

R&D Capital and Executive Compensation

Abstract

Intangible assets have become a key determinant for firm growth and the creation of competitive advantage. Widespread technological changes direct much attention to the importance of R&D capital in the value-creation process. However, managers' efforts in R&D activities are not directly observable and managers are endowed with private information about the value and opportunities of the firm's investment in R&D. In the presence of moral hazard and asymmetric information, the design of managerial compensation contracts plays an important role to induce managers to optimize the investment/management of R&D capital. Accounting earnings and stock prices are most frequently observed as performance measures in executive compensation contracts, but may not fully reflect managerial efforts in investing/managing R&D activities. Under generally accepted accounting principles, R&D capital is not reported in firms' financial statements and the investment in research and development are required to be immediately expensed. Thus, tying executive compensation to the aggregate earnings numbers, such as traditional ROA or ROE, may induce undesirable managerial behaviors of over-/under-investment and reduce contract efficiency. Our results show that the CEO cash compensation is less sensitive to traditional accounting earnings and stock returns when firms have higher R&D capital, suggesting that the boards of directors adjust executive incentive arrangements to discourage misallocation of managerial efforts on R&D activities.

Key words: Executive Compensation; R&D Capital; Intangible assets; ROE; Incentive Contract

中文摘要

無形資產已成為公司成長及創造競爭優勢的關鍵決定因素，近年來科技日新月異，研發活動在企業價值創造過程中的重要性更是備受關注。然而，由於經營權與所有權分離，公司高階主管對研發的機會及其潛在的價值有較多的資訊，且其在研發上的努力無法直接觀察而得知；在道德危機與資訊不對稱的情況下，高階主管獎酬契約的設計，在激勵高階主管作出最佳研發支出決策上，扮演了重要的角色；會計盈餘與股票價格常被用來作為高階主管獎酬契約的績效指標，但是此二項指標並不能充分反應出經理人對研發活動所投入的努力。在一般公認會計原則的規範下，研發支出必須立即認列為費用，且研發資本並未在財務報表上認列。因此，如果使用傳統的盈餘數字（如資本報酬率或股東權益報酬率）作為績效指標來決定高階主管的獎酬時，會低估高階主管於研發支出所投入的努力，而無法給予高階主管誘因以做最適當的研發決策，並且降低了獎酬契約的效率。本研究結果發現當公司的研發資本較高時，高階主管現金獎酬和傳統的盈餘數字及股票報酬的敏感性均下降，顯示董事會調整獎酬契約以提高契約效率並避免給予高階主管在研發活動上的不當誘因。

關鍵詞：高階主管獎酬、研發資本、無形資產、股東權益報酬率、獎酬契約

I. Introduction

In recent years, intangible assets have become a key determinant for firm growth and the creation of competitive advantage (Porter 1980; Lev 2001). A firm's value not only depends on the value of its physical assets, such as plant and equipment, but most importantly, on the intangible assets it possessed, such as brand names, patents, and know-how. Thus, the creation, acquisition, and management of intangible assets are activities that gain importance in the value-creating process of modern firms. However, managers' efforts in managing intangibles are not directly observable and managers are endowed with private information about the value and opportunities of the firm's investment in intangible assets. In the presence of moral hazard and asymmetric information, the design of managerial compensation contracts plays an important role to induce managers to optimize the investment/management of intangible assets.

Accounting numbers and stock prices are most frequently observed as performance measures in executive compensation contracts (Murphy 2000). However, traditional earnings measures and stock prices may not fully reflect managerial efforts in investing/managing intangible assets. Under generally accepted accounting principles, many types of intangible assets are not reported in firms' financial statements and the investment in creating intangibles, such as research and development spending and advertising expenditures, are considered as period costs and required to be immediately expensed. When executive compensation is tied to the aggregate accounting numbers, such accounting treatments on intangible assets and the related investments induce undesirable managerial behaviors of underinvestment, especially when the executive approaches retirement, i.e. horizon problem (Dechow and Sloan 1991; Cheng 2004) and when such "expenses" jeopardizes the ability to report positive or increasing income in the current period, i.e. myopia problem (Baber, Fairfield, and Haggard 1991 and Cheng 2004).

On the other hand, a firm's stock price is a function of the managers' actions and some exogenous noise factors that are beyond the managers' control (Sloan 1993). Thus, although the stock price of a firm incorporates market expectation on firm value, it may be a noisy indicator of managerial efforts in managing intangible assets. In addition, prior studies document that stock prices do not fully incorporate the value of off-balance assets (Hall 1993; Hall and Hall 1993; Lev and Sougiannis 1996).¹ Chan, Lakonishok, and Sougiannis (2001) further show that R&D intensity is positively associated with return volatility, which increases the noise of the stock return as a performance measure. Overall, solely relying on aggregate earnings numbers and/or stock prices may not provide executives with sufficient incentives to invest in creating/managing intangible assets and may impair the efficiency of compensation contract. The purpose of this study is to investigate whether the boards of directors adjust executive incentive arrangements to reward and encourage managerial efforts in managing intangible assets.

Among various types of intangible assets, we specifically focus on firms' R&D

¹ There are also observers suggesting that investors overestimate the benefits from R&D and thus valuations attached to R&D-intensive technology stocks are excessive. See detailed discussion in Chan, Lakonishok, and Sougiannis (2001).

capital for the following reasons. First, extensive R&D research in economics and related areas shows that R&D makes a significant contribution to an industry's or firm's rate of technological innovation and productivity change (Mansfield 1980 and Lev and Sougiannis 1996). Second, research and development capital, as a major form of intellectual capital, has lately attracted much attention from investors and researchers due to recent widespread technological change and the growth of science- and knowledge-based industries (Chan, Lakonishok, and Sougiannis 2001). Third, unlike many other kinds of spending on intangible assets, R&D expenditures are required to be disclosed in the financial statements under generally accepted accounting principle and thus focusing on R&D provides the best data availability for the empirical procedures needed.

Managerial R&D efforts mainly contain two parts: 1) investment in R&D to create future intangible assets and 2) effectively managing existing R&D capital to maximize firm value. Prior research concerning R&D and compensation has focused on the flow of R&D investments and use proxies for R&D investment, such as the changes in R&D spending or R&D expense to sales ratio, to interact with the ROE, ROA, or stock return (e.g. Clinch 1991, Cheng 2004). These variables only account for managerial efforts on R&D investment, and ignore managerial efforts in effectively utilizing R&D capital cumulated from R&D investment in previous years. In addition, to avoid over-/under-investment in R&D, the decisions on investment in R&D should take into account the level of R&D capital currently on hand. In this study, we estimate firm-specific R&D capital and examine whether compensation contracts adjust for R&D investment and R&D capital not reflected in reported earnings and book value.

The estimation of firm-specific R&D capital follows the procedure in Lev et al. (2005). They estimate the useful life of R&D spending and its impact on earnings across a variety of industries. These estimates then measure the proportion of past R&D spending that is still productive in a given year, i.e. R&D capital. Based on the estimated useful life and R&D capital, we examine how the relation between executive compensation and stock- and accounting-based performance measures varies with R&D capital.

Overall, we find a strong downward association between R&D capital and the strength of the implicit relation between CEO cash compensation and both stock- and accounting-based performance measures. Specifically, both slope coefficients from a regression of estimated compensation numbers on stock return and accounting return on equity decrease systematically with R&D capital. Thus, high R&D capital firms appear to tie compensation awards less closely to stock- and accounting-based performance measures than do low R&D capital firms.

The potential contribution of this study is two-fold. First, it contributes to recent research focusing on intangible assets (or intellectual capitals). Due to the growth of technology industries, R&D capital becomes an important form of intangible assets that has lately attracted much attention from investors and researchers (Chan et. al. 2001). Our investigation on the relation between R&D capital and managerial compensation helps to understand how firms motivate the managers to manage their intangible assets. Second, this study sheds light on the incentives managers face when making intellectual capital related decisions and

enhances our understanding of how managers exercise their discretions on R&D investment decisions. Accounting research investigating managerial discretion on R&D investment decisions has mainly focused on how current R&D spending is adjusted to meet short-term earnings objectives that consequently impact managers' accounting-based bonuses. (Dechow and Sloan 1991, Baber et. al. 1994, Bushee 1998). However, to avoid over/under-investment in the long run, current period R&D spending should be invested based on the level of R&D capital accumulated from prior period to achieve the optimal level of R&D capital and such adjustments depend on how well managers' interests are aligned with shareholders interests.

The next section of the paper summarizes relevant previous research and develops the hypotheses. Section 3 explains the sample and the research design. Section 4 summarizes the results.

II Literature Review and Hypotheses Development

Agency theory suggests that optimal contracts relate executive compensation directly with performance measures presumed to be correlated with management's actions. The strength of the relation between compensation and performance measure is partly determined by the relative informativeness of the performance measures. Specifically, the sensitivity of executive compensation to a given performance measure is increasing in the "signal-to-noise" ratio of the performance measure in evaluating management's efforts (Lambert and Larcker 1987; Banker and Datar 1989; Sloan 1993).

Much of the accounting literature has been devoted toward identifying the appropriate performance measure and evaluating the weights placed on alternative performance measures. For example, several studies, such as Abdel-Khalik (1985), Clinch (1991), Clinch and Magliolo (1993), Dechow, Huson, and Sloan (1994), Healy, Kang and Palepu (1987), Gaver and Gaver (1998), and Natarajan (1996) have evaluated the weights on alternative measures of earnings, or components of earnings. Other studies, such as Baber, Janakiraman, and Kang (1996), Baber, Kang and Kumar (1998), Baber, Kang and Kumar (1999), Janakiraman, Lambert, and Larcker (1992), Ke, Petroni, and Safieddine (1999), Lambert and Larcker (1987), and Sloan (1993) have examined the relative weights placed on earnings and market returns in compensation plans. Overall, the empirical evidence has shown statistically significant positive associations between executive compensation and performance measures. Such relations are robust with respect to alternative samples and methodologies.

In the case of R&D, compensation contracts that tie executive compensation to traditional accounting measures or stock performance measures may not be able to fully capture managers' efforts in R&D investment or in utilizing firm's R&D capital to maximize firm value. The mandated full expensing of R&D results in a negative impact of R&D expenditures on current accounting earnings. Thus, when managerial compensation is tied to traditional accounting measures such as ROA, ROE, or EPS, the managers have the incentive to boost current accounting earnings by reducing R&D expenditures. For example, Baber, Fairfield, and Haggard (1991) show that managers are more likely to consider current-period income effects when

making R&D decisions than when making capital-spending decisions, whose costs are amortized over a number of accounting period. In addition, because of the difficulties in measuring the value, many types of intangible assets are not reported in firms' balance sheet under generally accepted accounting principles. Thus, deflating earnings by total assets or equity obtained from balance sheet may overstate the profitability and efficiency of a firm in utilizing its assets on hand or investment by the shareholders.

One the other hand, although stock prices is forward-looking and would reflect market perceptions of R&D investment, current stock prices do not fully reflect the future benefits of R&D spending because of the information asymmetry exist between manager and shareholder (Clinch 1991) and the uncertainty of realized benefits from current R&D spending (Lev and Sougiannis 1996; Chan, Lakonishok, and Sougiannis 2001)². Hall (1993) and Hall and Hall (1993) suggest that investors have short time horizons and fail to anticipate the rewards from long-term investments such as R&D.

To provide managers with sufficient incentives to increase R&D efforts, the boards of directors may adjust executive compensation arrangements to mitigate the potential problems derived from evaluating managerial performance based on traditional accounting measures. Prior research has looked into the possible adjustments that the board of directors would make to mitigate the undesirable managerial opportunistic behaviors. Based on the assumption that stock prices will immediately reflect market perception of R&D efforts, Clinch (1991) argues that compensation have a stronger association with stock return than with accounting earnings when R&D increases, but provides inconclusive empirical evidence. The inconclusive results can be explained by latter studies that document market mis-pricing of R&D capital in R&D intensive companies. For example, Hall (1993) suggests that investors have short time horizons and fail to anticipate the rewards from long-term investments such as R&D. Lev and Sougiannis (1996) document that R&D capital does not appear to be fully reflected contemporaneously in stock prices. Their finding suggests investor's under-reaction to R&D information or an extra-market risk factor associated with R&D capital. Chan, Lakonishok, and Sougiannis (2001) find that market prices on average incorporate the future benefits from R&D, but the lack of accounting information on R&D capital increases stock volatility. The increase in stock volatility decreases the "signal-to-noise" ratio of stock return as a performance measure.

Another possible adjustment to CEO compensation in mitigating the undesirable managerial opportunistic behavior in R&D spending is studied by Cheng (2004). Cheng (2004) finds that compensation committees seeking to prevent opportunistic reduction in R&D spending by relating CEO compensation positively with R&D spending when the CEO approaches retirement and when the firm faces a small earnings decline or small loss. However, a firm's R&D efforts contain two parts: 1) investment in R&D to create future intangible assets and 2) effectively managing existing R&D capital to maximize firm value. Past studies investigating the association between R&D and executive compensation have been mainly focused on the former one and looked at the "flow" of R&D, i.e. R&D expenditures incurred

² There are also observers suggesting that investors overestimate the benefits from R&D and thus valuations attached to R&D –intensive technology stocks are excessive. See detailed discussion in Chan, Lakonishok, and Sougiannis (2001).

during the period (eg. Clinch 1991; Baber, Janakiraman, Kang 1996; Cheng 2004). The link between compensation and R&D efforts in managing R&D capital accumulated from prior years to maximize firm value has been overlooked in the literature.

Traditional accounting measures in compensation contracts, such as ROA or ROE, have the meaning of measuring how efficient managers use firms' assets or owners' investment to produce earnings. However, intangible assets are usually not shown in the financial statements, specifically balance sheet. Thus, the denominators, total assets or shareholder's equity, are usually understated, especially for firms possessing important intangible assets, such as brand name, know-how, and competitive advantages. To address these concerns, this study posits that the compensation committees of boards of directors adjust CEO compensation for R&D capitalization. The adjustment includes adjusting reported earnings and book value to reflect the capitalization of R&D. Prior research has found such adjustments to be strongly associated with stock prices and returns, though still not appear to be fully reflected in current stock prices (Lev and Sougiannis 1996; Chan, Lakonishok, and Sougiannis 2001). In this study, we aim to examine whether compensation committees value managers' efforts in R&D and adjust CEO compensation to account for the R&D efforts.

The discussion above leads to the following testable hypotheses:

H1: *Ceteris paribus*, CEO compensation is less sensitive to traditional earnings measure (measured as ROE) when the firm has greater R&D capital.

H1: *Ceteris paribus*, CEO compensation is less sensitive to stock return when the firm has greater R&D capital.

III. Empirical Design

Sample and Data

Our sample consists of all firm-years during 1993-2004 with sufficient data from ExecuComp for the compensation and stock return data and Compustat for the accounting data. The sample period starts from 1993 because the data in ExecuComp start from 1992 and lagged compensation data are required to compute the changes in bonuses. We delete the observations that are either in the year of CEO change or in the year after. This is because our measure of changes in bonuses requires data on a full year's bonus for the same CEO for two consecutive years.

Estimation of R&D capital

Generally accepted accounting principles mandate the full expensing of R&D expenditures in financial reporting. Accordingly, the R&D (innovative) capital is absent from firms' balance sheets and we have to estimate it for the sample firms. We estimate R&D capital based on industry-specific useful life of R&D investment developed by Lev et al. (2005). This procedure modifies the procedure in Lev and Sougiannis (1996) and follows straight-line amortization over assumed industry-specific lives. The specific amortization period ranges from 4 years in the

Scientific Instruments industry (SIC: 38) and the Machinery and Computer Hardware industry (SIC: 35) to 8 years in the Chemical and Pharmaceuticals industry (SIC: 28) and the Electrical and Electronics industry (SIC: 36).³

Hypotheses Testing

The extant literature suggests various compensation-performance specifications. Similar to Lambert and Larcker (1987), Jensen and Murphy (1990), and Baber, Janakiraman, and Kang (1996), our basic model specification regresses changes in CEO compensation on changes in ROE and stock returns. This basic model examines the sensitivity of CEO compensation to the accounting performance, changes in ROE and stock returns.

$$\Delta COMP_{it} = \alpha_0 + \alpha_1 \Delta ROE_{it} + \alpha_2 RET_{it} + \varepsilon \quad (7)$$

We use two measures of CEO compensation: cash compensation and total compensation. CEO cash compensation is the sum of CEO salary and annual bonus. CEO total compensation is the sum of CEO cash compensation, option compensation, fringe benefits, and other long-term incentives. ROE is measured as earnings before extraordinary items and discontinued operation divided by the average common stockholders' equity. Stock return is measured using the sum of capital gains and dividends divided by the stock price at the beginning of the year.

To examine the first hypotheses, we modify the basic model by interacting R&D capital (RDT), measured as the estimated R&D capital relative to book value, with the performance measures, ROE and RET.

$$\begin{aligned} \Delta COMP_{it} = & \beta_0 + \beta_1 \Delta ROE_{it} + \beta_2 RET_{it} + \beta_3 \Delta ROE_{it} \times RDT_{it} \\ & + \beta_4 RET_{it} \times RDT_{it} + \beta_5 RDT_{it} + \varepsilon \end{aligned} \quad (8)$$

Generally, we expect $\beta_1 > 0$ and $\beta_2 > 0$ for a positive pay-for performance sensitivity. Hypothesis 1 predicts that the sensitivity of CEO compensation to accounting earnings numbers is lower when firms have higher R&D capital ($\beta_3 < 0$). Hypothesis 2 predicts that the sensitivity of CEO compensation to stock return is lower when the firms have higher R&D capital as prior research shows that stock prices undervalue firms' R&D capital.⁴

IV. Summary of Results

Overall, we find that changes in CEO cash compensation is positively related to changes in return on equity and stock return, consistent with a positive

³ See Lev et al. (2005) for further details.

⁴ Prior studies, such as Clinch (1991) and Baber et. al. (1996), predict the coefficient on the interaction term between RET and R&D spending to be positive. This is based on the assumption that market incorporates the benefit of R&D spending. However, Lev and Sougiannis (1996) show that market still undervalues firm's R&D capital.

pay-for-performance relation. When interacting changes in return on equity with the estimated R&D capital, we find that the coefficient on the interaction term is significantly negative, suggesting that the sensitivity between CEO cash compensation and accounting return is reduced when firms have a greater extent of R&D capital. This is consistent with our prediction that when a firm has greater R&D capital, accounting return becomes a less desirable performance measure as the noise in reflecting CEO's efforts in managing R&D capital increases.

On the other hand, the coefficient on the interaction term between stock return and the estimated R&D capital is significantly negative, suggesting that the sensitivity between CEO compensation and stock return is lower when a firm has higher R&D capital. This is consistent with our prediction that as shown in prior research that stock prices undervalue a firm's R&D capital (eg. Chan, Lakonishok, and Sougiannis, 2001), stock return becomes an inappropriate performance measure for firms with greater R&D capital. In sum, CEO cash compensation is less sensitive to both accounting return and stock return when a firm has greater R&D capital.

When changes in total compensation are used as the dependent variable, the coefficients on changes in return on equity and stock return remain significantly positive. However, the coefficients on the interaction terms with R&D capital are no longer significant. Not surprisingly, the inclusion of long-term compensation introduces more noises to the regression model, as the use of stock compensation usually contains other strategic considerations than tying compensation to performance.

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