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Human capital cost and investment policy

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Abstract

In this paper, we examine the link between human capital cost and investment policy. We find a significantly positive relationship between investment risk and the cost of human capital measured by average employee pay, especially when employees have strong bargaining power. We further investigate various channels through which investment risk influences human capital cost and find strong empirical support that these channels are important drivers. Our results suggest that a higher human capital cost associated with an increase in investment risk discourages firms from making valuable but risky investments in the future, leading to a potential problem of underinvestment.

KEYWORDS

firm risk, human capital, human capital cost, investment policy

JEL CLASSIFICATION

E24; G31; G32; J24

1 | INTRODUCTION

An aggressive investment policy is often associated with high business risk: if successful, it benefits the firm in the long run; if not, it may hasten business failure. The literature identifies one of the causes of corporate failure, as summarized in Argenti (1976), as insufficient consideration of research and development (R&D) costs. Dambolena and Khoury (1980) show that firms with a substantial degree of instability, measured by the standard deviation of financial ratios, have a higher likelihood of bankruptcy than those with a low degree of instability. For bankrupt firms, the degree of instability increased significantly over the period leading up to corporate failure.[1] When large investments fail, the firm faces a high possibility of operating losses, which ultimately leads to cessation of operations. Thus, investment risk is undeniably one of the most important determinants of business failure.

At the same time, the literature on labor economics (e.g., Clark, Georgellis, & Sanfey, 2001; Clark & Oswald, 1994) shows that employees' fear of job loss is a major concern, regardless of whether a replacement job is obtainable. The more aggressive a firm's investment policy is, the riskier the firm, and hence the higher the risk of the human capital loss borne by employees. The labor market literature also shows that employees can gain bargaining power against their employers with outside job opportunities (Campbell, Ganco, Franco, & Agarwal, 2012; Lewis & Yao, 2001; Smith, 2006) and in the presence of labor unions (Hendricks, 1994). With bargaining power, rational employees may be able to demand a higher wage to compensate for the risk of human capital loss associated with corporate investment policies. More specifically, more aggressive investment activities may be linked to higher human capital costs. This conjecture has important implications for firms. If human capital costs increase as the risk of an investment project increases, the expected future cash flows decrease, assuming that the initial cash outlay remains relatively flat. This leads to a drop in the net present value (NPV) even if the cost of capital does not rise as a result of an increase in project risk. Moreover, if human capital costs increase significantly, firms may have strong incentives to forgo risky projects. Our paper provides an additional explanation of the problem of underinvestment, apart from agency theory. In the next section, we illustrate this line of motivation using a simple theoretical framework.

The labor economics literature has long established that workers require firms to provide a premium in wages or benefits to compensate for potential job losses (e.g., Abowd & Ashenfelter, 1981; Topel, 1984). However, the relationship between human capital and corporate policy is explored little in the corporate finance literature. One stream of literature links human capital to a firm's financing policy (e.g., Berk, Stanton, & Zechner, 2010; Chemmanur, Cheng, & Zhang, 2013). Berk et al. (2010) argue that employees at a levered firm are entrenched in an optimal labor contract and therefore face a high human capital cost from bankruptcy.[2] Chemmanur et al. (2013) find empirical support for the predictions of Berk et al. (2010) and document that wages have significant explanatory power for firm leverage. Agrawal and Matsa (2013) add to this line of research by arguing that firms choose conservative financial policies to mitigate workers' exposure to unemployment risk. They find that higher unemployment benefits (i.e., lower unemployment risk) lead to higher corporate leverage. Lee, Mauer, and Xu (2018) link human capital to major corporate events by examining whether human capital relatedness plays a role in mergers and acquisitions. They find that the likelihood of a merger, merger returns, and post-merger performance are higher when the acquirer and the target have a higher degree of human capital relatedness. They indicate that this finding is driven by a reduction in human capital costs, as low-quality and/or duplicate employees can be dismissed as a result of a merger.

Another line of research has examined the relationship between CEO compensation and corporate investment policy, proxied mainly by R&D expenditure. For example, Clinch (1991), Smith and Watts (1992), Baber, Janakiraman, and Kang (1996), Gaver and Gaver (1998), Ryan and Wiggins (2002), and Coles, Daniel, and Naveen (2006) find a positive relationship between proxies for investment opportunity and compensation tied to stock performance. In contrast, Bizjak, Brickley, and Coles (1993), Yermack (1995) and Lev and Sougiannis (1996) find a negative relationship between investment policy and the total or cash compensation of CEOs. Matsunaga (1995) finds no significant association between R&D expenditure and the value of employee stock options granted. Cheng (2004) suggests a possible reason for the mixed findings: it is unclear whether corporate boards design compensation packages to motivate aggressive R&D expenditure because of concern over possible overinvestment.

However, few studies have focused on the relationship between average employee pay and investment policy. Among them, Clinch (1991) collects a sample of pay for average and key employees, focusing his analysis on key employees, whom he defines as top officers in high-level management or administrative positions, such as the chairman of the board or the chief operating officer.[3] He finds an empirical relationship between compensation for key employees and a firm's R&D activities. He argues that it is difficult to interpret this finding based on the well-known determinants of compensation practices, including motivation-based concerns (moral hazard), information-based concerns (adverse selection), and tax issues. He conjectures that, particularly at large companies, nonexecutive employees may have little involvement in a firm's investment decisions. Thus, it is unclear how to interpret a link between risky investment (e.g., R&D expenditure) and the characteristics of compensation packages for key employees.

Unlike Clinch (1991), this paper focuses on average employees working at a firm. We provide a novel explanation from the perspective of human capital costs for Clinch (1991)'s finding of an indirect link between nonexecutive employee compensation and R&D policy. We argue that the positive relationship between investment risk and employee compensation is driven by the inability of employees to ensure their human capital and bargaining power against their employer: under-diversified employees with strong bargaining power can demand a premium (therefore, higher pay) to compensate for potential job loss due to risky investment. Consistent with this conjecture, our empirical findings support a positive effect of investment risk on average employee pay.

Our results indicate that human capital cost is significantly positive in relation to the level of investment risk measured by cash-flow volatility and unlevered stock return volatility. We further examine the positive relation by conditioning it on employees' bargaining power against their employers. By analyzing subsamples of industrial firms with high and low labor union participation, we reveal that employees' bargaining power accentuates the positive relationship between average employee pay and investment risk. In particular, the coefficient on the proxy for investment risk is positive and significant in three of the four models in the sample with high union participation. Conversely, the effect of investment risk on employee pay is significant in the model with low union participation. Using the adoption of the North American Free Trade Agreement (NAFTA) as an exogenous shock to the availability of employment opportunities, we find further support for our hypothesis. More specifically, we observe a negative and significant coefficient on the interaction term of investment risk and the NAFTA dummy variable for all industries, the manufacturing subsample, and the nonmanufacturing subsamples respectively. This is consistent with our prediction that a lower number of employment opportunities weakens the impact of investment risk on human capital costs. Moreover, we investigate four possible channels through which risky investment affects human capital cost: corporate diversification, R&D expenditure, advertising expenditure, and acquisition activity. As diversification reduces the total firm risk, we find that firms with a larger number of business segments, entropy index, or geographic segment dispersion are associated with lower human capital costs. However, the literature suggests that R&D expenditure, advertising expenditure, and acquisitions are considered major drivers of investment risk. We observe a positive relationship between each of the three channels and a firm's human capital cost, which is consistent with our hypotheses. Lastly, we complete the loop by providing evidence on the feedback effect of human capital costs on a firm's investment policy. Labor-intensive firms have a high ratio of labor and pension expenses to total assets, reflecting a heavy burden from human capital costs. Compared to firms that are less labor intensive, labor-intensive companies face greater aggregate labor costs when investment risk increases. Therefore, we expect that labor intensity may lead to a downward adjustment in future risky investment to avoid incurring a large increase in human capital cost. We show that labor-intensive firms have significantly less risky future investment than nonlabor-intensive firms.

We perform various tests to address the potential concerns about endogeneity. Our baseline regressions include the firm-year fixed effect to control for possible firm-specific and time-invariant biases. One of the main endogeneity concerns is whether the results are driven by employee skills or talent. For example, firms hire talented employees to manage creative projects, which are generally associated with greater risk than less-creative projects. Thus, the relationship between investment risk and human capital costs may reflect the link between investment risk and employee talent or skills. To address this concern, we identify skill and pay levels as proxies for employee skills and divide the sample into subsamples by these proxies respectively. Nonadvanced-skills and low-pay firms are used to represent firms with unskilled workers. We find a positive and significant relationship between investment risk and human capital costs, regardless of employee skills. In particular, the link remains strong and consistent at the nonadvanced-skills and low-pay firms. Our finding alleviates the concern that our main results are driven by employee skills.

Furthermore, we identify other possible endogeneity concerns: reverse causality, omitted variables, and simultaneity. First, average employees may not have direct control over their employer's investment policy, however, firms may have incentives to adjust their investment policy out of consideration for labor costs. This could lead to reverse causality. Second, Berk et al. (2010) and Chemmanur et al. (2013) show that leverage is an influential factor in employee compensation, and numerous studies suggest strong interactions between the capital structure and investment policies (Childs, Mauer, & Ott, 2005; Mauer & Sarkar, 2005; Smith & Watts, 1992). For example, Chemmanur et al. (2013) find that leverage is positively related to labor costs because employees demand to be compensated for the risk of job loss due to the financial risk associated with leverage. Therefore, it is necessary to account for the endogenous link between employee compensation and leverage and for the fact that employee pay and the investment policy are determined simultaneously. We use system-generalized method of moments (GMM) to address concerns about reverse causality, omitted variables, and the simultaneous determination of investment risk, employee compensation, and firm leverage.

We make the following contributions to the literature. First, our study contributes to the nascent but growing literature on the link between human capital and corporate policies by showing that a firm's investment decisions have a positive and strong impact on human capital costs. Our results also provide further understanding of the determinants of employee wages. Second, we offer a novel explanation for underinvestment problems in addition to the implications offered by agency theory. We find that investment risk, as measured by cash-flow volatility and unlevered stock return volatility, has a significantly positive impact on human capital cost, measured by average employee pay. This main finding suggests that employees with strong bargaining power can demand higher pay to compensate for the potential human capital loss associated with their employer's investment risk. Consequently, managers may pass on positive NPV projects if the incremental labor cost is large enough to offset the NPV of the investment.[4]

The rest of the paper is organized as follows. Section 2 describes the theoretical setting that motivates our study and the associated testable hypotheses. Section 3 discusses our variable construction, data collection, and descriptive statistics of the sample. Section 4 presents our empirical results and various robustness tests to address concerns about endogeneity. In Section 5, we show results from an exploration of channels through which investment risk affects employee pay. Section 6 presents the results of the feedback effect of labor intensity on a firm's investment policy. We conclude in Section 7.

2 | THE CONCEPTUAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

2.1 | The conceptual framework

In a setting in which employees cannot ensure their own human capital, Berk et al. (2010) endogenously derive managerial entrenchment as an optimal response to labor market competition. Their model predicts an inverse relationship between entrenchment and leverage, providing 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 closing of operations. Certain variables, such as credit ratings, provide a link between firm characteristics and the probability of bankruptcy or closing, conveying important information to employees.

Unlike Berk et al. (2010), we focus on the risk arising from a firm's expenditure on risky investment, rather than assuming that a firm earns a risk-free return on all invested capital.[5] We posit that a firm may offer higher wages to employees as compensation for additional investment risk, in particular, with presence of labor unions or when employee can find a replacement job quickly. By incorporating employee bargaining power, the framework allows an imperfectly competitive market for labor, in which employees can extract varying levels of above-market rents from the firm.[6] Another potentially influential factor considered in the framework is industry-specific business risk. Some businesses, such as financial services and construction, can be affected more by economic shocks than others. Employees' concerns about job loss in those businesses reduce the labor supply and affect firms' policies on setting wages, even when they are far from bankruptcy. Following Harris and Holmstrom (1982) and Berk et al. (2010), we present a simple conceptual framework to motivate a potentially positive relationship between expenditures on risky investment and labor cost. This positive relationship is expected to be strengthened by strong employees' bargaining power and high business risk.

Assume the exogenous market wage for an employee is W_R. If a firm invests only in risk-free investment, then the equilibrium wage, W^*, must satisfy the condition:

$$W^* = b(\beta) W_R \tag{1}$$

where parameter $\beta \in (0,1)$ represents the extent of employee bargaining power and $b'(\beta) > 0$.[7]

Consider a firm that makes risky investments, denoted I, and assume the probability of failure (i.e., complete shutdown) is $P(c,I) = cP(I)$, where parameter $c \in (0,1]$ is a constant that represents the product price sensitivity to an unexpected shock in the demand market, $P'(I) > 0$ and $P(0) = 0$. The equilibrium wage under these conditions must satisfy the condition:

$$E\left[\tilde{W}\right] = P(0) + (1-P) W^{**} = b(\beta) W_R \tag{2}$$

Or

$$W^{**} = \frac{b(\beta) W_R}{1-P} \tag{3}$$

Using $P = P(c,I)$, we calculate that

$$\frac{\partial W^{**}}{\partial I} = \frac{cb(\beta) W_R P'(I)}{(1-P(c,I))^2} > 0 \tag{4}$$

The equilibrium wage increases with expenditure on risky investments. Thus, the labor cost is higher at a firm with risky investments. Further, we calculate that

$$\frac{\partial W^{**}}{\partial I \partial \beta} = \frac{cb'(\beta) W_R P'(I)}{(1-P(c,I))^2} > 0 \tag{5}$$

and

$$\frac{\partial W^{**}}{\partial I \partial c} = \frac{b(\beta) W_R P'(I) + 2(1-P(c,I)) P(I)}{(1-P(c,I))^4} > 0 \tag{6}$$

The strength of the positive relationship between the equilibrium wage and risky investment expenditures increases with employee bargaining power and product price sensitivity to changes in demand.

The critical assumption in this framework is that employees have firm-specific human capital that is not easily transferable to another firm. This means that when an employee loses her job and returns to the job market, she would not be compensated at a comparable level at another firm or would bear considerable expenses for retraining to meet the needs of another employer, even if the new employer is willing to pay a similar wage. In other words, labor market friction exists and the aforementioned costs (i.e., lower pay or the cost of retraining) are borne by the employee, who will not be able to find the same job without bearing these nontrivial costs. When a firm invests in risky projects, it increases the risk borne by the firm. As a result, the potential loss of human capital prompts employees to demand higher compensation. Importantly, we assume that each firm faces switching costs (e.g., unionization, unique human capital, and training costs), and those costs generate bargaining power for employees. When a firm has zero outside options, if it invests in risky projects, it could be expected to compensate its employees with higher wages in order to reduce potential switching costs. In our framework, a sector's resilience to shocks is considered a determinant of the relationship between wages and investment risk. Higher-risk businesses, such as those involved in alcohol, construction, and financial services, might be more sensitive to market shocks and/or regulatory reforms than other businesses. The under-diversified nature of those businesses might further increase employee concerns about becoming unemployed due to investment failure, therefore, workers demand higher pay. The firm, in turn, may have to adopt a more conservative investment policy because of the incremental labor cost associated with risky investment. This theoretical framework is the basis for our hypotheses.

2.2 | Hypothesis development

As discussed earlier, employees may demand a higher wage to compensate for potential job loss due to risk taken by their employer. In other words, greater investment risk is likely to lead to higher human capital costs. Based on this theoretical prediction, discussed above, we posit the following hypothesis:

Hypothesis 1 *Average employee pay increases with investment risk.*

To explore the positive relationship between average employee pay and investment risk, we identify a possible factor that strengthens the relationship: employee bargaining power. Employee bargaining power against an employer plays an important role in determining the relationship between employee pay and a firm's investment risk. The labor market literature examines employees' bargaining power against their employers. For example, Lewis and Yao (2001) study how contract openness, with corresponding impacts on worker mobility, varies according to the market environment. They find that an engineer's power to bargain for the openness provisions depend on his outside options and ability to find employment with another firm. Smith (2006) points out that workers' power over where to sell their labor services is crucial to the concept of work effort, which can be viewed as mobility power. Individuals or work groups can use the threat of leaving to bargain with their employer regarding various aspects of their work, such as raises, department/division transfers, and training resources. Hendricks (1994) finds that, before deregulation, unions in the trucking, railroad, airline, and telecommunications industries could negotiate members' wages that were at least 14% higher than the wages received by nonunionized workers.

When employees have more bargaining power—for instance, as a member of a labor union or by having more outside employment opportunities—they are in a more favorable position when negotiating with their employer. If a firm makes riskier investments, employees demand a higher wage to compensate for the additional risk. If the employer does not conform or comply, employees may leave to find another job with a pay level consistent with that of the level of firm risk or initiate a strike by union members, conditioned on the existence of a union. In either case, the firm incurs significant labor costs. By contrast, when employees have little or no bargaining power, the effect of firm risk on employee pay is limited because employees may hesitate to leave their current job even if they face a higher risk of potential job losses when the employer makes riskier investments. We formalize this discussion with the following testable hypothesis:

Hypothesis 2 *The strength of the positive relationship between average employee pay and investment risk is enhanced by employee bargaining power.*

We examine the channels through which investment risk affects the cost of human capital. Lewellen (1971) argues that a more diversified enterprise enhances lenders' operational stability and increases aggregate debt capacity. He attributes this additional debt capacity to a co-insurance effect, in which a diversified firm's segment cash flows that are not perfectly correlated with one another reduce the overall variance in the firm's cash flows. Subsequent researchers, such as Berger and Ofek (1995) and Kuppuswamy and Villalonga (2016), find that a diversified firm has higher leverage than a comparable portfolio of standalone firms. We follow the literature in arguing that diversification can be used to measure a firm's investment risk. In particular, the less diversified a firm is, the riskier its investments are. We use the number of business segments, the entropy index, and geographic segment dispersion as proxies for the degree of diversification. R&D expenditure is long established in the literature as a popular measure for risky investment (e.g., Baber et al., 1996; Clinch, 1991; Gaver & Gaver, 1998; Ryan & Wiggins, 2002; Smith & Watts, 1992). Harris and Raviv (1991) argue that R&D expenditure and advertising expenses can be used to measure the extent to which assets are intangible. Miller and Bromiley (1990) develop a taxonomy of strategic risk that deals with the level of investment in physical assets and intangible resources that accrue from R&D and advertising expenditure. Following the literature, we adopt R&D and advertising expenditure as additional channels of investment risk. Lastly, we use the total acquisition amount in a year as another channel or source of investment risk. Lubatkin and O'Neill (1987) study how mergers influence capital market risk and find that all types of mergers are associated with a significant increase in nonsystematic 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 a higher level of personal wealth vested in the firm's equity. In summary, we use corporate diversification, R&D expenditure, advertising expenditure, and the acquisition amount as possible channels through which risky investment affects human capital cost. As diversification reduces investment risk while the other three contribute to investment risk, we formulate our last hypothesis as follows:

Hypothesis 3 *A smaller number of business segments, the entropy index, or geographic segment dispersion, greater R&D expenditure, higher advertising expenditure, or more acquisition activities increase a firm's investment risk and therefore the human capital cost.*

3 | MAIN VARIABLES, SAMPLE CONSTRUCTION, AND DESCRIPTIVE STATISTICS

3.1 | Main variables

Our measures of investment risk are outcome measures and are not policy related: cash-flow volatility for operational risk and unlevered stock return volatility for asset risk. Cash-flow volatility and stock return volatility are two commonly used measures of investment-related firm risk. Ryan and Wiggins (2001) argue that firms with risky investments or volatile operating cash flows use incentive compensation with a nonlinear payoff to limit a manager's downside risk. They find that high-R&D firms have cash-flow volatility of 0.50, compared with 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. Coles et al. (2006) study managerial incentives and risk taking. They use stock return volatility as a proxy for firm risk. In addition, the literature finds that cash-flow volatility is closely related to stock return volatility (e.g., Campbell, Lettau, Malkiel, & Xu, 2001; Huang, 2009; Irvine & Pontiff, 2009). Following Kuppuswamy and Villalonga (2016), we calculate cash-flow volatility as the standard deviation of the ratio of operating income after depreciation to assets over the previous eight quarters.[8] We adopt the empirical methodology used by Childs et al. (2005) and Schwert and Strebulaev (2014) to estimate unlevered stock return volatility.[9] Volatility is based on the daily stock returns in the prior two years.

We use average employee pay to measure the cost of human capital.[10] Following Chemmanur et al. (2013), we use data from Compustat to construct two measures of average employee pay: the first is staff expenses divided by the number of employees, and the second is sales, general, and administrative expenses (SGA) divided by the number of employees: 69.4% of the Compustat firm-year observations from 1950 to 2015 have a valid SGA (332,886 of 479,448 observations), while 18.2% (87,216 of 479,448 observations) have nonmissing values for staff expenses. It is important to note that staff expenses are highly correlated with SGA and have a correlation coefficient of 0.83.

Based on information from the Compustat Business Segment data files, we calculate the number of segments with different four-digit Standard Industrial Classification (SIC) codes, entropy index, and geographic segment dispersion to measure the level of corporate diversification. The entropy index is calculated as $\sum_{i=1}^{n} S_i \ln\left(1/S_i\right) = -\sum_{i=1}^{n} S_i \ln\left(S_i\right)$, where n is the number of segments and S_i is the ratio of segment i sales to total firm sales. A higher entropy index indicates greater diversification, and lower values indicate more concentration. Single-segment firms have an entropy index of zero. The geographic segment type equals 1 if the segment is domestic and 2 if the segment is nondomestic or totally foreign.[11] We define geographic segment dispersion as the average of the geographic segment types within a firm. Higher geographic segment dispersion indicates greater diversification. We define a firm's acquisition activity as the ratio of the total value of acquisitions in a year to total assets. Variable definitions are specified in detail in Appendix A.

3.2 | Sample construction

Starting with all Compustat firms, we exclude financial and utility companies and firms with less than a hundred employees. Firm-year observations with a nonpositive book value of equity are excluded. We then require nonmissing information on

TABLE 1 Descriptive statistics

	N	Mean	*SD*	Min	Median	Max
Staff expense per employee (in $ thousands)	6,710	34.403	19.593	1.553	34.737	93.166
Staff expense per employee	6,710	0.0002	0.0004	0.000	0.0002	0.003
SGA per employee (in $ thousands)	72,427	51.134	45.172	1.849	36.302	236.586
SGA per employee	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
Entropy index	61,042	0.217	0.409	0	0	2.238
Geographic segment dispersion	22,764	1.255	0.436	1	1	2
CAPEX	71,771	0.065	0.085	0.003	0.040	0.589
R&D	72,427	0.126	4.933	0.000	0.026	976.500
Advertisement	32,516	0.031	0.042	0.000	0.016	0.256
Acquisition	72,427	0.037	0.167	0.000	0.000	1.285
Sales (in $ millions)	72,427	2,308.940	7,318.930	6.232	215.886	53,674.000
Advanced skills dummy	72,427	0.312				
Average sales per employee (in $ thousands)	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-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
Market capitalization	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 in thousands	72,427	10.250	25.064	0.107	1.520	165.000
Labor union (%)	62,334	9.962	8.242	0.000	8.100	73.600

Note: We report descriptive statistics for the average employee sample. We require firm-years in the Compustat database that have cash-flow volatility, unlevered stock return volatility, SGA (selling, general, and administrative expenses), and firm-level data. The full employee sample covers the period from 1976 to 2015. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. All variables are defined in Appendix A.

investment risk measures, SGA, staff expenses, and other firm characteristics, including market capitalization, market to book, market leverage, average sales per employee, the fixed asset ratio, ROA, ROE, cash, and firm age. We collect information on company segments from the Compustat Business Segment data files. Information on acquisitions is obtained from the mergers and acquisitions database at SDC platinum. All dollar amounts are adjusted to 1992 constant dollars using the consumer price index (CPI) reported by the Bureau of Labor Statistics. Industry classifications are based on the Fama-French 49-industry classification. Our final sample contains 72,427 firm-year observations (of which 6,710 firm-year observations have staff expenses) from 1976 to 2015.[12] A closer look at the industry distributions of the two samples shows that both samples are fairly evenly distributed, with R&D-intensive industries (advanced skills) and labor-intensive industries (nonadvanced skills). Overall, the two samples have similar distributions. The industry distribution in the Fama-French 12 Industry Portfolio is shown in detail in Appendix B.

3.3 | Descriptive statistics

Table 1 presents the descriptive statistics of the variables used in our baseline regressions. The mean is $34,403 for staff expenses and $51,134 for SGA. The standard deviations of cash-flow volatility and unlevered stock return volatility are relatively high (0.022 and 0.017, respectively) compared with their means (0.020 and 0.030). The fixed asset ratio is calculated as the gross property, plant, and equipment scaled by total assets, and the sample mean is 24.9%. The number of segments, the entropy

TABLE 2 Correlations matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Staff expense per employee	1									
(2) SGA per employee	0.7584***	1								
(3) Cash-flow volatility	0.3292***	0.4395***	1							
(4) Unlevered stock return volatility	0.4464***	0.4681***	0.4380***	1						
(5) No. of segments	−0.1994***	−0.1964***	−0.1768***	−0.2727***	1					
(6) Entropy index	−0.2114***	−0.2066***	−0.1908***	−0.2844***	0.9132***	1				
(7) Geographic segment dispersion	−0.0166	−0.0240***	−0.0342***	0.0290***	0.0333***	0.0362***	1			
(8) R&D	0.0867***	0.0773***	0.0237***	0.0148***	−0.0101**	−0.0105***	0.007	1		
(9) Advertisement	0.1311***	0.2071***	0.2207***	0.0976***	−0.0272***	−0.0266***	−0.0019	0.1354***	1	
(10) Acquisition	0.0231*	0.0823***	0.0551***	0.0901***	−0.0439***	−0.0455***	0.0292***	0.002	0.0645***	1

Note: We report Pearson correlation coefficients between human capital cost and proxies for investment risk. We require firm-years to be in 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 the period from 1976 to 2015. ***, **, and * indicates significance at the 1%, 5%, and 10% levels respectively.

TABLE 3 Effects of investment risk on average employee pay

	Staff expense per employee		SGA per employee	
	(1)	(2)	(3)	(4)
Cash-flow volatility	0.959**		4.318***	
	(2.41)		(9.56)	
Unlevered stock return volatility		−0.092		4.493***
		(−0.12)		(6.71)
Market capitalization	−0.054***	−0.057***	−0.182***	−0.176***
	(−4.84)	(−4.80)	(−16.82)	(−15.96)
Market-to-book	0.028***	0.032***	0.140***	0.149***
	(3.20)	(3.61)	(17.30)	(18.18)
Market leverage	−0.264***	−0.274***	−1.040***	−0.920***
	(−3.85)	(−3.57)	(−16.80)	(−14.12)
Average sales per employee	0.020	0.017	−0.515***	−0.488***
	(0.34)	(0.29)	(−3.46)	(−3.28)
Fixed asset ratio	0.060	0.061	−0.145	−0.124
	(0.78)	(0.78)	(−1.48)	(−1.27)
ROA	−0.660***	−0.704***	−3.931***	−4.061***
	(−4.22)	(−4.37)	(−27.71)	(−28.84)
ROE	0.024	0.026	0.289***	0.284***
	(1.37)	(1.44)	(11.18)	(11.02)
Cash	0.348***	0.359***	1.332***	1.344***
	(3.35)	(3.43)	(17.24)	(17.38)
Firm age	0.001	0.0005	0.048***	0.049***
	(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

Note: The dependent variables are two proxies for average employee pay: staff expense per employee and SGA per employee. We use cash-flow volatility and unlevered stock return volatility as two proxies for investment risk. 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. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

index, geographic segment dispersion, R&D expenditure, advertising expenditure, and total acquisition amount are variables of interest in channel testing. On average, a sample firm has about 1.5 segments, an entropy index of 0.2, and geographic segment dispersion of 1.3. We report the scaled values by total sales for the other three channels for risky investments: 0.126, 0.031, and 0.037 for R&D expenditure, advertisement expenditure, and acquisitions, respectively.

Table 2 reports the pairwise correlations for all variables of interest. We see that the average employee pay variables are positively correlated with the risky investment measures, providing preliminary evidence of a positive relationship between human capital costs and investment risk. We also find that the average employee pay variables are negatively correlated with the number of segments (corporate diversification) but are positively correlated with R&D expenditure, advertising expenditure, and the acquisition amount.

4 | EMPIRICAL TESTS ON THE LINK BETWEEN INVESTMENT RISKINESS AND AVERAGE EMPLOYEE PAY

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

TABLE 4 Bargaining power subsample analysis

	Top quintile union coverage		Bottom quintile union coverage	
	(1)	**(2)**	**(3)**	**(4)**
Dependent variable = Staff expense per employee				
Cash-flow volatility	0.587		1.147	
	(1.52)		(1.08)	
Unlevered stock return volatility		3.284***		−1.310
		(3.44)		(−0.91)
Controls	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.570	0.576	0.561	0.570
Number of observations	2,079	2,079	1,170	1,170
Dependent variable = SGA per employee				
Cash-flow volatility	7.014***		6.829***	
	(6.35)		(7.02)	
Unlevered stock return volatility		7.016***		1.954
		(4.97)		(1.07)
Controls	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Adjusted *R*-squared	0.530	0.524	0.565	0.530
Number of observations	21,020	21,020	12,552	12,552

Note: The dependent variables are two proxies for average employee pay: staff expense per employee and SGA per employee. Columns (1) and (2) report results for firms with labor union coverage in the bottom quintile of the sample in a year. Columns (3) and (4) report results for firms with labor union coverage in the top quintile of the sample in a year. Regressions include all control variables, firm-fixed effects, and year-fixed effects. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. *T*-statistics (in parentheses) are calculated using robust standard errors corrected for clustering of observations at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

4.1 | Baseline Regressions

To estimate the effect of investment risk on average employee pay, we estimate the following baseline regression model:

$$EmployeePay_{it} = \delta_0 + \delta_1 InvestmentRisk_{it} + \delta_2 MktCap_{it} + \delta_3 MtB_{it} + \delta_4 MktLev_{it} + \delta_5 AvgSale_{it} + \delta_6 PPE_{it} + \delta_7 ROA_{it} + \delta_8 ROE_{it} + \delta_9 Cash_{it} + \delta_{10} FirmAge_{it} + \varepsilon_{it} \tag{7}$$

where $InvestmentRisk_{it}$ measures volatility, i.e., cash-flow volatility or unlevered stock return volatility, $MktCap_{it}$ is the logarithm of market capitalization., MtB_{it} is the market-to-book ratio, $MktLev_{it}$ is market leverage calculated as total debt divided by the market value of assets, $AvgSale_{it}$ is average sales per employee, PPE_{it} is the fixed asset ratio, ROA_{it} and ROE_{it} are the return on assets and return on equity, respectively, $Cash_{it}$ is the ratio of cash and marketable securities to the book value of assets, and $FirmAge_{it}$ is the number of years from the first year recorded in Compustat to year t.

Regression results are presented in Table 3. Models 1 and 2 report the results for which staff expense is used as a proxy for average employee pay, and Models 3 and 4 present the results for which SGA serves as a proxy. We find that cash-flow volatility has a significant and positive impact on average employee pay. The coefficient on unlevered stock return volatility is significant and positive when SGA is used as a proxy for average employee pay. The results are generally consistent with H1. A 10% increase in cash-flow volatility results in an increase of 1.407% in average employee pay, measured by staff expenses.[13] For a typical sample firm with an average firm value of $2,308.94 million (measured by total sales) and 10,250 employees, this increase in cash-flow volatility is associated with a $333 million increase in human capital costs, or an increase of about $32,476 per employee. The economic impact is too large to ignore.[14]

TABLE 5 Natural experiment: the influence of NAFTA on the human capital/investment risk relation

	Dep. Var. = Staff expense per employee					
	All industries	**All industry**	**Mfg. industries**		**Non-mfg. industries**	
Panel A	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Cash-flow volatility	2.756***		2.168**		3.532*	
	(3.21)		(2.61)		(1.93)	
Cash-flow vol. × NAFTA	**−2.278****		**−2.088**		**−2.409**	
	(−2.05)		**(−1.47)**		**(−1.27)**	
Unl. stock return vol.		9.442***		6.087***		13.06***
		(5.45)		(3.05)		(4.57)
Unl. stock return vol. × NAFTA		**−8.890*****		**−3.292**		**−14.570*****
		(−3.35)		**(−1.01)**		**(−3.42)**
NAFTA	−0.107*	−0.0294	−0.018	−0.036	−0.246**	−0.029
	(−1.77)	(−0.58)	(−0.29)	(−0.54)	(−2.43)	(−0.35)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-square	0.502	0.509	0.488	0.490	0.518	0.536
Number of observations	6,710	6,710	4,377	4,377	2,333	2,333
Panel B	Dep. Var. = SGA per employee					
Cash-flow volatility	9.740***		10.230***		8.284***	
	(9.53)		(11.05)		(4.72)	
Cash-flow vol. × NAFTA	**−3.764*****		**−5.595*****		**−0.553**	
	(−3.97)		**(−7.89)**		**(−0.76)**	
Unl. stock return vol.		16.810***		17.640***		15.200***
		(6.41)		(7.28)		(3.02)
Unl. stock return vol. × NAFTA		**−15.580*****		**−17.150*****		**−12.190****
		(−7.02)		**(−8.24)**		**(−2.64)**
NAFTA	−0.352***	−0.225*	−0.235***	−0.117***	−0.610***	−0.453**
	(−2.86)	(−1.84)	(−3.80)	(−3.20)	(−3.08)	(−2.80)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-square	0.557	0.554	0.585	0.584	0.524	0.519
Number of observations	72,427	72,427	46,099	46,099	26,328	26,328

Note: This table presents industry-level results of the effect of NAFTA on the human capital/investment risk relation. The dependent variable is staff expense per employee in Panel A and SGA per employee in Panel B. Columns 1 and 2 report results for all industries. Columns 3 and 4 report results for manufacturing industries and Columns 5 and 6 report results for nonmanufacturing industries. Manufacturing industries have SIC codes between 2000 and 3,999. Nonmanufacturing industries have SIC codes below 2000 and above 3,999. NAFTA equals one for observations in 1994 and later and equals zero otherwise. Regressions include all control variables, industry-fixed effects and year-fixed effects. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. T-statistics (in parentheses) are calculated using robust standard errors corrected for clustering of observations at the industry level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively. Bold values indicate variables of interest.

4.2 | Average employees' bargaining power

We recognize that the strength of the relationship between firm investment risk and employee pay hinges upon the bargaining power of employees. Employees with strong bargaining power are more likely to have clout when it comes to demanding employee pay that is commensurate with a firm's investment risk. Following the labor market literature discussed above, we adopt two proxies to capture the bargaining power of employees: labor union participation and the availability of outside employment opportunities. Employee bargaining power is expected to increase among employees who are union members and so are the prospects of comparable employment opportunities in the labor market. We collect data on union membership from www.unionstats.com, which is an internet site offering estimates on private and public sector union membership, coverage, and density. The database was constructed by Barry Hirsch and David Macpherson based on the monthly household Current Population Survey (CPS) and methods developed by the Bureau of Labor Statistics. Data on union coverage is available beginning in 1983, and we define union coverage on a firm-year basis as the percentage of employees who are union members.

We consider firms with high union coverage as those whose union coverage is in the top quintile of the sample, whereas firms with low union coverage are at in the bottom quintile of the sample. We conjecture that firms with high union coverage have greater bargaining power. The results in Table 4 suggest that the coefficient on the investment risk proxy is positive and significant in three of four models in the high union coverage subsample. Conversely, the effect of investment risk on employee pay is significant in only one of the four models for firms with low union coverage. Consistent with H2, the strength of the relationship between investment risk and employee pay is closely related to the bargaining power of employees. Employees with strong bargaining power, as indicated by robust union coverage, are in a favorable position to demand compensation that is commensurate with investment risk.

Next, we follow Kale, Ryan, and Wang (2019) in using a quasi-natural experiment to explore how employee bargaining power plays a role in the link between investment risk and human capital cost. Hakobyan and McLaren (2016) show that NAFTA resulted in a drop in employment opportunities primarily in manufacturing. We regard NAFTA as an external shock to the labor market across industries with the conjecture that the impact of the shock is greater in the manufacturing sector. The implementation of NAFTA allows us to examine the effect of investment risk on human capital cost using an exogenous shock to the labor market. Specifically, if fewer job opportunities are available, it is harder for employees to find a replacement job; hence they have less bargaining power vis-à-vis their employer. Therefore, we expect that implementation of NAFTA weakens the positive relationship between investment risk and employee pay.

We divide the sample into subsamples of manufacturing with an SIC code of 2000–3999 and nonmanufacturing industries. Our variable of interest is the interaction between investment risk measures (cash-flow volatility and unlevered stock return volatility) and the dummy variable NAFTA (which equals one for 1994 and afterward, and 0 before 1994). We present the results in Panels A and B of Table 5: Models 1 and 2 show the results for all industries, Models 3 and 4 are for manufacturing, and Models 5 and 6 are for nonmanufacturing industries. Consistent with our prediction that having fewer employment opportunities weakens the impact of investment risk on human capital cost, we observe a negative and significant coefficient on the interaction term between investment risk and NAFTA in all industries and in the manufacturing and nonmanufacturing subsamples respectively. It suggests that a more (less) favorable labor market strengthens (weakens) the relationship between investment risk and employee pay. Overall, our analysis of the implementation of NAFTA supports the impact of employee bargaining power on the relationship between investment risk and human capital cost.

4.3 | Robustness Tests

One of the main endogeneity concerns is whether our results are driven by employee skills. More specifically, firms have invested heavily in risky projects (e.g., pharmaceutical or high-technology firms) may hire more skilled workers, who are generally paid better than unskilled workers. To address this issue, we include a dummy for advanced skills to control for employee skills in our baseline regressions, as shown in Panel A of Table 6. The results suggest that, across all models, the coefficients on cash-flow volatility and unlevered stock return volatility are significantly positive. To further address the potential endogeneity concern over "pay for skills," we divide our sample into firms with nonadvanced skills and advanced skills as well as low-paying vs. high-paying firms. Employees at firms with nonadvanced skills and low pay are considered unskilled workers. If our "pay for risk" argument is valid, we should observe the positive effect of investment risk on average employee pay in the subsamples of firms with nonadvanced skills and low pay. We identify industries with advanced skills by including high-technology industries and the oil and gas industry.[15] We follow Carpenter and Petersen (2002) in identifying high-tech industries using the first three-digit SIC codes 283, 357, 361, 362, 366, 367, 382, 384, 386, and 387, and follow Jin and Jorion (2006) in identifying the oil and gas industry with the SIC code 131. A detailed breakdown of these industries is in Appendix C. Results for the subsamples of firms with advanced skills and nonadvanced skills are in Panel B of Table 6. In the SGA regressions, we find that both investment risk measures have a significant (at the 1% level) and positive effect on average employee pay across all models and subsamples. The regression results using staff expenses suggest a generally positive impact of investment risk on employee pay. In particular, the effect of cash-flow volatility is significant at the 5% level for unskilled workers. However, because of the sample size the effects are not statistically significant for firms with advanced skills. Based on the median values

TABLE 6 Robustness test on unskilled workers vs. skilled workers

	Staff expense per employee		SGA per employee	
	(1)	**(2)**	**(3)**	**(4)**
Panel A. Industry-year fixed effects with advanced skills dummy				
Cash-flow volatility	1.314**		7.316***	
	(1.99)		(15.12)	
Unlevered stock return volatility		2.161*		5.387***
		(1.67)		(6.91)
Market capitalization	−0.0810***	−0.0775***	−0.176***	−0.177***
	(−12.39)	(−11.49)	(−32.27)	(−29.83)
Market-to-book	0.0654***	0.0683***	0.180***	0.200***
	(5.23)	(5.23)	(21.47)	(23.51)
Market leverage	−0.486***	−0.436***	−1.341***	−1.268***
	(−6.22)	(−5.38)	(−22.02)	(−19.08)
Average sales per employee	0.0869*	0.0884*	−0.123**	−0.0962
	(1.85)	(1.88)	(−1.97)	(−1.51)
Fixed asset ratio	0.197***	0.192***	0.198***	0.209***
	(3.63)	(3.54)	(3.40)	(3.60)
ROA	−1.689***	−1.678***	−5.844***	−6.075***
	(−9.21)	(−8.91)	(−42.69)	(−44.22)
ROE	0.0680**	0.0677**	0.433***	0.422***
	(2.49)	(2.49)	(15.47)	(15.01)
Cash	0.421***	0.427***	1.351***	1.338***
	(3.30)	(3.37)	(20.06)	(19.79)
Firm age	0.000167	0.000336	−0.00398***	−0.00422***
	(0.14)	(0.27)	(−3.70)	(−3.86)
Advanced skills dummy	−0.0144	−0.0177	0.0248	0.0111
	(−0.43)	(−0.53)	(0.52)	(0.22)
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

	Nonadvanced Skills firms		Advanced Skills firms	
Panel B: Non-adv. skills vs. Adv. skills	**(1)**	**(2)**	**(3)**	**(4)**
Dependent variable = Staff expense per employee				
Cash-flow volatility	1.072**		0.972	
	(2.32)		(1.20)	
Unlevered stock return volatility		0.321		−0.570
		(0.43)		(−0.26)
Controls	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.904	0.903	0.911	0.911
Number of observations	5,366	5,366	1,344	1,344

(Continues)

TABLE 6 (Continued)

Panel B: Non-adv. skills vs. Adv. skills	Nonadvanced Skills firms (1)	(2)	Advanced Skills firms (3)	(4)
Dependent variable = SGA per employee				
Cash-flow volatility	4.723***		3.741***	
	(9.15)		(4.56)	
Unlevered stock return volatility		5.028***		4.057***
		(6.24)		(3.34)
Controls	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.823	0.822	0.823	0.822
Number of observations	49,571	49,571	22,856	22,856

Panel C. Low-paying vs. High-paying	Low-paying firms (1)	(2)	High-paying firms (3)	(4)
Dependent variable = Staff expense per employee				
Cash-flow volatility	1.246**		0.661	
	(2.51)		(1.10)	
Unlevered stock return volatility		−0.064		−1.543
		(−0.08)		(−0.94)
Controls	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.883	0.881	0.934	0.934
Number of observations	3,544	3,544	3,166	3,166
Dependent variable = SGA per employee				
Cash-flow volatility	1.663***		4.486***	
	(4.26)		(7.61)	
Unlevered stock return volatility		1.652***		4.984***
		(2.90)		(5.13)
Controls	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.812	0.812	0.831	0.831
Number of observations	29,749	29,749	42,678	42,678

Note: The dependent variables are two proxies for average employee pay: staff expense per employee and SGA per employee. Regressions in Panel A include a dummy variable for firms with advanced skills and industry- and year-fixed effects. We separate the full sample into firms with advanced skills and nonadvanced skills in Panel B and low-paying firms and high-paying firms in Panel C. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. *T*-statistics (in parentheses) are calculated using robust standard errors corrected for clustering of observations at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

of staff expenses per employee and SGA per employee by year, we separate the full sample into high-paying (above-median) and low-paying firm (below-median) subsamples and report the results in Panel C. Similarly, in the SGA regressions, we find that both risk measures have significantly positive effects on average employee pay at the 1% significance level. Our findings suggest that the positive relationship between investment risk and human capital cost is unlikely to be driven by the positive relationship between worker skills and employee pay.

TABLE 7 System-GMM Estimation of the Effects of Investments Risk on Average Employee Pay

	Staff expense per employee		SGA per employee	
	(1)	(2)	(3)	(4)
Panel A. How many lags of human capital cost are needed for dynamic completeness				
Adjusted labor costs (one lag)	0.758***		0.810***	
	(8.16)		(37.90)	
Adjusted labor costs (two lag)	0.180	0.849***	−0.013	0.645***
	(1.60)	(7.62)	(−0.52)	(29.23)
Adjusted labor costs (three lag)	−0.061	−0.075	0.006	−0.007
	(−0.78)	(−0.79)	(0.44)	(−0.43)
Market capitalization	−0.004***	−0.007***	−0.023***	−0.048***
	(−3.66)	(−3.77)	(−12.16)	(−16.12)
Market-to-book	0.002	0.002	0.012***	0.029***
	(1.01)	(0.75)	(2.74)	(4.74)
Market leverage	0.003	−0.017	−0.272***	−0.470***
	(0.17)	(−0.65)	(−11.90)	(−14.42)
Average sales per employee	0.000*	0.000	0.000***	0.000
	(1.91)	(1.39)	(2.76)	(1.08)
Fixed asset ratio	0.018	0.032*	0.096***	0.163***
	(1.35)	(1.70)	(5.47)	(6.21)
ROA	−0.107***	−0.200***	−1.408***	−2.246***
	(−2.84)	(−3.16)	(−19.31)	(−22.19)
ROE	−0.002	0.004	0.019	0.088***
	(−0.40)	(0.50)	(1.44)	(4.93)
Cash	0.046**	0.099***	0.118***	0.260***
	(2.39)	(2.91)	(4.58)	(6.78)
Firm age	0.000*	0.001***	0.002***	0.003***
	(1.90)	(3.06)	(7.19)	(7.66)
Advanced skills dummy	−0.014	−0.018	−0.009	−0.011
	(−1.04)	(−1.03)	(−0.69)	(−0.56)
Fixed effects	Yes	Yes	Yes	Yes
Adjusted *R*-squared	0.934	0.877	0.849	0.753
Number of observations	4,071	4,114	47,868	48,362
	Staff expense per employee		**SGA per employee**	
	(1)	**(2)**	**(3)**	**(4)**
Panel B. System-GMM				
Adjusted labor costs (one lag)	0.451***	0.601***	0.559***	0.423***
	(4.11)	(4.17)	(14.63)	(6.56)
Cash-flow volatility	2.285*		5.463**	
	(1.82)		(2.03)	
Unlevered stock return volatility		2.263**		6.482**
		(2.23)		(2.18)
Market capitalization	−0.049***	0.020	0.078*	−0.054
	(−2.58)	(0.05)	(1.89)	(−0.98)

(Continues)

TABLE 7 (Continued)

	Staff expense per employee		SGA per employee	
	(1)	**(2)**	**(3)**	**(4)**
Market-to-book	0.028**	0.008	−0.176***	−0.057
	(2.13)	(0.36)	(−4.58)	(−1.04)
Market leverage	−0.050	0.020	−0.349	−0.273
	(−0.68)	(0.16)	(−1.41)	(−0.71)
Average sales per employee	0.0002	0.0001	−0.001	−0.001
	(1.59)	(1.15)	(−0.70)	(−1.01)
Fixed asset ratio	−0.274	−0.007	−0.520	−0.077
	(−1.64)	(−0.07)	(−0.76)	(−0.08)
ROA	−0.428**	−0.427*	−0.419***	−1.431***
	(−2.42)	(−2.09)	(−3.26)	(−2.67)
ROE	−0.044	0.003	0.082	−0.000
	(−1.56)	(0.09)	(0.61)	(−0.00)
Cash	−0.070	0.128	0.467	0.675
	(−0.80)	(1.03)	(1.29)	(1.39)
Firm age	−0.002*	0.001	0.004	0.004
	(−1.83)	(0.61)	(1.23)	(0.75)
Advanced skills dummy	0.237	0.292	−1.789	−8.230*
	(0.13)	(0.62)	(−0.92)	(−1.73)
AR(1) test (p-value)	0.009	0.012	0.000	0.000
AR(2) test (p-value)	0.565	0.349	0.152	0.192
Hansen J-statistic (p-value)	1.000	1.000	0.265	0.877
Diff-in-Hansen J-statistic (*p*-value)	0.996	1.000	0.250	0.883
Number of observations	5,642	5,642	62,748	62,748

Note: The table reports the results of system-GMM estimation of the effects of investment risk on average employee pay. The system-GMM estimation jointly estimates a system of equations of levels and first differences, where the empirical lags of first differences are used as instruments for the level equation and empirical lags of levels are used as instruments for the first-differences equation. The dependent variables are two proxies for average employee pay: staff expense per employee and SGA per employee. We use the first lag of adjusted labor costs in the dynamic model based on the results of the dynamic completeness test in Panel A. We use explanatory variables lagged two to seven years as instruments for the current explanatory variables. Except for industry- and year-fixed effects, we assume that all explanatory variables are endogenous. System-GMM estimates and diagnostic tests are reported in Panel B. 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. Dynamic-GMM assumes that twice-lagged (i.e., second-order) residuals are not auto-correlated, but requires the presence of first-order 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. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. *T*-statistics (in parentheses) are calculated using robust standard errors corrected for clustering of observations at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

To address the concerns about reverse causality, omitted variables, and the simultaneity of human capital cost, investment risk, and leverage, we use the system-GMM estimation proposed by Arellano and Bover (1995) and Blundell and Bond (1998). This estimation method, typically referred to as dynamic-GMM, uses the history of endogenous variables as instruments for the current value of the variables. We use the lagged values of average labor cost, investment risk, and leverage, as well as all the other explanatory variables as instruments for the current value of human capital cost, investment risk, and leverage.

To conduct the system-GMM estimation, we first specify the baseline specification in Equation (1) as a dynamic model by adding lags of the dependent variable (staff expense per employee or SGA per employee). The optimal number of lags must ensure dynamic completeness and that the lagged values of the right-hand-side variables at deeper lags form an exogenous source of variation (i.e., are uncorrelated with the error of the dynamic leverage specification). The dynamic specification is then written in the first-difference form to eliminate potential biases resulting from the time-invariant unobserved heterogeneity. Lagged values of investment risk, leverage, and all other right-hand-side variables (except for fixed effects) are added to the difference equation as instruments for the existing set of explanatory variables. We then construct a second equation using the first-difference variables as instruments in the original equation in levels and form a stacked system of equations in levels and differences. We use this stacked system of equations to implement system-GMM. The system-GMM estimator produces efficient estimates of coefficients on investment risk, while accounting for simultaneity and the dynamic relation among variables and controlling for the time-invariant unobserved heterogeneity.

We report the results using the system-GMM estimator in Table 7. Panel A tests the number of lags of staff expense per employee and SGA per employee that are needed to ensure dynamic completeness. These regressions include up to three lags of the dependent variable and controls variables in the baseline regression model as described in Equation (1). The results show that one lag is sufficient to capture the dynamics of labor costs. In Columns 1 and 3, only the first lag of the dependent variable is statistically significant, while the older lags are insignificant. In Columns 2 and 4, the second lag becomes significant after we drop the first lag. These results suggest that all relevant information in older lags is subsumed by the first lag of labor costs. Therefore, we use one lag of staff expense per employee or SGA per employee in the system-GMM.

Panel B reports the results of the system-GMM estimation. The regressions use one lag of average labor costs and deeper lags of all other right-hand-side variables (two to seven lags). 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 Eichenbaum, Hansen, and Singleton (1988). If our exogeneity assumptions are valid, the residuals in the first differences should be correlated and the residuals in the second differences should be uncorrelated. This is what we observe in the system results. Furthermore, the Hansen *J*-test of overidentification for the equation in differences, and the difference-in-Hansen *J*-test of overidentification for the equation in levels are not rejected. Therefore, we cannot reject the null hypothesis that the lagged level and lagged difference instruments in the system-GMM equations are exogenous. Across all models, we observe a statistically significant and positive relationship between the proxies for investment risk and average employee pay. This effect is economically significant, unlike the coefficient estimates reported in Panel A of Table 6. Overall, we continue to find a strong and positive relationship between average labor costs and investment risk. Consistent with H1, the results from the system-GMM regressions provide confirmation of our main finding of a positive association between investment risk and average employee pay.

5 | CHANNELS OF INVESTMENT RISK

To further explore the impact of investment risk on human capital cost, we examine its policy channels. Following the literature, we investigate four investment policy channels for risk: corporate diversification (measured by the number of business segments, the entropy index, and geographic segment dispersion), R&D expenditure, advertising expenditure, and acquisition activities. We first test the relation between the four channels and investment risk. We include a squared variable of the number of segments in the regressions because the literature suggests that the level of diversification may have a nonlinear relationship with compensation (e.g., Duru & Reeb, 2002; Rose & Shepard, 1994). We expect to see R&D expenditure, advertising expenditure, and acquisition activities as contributors to investment risk; diversification, by contrast, reduces risk. The results in Table 8, Panels A and B are consistent with our predictions.[16] Next, we examine the third hypothesis H3 on the possible channels through which firm investment risk has an impact on human capital cost. Because diversification reduces investment risk, while R&D expenditure, advertising expenditure, and acquisition amount increase investment risk, we expect to see that human capital cost increases R&D expenditure, advertising expenditure, and acquisition amounts, but decreases diversification. Panel A of Table 9 reports the results using staff expenses as a proxy for average employee pay. Except for the acquisition amount, all other channels (the number of segments, the entropy index, geographic segment dispersion, R&D expenditure, and advertisement expenditure) have a significant effect, with the expected signs on average employee pay. The positive and significant coefficient on the number of business segments squared supports a nonlinear relation between the number of business segments and human capital cost. Panel B reports the results when SGA is the proxy for average employee pay. The results provide further confirmation that the channels through which investment risk affects human capital cost. In particular, the coefficient on the number of segments is negative and significant at the 1% level, whereas the coefficients on R&D expenditure, advertising expenditure, and the acquisition amount are positive and significant at the 1% level. In sum, our findings provide strong support for H3.[17]

6 | LABOR INTENSITY'S FEEDBACK EFFECT

So far, we have presented empirical support for a positive relationship between a firm's investment risk and human capital cost, explored the critical role of employee bargaining power in this relationship, and examined the possible channels

TABLE 8 Channels for investment risk

Panel A	Cash-flow volatility (1)	Unlevered stock return volatility (2)
No. of segments	−0.006***	−0.004***
	(−10.17)	(−9.06)
No. of segments squared	0.0005***	0.0003***
	(6.05)	(5.03)
R&D	0.007***	0.003***
	(4.09)	(3.72)
Advertisement	0.101***	0.025***
	(11.43)	(5.24)
Acquisition	0.003**	0.003***
	(2.27)	(5.30)
Year-fixed effects	Yes	Yes
Industry-fixed effects	Yes	Yes
Adjusted R-squared	0.164	0.386
Number of observations	27,428	27,428
Panel B	**Cash flow volatility (1)**	**Unlevered stock return volatility (2)**
Entropy index	−0.00823***	−0.00646***
	(−14.56)	(−14.38)
Geographic segment dispersion	−0.00176***	−0.00101**
	(−2.59)	(−2.22)
R&D	0.0104***	0.00429***
	(5.19)	(3.65)
Advertisement	0.0885***	0.0155***
	(9.29)	(2.98)
Acquisition	0.00131	0.00268***
	(1.04)	(3.92)
Year-fixed effects	Yes	Yes
Industry-fixed effects	Yes	Yes
Adjusted R-squared	0.160	0.371
Number of observations	22,414	22,414

Note: We test four possible channels for investment risk. The channels we investigate are corporate diversification (no. of segments, entropy index, and geographic segment dispersion), R&D expenditure, advertising expenditure, and total value of all acquisition deals in a year. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. T-statistics (in parentheses) are calculated using robust standard errors corrected for clustering of observations at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

through which investment risk affects human capital cost. One important and intriguing question remains: When the cost of human capital increases as a result of increased investment risk, how does a firm's future investment policy respond to the increased human capital cost? Firms in more labor-intensive industries face a greater increase in human capital cost due to an increase in investment risk. Consequently, these firms may choose to lower their risky investments due to the higher human capital cost needed for such investment. We expect to see a feedback effect from the increased human capital cost on reducing the amount of future risky investments, especially for firms in more labor-intensive industries. Following Dewenter and Malatesta (2001) and Agrawal and Matsa (2013), we construct a variable for labor intensity as the ratio of labor and pension expenses to total assets. We empirically test this prediction by regressing each of the four risky investment channels on the lagged labor intensity measure. We expect to see that labor intensity is positively related

TABLE 9 Effects of investment risk channels on average employee pay

	Dependent variable = Staff expense per employee				
Panel A	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
No. of segments	−0.057***				
	(−4.02)				
No. of segments squared	0.007***				
	(3.81)				
Entropy index		−0.039**			
		(−2.04)			
Geo. segments dispersion		−0.009			
		(−0.23)			
R&D			0.002***		
			(24.94)		
Advertisement				1.410***	
				(2.88)	
Acquisition					0.010
					(0.26)
Market capitalization	−0.090***	−0.093***	−0.083***	−0.083***	−0.083***
	(−12.79)	(−10.95)	(−12.94)	(−9.21)	(−12.93)
Market-to-book	0.065***	0.059***	0.069***	0.067***	0.070***
	(4.41)	(3.60)	(5.39)	(5.69)	(5.48)
Market leverage	−0.590***	−0.713***	−0.505***	−0.525***	−0.503***
	(−6.27)	(−6.02)	(−6.44)	(−5.28)	(−6.43)
Average sales per employee	−0.000	−0.000	0.000**	0.000	0.000*
	(−1.25)	(−1.15)	(1.97)	(1.64)	(1.87)
Fixed asset ratio	0.231***	0.271***	0.196***	0.140*	0.195***
	(3.57)	(3.41)	(3.64)	(1.82)	(3.62)
ROA	−1.746***	−1.922***	−1.733***	−1.779***	−1.744***
	(−8.35)	(−8.01)	(−9.41)	(−7.67)	(−9.47)
ROE	0.116***	0.161***	0.071***	0.119***	0.069**
	(2.96)	(3.28)	(2.59)	(3.35)	(2.55)
Cash	0.481***	0.561***	0.433***	0.324**	0.436***
	(3.36)	(3.41)	(3.48)	(2.12)	(3.51)
Firm age	−0.000	−0.001	−0.000	0.001	−0.000
	(−0.15)	(−0.42)	(−0.20)	(0.41)	(−0.10)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.521	0.541	0.501	0.545	0.497
Number of observations	4,580	3,539	6,710	2,975	6,710
	Dependent variable = SGA per employee				
Panel B	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
No. of segments	−0.188***				
	(−8.96)				
No. of segments squared	0.029***				
	(8.51)				

(Continues)

TABLE 9 (Continued)

Panel B	Dependent variable = SGA per employee (1)	(2)	(3)	(4)	(5)
Entropy index		−0.035*			
		(−1.68)			
Geo. segments dispersion		−0.134***			
		(−5.42)			
R&D			0.012***		
			(3.61)		
Advertisement				3.853***	
				(8.76)	
Acquisition					0.114***
					(3.05)
Market capitalization	−0.209***	−0.219***	−0.194***	−0.226***	−0.194***
	(−33.28)	(−32.67)	(−35.37)	(−29.10)	(−35.35)
Market-to-book	0.202***	0.211***	0.208***	0.204***	0.207***
	(23.47)	(23.55)	(24.91)	(17.33)	(24.63)
Market leverage	−1.562***	−1.539***	−1.460***	−1.555***	−1.465***
	(−24.11)	(−21.78)	(−24.05)	(−17.41)	(−24.09)
Average sales per employee	−0.000***	−0.000*	−0.000	0.000	−0.000
	(−3.83)	(−1.95)	(−1.01)	(1.10)	(−1.11)
Fixed asset ratio	0.172***	0.167**	0.215***	0.260***	0.220***
	(2.68)	(2.33)	(3.70)	(2.78)	(3.79)
ROA	−6.160***	−5.964***	−6.223***	−5.720***	−6.248***
	(−43.81)	(−39.13)	(−46.66)	(−30.15)	(−46.67)
ROE	0.457***	0.439***	0.433***	0.474***	0.436***
	(14.88)	(13.54)	(15.51)	(12.27)	(15.55)
Cash	1.435***	1.427***	1.344***	1.205***	1.345***
	(20.24)	(19.16)	(19.94)	(12.35)	(19.92)
Firm age	−0.006***	−0.006***	−0.006***	0.003*	−0.006***
	(−5.26)	(−4.53)	(−5.18)	(1.77)	(−5.13)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.556	0.547	0.550	0.542	0.549
Number of observations	61,042	51,396	72,427	32,516	72,427

Note: We test four channels through which investment risk may affect average employee pay. The channels we investigate are corporate diversification (number of segments, entropy index, and geographic segment dispersion), R&D expenditure, advertising expenditure, and total value of all acquisition deals in a year. All regressions include industry-fixed effects and year-fixed effects. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. *T*-statistics (in parentheses) are calculated using robust standard errors corrected for clustering of observations at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

to corporate diversification, i.e., the number of business segments, the entropy index, and geographic segment dispersion, and negatively related to R&D expenditure, advertising expenditure, and the acquisition amount. The results reported in Table 10 are consistent with our predictions: labor intensity is positively and significantly associated with the number of business segments and the entropy index and is negatively and significantly associated with R&D expenditure and the acquisition amount. Our findings provide empirical support for a feedback effect in which firms adjust their investment policy to respond to an increase in human capital costs.

TABLE 10 Effect of labor intensity on investment risk channels

Lagged variables (one lag)	Number of segments (1)	Entropy (2)	Geographic dispersion (3)	R&D (4)	Advertisement (5)	Acquisition (6)
Labor intensity	0.765***	0.317***	0.070	−0.092**	−0.017	−0.056***
	(3.34)	(3.25)	(0.55)	(−1.98)	(−1.27)	(−2.97)
Log(sales)	0.126***	0.054***	0.016***	−0.009***	0.001**	−0.003***
	(12.14)	(12.70)	(5.58)	(−3.17)	(2.14)	(−6.61)
Market-to-book	−0.045***	−0.020***	0.017***	0.057	0.003***	0.013***
	(−8.90)	(−9.77)	(6.01)	(1.62)	(6.43)	(11.65)
Book leverage	0.138**	0.084***	−0.095***	0.156	−0.008	0.006
	(2.36)	(3.23)	(−3.18)	(0.68)	(−1.60)	(1.01)
Surplus cash	−0.490***	−0.201***	0.230***	0.158	−0.013***	0.005
	(−9.84)	(−9.14)	(7.43)	(1.30)	(−2.62)	(0.47)
Annual stock	0.021***	0.009***	−0.008***	0.017	−0.001*	0.002*
Return	(4.71)	(4.62)	(−3.51)	(0.68)	(−1.70)	(1.65)
Free cash flow	0.230***	0.114***	−0.214***	−0.746***	−0.023***	0.005
	(4.12)	(4.70)	(−6.51)	(−9.28)	(−4.01)	(0.54)
Advanced skills	−0.117***	−0.033***	0.093***	0.134**	−0.012***	0.008***
dummy	(−4.55)	(−2.86)	(8.53)	(1.99)	(−7.25)	(3.36)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.111	0.110	0.069	0.001	0.055	0.023
No. of obs.	39,044	39,044	40,611	47,095	20,117	47,095

Note: We test the feedback effect of investment risk on human capital cost, in particular, the effect of investment policy on labor intensity. The channels we investigate are the number of segments, the entropy index, geographic segment dispersion, R&D expenditure, advertising expenditure, and the total value of all acquisition deals in a year. The variable of interest is labor intensity at the industry level by the three-digit NAICS. All explanatory variables are lagged one year. All continuous variables are winsorized at the 1% and 99% percentiles of their distributions. T-statistics (in parentheses) are calculated using robust standard errors corrected for clustering of observations at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

7 | CONCLUSION

The recent literature has started to shed more light on the role of human capital costs in influencing corporate policies. In this paper, we conjecture that employees bear large human capital losses from a firm's risky investments. In a theoretical framework, we present the risk borne by the firm and its employees arising from a decision to engage in risky investments. We empirically examine the relationship between investment risk and human capital cost. Our findings support a strong and positive relationship between human capital cost and investment risk. More specifically, using two measures of investment risk—cash-flow volatility and unlevered stock return volatility—we find that investment risk is significantly positively correlated with average employee pay. The positive relationship is both statistically and economically significant. For example, for every one-standard deviation increase in cash flow volatility, the average employee pay increases by 14.07%. We further show that firms with employees who have more bargaining power exhibit a stronger relation between investment riskiness and average employee pay. Our results remain robust after various tests for endogeneity.

The link between investment riskiness and human capital cost may be driven by various policy channels resulting in investment risk. We explore four possible channels for investment riskiness: corporate diversification, R&D expenditures, advertising expenditures, and acquisition amounts. We find support for a significant relation between each of the channels and human capital cost. In particular, we find that a firm's R&D expenditures, advertising expenditures, and acquisition amounts are positively related to human capital cost, while diversification level is negatively related. Lastly, we explore the possible feedback effect of an increased human capital cost on a firm's investment policy. We show that labor-intensive firms have future investments that are significantly less risky than nonlabor-intensive firms. Our findings suggest that an increased human capital cost due to investment riskiness may discourage a firm to take on valuable but risky investments in the future, resulting in a potential underinvestment problem. Overall, our study contributes to the nascent but growing literature of the impact of human capital on a firm's investment policy.

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ENDNOTES

[1] In their study, Dambolena and Khoury (1980) use 19 different financial ratios, such as net profit over sales, current ratio, acid test, and debt ratio.

[2] The only friction is the inability of employees to ensure their human capital. In their model, entrenchment is the efficient response to this friction, rather than exogenously imposed inefficiency.

[3] Clinch (1991) reports the univariate results of average employee compensation but focuses on key employees in the multivariate regression. In addition, the regressions are based on a subsample of 200 firms randomly selected from the full sample of 843 firms.

[4] In Sections 4.1 and 6.1, we show that the impact of investment risk on labor cost is economically significant.

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

[6] An imperfectly competitive market for labor is plausible in practice. Many factors, such as unionization and firm-borne employee switching costs, can lead to efficiencies in the labor market that allow employees to extract rents above the reservation wage.

[7] $b(\beta) \in \left[1, \frac{\pi}{W_R}\right)$, where π is the firm surplus from unit labor production.

[8] Alternatively, we use the operating income before depreciation and find similar results.

[9] We estimate the unlevered stock return volatility as (1 - market leverage ratio) × stock return volatility.

[10] We also adopt CEO compensation as an alternative measure. CEO total compensation is the sum of salary, bonus, other annual, restricted stock grants, long-term incentive plan payouts (LTIP), all other, and the 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 total compensation minus salary, bonus, other annual pay, and LTIP. The results are similar to those based on average employee measures.

[11] Compustat segment data also provide information on geographic area codes. The codes indicate the state, country, or region. As most of the codes for the firm-year observations in our sample reflect a rough description of the region, rather than a specific location (e.g., "Americas," "W_EUR," "L_AMER," "CENTRAL," "L_VALLEY," "NONE," and "OTHER"), it is not feasible to obtain a good measure of geographic distance based on these codes. As a result, we focus on using the geographic segment dispersion based on the geographic segment type data.

[12] We start with all Compustat firms dating back to 1950. Because we use acquisition activities from the SDC platinum database as a channel for risky investment and this data availability starts in 1976, our final sample of average employee pay is for the period 1976 to 2015.

[13] The increase in staff expenses is equal to the coefficient of cash-flow volatility times 10% of the standard deviation of cash-flow volatility divided by the mean of average employee pay per sale (1.407% = (0.959 × 0.0022)/0.15). Using SGA as a proxy for average employee pay, the economic effect of a one-standard-deviation increase in cash-flow volatility (unlevered stock return volatility) is a 1.25% (1.01%) increase in human capital cost.

[14] One explanation for the large economic significance is that the standard deviation of the two volatility variables is almost as large as their means, as shown in Table 1.

[15] We include the oil and gas industry because it is known for having petroleum engineers. We thank an anonymous referee for this suggestion.

[16] We regress the entropy index separately from the number of segments because they are highly correlated at 0.91. We also calculated the Herfindahl Index (HHI) as $\sum_{i}^{n} S_i^2$ where n is the number of segments, and S_i is the share of segment i sales to total firm sales. The HHI ranges from zero, when the firm has many segments (highly diversified), to one, when the firm has only one segment (i.e., zero diversification). We have consistent results using the HHI as the entropy index. The results are available from the author upon request.

[17] We also explore the degree to which the risk is relative to what we would predict by running a two-stage regression model. We run a first-stage regression of each risk measure (i.e., R&D, advertising expense, and acquisition activity) on a set of explanatory variables and use the residual of each risk measure in the second-stage regressions of employee pay. The coefficients on the residuals of three risk measures in the second-stage regressions are almost identical to the original results. The results are available from the author upon request.

REFERENCES

Abowd, J. M., & Ashenfelter, O. C. (1981). Anticipated unemployment, temporary layoffs, and compensating wage differentials. In S. Rosen (Ed.), *Studies in Labor Markets* (pp. 141–170). Chicago: University of Chicago Press.

Agrawal, A. K., & Matsa, D. A. (2013). Labor unemployment risk and corporate financing decisions. *Journal of Financial Economics*, *108*(2), 449–470. https://doi.org/10.1016/j.jfineco.2012.11.006

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*(1), 29–51. https://doi.org/10.1016/0304-4076(94)01642-D

Argenti, J. (1976). Corporate planning and corporate collapse. *Long Range Planning*, *9*(6), 12–17. https://doi.org/10.1016/0024-6301(76)90006-6

Baber, W. R., Janakiraman, S. N., & Kang, S. H. (1996). Investment opportunities, and the structure of executive compensation. *Journal of Accounting and Economics*, *21*(3), 297–318. https://doi.org/10.1016/0165-4101(96)00421-1

Berger, P. G., & Ofek, E. (1995). Diversification's effect on firm value. *Journal of Financial Economics*, *37*(1), 39–65. https://doi.org/10.1016/0304-405X(94)00798-6

Berk, J. B., Stanton, R., & Zechner, J. (2010). Human capital, bankruptcy, and capital structure. *Journal of Finance*, *65*(3), 891–926. https://doi.org/10.1111/j.1540-6261.2010.01556.x

Bizjak, J. M., Brickley, J. A., & Coles, J. L. (1993). Stock-based incentive compensation and investment behavior. *Journal of Accounting and Economics*, *16*(1–3), 349–372. https://doi.org/10.1016/0165-4101(93)90017-A

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*(1), 115–143. https://doi.org/10.1016/S0304-4076(98)00009-8

Campbell, B. A., Ganco, M., Franco, A. M., & Agarwal, R. (2012). Who leaves, where to, and why worry? Employee mobility, entrepreneurship and effects on source firm performance. *Strategic Management Journal*, *33*(1), 65–87. https://doi.org/10.1002/smj.943

Campbell, J. Y., Lettau, M., Malkiel, B. G., & Xu, Y. (2001). Have individual stocks become more volatile? An empirical exploration of idiosyncratic risk. *Journal of Finance*, *56*(1), 1–43. https://doi.org/10.1111/0022-1082.00318

Carpenter, R. E., & Petersen, B. C. (2002). Capital market imperfections, high-tech investment, and new equity financing. *Economic Journal*, *112*(477), F54–F72. https://doi.org/10.1111/1468-0297.00683

Chemmanur, T. J., Cheng, Y., & Zhang, T. (2013). Human capital, capital structure, and employee pay: An empirical analysis. *Journal of Financial Economics*, *110*(2), 478–502. https://doi.org/10.1016/j.jfineco.2013.07.003

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

Childs, P. D., Mauer, D. C., & Ott, S. H. (2005). Interactions of corporate financing and investment decisions: The effects of agency conflicts. *Journal of Financial Economics*, *76*(3), 667–690. https://doi.org/10.1016/j.jfineco.2004.06.012

Clark, A., Georgellis, Y., & Sanfey, P. (2001). Scarring: The psychological impact of past unemployment. *Economica*, *68*(270), 221–241. https://doi.org/10.1111/1468-0335.00243

Clark, A. E., & Oswald, A. J. (1994). Unhappiness and unemployment. *Economic Journal*, *104*(424), 648–659. https://doi.org/10.2307/2234639

Clinch, G. (1991). Employee compensation and firms' research and development activity. *Journal of Accounting Research*, *29*(1), 59–78. https://doi.org/10.2307/2491028

Coles, J. L., Daniel, N. D., & Naveen, L. (2006). Managerial incentives and risk-taking. *Journal of Financial Economics*, *79*(2), 431–468. https://doi.org/10.1016/j.jfineco.2004.09.004

Dambolena, I. G., & Khoury, S. J. (1980). Ratio stability and corporate failure. *Journal of Finance*, *35*(4), 1017–1026. https://doi.org/10.1111/j.1540-6261.1980.tb03517.x

Dewenter, K. L., & Malatesta, P. H. (2001). State-owned and privately owned firms: An empirical analysis of profitability, leverage, and labor intensity. *American Economic Review*, *91*(1), 320–334. https://doi.org/10.1257/aer.91.1.320

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

Eichenbaum, M. S., Hansen, L. P., & Singleton, K. J. (1988). A time series analysis of representative agent models of consumption and leisure choice under uncertainty. *Quarterly Journal of Economics*, *103*(1), 51–78. https://doi.org/10.2307/1882642

Gaver, J. J., & Gaver, K. M. (1998). The relation between nonrecurring accounting transactions and CEO cash compensation. *Accounting Review*, *73*(2), 235–253.

Gilchrist, S., & Himmelberg, C. P. (1995). Evidence on the role of cash flow for investment. *Journal of Monetary Economics*, *36*(3), 541–572. https://doi.org/10.1016/0304-3932(95)01223-0

Hakobyan, S., & McLaren, J. (2016). Looking for local labor market effects of NAFTA. *Review of Economics and Statistics*, *98*(4), 728–741. https://doi.org/10.1162/REST_a_00587

Harris, M., & Holmstrom, B. (1982). A theory of wage dynamics. *Review of Economic Studies*, *49*(3), 315–333. https://doi.org/10.2307/2297359

Harris, M., & Raviv, A. (1991). The theory of capital structure. *Journal of Finance*, *46*(1), 297–355. https://doi.org/10.1111/j.1540-6261.1991.tb03753.x

Hendricks, W. (1994). Deregulation and labor earnings. *Journal of Labor Research*, *15*(3), 207–234. https://doi.org/10.1007/BF02685767

Hirsch, B. T., & Macpherson, D. A. (2003). Union membership and coverage database from the current population survey: Note. *ILR Review*, *56*(2), 349–354.

Huang, A. G. (2009). The cross section of cashflow volatility and expected stock returns. *Journal of Empirical Finance*, *16*(3), 409–429. https://doi.org/10.1016/j.jempfin.2009.01.001

Irvine, P. J., & Pontiff, J. (2009). Idiosyncratic return volatility, cash flows, and product market competition. *Review of Financial Studies*, *22*(3), 1149–1177. https://doi.org/10.1093/rfs/hhn039

Jin, Y., & Jorion, P. (2006). Firm value and hedging: Evidence from US oil and gas producers. *Journal of Finance*, *61*(2), 893–919. https://doi.org/10.1111/j.1540-6261.2006.00858.x

Kale, J. R., Ryan, H. E. Jr, & Wang, L. (2019). Outside employment opportunities, employee productivity, and debt discipline. *Journal of Corporate Finance*, *59*, 142–161. https://doi.org/10.1016/j.jcorpfin.2016.08.005

Kuppuswamy, V., & Villalonga, B. (2016). Does diversification create value in the presence of external financing constraints? Evidence from the 2007–2009 financial crisis. *Management Science*, *62*(4), 905–923. https://doi.org/10.1287/mnsc.2015.2165

Lee, K. H., Mauer, D. C., & Xu, E. Q. (2018). Human capital relatedness and mergers and acquisitions. *Journal of Financial Economics*, *129*(1), 111–135. https://doi.org/10.1016/j.jfineco.2018.03.008

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

Lewellen, W. G. (1971). A pure financial rationale for the conglomerate merger. *Journal of Finance*, *26*(2), 521–537. https://doi.org/10.1111/j.1540-6261.1971.tb00912.x

Lewis, T. R., & Yao, D. (2001). Innovation, knowledge flow, and worker mobility. Unpublished manuscript, Warrington School of Business, University of Florida.

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

Matsunaga, S. R. (1995). The effects of financial reporting costs on the use of employee stock options. *Accounting Review*, *70*(1), 1–26.

Mauer, D. C., & Sarkar, S. (2005). Real options, agency conflicts, and optimal capital structure. *Journal of Banking & Finance*, *29*(6), 1405–1428. https://doi.org/10.1016/j.jbankfin.2004.05.036

May, D. O. (1995). Do managerial motives influence firm risk reduction strategies? *Journal of Finance*, *50*(4), 1291–1308. https://doi.org/10.1111/j.1540-6261.1995.tb04059.x

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

Rose, N. L., & Shepard, A. (1994). Firm diversification and CEO compensation: Managerial ability or executive entrenchment? Working paper. National Bureau of Economic Research.

Ryan, H. E. Jr, & Wiggins, R. A. III (2001). The influence of firm-and manager-specific characteristics on the structure of executive compensation. *Journal of Corporate Finance*, *7*(2), 101–123. https://doi.org/10.1016/S0929-1199(00)00021-3

Ryan, H. E. Jr, & Wiggins, R. A. III (2002). The interactions between R&D investment decisions and compensation policy. *Financial Management*, *31*(1), 5–29.

Schwert, M., & Strebulaev, I. A. (2014). Capital structure and systematic risk. Working paper. Rock Center for Corporate Governance at Stanford University.

Smith, C. (2006). The double indeterminacy of labour power: Labour effort and labour mobility. *Work, Employment and Society*, *20*(2), 389–402. https://doi.org/10.1177/0950017006065109

Smith, C. W., & Watts, R. L. (1992). The investment opportunity set and corporate financing, dividend, and compensation policies. *Journal of Financial Economics*, *32*(3), 263–292. https://doi.org/10.1016/0304-405X(92)90029-W

Topel, R. H. (1984). Equilibrium earnings, turnover, and unemployment: New evidence. *Journal of Labor Economics*, *2*(4), 500–522. https://doi.org/10.1086/298044

Yermack, D. (1995). Do corporations award CEO stock options effectively? *Journal of Financial Economics*, *39*(2–3), 237–269. https://doi.org/10.1016/0304-405X(95)00829-4

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APPENDIX A. Variable definitions

Variable	Description (data source)
Employee characteristics	
Staff expense per employee	Labor expenses divided by number of employees scaled by total sales. (Compustat)
SGA per employee	Selling, general, and administrative expense divided by number of employees scaled by total sales. (Compustat)
Number of employees	Total number of employees in a firm-year. (Compustat)
Proxies for risky investments	

(Continues)

APPENDIX A (Continued)

Variable	Description (data source)
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)
Number of segments	Number of segments with different four-digit SIC code. (Compustat/Segment)
Geographic segment dispersion	Using the geographic segment type variable from the Compustat segment data (one for total foreign, two for domestic, and three for nondomestic), we define geographic segment type to be 1 for domestic segment, and two for nondomestic or total foreign segment. Geographic segment dispersion is defined as the average of the geographic segment type(s) within a firm to reflect the dispersion of a firm's geographic segments. (Compustat/Segments)
Entropy index	Entropy index is computed as $\sum_{i=1}^{n} S_i \ln\left(1/S_i\right) = -\sum_{i=1}^{n} S_i \ln\left(S_i\right)$, where n is the number of segments and S_i is the share of segment i sales to total firm sales. Higher entropy index values indicate greater diversification, while lower values indicate more concentration. Single segment firms have an entropy index of zero. (Compustat/Segment)
Herfindahl Index (HHI)	Herfindahl Index is computed as $\sum_{i}^{n} S_i^2$ where n is the number of segments, and S_i is the ratio of segment i sales to total firm sales. The Herfindahl Index ranges from zero, when the firm has many segments (high diversification), to one, when the firm has only one segment (i.e., zero diversification). (Compustat/Segment)
R&D	Ratio of research and development expense to total sales. (Compustat)
Advertisement	Ratio of advertisement expenditure to total sales. (Compustat)
Acquisition	Ratio of total value of acquisition in a year to total sales. (SDC/Compustat)
Proxies for labor intensity	
Labor intensity	Ratio of labor and pension expenses to total assets. Measure is based on the three-digit North American Industry Classification System (NAICS). (Compustat)
Control variables	
Market capitalization	Logarithm of market capitalization in constant dollars using the CPI with base year 1992. (Compustat)
Average sales per employee	Amount of total sales divided by number of employees. (Compustat)
Market leverage	Total debt divided by the market value of total assets (book value of assets − book value of equity + market value of equity). (Compustat)
Book leverage	Total debt divided by the book value of total assets. (Compustat)
Market-to-book	Ratio of book assets plus the difference between the market and book value of equity to the book value of assets. (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 in the database to year t. (Compustat)
Surplus cash	The ratio of operating activities net cash flow – depreciation and amortization + R&D expense to book value of total assets. (Compustat)
Free cash flow	The ratio of operating income before depreciation – interest expense – income tax – capital expenditures to the book value of total assets. (Compustat)
Annual stock return	Ratio of difference between stock price at year t plus dividend per share and stock price at year/t to stock price at year/t. (Compustat)
Advanced skills dummy	Defined as an indicator variable that takes a value of one if a firm is involved in a high-tech industry and/or oil and gas industry, and zero otherwise. We follow Carpenter and Petersen (2002) in identifying high-tech industries using first three-digit SIC codes 283, 357, 361, 362, 366, 367, 382, 384, 386, and 387, and Jin and Jorion (2006) in identifying the oil and gas industry by the SIC code 131.
NAFTA	Dummy variable that equals one if the fiscal year is 1994 and later, zero otherwise.

(Continues)

APPENDIX A (Continued)

Variable	Description (data source)
Labor union	Percentage of employed workers who are union members. Data available at www.unionstats.com. It is an internet data resource providing private and public sector labor union membership, coverage, and density estimates compiled from the monthly household Current Population Survey (CPS) using BLS methods. The database, constructed by Barry Hirsch (Andrew Young School of Policy Studies, Georgia State University) and David Macpherson (Department of Economics, Trinity University), was created in 2003 and is updated annually.

APPENDIX B. Industry distribution across fama-french 12 industry portfolios

FF−12		Staff exp. and SGA		SGA only	
Industry	Description	Frequency	Percent	Frequency	Percent
1	Consumer Nondurables—Food, Tobacco, Textiles, Apparel, Leather, Toys	508	7.57	2,772	4.22
2	Consumer Durables—Cars, TVs, Furniture, Household Appliances	269	4.01	2,786	4.24
3	Manufacturing—Machinery, Trucks, Planes, Off Furn, Paper, Com Printing	1,544	23.01	11,651	17.73
4	Oil, Gas, and Coal Extraction and Products	530	7.90	938	1.43
5	Chemicals and Allied Products	464	6.92	2,606	3.97
6	Business Equipment—Computers, Software, and Electronic Equipment	912	13.59	23,185	35.28
7	Telephone and Television Transmission	195	2.91	656	1.00
9	Wholesale, Retail, and Some Services (Laundries, Repair Shops)	1,191	17.75	9,847	14.98
10	Healthcare, Medical Equipment, and Drugs	703	10.48	7,629	11.61
12	Other—Mines, Constr, BldMt, Trans, Hotels, Bus Serv, Entertainment	394	5.87	3,647	5.55
Total		6,710	100.00	65,717	100.00

APPENDIX C. Industries requiring advanced skills

Three-digit SIC	Description	Firm-year obs.	Percent
131	Crude petroleum and natural gas	289	1.26
283	Drugs and medicinals	3,652	15.98
357	Office and computing equipment	3,529	15.44
361	Specialty transformers and switchgear apparatus	256	1.12
362	Electrical industrial apparatus	595	2.60
366	Communications equipment	3,048	13.34
367	Electronics components	4,639	20.30
382	Industrial measuring instruments	2,983	13.05
384	Surgical instruments	3,505	15.34
386	Photographic equipment and supplies	346	1.51
387	Clockwork-operated devices	14	0.06
Total		22,856	100.00