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Abstract

As managers approach retirement, their career horizons become shorter and they might start to behave opportunistically by taking a more risk-averse and short-term orientation. Long-term risky investments, such as research and development, can suffer the most from this problem as their payoff comes long after CEOs retire. To mitigate such behavior, most executive compensation contracts include long-term performance incentives. In this study, we hypothesize that long-term debt-like compensation in the form of defined benefit pension can make the career horizon problem more severe. We empirically examine the impact of managerial opportunism, influenced by pension compensation, on the research and development investments. We find that on average UK CEOs do not curtail research and development as their career horizons become shorter. But, the defined-benefit pension component of executive compensation leads CEOs, who are closer to retirement, to decrease R&D investments. Our results imply that executive compensation contracts need to be appropriately adjusted when managers approach retirement.

Keywords: Risk-taking, Executive compensation, Career horizon, Pension.

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As managers approach retirement, their career horizons become shorter and they might start to behave opportunistically by taking a more risk-averse and short-term orientation. Long-term risky investments, such as research and development, can suffer the most from this problem as their payoff comes long after CEOs retire. To mitigate such behavior, most executive compensation contracts include long-term performance incentives. In this study, we hypothesize that long-term debt-like compensation in the form of defined benefit pension can make the career horizon problem more severe. We empirically examine the impact of managerial opportunism, influenced by pension compensation, on the research and development investments. We find that on average UK CEOs do not curtail research and development as their career horizons become shorter. But, the defined-benefit pension component of executive compensation leads CEOs, who are closer to retirement, to decrease R&D investments. Our results imply that executive compensation contracts need to be appropriately adjusted when managers approach retirement.

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Top managers frequently make strategic investment decisions that have far-reaching implications for company shareholders and many other stakeholders. Research and development expenditures, mergers, acquisitions and restructurings are typical examples of such decisions. The agency theory whereby the interests of managers differ from those of shareholders and debtholders (Jensen and Meckling, 1976) has commonly been used to understand the managerial rationale behind these decisions. Sanders and Hambrick (2007) argue that key decisions taken by firms are also influenced by personal characteristics of chief executive officers (for example, education, experience, tenure).

In this study, we first focus on the age of CEOs, which is an important personal characteristic of executives. Younger managers have longer employable periods in the future (i.e., career horizon) compared to older managers. They have more career reputation concerns and are therefore motivated to undertake long-run investment projects. On the other hand, older executives have shorter career horizon and are more likely to forego long-run investments because the realized gains of these investments may not benefit them during the rest of their tenure. Empirical examination of this ethical dilemma is the main objective of our study. We ask the question: do executives with shorter career horizons act opportunistically?

Interestingly, extant research shows conflicting findings. A few studies find that older CEOs are less likely to undertake risky research and development (R&D) projects (e.g., Gibbons and Murphy, 1992a; Barker and Mueller, 2002; Lundstrum, 2002; Serfling, 2014). Yet, other studies fail to observe a reduction in R&D spending when CEOs approach retirement (Conyon and Florou, 2006; Cazier, 2011). Yim (2013) and Li, Low & Makhija (2017) document that in the United States, older CEOs undertake fewer acquisitions, and Zhang, Sabherwal, Jayaraman & Ferris (2016) find that younger CEOs in the United Kingdom are more likely to engage in acquisitions. Gibbons and Murphy (1992b) and Dechow and Sloan (1991) suggest that the disagreement may be due to the (equity) incentives provided to the CEOs nearing retirement. Equity-based compensation can affect managers' risk-taking behavior. To date, no consensus exists in the literature on whether CEO career horizon actually has a bearing on risky investments and whether incentive compensation plays a significant role. Moreover, the precise theoretical motivation for this (hypothesized) link is unclear. Why would CEOs be less motivated to invest in R&D and other risky projects as they approach retirement? What is the underlying mechanism that links career horizon to risk-taking decisions?

In this paper, we propose and test an incentive-based answer to these questions by using a framework that combines the agency theory (Jensen and Meckling, 1976) with the upper echelons theory (Hambrick and Mason, 1984). The former highlights the divergent interests of managers, shareholders & debtholders and the importance of providing incentive compensation, while the latter emphasizes the role of managerial characteristics in corporate decision-making. We specifically focus on the interaction between the career horizon of CEOs and the compensation incentives received by them.

We argue and show that it is the provision of defined benefit (DB) pension that is largely responsible for the finding that shorter career horizon of CEOs is associated with reduction in risky investments. Overall, CEOs do not necessarily curtail R&D spending as their career horizons shorten. But, when we take DB pension compensation into account, we find that it effectively influences R&D spending. Defined benefit pension induces managers to adopt conservative investment policy. When CEOs hold considerable defined benefit pension, they are motivated to take less risky investment decisions so that they can preserve their long-term pension benefits. This kind of behavior is more pronounced when CEOs approach retirement. Our result suggests that the career horizon effect found in some previous studies can, at least partially, be explained by pension compensation. Our result is consistent with that of Kalyta (2009a) who finds that firms reduce R&D expenditures when the CEOs have performance-contingent retirement plans.

The study contributes to the literature in a number of ways. First, we examine a relatively little studied form of executive compensation (Cadman and Vincent, 2015) and document that defined benefit pension compensation paid to CEOs can create the career horizon problem by providing a significant risk-reduction incentive. In an earlier study, Belkhir and Boubaker (2013) document that banks are more likely to hedge if their CEOs have more defined benefit pensions. Their findings indicate strong risk-reduction incentives provided by executive defined benefit pensions in banks. Unlike Belkhir and Boubaker (2013), our study examines a common but strategic type of risky investment, research and development.

Second contribution comes from the international character of our study, in particular the investigation of British companies. The vast majority of studies on DB pension examine US firms. Several authors examine the impact on firm risk (e.g., Anantharaman and Lee, 2014; Bennett, Guntay & Unal, 2015; Bekkum, 2016). Others investigate how corporate policies of US firms are also influenced by DB pension, for example dividend policy (e.g., Caliskan and Doukas, 2015; Eisdorfer, Giaccotto & White, 2015), cash holdings (Liu, Mauer & Zhang, 2014) and tax policy (e.g., Chi, Huang & Sanchez, 2017; Chaudhry, Yong & Veld, 2017). On the other hand, there is a dearth of studies analyzing the impact of DB pension on corporate policies and firm risk for non-US firms. Compared to the USA, both CEO power and standard pay incentives in the UK are relatively weak, making it harder for CEOs to influence corporate policies for their own benefit. Executive pension in the UK can also contribute to the career horizon problem. In the UK, executive pensions can take different forms: defined benefit pension, defined contribution pension and cash in lieu. Since the defined benefit pension plans are generally underfunded executives may suffer substantial losses when the firm defaults. UK government-backed pension protection fund (PPF) can only shield a tiny fraction of top UK executives' defined benefit pension (annual cap at £38,505 from 1st of April, 2017). Therefore, DB pension may provide unique risk-reduction incentives for UK top managers, while other forms of pension payment (defined contributions and cash in lieu) are not able to do so. Because the differences in DB pensions as well as the institutional and governance practices in the US and the UK can be important, performing an analysis with UK data can be a significant addition to the extant literature by providing interesting insights. In an earlier study, Kabir, Li &Veld-Merkoulova (2013) examine the effect of DB pension on the cost of debt of a sample of UK firms. Goh and Li (2015) document that British top managers are likely to use pension compensation to substitute cash bonuses, lowering the pay-performance sensitivity. Our study now focuses on another side-effect of DB pension: change in risky investments.

Third, we provide a new understanding of ethical practices in business, especially when a firm's strategic decisions interact with the compensation received by its executives. Our study is related to an earlier study of Inci (2012), which demonstrates that managers with shorter tenure are more likely to use profitable insider trading to compensate for the lower wages. We add to research highlighting the moral hazard problem associated with managerial risk-taking behavior and executive compensation, such as the study of Conyon and He (2016), who document that CEOs receive lower compensation when firms are detected in committing fraud.

Finally, we contribute to the literature by adopting a conceptual framework that combines insights from the upper echelons theory with those of the agency theory. Our research thus follows an increasing number of studies that started to examine risk related issues using multiple theory perspectives (e.g., Li and Tang, 2010; Bao, Fainshmidt, Nair & Vracheva, 2014).

Theory and hypotheses

In investigating the joint effect of CEO career horizon and pension compensation on corporate risk-taking decisions, we adopt a conceptual framework by combining the standard agency theory (Jensen and Meckling, 1976) with the upper echelons theory (Hambrick and Mason, 1984). The agency theory predicts that managers are motivated to act opportunistically to foster their own interests rather than those of the shareholders. They will therefore be less inclined to take decisions that will inadvertently increase firm risk to the extent that their own jobs will be in danger. Many scholars use agency theory in examining risk-taking activities and executive pay (e.g., Conyon and He, 2016). The upper echelons theory postulates that managerial background characteristics (i.e., age, education, experience) determine firm's strategic choices (i.e., risk-taking, product innovation, capital intensity) which in turn determine the level of its performance. Several studies adopt this theory in explaining various firm-specific issues and outcome (e.g., Bao et al., 2014; Delgado-García, de la Fuento-Sabate & de Quevedo-Puente., 2010). The particular managerial characteristic we focus on is the age of top executives.

Hambrick and Mason (1984) argue that older executives will be less inclined to pursue risky strategies not simply because of less physical and mental stamina, and greater psychological commitment to the organizational status quo, but also because of financial and career security considerations. They may not wish to endanger their retirement income by taking risky actions. As a proxy of corporate risk-taking decisions made by CEOs, we consider research and development expenditures of firms. These long-term investment decisions are characterized by uncertain future cash flows but have foremost implications for corporate performance.

Career horizon problem

The career horizon problem has garnered attention of academic research for a long time (see early studies by Dechow and Sloan, 1991; Brickley, Linck & Coles, 1999). The focus was on analyzing whether and how investment decisions varied among younger and older top managers. Older managers may have little or less career reputation concerns compared to their younger counterparts who might be more motivated to boost their reputation via greater effort and higher firm performance. Fama (1980) argues that explicit compensation contracts may not even be necessary because career concerns create sufficient implicit incentives for managers to exert optimal level of effort. The managerial labor market updates its belief on young managers' abilities and rewards bright ones with better future employment opportunities. However, these incentives for higher managerial effort and performance decline for CEOs with shorter remaining career horizons. In such a circumstance, Gibbons and Murphy (1992b) argue that incentive compensation can provide explicit incentives for superior performance.

R&D expenditure is a typical long-term investment decision that may not fully benefit CEOs with shorter career horizons. There are several reasons for it. First, R&D investment has a long and uncertain payback period compared to capital expenditures. It takes away firm's scarce cash resources which otherwise may be used for activities that serve older CEO's immediate personal and financial interests. Furthermore, R&D spending can be expensed in the current period that may lead to lower reported earnings. Studies show that retiring CEOs tend to artificially increase reported earnings for personal gains such as bonuses and pensions (e.g., Davidson, Xie, Xu & Ning, 2007; Kalyta, 2009b). Considering the direct relationship between R&D spending and current reported earnings, CEOs with short career horizons may therefore have the incentive to sacrifice such investment for their own interests. Several studies support this conjecture by documenting that older managers curtail R&D spending (e.g., Gibbons and Murphy, 1992a; Barker and Mueller, 2002; Lundstrum, 2002; Serfling, 2014). However, in an earlier study, Murphy and Zimmerman (1993) argue that the decline in R&D expenditure for outgoing CEOs is more likely to be explained by poor accounting performance rather than by short career horizons. Therefore, there is still a significant debate concerning existence and cause of career horizon problem. We hypothesize the following relationship:

H1: CEOs with shorter career horizon spend less on research and development compared to similar firms.

Executive compensation and R&D investment

To overcome the uncertainty associated with risky decision-making, the provision of stock-based compensation such as stock options and equity to managers is encouraged. Gibbons and Murphy (1992b) argue that equity incentive compensation can mitigate the career horizon problem by aligning the interests of managers with those of shareholders. With a large amount of equity incentives, executives will no longer be reluctant to undertake risky investments with long-term payoffs; they will rather be motivated to keep focusing on firm's success and enhancing future firm performance. Dechow and Sloan (1991) provide supporting evidence. They observe that equity-based pay reduces the tendency among older CEOs to cut R&D expenditures in their final years in office.

However, the real effectiveness of stock-based incentives remains inconclusive. Scholars point out negative aspects of stock options like short-termism, delayed investments and adoption of manipulative practices. Davidson et al., (2007) argue that incentive-based compensation can encourage older CEOs nearing retirement age to engage in income-increasing earnings management. But, Cheng (2004) finds that retiring CEOs who receive more stock option grants are not engaged in opportunistic activity like reducing their firms' R&D investments. Matta and Beamish (2008) observe that CEOs near retirement prefer to preserve the realized gains from their equity and in-the-money option holdings, and therefore avoid taking risky decisions like international acquisitions. Xu and Yan (2014) find that retiring CEOs' vested, in-the-money option holdings accentuate their preference for quicker and more certain investment returns.

So far, studies of the effects of executive compensation on the career horizon problem were limited to the equity-based incentive compensation only. However, debt-like compensation (such as pension benefits) has been shown to significantly affect managerial decisions (Kabir et al., 2013; Sundaram and Yermack, 2007). The agency theory provides a basis to understand manager's risk-taking behavior resulting from pension compensation. Jensen and Meckling (1976) argue that debt-like compensation could be used to alleviate the excessive risk-taking incentives of managers. Sundaram and Yermack (2007) state that as CEOs approach retirement, their compensation packages become disproportionately biased towards accrued pension-based compensation. They argue that defined benefit pension can be viewed similar to the debt of the firm because it is liable to pay a promised amount of pension to the executives after their retirement. Top managers' attitude for risk-taking may thus be affected when they become inside debt-holder due to defined benefit pension they hold. When a risky investment becomes successful, debt-holders do not derive any extra benefit because of their fixed claim. But, if the investment goes wrong, debt-holders suffer as they may even fail to recover their value of initial investment. In the extreme event of bankruptcy, the firm may not be able to pay the executives the full amount of pension it promised. Similarly, CEOs with defined benefit pension (inside debt holder) cannot claim any extra benefit if the risky R&D investments become successful; while they may suffer severely (e.g., cannot get the fully promised pension) if research and development projects turn bad.

The riskiness of the firm's activities has therefore a direct impact on the risk and value of CEO pensions. If pensions are relatively important compared to other types of compensation and to human capital of a CEO, as is the case of managers nearing retirement, the CEO is expected to maximize the pension value by decreasing R&D and other risky investments. Due to this asymmetric pay-off structure associated with risky investments, CEOs with considerable amount of defined benefit pension may become cautious with R&D spending. Therefore, defined benefit pension may discourage CEOs to undertake R&D investments.

Empirical research shows support of the proposition that pensions induce CEOs to become more risk-averse. Sundaram and Yermack (2007) document that firms that offer CEOs more pensions are less likely to become insolvent. Kalyta (2009a) observe that R&D expenditures decline when CEOs expect to receive retirement benefits. Cassell, Huang, Sanchez and Stuart (2012) also find that the accumulated pension benefits and deferred compensation reduce R&D expenditures of firms. Hence, our second hypothesis is:

H2: CEOs with more pension spend less on research and development compared to similar firms.

Age, pension compensation and R&D investment

Pension of CEOs is expected to increase with their tenure in the firm. As CEOs grow older, the impact of their pensions on investment decisions is also expected to increase dramatically. This is because older CEOs who are closer to access their pension are more likely to be concerned with the safety of their pensions and are more motivated to take actions to maximize the prospect of receiving their promised pension after retirement. Since R&D investments usually create a higher level of risk and may decrease the probability of defined-benefit pension payment, CEOs with a short career horizon would be reluctant to invest in such projects. Hence, we expect that larger amount of pensions will motivate CEOs to cut R&D spending when they approach retirement. Our third hypothesis is:

> *H3:* CEOs with shorter career horizon and more pension spend less on research and development compared to similar firms.

Methods

To test the first hypothesis − CEOs with short career horizons would spend less on research and development expenditures − we follow prior research and estimate the following multivariate regression model:

$$R\&D_{i,t} = ß_0 + ß_1\, Career\ horizon_{i,t} + \sum ß_2\, Controls_{i,t} + \sum ß_3\, Industry + \sum ß_4\, Year + \varepsilon_{i,t}\,. \quad (1)$$

The dependent variable $R\&D_{i,t}$ refers to the research and development expenditure of firm *i* in year *t*. Research and development expenditure decisions provide a good example of firm's risky investments because the outcome of these investments are far away and frequently do not provide the intended payoffs (Lundstrum, 2002; Cassell et al., 2012). We use several robust measures in estimating firm's R&D investment. First, following Serfling (2014), we scale R&D expenditure by total assets, both measured at the end of the fiscal year. Second, following Lundstrum (2012) and Cassell et al., (2012), we divide R&D spending by total sales. Third, in order to reflect the fact that R&D investment can be highly correlated with industry and firm-specific factors, we construct *Abnormal R&D* as the difference between the actual and the expected R&D spending[1,2].

All variables used in the study are defined in Appendix.

To estimate the effect of the career horizon of CEOs in regression model (1), we employ several indicators. First, we assume that CEO age has a linear effect on R&D expenditures and use the age of CEO (e.g., Barker and Muller, 2002; McClelland, Barker & Oh, 2012). To account for a possible non-linear effect of career horizon problem, we consider the age squared as the second measure (McClelland et al., 2012). The mandatory retirement age of 65 in the UK was only abolished in 2011 (by *The Employment Equality (Repeal of Retirement Age Provisions) Regulations 2011*), which means that there is a clear link between CEO age and career horizon in our sample. In regression model (1), our main focus is on the coefficient $ß_{1,}$ which measures the association of corporate risk-taking with the career horizon of CEOs.

In estimating the regression model, we include a set of control variables to account for firm-specific characteristics that can also influence R&D expenditure of firms.[3] These variables are CEOs' equity incentives, firm size, profitability, leverage, free cash flows and growth prospects. We account for industry-specific and time-specific effects by including industry and year dummies. In particular, controlling for

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[1] The expected R&D spending is calculated using the following regression specification:

$$R\&D_{i,t} = \alpha_0 + \alpha_1 \, R\&D_{industry\ median,\ t} + \sum \alpha_{2,\ j} \ Controls_{j,i,t} \ ,$$

where *R&D* $_{industry\ median}$ is the median R&D expenditure of firms operating in the same industry. A negative value of *Abnormal R&D* indicates that the firm spends less than expected; a positive value suggests higher-than-expected R&D.

[2] Since the obtained results are similar, we do not report results for *R&D/Sales* and *Abnormal R&D* in the paper.

[3] We do not include CEO tenure as an additional control as it is highly correlated with CEO age. Cassell et al. (2012) also report a similar finding. Nevertheless, we perform robustness check regressions including tenure and find that our main results remain qualitatively similar.

industry is important, as there might be significant cross-sectional variation across industries with regard to firm risk-taking and CEO characteristics.

Model (1) is estimated assuming a contemporaneous relationship between age and R&D investment. One can question this contemporaneous relationship and conjecture that future investment is more likely to be affected by current age of the CEO. One can also raise the issue of potential endogeneity whereby high (low) R&D firms might choose employing younger (older) CEOs. To alleviate these concerns, we perform a robustness analysis in which R&D of (t + 1) is regressed on age and firm characteristics measured from current year (t).

For the second hypothesis, we test whether or not defined benefit pension discourages R&D spending. We follow prior research (e.g., Cassell et al., 2012) and estimate the following regression model:

$$R\&D_{i,t} = \beta_0 + \beta_1\ Pension\ compensation_{i,t} + \sum \beta_2\ Controls_{i,t} + \sum \beta_3\ Industry + \sum \beta_4\ Years + \varepsilon_{i,t}\,. \qquad (2)$$

As standard in the literature (e.g., Cassell et al., 2012), we perform the analysis using OLS estimation with industry and year fixed effects. A common estimation concern for studies like ours is that of potential endogeneity between corporate investment and executive compensation. It is possible that high (low) risk firms choose CEOs who work with (without) defined benefit pensions or more (less) pension compensation. To address this endogeneity concern, we perform a robustness analysis by following the approach used by Cassell et al., (2012) and examine the impact of CEO pension of current year on future R&D investment (e.g., R&D in year t + 1).

In estimating Model (2), we employ five empirical proxies of pension compensation of CEOs. The first compensation variable of interest is annual pension increment. It is estimated as the difference in total transfer value of defined benefit pension between two consecutive years divided by total annual compensation (calculated as the sum of salary, bonuses, pension increment and the estimated value of restricted shares and option grants). The second proxy we employ is the natural logarithm of the total transfer value of pension in each year. The third construct is pension to equity ratio, measured as total transfer value of CEO pension scaled by value of his/her equity holdings (shares and stock options). As the fourth proxy, we use pension dummy. It equals to one if a CEO has defined benefit pension, and zero otherwise. The fifth proxy we use is relative pension to equity ratio. It is calculated as ratio of total transfer value of CEO's defined benefit pension to his or her equity value scaled by the firm's debt to equity ratio (Liu et al., 2014).

For the third hypothesis, we test whether there is a negative relation between pension compensation and R&D for the CEOs with short career horizon. The model we estimate is the same as Model (2). For a more precise examination of the career horizon problem, we follow prior research (e.g., Brickley et al., 1999; Serfling, 2014) and estimate the model for CEOs who are close to retirement. The impact of defined benefit pension is expected to be significant for retiring CEOs. They may be more concerned with the security of their pensions. We use 58 years (the value of the 75th percentile) as the cut-off point to define CEOs who are close to retirement.[4]

Sample

[4] Using a higher cut-off age (60 years) reduces the number of sample observations and the statistical significance, but does not materially change the conclusion of the study.

We collect data for UK FTSE 350 non-financial and non-utilities firms for the period 2003 – 2013. We start with 2003 because this is the first year UK publicly traded firms had to publicly disclose detailed information about directors' pensions. For firms to be included in the sample, we require availability of data on R&D, CEO compensation and firm-characteristics. R&D and firm characteristics data are collected from DataStream. The data on bonus, equity incentives and age of CEOs are collected from BoardEx, while that on defined benefit pension are manually collected from annual reports of firms.

Cheng (2004) suggests that only industries where R&D is intensive and crucial are meaningful for empirical analysis. Firms operating in trade, hotels and restaurants industries are therefore not included in the sample. Following Gibbons and Murphy (1992a), firms that spend over a quarter of total sales on R&D are excluded because the heavy dependence on R&D is mainly due to firms' idiosyncratic business models.[5] We require that R&D expenditures of firms are at least greater than 0.1% of total sales. We also exclude the observations where CEO is in his or her first year in office because it is difficult to judge whether R&D spending decisions in these cases were made by the new or the previous CEO. The final sample comprises panel data of 609 firm-year observations representing on average about 60 firms per year. Sixty-nine percent of the observations come from manufacturing industries, which include the chemicals, the allied products and the electronic products industries. Non-manufacturing industries represent 31% of the sample.

To remove the influence of extreme observations, the variables are winsorized at 1 percent level in both tails. The average amount of R&D spending of sample firms is £178.62 million, while the median is £23.8 million. Firms included in the sample are

[5] An examination of the annual reports of firm whose R&D intensity is greater than 25% reveals that the revenue of these firms mainly come from licensing intellectual property or contracts. This activity is not comparable with most of our sample firms that manufacture and sell their own products.

relatively large ones and spend a considerable amount of money on R&D investments. Table 1 presents the means, medians, standard deviations and pairwise correlations for the variables in this study. We find that the average firm's R&D expenditures are 3.82 percent of its total assets. The level of R&D intensity decreases from a high of about 5.28% for the 75th percentile firm to a low of about 0.57% for the 25th percentile firm.

[Insert Table 1 here]

The mean (median) value for annual CEO compensation is £3.38 million (£1.91 million). The mean annual pension increment is 8.9%. Forty-eight percent of CEOs in our sample have defined benefit pension. Examining a sample of US firms in 2006-2008, Cassell et al., (2012) find that 53% of firms have defined benefit pension schemes. The high cost of maintaining defined benefit pensions, especially after the recent financial crisis, may have contributed to the declining popularity of defined benefit pensions. We find that the mean transfer value of defined benefit pension in our sample is £2.02 million. Considering that less than half of sample firms have defined benefit pension, the average total pension value for CEOs with pension is more than £4 million. We observe that the average ratio of pension to accumulated equity value is 0.31 in our sample, compared to that of 0.40 in the US reported by Cassell et al., (2012). The relative pension to equity ratio indicates that more than three-quarter of CEOs in our sample have a pension to equity ratio which is less than the firm's debt to equity ratio. We also find that the equity incentives of median CEO equals 0.33%.

The analysis of various firm characteristics variables shows that the general profile of sample firms is large, less leveraged and profitable. Sample firms also have good growth prospects and positive free cash flows. We also observe that the average CEO in the sample is about 53 years old. Less than a quarter of CEOs are over 58 years old. Given that the usual age for (state) pension entitlement is 65 in the UK, the result indicates that the average CEO in our sample is far away from retirement.

The correlations among the variables is also shown in Table 1. We find that R&D intensity is negatively related to four different measures of defined benefit pension. It is positively related to equity incentives of CEOs. The age of CEO is positively related to all pension variables as well as to equity incentives. This positive correlation measure indicates that CEOs in general accumulate more pensions and equity incentives as they get older. Firm profitability, free cash flows and growth prospects are also positively related to R&D intensity, while firm size and leverage are negatively related to R&D intensity.

Results

In order to assess whether career horizon problems exists in our sample, we start with comparing raw values of R&D investments across groups of firms led by CEOs with very different age and pension compensation characteristics. Figure 1 presents average R&D investment for four extreme groups of firm-year observations: those in the highest/lowest age quartiles, and in the highest/lowest pension quartiles. Since in only 48% of observations CEOs have any defined benefit pension, all observations in the lowest pension quartile correspond to zero pension.

[Insert Figure 1 here]

The results presented in Figure 1 indicate that there is considerable heterogeneity in R&D investments across these groups of firms. While the firms led by younger CEOs without any pensions spend on average 5.86% of their assets on research and development, CEOs with the highest pension entitlements in the same age category only invest 0.99% in R&D. This difference is significant at 1% level (*t*-statistics of 4.87). Overall, Anova F-test for equality of the means of R&D $_t$ for all four groups is significant at 1% level, which confirms that there are significant variations between R&D investment levels, driven by age and pension benefits.

However, while Figure 1 confirms our expectations of the existence of a relation between age, pensions and R&D, this analysis does not take into account other variable. For example, it is possible that firm size, industry or profitability play an important role in R&D investments. For a formal treatment of such a relation, we turn to multivariate analysis in the following sections.

Age and R&D investment

Hypothesis 1 states that firms where CEOs have shorter career horizons will reduce research and development expenditures. To test this hypothesis, we estimate regression Model (1), where we regress R&D investments on the age of CEOs and control variables. The regression result is presented in Table 2 (industry and year effects are included but not reported). Regressions in Table 2 are estimated assuming both contemporaneous ($R\&D_t$ is used as the dependent variable) and lead-lag relationship ($R\&D_{t+1}$ is used as the dependent variable).

The results presented for Model (1) show that both contemporaneous and lagged CEO age the estimated regression coefficients are statistically insignificant. CEO age does not appear to influence R&D spending. The finding is in line with the lack of R&D reduction by retiring CEOs, found by Conyon and Florou (2006) for the UK and

Cazier (2011) for the US[6]. Both studies as well as our results do not support the hypothesis that CEOs with short career horizon reduce risky investment in R&D.

[Insert Table 2 here]

We explore the possibility of a non-linear effect of career horizon on R&D investments. Therefore, we estimate regression model that includes squared CEO (log) age. We find that in Regression (2) the regression coefficients of CEO age squared variable is statistically insignificant. When lagged R&D is used as the dependent variable in Regression (4), the coefficient of age squared is also insignificant. The results once again indicate that CEOs do not cut R&D spending as their career horizon becomes shorter. Therefore, we find no support for Hypothesis 1.[7]

With respect to control variables used in estimating the career horizon problem, we find that R&D spending is positively related with CEO's equity incentives, company's free cash flow and growth prospects. On the other hand, firm size, profitability and leverage are negatively associated with R&D investments. Most of these results are similar to those documented in prior studies. For example, equity compensation is meant to incentivize CEOs to invest more in risk-taking projects; this explains the observed positive relationship. Firms with higher free cash flows and better growth prospects also invest more in R&D. Poorly performing and highly leveraged firms tend to reduce risky investments.

Pension and R&D investment

To test our second hypothesis, we examine the effect of defined benefit pension on R&D spending. We report the regression results in Table 3. We present the results for

[6] Our results are not consistent with those of Barker and Muller (2012) and Serfling (2014). The difference can be due to different sample selection, research design and lack of appropriate control variables used in these studies.

[7] In unreported results, we use indicator variables of CEO age using different cut-off points (58 and 60 years) to proxy shorter career horizon. The results are similar.

contemporaneous R&D in Panel A and lagged R&D in Panel B. We observe that the coefficients of pension value, pension dummy and relative pension to equity are significantly negative in both Panel A and B. For example, the coefficient of pension dummy in Panel A of Table 3 is -0.94, significant at 1% level. It indicates that if a CEO has defined benefit pension, his or her firm will invest 0.94% less in R&D. For relative pension to equity, the coefficient is -0.20; it is also statistically significant at 1% level. Similar results are obtained for lagged R&D in Panel B. The regression coefficients of two remaining pension variables, pension increment and pension to equity ratio, are also negative across both panels, but not statistically significant (*t*-statistics ranging from -1.52 to -1.62). These findings indicate that defined benefit pension discourages R&D spending, supporting our second hypothesis. The evidence is in line with the results of Cassell et al., (2012). The signs of the coefficients of all control variables are significant and similar to those obtained earlier in Table 2.

[Insert Table 3 here]

Age, pension and R&D investment

We argue that the career horizon effect will be most acute when CEOs are closer to retirement and also hold a sizeable amount of defined benefit pensions. Hypothesis 3 predicts that research and development expenditures will be lower in firms that have CEOs with short career horizons and substantial pension compensation. If our conjecture (that pension drives the career horizon effect) is correct, we should observe that more defined benefit pension is associated with lower R&D for retiring CEOs.

We therefore proceed to estimate the impact of defined benefit pension on R&D spending for CEOs who are close to retirement. In the UK, the default age for retirement was 65 years before 2011. However, CEOs can choose to retire earlier for many different reasons. Conyon and Florou (2006) state that identifying retiring CEOs is a complicated task because firms usually do not announce the true reason behind their departures. In analyzing a sample of US CEOs, Cassell et al., (2013) find that the average age at retirement is 61 years and approximately 65% of CEOs retire when they are at least 60 years old. As we do not know the actual retirement date of CEOs, we decide to use a mechanical approach. Because the 75th percentile of CEO age in our sample is 57.3 years, we adopt 58 years as the cut-off rate to identify those CEOs who are close to retirement. This criterion also enables us to examine a relatively larger sample (124 firm-year observations).[8]

Table 4 reports the regression results. We observe in Panel A that all five coefficient estimates of pension variables are significantly negative for CEOs who are close to retirement. We find similar result in Panel B when we use lead R&D as an alternative proxy variable. Also, the magnitude of the coefficients increases when we restrict our sample to CEOs with shorter career horizons. For example, while in Panel A of Table 3 we found that, for the whole sample, existence of defined benefit pension decreases R&D by 0.94%, for the older CEOs this effect is equal to 2.18% (Regression 4 in Table 4). These findings indicate that CEOs are more likely to reduce R&D investments when two conditions are met: CEOs are closer to retirement and they have a large chunk of defined benefit pension. Older CEOs appear to be particularly concerned with not jeopardizing their pensions and therefore curtail risky investments. Hence, our third hypothesis is supported.

[Insert Table 4 here]

Robustness tests

[8] In untabulated results, we use an alternative cut-off age of 60 years. The sample size then reduces to 72 observations. Yet, the results remain very similar.

Our main results are based on the multivariate OLS regressions, designed to test whether a CEO's pension pay ($Pension_t$) will affect his or her firm's contemporary and future research and development spending (RD_t and RD_{t+1}). A possible endogeneity concern is that our explanatory variable (CEO pension) may be correlated with the error term of dependent variable (R&D spending). For example, a CEO's pay structure design may be subject to his or her firm's investment appetite. To address such a concern, we employ a two-stage least square model. In the first stage, we use multivariate regressions to predict a CEO's pension compensation. By using US data, Sundaram and Yermack (2007) and Cassell et al., (2012) find out that a CEO's pension is affected by his or her age, tenure and a set of firm characteristics. We follow their method in this stage. In the second stage, we replace the dependent variable of real CEO pension with the predicted CEO pension value from the first stage regression.

[Insert Table 5 here]

These results are reported in Table 5. In Panel A, we report the first stage regression results. Similar with Sundaram and Yermack (2007) and Cassell et al., (2012), we observe a positive relation between a CEO's pension value and his or her age and/or tenure. Larger and more profitable firms are more likely to award higher pensions to their CEOs. In Panel B, we find out that a firm's research and development spending is negatively related with its predicted pension increment (column 1) and pension value (column 2). The results are consistent with our previous findings in Table 3, when we use OLS models. In other words, we still find that pensions discourage R&D spending by using predicted pension value (controlling for other factors that determine a CEO's pension value). Therefore, the endogeneity concern in our study may be mitigated, if not completely eliminated.

Discussion and conclusions

This study is an empirical examination of managerial opportunistic behavior that can arise from their remaining career horizon and pension compensation. Prior studies document that risk-taking decisions of CEOs are influenced by their career concerns (Barker and Mueller, 2002; Davidson et al., 2007; Mata and Beamish, 2008). The career horizon of CEOs is expected to be positively related to R&D investments because the uncertainty of payoff and the long payback period may not fully benefit older CEOs. Antia, Pantzalis & Park (2010) argue that managers approaching retirement age become more myopic as they tend to adopt a short-term orientation and place less weight on cash flows occurring after their employment time horizon. Such an opportunistic investment behavior will have a considerable negative bearing on company growth and performance.

Agency theory argues that awarding risk-averse managers with stock- and options-based compensation is expected to motivate them to undertake riskier investments. Previous studies highlight the importance of equity-based incentive compensation as a remedy of the career horizon problem. For example, Dechow and Sloan (1991) find that CEOs approaching retirement cut R&D spending but equity incentives help to reduce this career horizon problem.

Our study is one of the first ones to examine the role of the opposite incentive, provided to the managers by offering defined benefit pension compensation, in the career horizon problem. We hypothesize that the increasing amount of built-up pension entitlements at the end of a CEO’s career provides an effective motivation to reduce risky investment and, therefore, can explain the career horizon effect. Given the risk-reducing incentive provided by defined benefit pension, we hypothesize that CEOs with more pension will curtail R&D expenditures. Moreover, as CEOs career horizon shortens we hypothesize that pension pay will further discourage risky investments. Our argument is that defined benefit pension compensation makes CEOs potential debt-holders of the firm, and a shorter career horizon increases the importance of pension compensation relative to other compensation components (salary, bonus, shares and stock options). The combined effect of both features would be that this category of CEOs would be even more conservative.

We use a novel dataset comprising of UK firms from 2003–2013 and document interesting results. First, we do not find that CEOs spend less on R&D when their career horizons become shorter in general. The result is consistent with the findings of prior studies (Conyon and Florou, 2006; Cazier, 2011). Second, we find that defined benefit pension discourages R&D investments. The result suggests that defined benefit pension effectively influences CEOs' risk-taking behavior. Our finding is consistent with Cassell et al. (2012) who examine a sample of US firms. Third, we find that the negative influence of pension on R&D spending is more severe for CEOs who are closer to retirement. Overall, our results suggest that the career horizon effect found in some previous studies can be, at least partially, explained by the CEO incentive structure where pension holdings may motivate CEOs to take less risky decisions in order to preserve their long-term pension benefits.

By decomposing the problem into remaining career horizon and compensation incentives, we show that both elements play an integral role in explaining changes in CEO investment behavior towards the end of their career. Our study thus provides a new evidence on the interactive relationship between career concern, executive compensation and strategic investments.

General implications

The findings of our study has significant implication for the board of directors. Board need to be aware of the ethical as well as economic consequences of the career horizon problem faced by older managers. They need to consider the combined 'side-effects' of all different compensation components of top managers and their career horizons on corporate strategic decisions. This is important because boards are responsible to effectively design optimal compensation contracts (both amount and types of pay and their differential impacts). They have to make appropriate adjustments in the structure of managerial pay packages especially for those top managers who are approaching the end of their career horizon and as such require additional balancing of incentives.

Our study has implications for managers, especially those who are nearing the end of their career horizon. They should be aware that investors and boards will rightly be concerned with the likelihood of managers engaging in myopic behaviors and may not therefore remain idle in providing these managers much discretion overs firm's investment policies. If risk-reduction is the primary objective of short-horizon managers, then they can consider avenues other than investment policies. Furthermore, since managers' career horizons need not end with retirement (Brickley et al., 1999), it may still be beneficial for them not to neglect numerous post-retirement opportunities.

International implications

Our study has significant international implications too because defined benefit pension prevails throughout the world. According to Antolin, Pugh & Stewart (2008), DB pension is a reflection of western philosophy that pension should be a plan of lifetime payment to replace pre-retirement income. Such a philosophy could partly explain why DB pension is predominant in North America and Western Europe. But, DB pension is also used in Latin America (e.g., Brazil), central Europe (e.g., Hungary), Oceania (e.g., Australia), Africa (e.g., South Africa) and Asia (e.g., Japan). For instance, "The Defined Benefit Occupational Pension Act" introduced in Japan in 2002 encourages Japanese firms to offer defined benefit corporate pension fund (*kakutei kyufu kigyo nenkin*) to their employees, which is in line with the lifetime employment culture in Japan. OECD (2013) reports that 18 out of 35 OECD (The Organisation for Economic Co-operation and Development) countries provide DB pension for all public sector workers, while private (occupational) scheme of DB pension is mandatory or quasi-mandatory in three countries: Iceland, the Netherlands and Switzerland. According to Willis Towers Watson Global Pension Assets Study 2017, global DB pension funds had total assets of $18,946 billion and accounted for 52% of total pension funds' assets at the end of 2016.

Although the growing DB pension deficit is forcing more and more sponsors to close such plans for new employees and offer defined contribution pension as the alternative (e.g., Gardner, McFarland & Scasso, 2017), DB pension will still remain internationally visible in the foreseeable future. The implications of our study therefore goes well beyond the UK. Risky but value-added investment could be forfeited if CEOs have a large amount of defined benefit pension in these countries as well.

Our study is also globally interesting because of a growing international evidence of age-related opportunistic behavior of CEOs. Analyzing public listed Chinese companies, Xie (2015) documents that investment propensity and efficiency are different between young and old Chinese CEOs. Young CEOs with longer career horizon are more likely to improve investment efficiency, resulting in a growth of firm value. Monem (2013) analyzes firms from Australia and documents that the age of CEO is positively related with the probability of CEO duality. He argues that age and tenure would help CEOs to grab the position of chair, which is not necessarily in the best interests of shareholders. Dang et al. (2017) employ data from eight East and Southeast Asia countries to examine the impact of CEO age on takeover outcomes. They find that acquirers are more likely to use partial-control takeovers if the CEO of target firm is old. They explain that older CEOs of target firms are more likely to resist a full-control acquisition attempt because they are more likely to be fired after takeover compared to younger CEOs. By analyzing UK firms, our paper thus enriches the study of CEO career horizon. The study highlights the fact the impact of CEO age on short-sighted behaviors is conditional on CEO defined benefit pension. For all other countries with defined benefit pension in operation, our study clearly suggests that managerial defined benefit pension should be considered in the research design of studies examining career horizon.

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Appendix. Variable definitions

Variable	Definition
Annual Compensation	The total amount of a CEO's salary, bonus, pension increment and estimated value of options and shares grants.
Pension Increment	The annual increase in total transfer value of a CEO's defined benefit pension scaled by CEO annual compensation.
Pension Value	The natural log of total transfer value of a CEO's defined benefit pension.
Pension to Equity	The total transfer value of a CEO's defined benefit pension scaled by the estimated value of CEO's accumulated equity incentives (the sum of value of ownership of shares and options).
Pension Dummy	Dummy variable equals one if a CEO has defined benefit pension, otherwise zero.
Relative Pension to Equity	The ratio of total transfer value of a CEO's defined benefit pension to his or her equity value scaled by the firm's debt to equity ratio.
Equity Incentives	The total number of shares and options held by a CEO scaled by the firm's total number of common shares outstanding.
CEO Age	The natural log of the age of the CEO.
R&D	The amount of research & development expenditures of a firm scaled by the book value of its total assets.
Firm Size	The natural log of the book value of a firm's total assets.
Profitability	Earning before interests and taxes scaled by the book value of total assets.
Leverage	Book value of firm's long-term debt scaled by the book value of total assets.
Free Cash Flows	Cash flows from operations minus capital expenditures, scaled by the book value of total assets.
Growth	Market value of common equity plus book value of total debt divided by the book value of total assets.

Figure 1. R&D investments, CEO age and defined benefit pensions.

This Figure presents mean R&D spending in subsamples based on CEO age and pension value. The values of Anova F-test for equality of the means of $R\&D_t$ for all four groups is 4.75 ($p < 0.01$); while that for $R\&D_{t+1}$ for all four groups is 4.33 ($p < 0.01$).

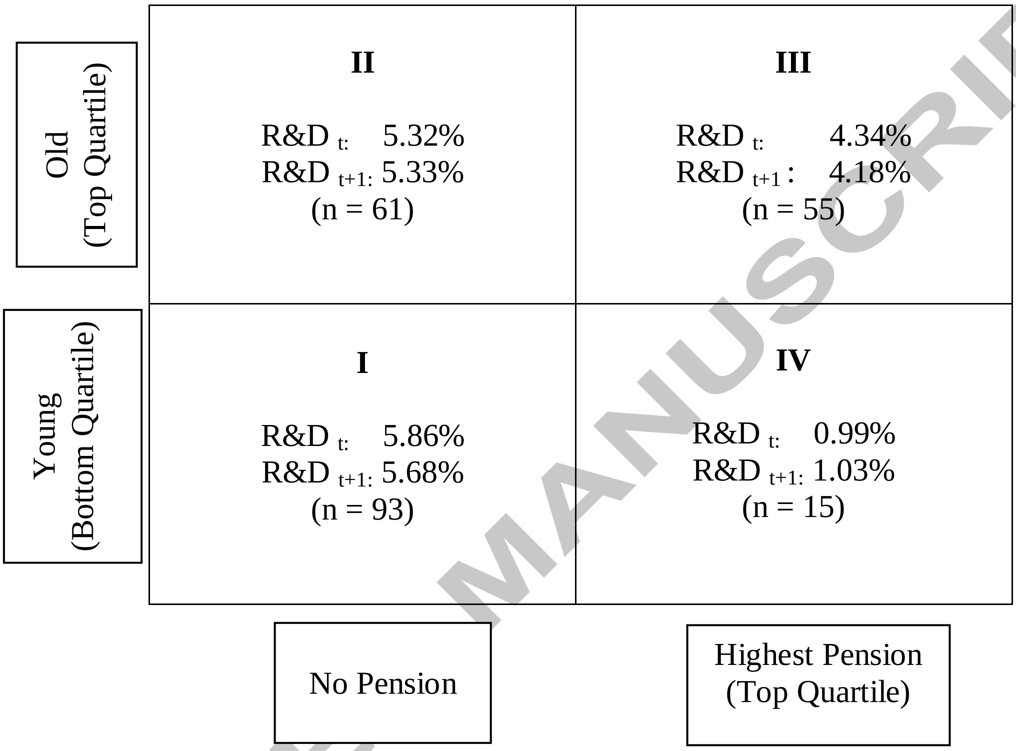

Table 1. Descriptive statistics and correlations

Variables	Mean	Med.	S.D.	1	2	3	4	5	6	7	8	9	10	11	12
1. R&D (%)	3.82	2.12	4.52	1.00											
2. CEO Age (years)	53.38	55.58	5.69	-0.03	1.00										
3. Pension Increment (%)	8.90	0.00	14.07	**-0.09**	**0.14**	1.00									
4. Pension Value (£ millions)	2.02	2.20	3.75	**-0.17**	**0.15**	**0.72**	1.00								
5. Pension to Equity (ratio)	0.31	0.00	0.61	**-0.06**	**0.20**	**0.75**	**0.59**	1.00							
6. Pension Dummy	0.48	0.00	0.50	**-0.18**	**0.10**	**0.65**	**0.96**	**0.52**	1.00						
7. Relative Pension to Equity (ratio)	1.09	0.00	2.72	0.02	**0.15**	**0.63**	**0.46**	**0.78**	**0.42**	1.00					
8. Equity Incentives (%)	1.45	0.33	5.05	**0.24**	**0.16**	**-0.08**	**-0.17**	**-0.11**	**-0.17**	**-0.09**	1.00				
9. Firm Size (£ billions)	12.09	1.31	30.91	**-0.38**	**0.15**	0.06	**0.24**	-0.00	**0.12**	**-0.14**	**-0.28**	1.00			
10. Profitability (%)	11.68	11.18	7.81	**0.09**	-0.01	**0.09**	**0.10**	**0.08**	0.06	**0.28**	0.05	-0.07	1.00		
11. Leverage (%)	15.12	14.49	12.08	**-0.39**	0.04	-0.04	**0.10**	-0.05	**0.10**	**-0.22**	**-0.19**	**0.35**	**-0.25**	1.00	
12. Free Cash Flows (%)	7.77	7.12	7.30	**0.32**	-0.04	-0.02	-0.04	0.03	-0.06	**0.16**	0.01	**-0.18**	**0.56**	**-0.29**	1.00
13. Growth (ratio)	1.72	1.45	1.10	**0.35**	-0.02	-0.01	-0.01	-0.01	0.00	**0.27**	**0.16**	**-0.37**	**0.60**	**-0.35**	**0.67**

Correlations in bold indicate statistical significance at 5% level.

Table 2. CEO career horizon and R&D investments

This table presents OLS regression results in which the dependent variable is R&D expenditure/total assets ratio. In columns1–2, the dependent variable is measured in year t. In columns 3–4, the dependent variable is measured in year (t+1). Test statistics (in parentheses) are adjusted using White heteroskedasticity-consistent standard errors. ***, **, and * represent significance level of 1%, 5% and 10%, respectively.

	Dependent Variable: R&D $_t$		Dependent Variable: R&D $_{t+1}$	
	(1)	(2)	(3)	(4)
Constant	3.52	132.18	4.76	97.26
	(0.61)	(0.96)	(0.75)	(0.62)
CEO Age	1.30	-63.90	1.15	-45.73
	(0.94)	(-0.91)	(0.77)	(-0.57)
CEO Age Squared		8.24		5.93
		(0.93)		(0.59)
Equity Incentives	0.07**	0.06*	0.06*	0.05
	(2.51)	(1.89)	(1.78)	(1.39)
Firm Size	-0.42***	-0.40***	-0.44***	-0.43***
	(-3.76)	(-3.53)	(-3.73)	(-3.52)
Profitability	-0.19***	-0.19***	-0.21***	-0.22***
	(-4.35)	(-4.37)	(-4.01)	(-4.04)
Leverage	-0.07***	-0.07***	-0.07***	-0.07***
	(-4.24)	(-4.13)	(-3.82)	(-3.73)
Free Cash Flow	0.17***	0.17***	0.16***	0.16***
	(3.42)	(3.41)	(3.22)	(3.21)
Growth	1.39***	1.40***	1.38***	1.38***
	(5.16)	(5.14)	(4.39)	(4.39)
Industry effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.30	0.30	0.25	0.25
No. of obs.	609	609	603	603

Table 3. CEO pension and R&D investments

This table presents OLS regression results in which the dependent variable is R&D expenditure/total assets ratio. In columns1–5, the dependent variable is measured in year t. In columns 6–10, the dependent variable is measured in year (t+1). Test statistics (in parentheses) are adjusted using White heteroskedasticity-consistent standard errors. ***, **, and * represent significance level of 1%, 5% and 10%, respectively.

Panel A. Dependent Variable: R&D $_t$

	(1)	(2)	(3)	(4)	(5)
Constant	2.38	1.53	1.61	1.72	-0.21
	(0.41)	(0.27)	(0.28)	(0.31)	(-0.04)
Pension Increment	-0.02				
	(-1.52)				
Pension Value		-0.08**			
		(-2.07)			
Pension to Equity			-0.42		
			(-1.57)		
Pension Dummy				-0.94***	
				(-3.13)	
Relative Pension to Equity					-0.20***
					(-2.62)
CEO Age	1.55	1.63	1.79	1.63	2.26
	(1.12)	(1.22)	(1.30)	(1.23)	(1.60)
Equity Incentive	0.06**	0.06**	0.06**	0.05*	0.04
	(2.27)	(2.06)	(2.04)	(1.81)	(1.39)
Firm Size	-0.40***	-0.37***	-0.42***	-0.38***	-0.43***
	(-3.59)	(-3.20)	(-3.77)	(-3.37)	(-3.83)
Profitability	-0.18***	-0.18***	-0.18***	-0.18***	-0.18***
	(-4.22)	(-4.21)	(-4.20)	(-4.23)	(-3.99)
Leverage	-0.07***	-0.07***	-0.07***	-0.06***	-0.07***
	(-4.38)	(-4.29)	(-4.33)	(-4.24)	(-4.55)
Free Cash Flows	0.16***	0.16***	0.16***	0.15***	0.16***
	(3.31)	(3.19)	(3.37)	(3.13)	(3.21)
Growth	1.39***	1.46***	1.38***	1.48***	1.53***
	(5.18)	(5.40)	(5.14)	(5.56)	(5.75)
Industry Effects	Yes	Yes	Yes	Yes	Yes
Years Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.31	0.31	0.31	0.31	0.31
No. of Obs.	609	609	609	609	609

Table 3. (Continued)

Panel B. Dependent Variable: R&D $_{t+1}$

	(6)	(7)	(8)	(9)	(10)
Constant	3.47	2.24	2.76	2.59	0.89
	(0.54)	(0.36)	(0.43)	(0.42)	(0.14)
Pension Increment	-0.02				
	(-1.62)				
Pension Value		-0.10**			
		(-2.38)			
Pension to Equity			-0.43		
			(-1.59)		
Pension Dummy				-1.11***	
				(-3.31)	
Relative Pension to Equity					-0.20***
					(-2.66)
CEO Age	1.43	1.57	1.67	1.56	2.15
	(0.96)	(1.08)	(1.10)	(1.08)	(1.44)
Equity Incentive	0.05	0.04	0.05	0.03	0.03
	(1.55)	(1.29)	(1.38)	(1.07)	(0.82)
Firm Size	-0.42***	-0.37***	-0.44***	-0.39***	-0.45***
	(-3.58)	(-3.11)	(-3.75)	(-3.32)	(-3.81)
Profitability	-0.20***	-0.21***	-0.21***	-0.20***	-0.20***
	(-3.90)	(-3.89)	(-3.89)	(-3.91)	(-3.71)
Leverage	-0.07***	-0.07***	-0.07***	-0.07***	-0.08***
	(-3.92)	(-3.86)	(-3.88)	(-3.81)	(-4.07)
Free Cash Flows	0.16***	0.15***	0.16***	0.14***	0.15***
	(3.10)	(2.95)	(3.17)	(2.88)	(3.00)
Growth	1.38***	1.46***	1.37***	1.48***	1.52***
	(4.42)	(4.66)	(4.39)	(4.80)	(4.87)
Industry Effects	Yes	Yes	Yes	Yes	Yes
Years Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.25	0.25	0.25	0.26	0.26
No. of Obs.	603	603	603	603	603

Table 4. CEO pension and R&D investments for CEOs with short career horizon

This table presents OLS regression results in which the dependent variable is R&D expenditure/total assets ratio for the sub-sample of CEOs older than 58 years. In columns 1–5, the dependent variable is measured in year t. In columns 6–10, the dependent variable is measured in year (t+1). Test statistics (in parentheses) are adjusted using White heteroskedasticity-consistent standard errors. ***, **, and * represent significance level of 1%, 5% and 10%, respectively.

Panel A. Dependent Variable: R&D $_t$

	(1)	(2)	(3)	(4)	(5)
Constant	-40.16	-33.82	-38.12	-29.82	-39.81
	(-1.17)	(-1.00)	(-1.10)	(-0.88)	(-1.09)
Pension Increment	-0.06***				
	(-2.69)				
Pension Value		-0.26***			
		(-2.64)			
Pension to Equity			-1.28***		
			(-3.09)		
Pension Dummy				-2.18***	
				(-3.08)	
Relative Pension to Equity					-0.25***
					(-2.68)
CEO Age	8.57	6.30	8.33	5.59	8.57
	(1.08)	(0.81)	(1.04)	(0.72)	(1.03)
Equity Incentive	0.09**	0.08**	0.09**	0.08*	0.05*
	(2.17)	(2.11)	(2.17)	(1.92)	(1.81)
Firm Size	0.27	0.50	0.22	0.44	0.24
	(1.08)	(1.08)	(0.85)	(1.63)	(0.87)
Profitability	-0.08	-0.09	-0.07	-0.10	-0.08
	(-1.24)	(-1.53)	(-1.10)	(-1.63)	(-1.28)
Leverage	-0.01	-0.02	-0.02	-0.03	-0.03
	(-0.36)	(-0.55)	(-0.50)	(-0.66)	(-0.72)
Free Cash Flows	0.22**	0.21**	0.21**	0.21**	0.20**
	(2.51)	(2.60)	(2.44)	(2.61)	(2.36)
Growth	1.36**	1.58***	1.30**	1.57***	1.47***
	(2.62)	(3.21)	(2.41)	(3.23)	(3.39)
Industry Effects	Yes	Yes	Yes	Yes	Yes
Years Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.47	0.46	0.48	0.47	0.48
No. of Obs.	124	124	124	124	124

Table 4. (Continued)

Panel B. Dependent Variable: R&D $_{t+1}$

	(6)	(7)	(8)	(9)	(10)
Constant	-37.44	-28.59	-35.70	-24.57	-36.27
	(-0.99)	(-0.77)	(-0.94)	(-0.67)	(-0.91)
Pension Increment	-0.06**				
	(-2.44)				
Pension Value		-0.30**			
		(-2.46)			
Pension to Equity			-1.26***		
			(-2.87)		
Pension Dummy				-2.44***	
				(-2.75)	
Relative Pension to Equity					-0.27**
					(-2.48)
CEO Age	7.90	4.94	7.72	4.27	7.73
	(0.90)	(0.58)	(0.87)	(0.50)	(0.84)
Equity Incentive	0.09	0.08	0.08	0.07	0.06
	(1.59)	(1.41)	(1.60)	(1.26)	(1.11)
Firm Size	0.20	0.46	0.15	0.38	0.17
	(0.79)	(1.61)	(0.59)	(1.56)	(0.59)
Profitability	-0.04	-0.05	-0.04	-0.06	-0.04
	(-0.72)	(-0.91)	(-0.59)	(-1.02)	(-0.64)
Leverage	0.01	0.01	0.01	-0.01	-0.01
	(0.27)	(0.02)	(0.15)	(-0.09)	(-0.12)
Free Cash Flows	0.24***	0.24***	0.24***	0.24***	0.22**
	(2.73)	(2.84)	(2.66)	(2.84)	(2.51)
Growth	1.29**	1.50***	1.23**	1.49***	1.64***
	(2.21)	(2.68)	(2.04)	(2.70)	(2.81)
Industry Effects	Yes	Yes	Yes	Yes	Yes
Years Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.43	0.44	0.44	0.45	0.46
No. of Obs.	124	124	124	124	124

Table 5. Two-stage least-squares regressions (2SLS) for CEO pension and R&D investments

This table presents the results of 2SLS analysis. First–stage regression results, where pensions are dependent variables, are presented in Panel A. Second-stage results are presented in Panel B, where we replace pension variables with the predicted value from the fist-stage regression. Test statistics (in parentheses) are adjusted using White heteroskedasticity-consistent standard errors. ***, **, and * represent significance level of 1%, 5% and 10%, respectively.

Panel A. First-stage results

	Pension Increment	Pension Value	Pension to Equity	Relative Pension to equity
	(1)	(2)	(3)	(4)
Constant	-38.70**	-14.01***	-3.33***	-13.81***
	(-2.05)	(-2.62)	(-4.14)	(-3.20)
CEO Age	5.86	0.79	0.79***	3.31***
	(1.17)	(0.56)	(3.59)	(2.98)
CEO tenure	2.19***	0.76***	0.06**	0.08
	(2.95)	(3.51)	(2.17)	(0.79)
Firm Size	1.08***	0.73***	0.01	0.02
	(3.11)	(7.80)	(-3.73)	(0.24)
Profitability	0.35***	0.09***	0.01**	0.08***
	(3.26)	(3.23)	(2.04)	(3.50)
Leverage	-0.11**	0.01	-0.01**	-0.02***
	(-2.16)	(0.60)	(-2.10)	(-3.23)
Free Cash Flow	-0.28**	-0.11***	-0.01	-0.05**
	(-2.05)	(-3.23)	(-0.86)	(-2.01)
Growth	-0.76	0.46**	-0.06*	0.49**
	(-0.99)	(2.16)	(-1.94)	(2.75)
Industry effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.09	0.14	0.13	0.16
No. of obs.	609	609	609	609

Table 5. (Continued)

Panel B. Second-stage results

	(1)	(2)	(3)	(4)
Constant	-20.50**	-1.29	8.01***	8.49***
	(-2.58)	(-0.37)	(3.73)	(3.92)
Predicted Pension Increment	-0.47***			
	(-3.83)			
Predicted Pension Value		-0.97***		
		(-3.07)		
Predicted Pension to Equity			-1.18	
			(-0.79)	
Predicted Relative Pension to Equity				0.10
				(0.24)
Equity Incentive	0.10***	0.11***	0.08***	0.07***
	(4.11)	(4.32)	(3.00)	(2.65)
Firm Size	0.04	0.31	-0.37***	-0.40***
	(0.26)	(1.29)	(-3.28)	(-3.64)
Profitability	-0.03	-0.10*	-0.17***	-0.20***
	(-0.41)	(-1.85)	(-3.67)	(-3.77)
Leverage	-0.12***	-0.06***	-0.07***	-0.06***
	(-5.10)	(-3.98)	(-4.05)	(-3.37)
Free Cash Flows	0.03	0.06	0.16***	0.17***
	(0.53)	(0.93)	(3.21)	(3.22)
Growth	1.17***	1.95***	1.34***	1.35***
	(4.34)	(5.93)	(4.77)	(3.94)
Industry Effects	Yes	Yes	Yes	Yes
Years Effects	Yes	Yes	Yes	Yes
Adj. R Square	0.32	0.32	0.30	0.47
No. of Obs.	609	609	609	609

Highlights

- Long-term debt-like compensation can aggravate the career horizon problem
- We examine the impact of pension compensation on the research and development investments
- On average, UK CEOs do not curtail research and development as their career horizons become shorter
- Defined-benefit pension component of executive compensation drives the career horizon problem in R&D investments
- To mitigate career horizon problem, executive compensation contracts need to be optimally adjusted when managers approach retirement