-0.007	-0.000	-0.057
	(1.55)	(0.78)	(1.08)	(-0.20)	(-0.03)	(-1.23)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.254	0.398	0.179	0.291	0.407	0.233
Number of observations	17,688	17,688	9,129	17,688	17,688	9,129

Table 4

System GMM Estimation of the Effects of Investments Riskiness on CEO Compensation

The table reports the results of system GMM estimation of the effects of risky investments on CEO compensation. The dependent variables are three measures of CEO compensation: Total compensation/sale, Cash compensation/sale and Equity-based compensation/sale of CEO. All control variables are considered to be endogenous with the exception of the year and industry dummy variables. We also include first lag of dependent variable in the dynamic GMM model. AR(1) and AR(2) are tests for first-order and second-order serial correlation in the first differenced residuals with the null hypothesis of no serial correlation. The null hypothesis of the Hansen test of overidentification is that all instruments are valid. The null hypothesis of the difference-in- Hansen test of exogeneity is that the instruments used for the equations in levels are exogenous. The coefficients are reported in terms of percentage. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. *T*-statistics (in parentheses) are computed using robust standard errors corrected for clustering of observations at the firm level. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Total comp/sale (1)	Cash comp/sale (2)	Equity-based comp/sale (3)	Total comp/sale (4)	Cash comp/sale (5)	Equity-based comp/sale (6)
Adjusted compensation (one lag)	0.472***	0.101***	0.380***	0.444***	0.638***	0.342***
	(8.82)	(9.57)	(5.10)	(6.76)	(17.29)	(4.43)
Cash flow volatility	2.938***	0.313	4.865*			
	(3.22)	(1.17)	(1.65)			
Unlevered stock return volatility				5.047***	0.052	13.440***
				(3.47)	(0.24)	(4.24)
Firm size	-0.048***	-0.029***	-0.076**	-0.053***	-0.011***	-0.030
	(-3.27)	(-7.89)	(-2.19)	(-4.31)	(-5.14)	(-1.30)
Market Leverage	0.019***	-0.152***	-0.979***	-0.114	-0.063***	0.137
	(2.66)	(-4.69)	(-2.75)	(-1.37)	(-4.40)	(0.56)
Market-to-book	-0.251***	0.002	0.029*	0.013*	0.002**	0.014
	(-3.15)	(1.30)	(1.81)	(1.94)	(2.20)	(0.74)
One-year return to shareholders	0.052**	0.011***	-0.006	0.030	0.001	-0.009
	(2.04)	(2.67)	(-0.08)	(1.16)	(0.15)	(-0.14)
Age	0.000	0.001	0.001	-0.000	-0.000	0.005
	(0.05)	(0.80)	(0.07)	(-0.11)	(-0.32)	(0.68)
Chairman	0.019	-0.003	0.034	0.036	-0.005	0.070
	(0.61)	(-0.46)	(0.30)	(1.31)	(-0.86)	(1.03)
Male	0.008	-0.014	-0.034	-0.029	-0.002	-0.069
	(0.12)	(-0.58)	(-0.10)	(-0.47)	(-0.16)	(-0.16)

High-tech dummy	-0.091	-0.004	0.432	-0.295	-0.026	-0.084
	(-0.42)	(-0.05)	(0.88)	(-1.02)	(-0.54)	(-0.28)
AR(1) test (p-value)	0.000	0.000	0.000	0.000	0.000	0.000
AR(2) test (p-value)	0.105	0.102	0.480	0.141	0.204	0.748
Hansen J-statistic (p-value)	1.000	1.000	0.165	0.989	0.705	0.152
Diff-in-Hansen J-statistic (p-value)	1.000	0.127	0.735	0.253	0.743	0.456
Number of observations	14,765	14,765	7,093	14,765	14,765	7,093

Table 5

Simultaneous Regressions: Effects of Investment Risk on CEO Compensation

The table reports the results obtained from a set of three simultaneous regressions:

1. $CEOComp_{i,t} = \gamma_0 + \gamma_1 RiskyInvestment_{i,t} + \gamma_2 Size_{i,t} + \gamma_3 MktLev_{i,t} + \gamma_4 MtB_{i,t} + \gamma_5 Age_{i,t} + \gamma_6 Return_{i,t} + \gamma_7 Chair_{i,t} + \gamma_8 Male_{i,t} + \varepsilon_{i,t}$
2. $RiskyInvestment_{i,t} = \alpha_0 + \alpha_1 CEOComp_{i,t} + \alpha_2 Industry\ median\ of\ RiskyInvestment_{i,t} + \alpha_3 Industry\ median\ of\ R\&D_{i,t} + \alpha_4 Size_{i,t} + \alpha_5 MktLev_{i,t} + \alpha_6 MtB_{i,t} + \alpha_7 Age_{i,t} + \alpha_8 Capex_{i,t} + \varepsilon_{i,t}$
3. $MktLev_{i,t} = \beta_0 + \beta_1 CEOComp_{i,t} + \beta_2 Industry\ median\ of\ MktLev_{i,t} + \beta_3 MTRB_{i,t} + \beta_4 Size_{i,t} + \beta_5 MtB_{i,t} + \beta_6 Cash_{i,t} + \beta_7 Capex_{i,t} + \varepsilon_{i,t}$

Panel A presents the results of Equation 1, penal B presents the results of Equation 2, and Panel C presents the results of Equation 3. *RiskyInvestment* is cash flow volatility in Column (1) – (3) and unlevered stock return volatility in Column (4) – (6) of Panel A. *CEOComp* are three measures of CEO compensation: total compensation/sale, cash compensation/sale and equity-based compensation/sale. *MTRB* is marginal tax rates based on income before interest is deducted. The coefficients are reported in terms of percentage. All regressions include year fixed effects. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. *T*-statistics (in parentheses) are computed using robust standard errors clustered at the firm level. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Regression 1

	Total comp/sale (1)	Cash comp/sale (2)	Equity-based comp/sale (3)	Total comp/sale (4)	Cash comp/sale (5)	Equity-based comp/sale (6)
Cash flow volatility	15.32***	3.288***	21.53***			
	(17.94)	(18.18)	(15.62)			
Unlevered stock return volatility				24.161***	3.553***	28.356***
				(29.12)	(19.11)	(25.10)
Firm size	-0.056***	-0.027***	-0.017***	-0.025***	-0.024***	0.008*
	(-19.26)	(-43.55)	(-3.45)	(-8.40)	(-36.27)	(1.76)
Market Leverage	-1.421***	-0.309***	-1.249***	-0.411***	-0.197***	0.355***
	(-21.63)	(-21.62)	(-11.83)	(-5.67)	(-12.05)	(2.93)
Market-to-book	0.008***	0.002***	0.001	0.015***	0.003***	0.015***
	(5.50)	(5.69)	(0.45)	(11.81)	(10.87)	(7.13)
One-year return to shareholders	-0.003***	0.001***	-0.003***	-0.001	0.001***	-0.001
	(-5.26)	(5.63)	(-4.03)	(-1.47)	(7.90)	(-1.10)
Age	-0.017***	0.001	-0.018**	0.009**	0.004***	-0.002
	(-2.80)	(0.61)	(-2.43)	(2.04)	(3.98)	(-0.39)
Chairman	-0.007	-0.002	-0.008	-0.014***	-0.004***	-0.009**
	(-1.42)	(-1.44)	(-1.27)	(-4.17)	(-4.47)	(-2.30)
Male	0.001	-0.001	-0.011	0.018	0.006*	0.034**
	(0.07)	(-0.25)	(-0.40)	(1.59)	(1.87)	(1.97)

Panel B. Regression 2

	Cash flow volatility			Unlevered stock return volatility		
	(1)	(2)	(3)	(4)	(5)	(6)

	(1)	(2)	(3)	(4)	(5)	(6)
Total comp/sale	0.035***			0.030***		
	(42.99)			(57.50)		
Cash comp/sale		0.145***			0.144***	
		(41.86)			(57.44)	
Equity-based comp/sale			0.033***			0.030***
			(32.05)			(39.53)
Industry median of risky investment	0.622***	0.689***	0.448***	0.362***	0.581***	0.234***
	(25.80)	(27.67)	(13.14)	(26.42)	(35.97)	(12.02)
Industry median of R&D/sale	-0.034***	-0.030***	-0.025***	-0.022***	-0.029***	-0.016***
	(-16.64)	(-16.25)	(-9.40)	(-16.67)	(-19.06)	(-7.72)
Firm size	0.001***	0.003***	0.000	0.000***	0.003***	-0.000***
	(11.80)	(22.45)	(0.17)	(3.25)	(25.40)	(-4.66)
Market Leverage	0.034***	0.028***	0.033***	0.009***	0.023***	-0.010***
	(14.79)	(12.69)	(10.00)	(5.21)	(12.17)	(-3.35)
Market-to-book	-0.000**	-0.000	0.000*	-0.000***	-0.000***	-0.000***
	(-2.30)	(-1.33)	(1.80)	(-13.44)	(-12.05)	(-7.44)
Age	0.000***	-0.000***	0.000***	0.000	-0.000***	0.000**
	(5.21)	(-7.71)	(4.12)	(1.16)	(-13.34)	(1.99)
CAPEX/sale	-0.002***	-0.002**	-0.003**	-0.004***	-0.007***	-0.004***
	(-2.83)	(-2.04)	(-2.47)	(-8.99)	(-11.59)	(-5.84)

Panel C. Regression 3

	Market leverage					
	(1)	(2)	(3)	(4)	(5)	(6)
Total comp/sale	0.222***			0.212***		
	(8.84)			(8.69)		
Cash comp/sale		-0.411***			-0.507***	
		(-5.23)			(-6.90)	
Equity-based comp/sale			0.278***			0.247***
			(8.85)			(8.10)
Industry median of market leverage	0.594***	0.422***	0.637***	0.603***	0.398***	0.668***
	(29.07)	(29.31)	(22.90)	(29.77)	(27.65)	(25.19)
Marginal tax rate	-0.063***	-0.135***	-0.019	-0.084***	-0.173***	-0.041*
	(-3.75)	(-10.61)	(-0.78)	(-5.08)	(-13.65)	(-1.83)

Firm size	0.007***	-0.019***	-0.001	0.007***	-0.021***	-0.002
	(4.06)	(-8.14)	(-0.71)	(3.94)	(-9.74)	(-1.16)
Market to book	-0.009***	-0.002***	-0.010***	-0.008***	-0.002***	-0.010***
	(-13.81)	(-5.13)	(-13.51)	(-13.79)	(-4.60)	(-13.01)
Cash	-0.460***	-0.191***	-0.510***	-0.438***	-0.174***	-0.452***
	(-17.23)	(-9.88)	(-14.29)	(-16.82)	(-9.59)	(-13.00)
CAPEX/sale	-0.096***	0.071***	-0.085***	-0.071***	0.082***	-0.024
	(-4.65)	(4.55)	(-3.07)	(-3.51)	(5.48)	(-0.92)
Number of observations	13,121	13,121	6,982	13,121	13,121	6,982

Table 6

Effects of Investment Risk on Average Employee Pay

The dependent variables are two proxies for average employee pay: staff expense per employee/sale and SGA (Selling, General and Administrative expense) per employee/sale. Regressions in Panel A include firm fixed effects and year fixed effects, regressions in Panel B include industry fixed effects and year fixed effects. We use cash flow volatility and unlevered stock return volatility as two proxies for risky investments. The coefficients are reported in terms of percentage. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. *T*-statistics (in parentheses) are computed using robust standard errors corrected for clustering of observations at the firm level. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Staff expense per employee/sale		SGA per employee/sale	
	(1)	(2)	(3)	(4)
Panel A. Firm-year fixed effects				
Cash flow volatility	0.096**		0.432***	
	(2.41)		(9.56)	
Unlevered stock return volatility		-0.009		0.449***
		(-0.12)		(6.71)
Firm size	-0.005***	-0.006***	-0.018***	-0.018***
	(-4.84)	(-4.80)	(-16.82)	(-15.96)
Market-to-book	0.003***	0.003***	0.014***	0.015***
	(3.20)	(3.61)	(17.30)	(18.18)
Market leverage	-0.026***	-0.027***	-0.104***	-0.092***
	(-3.85)	(-3.57)	(-16.80)	(-14.12)
Average sale per employee	0.000	0.000	-0.000***	-0.000***
	(0.34)	(0.29)	(-3.46)	(-3.28)
Fixed asset ratio	0.006	0.006	-0.014	-0.012
	(0.78)	(0.78)	(-1.48)	(-1.27)
ROA	-0.066***	-0.070***	-0.393***	-0.406***
	(-4.22)	(-4.37)	(-27.71)	(-28.84)
ROE	0.002	0.003	0.029***	0.028***
	(1.37)	(1.44)	(11.18)	(11.02)
Cash	0.035***	0.036***	0.133***	0.134***
	(3.35)	(3.43)	(17.24)	(17.38)
Firm age	0.000	0.000	0.005***	0.005***
	(0.06)	(0.03)	(3.55)	(3.62)
Year fixed effect	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
Adjusted R-squared	0.906	0.905	0.824	0.823
Number of observations	6,710	6,710	72,427	72,427
Panel B. Industry-year fixed effects				
Cash flow volatility	0.131**		0.732***	
	(2.00)		(15.12)	
Unlevered stock return volatility		0.215*		0.540***
		(1.66)		(6.92)
Firm size	-0.008***	-0.008***	-0.018***	-0.018***
	(-12.42)	(-11.49)	(-32.29)	(-29.83)

Market-to-book	0.007***	0.007***	0.018***	0.020***
	(5.23)	(5.23)	(21.47)	(23.51)
Market leverage	-0.049***	-0.044***	-0.134***	-0.127***
	(-6.22)	(-5.39)	(-22.03)	(-19.08)
Average sale per employee	0.000*	0.000*	-0.000*	-0.000
	(1.83)	(1.85)	(-1.95)	(-1.50)
Fixed asset ratio	0.020***	0.019***	0.020***	0.021***
	(3.64)	(3.54)	(3.44)	(3.62)
ROA	-0.169***	-0.168***	-0.584***	-0.608***
	(-9.22)	(-8.92)	(-42.69)	(-44.21)
ROE	0.007**	0.007**	0.043***	0.042***
	(2.47)	(2.47)	(15.47)	(15.01)
Cash	0.042***	0.043***	0.135***	0.134***
	(3.31)	(3.37)	(20.08)	(19.80)
Firm age	0.000	0.000	-0.000***	-0.000***
	(0.14)	(0.27)	(-3.71)	(-3.87)
High-tech dummy	-0.003	-0.003	0.001	-0.000
	(-0.64)	(-0.70)	(0.16)	(-0.09)
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
Adjusted R-squared	0.500	0.499	0.556	0.550
Number of observations	6,710	6,710	72,427	72,427

Table 7

System GMM Estimation of the Effects of Investments Riskiness on Average Employee Pay

The table reports the results of system GMM estimation of the effects of risky investments on average employee pay. The dependent variables are two proxies for average employee pay: staff expense per employee/sale and SGA (Selling, General and Administrative expense) per employee/sale. All control variables are considered to be endogenous with the exception of the year and industry dummy variables. We also include first lag of dependent variable in the dynamic GMM model. AR(1) and AR(2) are tests for first-order and second-order serial correlation in the first differenced residuals with the null hypothesis of no serial correlation. The null hypothesis of the Hansen test of overidentification is that all instruments are valid. The null hypothesis of the difference-in- Hansen test of exogeneity is that the instruments used for the equations in levels are exogenous. The coefficients are reported in terms of percentage. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. *T*-statistics (in parentheses) are computed using robust standard errors corrected for clustering of observations at the firm level. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Staff expense per employee/sale		SGA per employee/sale	
	(1)	(2)	(3)	(4)
Adjusted labor costs (one lag)	0.505***	0.584***	0.565***	0.423***
	(3.85)	(3.63)	(14.33)	(6.56)
Cash flow volatility	0.335***		0.619**	
	(2.59)		(2.24)	
Unlevered stock return volatility		0.240*		0.648**
		(1.91)		(2.18)
Firm size	-0.001	-0.004	0.008*	-0.005
	(-0.10)	(-1.49)	(1.69)	(-0.98)
Market-to-book	0.001	0.003	-0.017***	-0.006
	(0.31)	(1.64)	(-4.24)	(-1.04)
Market leverage	-0.012	0.005	-0.020	-0.027
	(-0.53)	(0.38)	(-0.73)	(-0.71)
Average sale per employee	0.000	0.000	-0.000	-0.000
	(0.82)	(0.71)	(-0.70)	(-1.01)
Fixed asset ratio	0.003	0.037	-0.037	-0.008
	(0.08)	(1.43)	(-0.57)	(-0.08)
ROA	-0.122*	-0.046*	-0.236***	-0.143***
	(-1.85)	(-1.66)	(-2.88)	(-2.67)
ROE	0.005	0.002	0.001	-0.000
	(0.28)	(0.53)	(0.09)	(-0.00)
Cash	0.003	0.022**	0.056	0.068
	(0.11)	(2.29)	(1.46)	(1.39)
Firm age	-0.000	-0.000	0.000	0.000
	(-0.34)	(-0.25)	(1.29)	(0.75)
High-tech dummy	-0.037	-0.075	-0.203	-0.830*
	(-0.13)	(-1.26)	(-1.01)	(-1.73)
AR(1) test (p-value)	0.010	0.018	0.000	0.000
AR(2) test (p-value)	0.922	0.488	0.115	0.192
Hansen J-statistic (p-value)	1.000	1.000	0.107	0.292
Diff-in-Hansen J-statistic (p-value)	1.000	1.000	0.155	0.883
Number of observations	5,642	5,642	62,748	62,748

Table 8

Subgroup analysis

The dependent variables are two proxies for average employee pay: staff expense per employee/sale (Panel A) and SGA (Selling, General and Administrative expense) per employee scaled by total sale (Panel B). In regressions 1-4, we compute the median values of staff expense per employee and SGA per employee by year, and separate the full sample into high pay (above-median) and low pay (below-median) groups using the median value of staff expense per employee and SGA per employee, respectively. In regressions 5-8, we separate full sample into high-tech firms and non-high-tech firms by high-tech dummy. Regressions include firm fixed effects and year fixed effects. The coefficients are reported in terms of percentage. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. *T*-statistics (in parentheses) are computed using robust standard errors corrected for clustering of observations at the firm level. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Low pay		**High pay**		**Non-high-tech firms**		**High-tech firms**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Dependent variable = Staff expense per employee/sale								
Cash flow volatility	0.125**		0.066		0.107**		0.100	
	(2.51)		(1.10)		(2.34)		(1.19)	
Unlevered stock return volatility		-0.006		-0.154		0.031		-0.074
		(-0.08)		(-0.94)		(0.42)		(0.32)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.883	0.881	0.934	0.934	0.904	0.903	0.913	0.912
Number of observations	3,544	3,544	3,166	3,166	5,471	5,471	1,239	1,239
Panel B. Dependent variable = SGA per employee/sale								
Cash flow volatility	0.166***		0.449***		0.473***		0.374***	
	(4.26)		(7.61)		(9.17)		(4.54)	
Unlevered stock return volatility		0.165***		0.498***		0.505***		0.400***
		(2.90)		(5.13)		(6.28)		(3.28)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.812	0.812	0.831	0.831	0.823	0.822	0.823	0.822
Number of observations	29,749	29,749	42,678	42,678	49,860	49,860	22,567	22,567

Table 9

Effect of Investment Risk Channels on CEO Compensation

We test four channels through which risky investments may affect CEO's total compensation. The channels we investigate are number of segments, R&D expenditures, advertising expenditures and total value of all acquisition deals in a year. The dependent variable is total compensation of CEO scaled by total sale. All regressions include firm fixed effects and year fixed effects. The coefficients are reported in in terms of percentage. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. *T*-statistics (in parentheses) are computed using robust standard errors corrected for clustering of observations at the firm level. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Total comp/sale			
	(1)	(2)	(3)	(4)
No. of segments	-0.022			
	(-1.26)			
No. of segments square	0.003			
	(1.19)			
R&D/sale		0.885***		
		(3.43)		
Advertisement/sale			1.582*	
			(1.80)	
Acq. amount/sale				0.101***
				(3.76)
Firm size	-0.028*	-0.014	-0.010	-0.024**
	(-1.76)	(-0.94)	(-0.68)	(-2.01)
Market Leverage	-0.482***	-0.450***	-0.370***	-0.410***
	(-6.31)	(-6.35)	(-4.48)	(-6.66)
Market-to-book	0.017***	0.016***	0.012***	0.014***
	(4.52)	(5.03)	(3.13)	(5.33)
One-year return to shareholders	-0.005	0.003	0.005	0.001
	(-0.43)	(0.27)	(0.38)	(0.09)
Age	-0.003***	-0.004***	-0.003***	-0.003***
	(-3.73)	(-3.83)	(-3.19)	(-4.37)
Chairman	0.028**	0.024**	0.030*	0.023**
	(2.31)	(2.12)	(1.95)	(2.50)
Male	-0.030	-0.005	-0.067	-0.038
	(-0.43)	(-0.09)	(-0.79)	(-0.86)
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.616	0.640	0.577	0.615
Number of observations	13,264	11,703	7,022	17,688

Table 10

Effects of Investment Risk Channels on Average Employee Pay

We test four channels through which risky investments may affect average employee pay. The channels we investigate are number of segments, R&D expenditures, advertising expenditures and total value of all acquisition deals in a year. The dependent variable in Panel A is staff expense per employee/sale, in Panel B is SGA per employee/sale. All regressions include firm fixed effects and year fixed effects. The coefficients are reported in terms of percentage. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. *T*-statistics (in parentheses) are computed using robust standard errors corrected for clustering of observations at the firm level. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Panel A. Dep. Var = Staff expense per employee/sale				
No. of segments	-0.004*			
	(-1.87)			
No. of segments square	0.0005*			
	(1.87)			
R&D/sale		0.0003***		
		(59.16)		
Advertisement/sale			0.081	
			(1.15)	
Acq. amount/sale				-0.002
				(-0.75)
Firm size	-0.008***	-0.006***	-0.006***	-0.006***
	(-4.73)	(-5.01)	(-4.06)	(-4.89)
Market-to-book	0.003***	0.003***	0.003**	0.003***
	(3.36)	(3.68)	(2.48)	(3.66)
Market leverage	-0.037***	-0.026***	-0.023**	-0.027***
	(-4.02)	(-4.00)	(-2.45)	(-3.90)
Average sale per employee	-0.000	0.000	0.000	0.000
	(-0.66)	(1.07)	(1.25)	(0.27)
Fixed asset ratio	0.013	0.007	0.005	0.006
	(1.21)	(0.92)	(0.43)	(0.79)
ROA	-0.075***	-0.068***	-0.071***	-0.070***
	(-3.82)	(-4.33)	(-2.87)	(-4.40)
ROE	0.003	0.003	0.004*	0.003
	(1.12)	(1.44)	(1.70)	(1.44)
Cash	0.044***	0.036***	0.029**	0.036***
	(3.11)	(3.40)	(2.34)	(3.43)
Firm age	0.000	0.001	0.000	0.000
	(0.17)	(0.46)	(0.10)	(0.04)
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.896	0.910	0.908	0.905
Number of observations	4,580	6,710	2,975	6,710
Panel B. Dep. Var = SGA per employee/sale				

No. of segments	-0.012***			
	(-5.12)			
No. of segments square	0.002***			
	(5.07)			
R&D/sale		0.001***		
		(4.32)		
Advertisement/sale			0.659***	
			(7.93)	
Acquisition amount/sale				0.017***
				(4.86)
Firm size	-0.020***	-0.019***	-0.020***	-0.019***
	(-17.28)	(-17.58)	(-12.50)	(-17.44)
Market-to-book	0.015***	0.015***	0.015***	0.015***
	(18.69)	(19.18)	(12.16)	(18.76)
Market leverage	-0.115***	-0.109***	-0.104***	-0.108***
	(-17.84)	(-17.54)	(-12.31)	(-17.38)
Average sale per employee	-0.000***	-0.000***	-0.000	-0.000***
	(-4.07)	(-3.01)	(-0.17)	(-3.08)
Fixed asset ratio	-0.007	-0.013	0.018	-0.013
	(-0.69)	(-1.28)	(1.36)	(-1.33)
ROA	-0.408***	-0.414***	-0.356***	-0.415***
	(-27.54)	(-29.30)	(-18.27)	(-29.30)
ROE	0.030***	0.029***	0.028***	0.029***
	(10.36)	(11.36)	(8.06)	(11.38)
Cash	0.140***	0.135***	0.133***	0.132***
	(17.72)	(17.39)	(13.58)	(17.02)
Firm age	0.004**	0.005***	0.005*	0.005***
	(2.57)	(3.69)	(1.94)	(3.60)
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.828	0.823	0.855	0.823
Number of observations	61,042	72,427	32,516	72,427