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虧損公司是否濫行研究發展投資？

Do Loss Firms Abuse R&D Investments?

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中文摘要

盈餘虧損頻率與研究發展投資均逐年上升,但虧損與研究發展投資的關係尚未被完全釐清。本研究以公司行為理論說明虧損公司增加研究發展投資的動機，另以展望理論分析虧損公司的風險偏好,並分析虧損對研究發展投資決策與此類投資決策對未來盈餘的影響。研究結果發現，相較於獲利公司，虧損公司有較多的研究發展投資，與公司行為理論相符。虧損公司的研究發展投資，並隨虧損擴大而增加，符合展望理論。換言之，展望動機是"虧損所誘發的研究發展投資"的重要因素。從未來盈餘績效來看,研究結果顯示展望動機所誘發的研究發展投資與未來盈餘成負向關聯，而高品質的財務報導能減少虧損公司過度投資(研究發展計劃)，進而紓緩因展望動機所誘發的無效率研究發展投資。

關鍵字: 虧損;研究發展投資;公司行為理論;展望理論;展望動機;展望動機所誘發的研究發展投資

Abstract

Both the frequency of negative earnings and R&D investment have been increasing. However, the relation between these two variables has not been fully explored. This study uses the behavioral theory of firm to explain loss firms' motivation to increase R&D and prospect theory to analyze loss firms' risk attitudes in terms of their R&D decision and the future financial performance of the loss-induced R&D. Results show that negative earnings induce firms to invest more in R&D, consistent with the behavioral theory. Further, R&D investment increases as firms' earnings become more negative, as proposed by the prospect theory. In other words, the prospect incentive is a critical factor of the "loss-induced" R&D. As regarding future operating performance, results indicate that prospect-based R&D is negatively associated with future earnings, and I further find that higher financial reporting quality curbs such unproductive activities by reducing loss firms' overinvestment in R&D.

Keywords: Losses; R&D; Behavioral Theory of Firm; Prospect Theory; Prospect Incentive; Prospect-Based R&D

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Tables and Figures

1. Introduction

Firm value is shifting from tangibles to intangibles with a significant increase in activities of research and development (R&D) (i.e., Lev and Zarowin, 1999) and there has been a substantial increase in reported losses (Hayn, 1995; Joos and Plesko, 2005; Skinner and Soltes, 2009). These two variables are highly related. For example, Joos and Plesko (2005) find that loss firms contain more R&D investments, and Li's (2011) untabulated results show that, among these loss firms, R&D are negatively associated with forecast earnings. Their results raises questions for us: Why do negative earnings, which imply a low marginal return to capital, encourage rather than discourage R&D investments? Based on Hayn (1995), who proposes that loss itself could persist for several years, I wonder whether loss firm's R&D is an important factor of loss persistency. That is, do loss firms invest in unproductive R&D? If so, what factor drives them to do this and how to mitigate such relationship?

Prior research in organization literature has provided behavioral theory (Cyert and March, 1963, henceforth BT) and prospect theory (Kahneman and Tversky, 1979, henceforth PT) for us to address our research questions. However, in my viewpoint, the above two theories are not yet integrated well to an intact theory to explain the association between loss and R&D, and further, its implication to future earnings. To illustrate, BT suggests that firms failing to attain a certain level of performance may seek to solve the problem by investing in R&D (in their term, failure-induced R&D, Chen and Miller, 2007; Chen, 2008), and their tolerance for risk may increase at the same time; however, the increased risk tolerance influences firms' behavior on "high-level decision making" rather than "R&D decision"[1]. In other words, BT attributes failure-induced R&D to the problem-solving incentive and excludes the risk-seeking incentive (in my term, prospect incentive) from R&D decision process. Respecting PT, except for giving formal proof on risk-seeking behavior when firms are under a certain performance level (Kahneman and Tversky, 1979), Bowman (1980) shows that such behavior may trigger undesirable results, i.e., a negative association between risk and return for firms. However, the above findings of PT have not been applied to explain the failure-induced R&D. In brief, although both BT and PT address the problem of firm's decision making, their main interests are different. BT examines firm's risky change, such as R&D, under different performance level and excludes the prospect incentive from R&D decision; while PT, rather than examining firm's R&D activities, it focuses on the relationship of prospect incentive (risk taking behavior) under different performance level and its subsequent financial results. This discrepancy restricts researchers under BT to predict the future performance of failure-induced R&D because it does not attribute such R&D to prospect incentive but

[1] To see the detailed explanation, please see section 2.2.

to problem-solving incentive, which lacks theoretical support upon the link of future performance.

As such, I try to bridge this gap by incorporating PT into BT, and therefore provide in-depth analyses on the following issues. (1) Since my investigation is on loss-R&D relationship, I first adopt the failure-induced R&D framework suggested by BT, and consider whether BT can be applied with a simple zero earnings point, which serves as a reference level for each firm, rather than a complex mixture of both firm itself and its competitors' recent and past performance. (2) Whether prospect incentive acts as an important factor in failure-induced R&D, i.e., BT overlooks the importance of prospect incentive in R&D decision since it excludes prospect incentive from R&D decision. (3) Whether a negative association between future earnings and prospect-based R&D (i.e., the increased R&D which is based on prospect incentive) exists since PT predicts that firm's prospect incentive (risk taking behavior) under its reference point (aspiration level) deteriorates future earnings. (4) From the accounting viewpoint, I wonder whether there exists mechanism to curb such undesirable and inefficient activity, thereby providing a potential moderator, financial reporting quality, and testing whether it mitigates firms' (those with higher prospect incentive) inclination to overinvest in R&D.

I therefore derive the hypotheses corresponding to each issue as follows. First, I expect BT can be applied with a simple zero earnings point, which serves as an reference point for management, because accounting literature has confirmed its (zero earnings point) importance by showing that management inclination to avoid losses (Graham et al., 2005; Hansen, 2010; Baber et al., 1991; Burgstahler and Dichev, 1997; Gunny, 2010). Second, I expect that prospect incentive drives firms with big loss to invest more in R&D compared with those in small losses because R&D is an investment with high uncertainty (Kothari et al., 2002) and firms tend to adopt projects with high risk when their losses become larger according to PT. Third, based on prior research, showing that risk taking behavior under adversity incurs worse future earnings (Bowman, 1980; Fiegenbaum and Thomas, 1988; Chang and Thomas, 1989; Fiegenbaum, 1990; Jegers, 1991; Sinha, 1994; Gooding et al., 1996; Lehner, 2000), I expect that the prospect-based R&D deteriorates future earnings. Forth, accounting literature has shown that both losses and R&D activities will increase the possibility of moral hazard, which in turn deteriorates future accounting performance[2]. To illustrate, once firms are in losses, they have great incentive to meet/beat zero earnings benchmark through manipulating discretionary accruals (e.g., Hansen, 2010) and real activities (Baber et al., 1991; Burgstahler and Dichev, 1997; Gunny, 2010);

[2] To see the detailed demonstration, please see section 2.4.

while investments in R&D will exacerbate the degree of information asymmetry between firms and their shareholders/debtholders (Clinch, 1991; Myers and Majluf, 1984; Aboody and Lev, 2000), which in turn increase the likelihood of moral hazard in which firms engage (Arrow, 1971; Pauly, 1974; Holmstrom, 1979; Healy and Palepu, 2001). Moral hazard may thus lead loss firms to engage in unproductive activities by driving them to overinvest R&D since their inclination to take undue risk increases. Since high quality financial reporting mitigates moral hazard by facilitating contracting and monitoring (Kanodia and Lee, 1998; Healy and Palepu, 2001), I therefore expect that reporting quality curbs unproductive R&D.

Distinct from prior studies, which employs the absolute difference between firm's ROE and its industry's contemporaneous median ROE as the measure of firm's risk taking behavior (Miller and Bromiley, 1990; Fiegenbaum, 1990; Jegers, 1991; Sinha, 1994; Gooding et al., 1996), I create a simpler proxy based on the fourfold risk attitudes proposed by PT to capture firm's risk taking incentive (prospect incentive). Measures of other variables are largely consistent with literature.

Based on a sample of 19,788 firm-years from 1993 to 2006, I find that loss firms increase their R&D spending, implying that zero earnings point serves as an aspiration level for firms (H1). Further, I find that firms with big loss invest more in R&D than those in small losses, indicating that prospect incentive (based on fourfold risk attitudes framework) drives loss firms to invest more on R&D (H2). Respecting the future performance of prospect-based R&D, I find that prospect-based R&D of loss firms deteriorates future earnings (H3). Further analyses show the effect of prospect incentive on R&D is less positive for firms with higher quality financial reporting, providing support for H4. These results hold after addressing the potential sample selection bias of missing value of R&D excluding those observations instead of resetting them to zero, and they are robust to using total assets and market capitalization of common stock to scale R&D (operating income before depreciation, advertising and R&D expenditures) as an alternative proxy for R&D (earnings). My evidence highlights the important role of prospect incentive in loss-induced R&D and thereby deteriorating firms' future earnings.

My study contributes to the literature along the following dimensions. First, with respect to my research design, I capture firms' prospect incentive by employing the characteristics of PT’s fourfold risk attitude argument which is different from the traditional industry median ROE approach, and further, I incorporate it into BT to explain the loss-induced R&D. By doing this, I show that prospect incentive exists and does affect loss firm’s R&D decision significantly, indicating that extant research may put overemphasis on problem-solving incentive, which lacks theoretical support and is immeasurable, and overlook the importance of prospect incentive when analyzing loss-induced R&D. Introducing prospect incentive into firm's investment decision extends the flexibility of the application of BT, i.e., researchers can examine the investment projects either with high risk or with low risk. To illustrate, since firms at different performance level may differ in risk preference, researchers can use this characteristic to predict firms' choice of investment projects, which cannot be achieved by existing BT framework. I also elaborate prior studies by presenting more detailed analyses on the R&D-aspiration level relationship with a PT perspective. In other words, I not only examine the effect of performance below/above the aspiration level on R&D but also examine whether firm's R&D investments vary among each region. Most importantly, my approach provides a framework to understand the implications of loss-induced R&D on firm's future accounting performance. To illustrate, since I emphasize the importance of prospect incentive on loss-induced R&D, rather than problem-solving incentive, I have a strong theoretical background (Bowman, 1980; Fiegenbaum and Thomas, 1988; Chang and Thomas, 1989; Fiegenbaum, 1990; Jegers, 1991; Sinha, 1994; Gooding et al., 1996; Lehner, 2000)[3] to predict there is a negative association between loss-induced R&D and future

[3] Researchers have found that firms in adversity and with excessive risk taking behavior perform worse in future. The possible reasons proposed by Fiegenbaum and Thomas (1988) are failed firms' inclination to escalating commitment, less diversified strategy, angency problem and organization inertia.

earnings, which cannot be achieved by existing BT framework. Hence, my study develop a new framework that can explain firms with different risk attitude invest differently in R&D and therefore lead to different financial results all at once, again, which cannot be achieved by existing BT framework.

Second, I find a new variable, prospect incentive[4], moderating R&D's future financial performance. Specifically, I show that as firm's losses become larger, which is accompanied by raising prospect incentive, R&D activities reduce the positive association between R&D activities and subsequent accounting performance. That is, while investments of loss firms can be those firms' attempt to revert to normal, as suggested by the abandonment option of Hayn (1995), their R&D expenditures fail to help them upon such objective. My results supplement Hayn (1995) by showing the actual performance of loss firms' investments and this more negative association between loss firms' R&D activities and subsequent accounting performance is consistent with Li (2011), who suggests that R&D activities of loss firms is negatively associated with forecast earnings. My results also extend prior studies (e.g., Lev and Sougiannis, 1996) that show a positive association between all firms' R&D

[4] I use the interaction of two dummy variables, LOSS and BIG, to capture the prospect incentive since firms' prospect incentive raises as their losses become larger, as per PT. The former is a dummy variable equal to one, if the earnings is negative, and the latter represents that firm's earnings to one-year lagged total assets is above (below) the industry's median value of profit (loss) firms' earnings to one-year lagged total assets in year t.

expenditures and subsequent earnings. It therefore may help investors improve their prediction on firms' future performance.

Third, my study adds to a growing empirical literature in accounting that examines how financial reporting quality affects investments (e.g., Bushman et al., 2005; Biddle and Hillary, 2006; McNichols and Stubben, 2008; Biddle et al., 2009; Chen et al., 2011). Distinct from prior studies, which examine the effect of reporting quality on the efficiency of "total investment" or "capital investment" (e.g., Biddle and Hillary, 2006; Biddle et al., 2009), my study examines the effect of reporting quality on the efficiency of "R&D". To illustrate, my evidence shows that higher reporting quality alleviate firms' (those with higher prospect incentive) inclination to overinvest in R&D, which in turn lead to worse future financial results as Ming-Liang et al. (2010) suggested.

The rest of the thesis is organized as follows: Section 2 develops the research questions. The research design is presented in Section 3. Section 4 presents the sample characteristics. Section 5 presents results, and Section 6 concludes the paper.

2. Literature review and hypotheses

This study addresses the issue of the interplay between loss and R&D activity. I analyze their relationship by four steps. First, I examine whether loss firms prefer R&D investments based on behavioral theory of the firm. Second, I examine whether loss-induced R&D is driven by prospect incentive based on prospect theory. Third, I examine whether prospect incentive on R&D therefore deteriorate future earnings for loss firms. Forth, I examine whether financial reporting quality will curb unproductive loss-induced R&D.

2.1 Losses induce R&D

Following Schumpeter (1942), researchers have postulated that absolute performance is a key determinant of firms' R&D investment decisions; however, there is no consensus on the directional effect of performance on R&D.[5] The behavioral theory of the firm (Cyert and March, 1963, hereafter BT) reconciles the conflicting arguments by providing a theoretical framework that uses relative performance to a certain level to explain firms' R&D investment decision. It models a firm as a goal-directed and history dependent system that utilizes simple rules to guide decision-making in response to performance feedback. Managers under BT use an "aspiration level[6]" to evaluate performance and the performance relative to the

[5] Some research find a positive effect of performance on R&D (Cameron et al., 1987; Grabowski, 1968; McKinley, 1993; Nelson and Winter, 1982), but others find a negative effect (e.g., Antonelli, 1989; Bolton, 1993).

[6] Aspiration level is defined as "the smallest outcome that would be deemed satisfactory by the decision maker" (Schneider, 1992) and could be seen as a function of recent performance, past performance levels (historical aspiration level), and the recent performance of other firms (social aspiration level). It is used by bounded rational individuals to determine the boundary between success and failure in continuous measures of performance (March and Simon, 1958).

aspiration level influences their inclination to take risks and make changes through R&D (March and Shapira , 1987, 1992; Shapira, 1986). According to BT, firms fail to attain the aspiration level may seek to solve performance problems by investing in R&D (Chen and Miller, 2007; Chen, 2008). It is because that managers under pressure generally believe that upgrading firm's technology will help to return to its aspiration level (Greve, 1998, 2003).

Although BT has explained why failure to achieve aspiration level induces R&D, it still leaves us an unanswered question of whether zero earnings point also serves as an aspiration level for managers since the organization literature formulate aspiration level as a function of historical aspiration level and social aspiration level as mentioned before. My study concerns about zero earnings point because that both loss and R&D are two important trends in the U.S. economy (Lev and Zarowin, 1999); however, the association between them remains largely unknown. If zero earnings point does serve as a reference point (i.e., aspiration level) for managers, it may have influence on managers' decision on R&D as BT suggested.

From viewpoint of accounting, I argue that zero earnings point has influence on firms' decision making (i.e., it could serve as an aspiration level for managers). To illustrate, Degeorge et al. (1999) argue that there are three-level earnings benchmarks for firms, including loss avoidance, earnings improvement, and analysts' forecasts.

Survey done by Graham et al. (2005) further shows that 65% of financial executives from public companies agree that loss avoidance benchmark is important.[7] Although loss avoidance does not lead the hierarchy among benchmarks (Brown and Caylor, 2005), its importance remains. For example, literature has shown that some managers try to meet/beat zero earnings benchmark by manipulating firms' discretionary accruals (e.g., Hansen, 2010) and real activities (Baber et al., 1991; Burgstahler and Dichev, 1997; Gunny, 2010).

As such, I hypothesize that zero earnings point can also be used as an aspiration level for firms, which in turn means that I can apply BT to predict loss firms' R&D investment behavior. Accordingly, I examine the following hypothesis:

H1. Zero earnings point serves as an aspiration level for firms. Therefore, loss firms invest more on R&D according to BT.

2.2 Determinants of loss-induced R&D

Prospect incentive

BT has guided much recent research on risky organizational changes, including firm's R&D investment decision. This theory proposes that firms' R&D

[7] This survey presents 84% of financial executives agree that the earnings improvement benchmark is important, and there are 69%, 65% agree that analyst forecast and loss avoidance benchmark is important respectively.

investments can be attributed to two types of organizational search, i.e., problemistic search and slack search. However, since my study focus only on loss-induced R&D, I put emphasis on problemistic search alone[8]. When firms fail to attain their aspiration level, they launch problemistic search which aims to solve the performance problems immediately. Problemistic search induces increased R&D when managers judge that upgrading firms' technology and product portfolio can solve the performance problems, and this judgment happens universally (Greve, 2003). Once firms' performance are above their aspiration level, they tend to maintain current routines and have limited motivation to search for anything new (Cyert and March, 1963; Levinthal and March, 1981).

However, what is the role of risk preference in the schema of loss-induced R&D? Although BT suggest that performance under aspiration level will increase managers' tolerance for risk, i.e., they are willing to take more risk, because they are under pressure from stakeholders to return to aspiration as soon as possible, the theory does not indicate whether risk seeking incentive has any association with loss-induced R&D. To illustrate, I refer to Greve's (2003) conceptual model for BT, shown in

[8] Problemistic search is defined as "search that is stimulated by a problem ... and is directed toward finding a solution to that problem" (Cyert and March, 1963); whereas slack search refers to search that is triggered by firms' endowment such as underused financial reserves, capacities, facilities and labor (Levinthal and March, 1981). In my study, slack search (firm's endowment) may be used as a control variable rather than a primary variable.

Figure 1. It shows that R&D is driven by two factors, problemistic search and slack search as mentioned before, and the latter is neutral from the firm's performance level unlike the former shows a direct negative association between firm's relative performance to its aspiration level and R&D. With respect to risk preference, denoted as risk tolerance, I can see that it influences firm's behavior at the later stage, "decision making", but not at the earlier "search" stage, which, in my opinion, implies that risk preference is irrelevant to R&D decision process and the problem-solving incentive is the only factor driving loss-induced R&D.

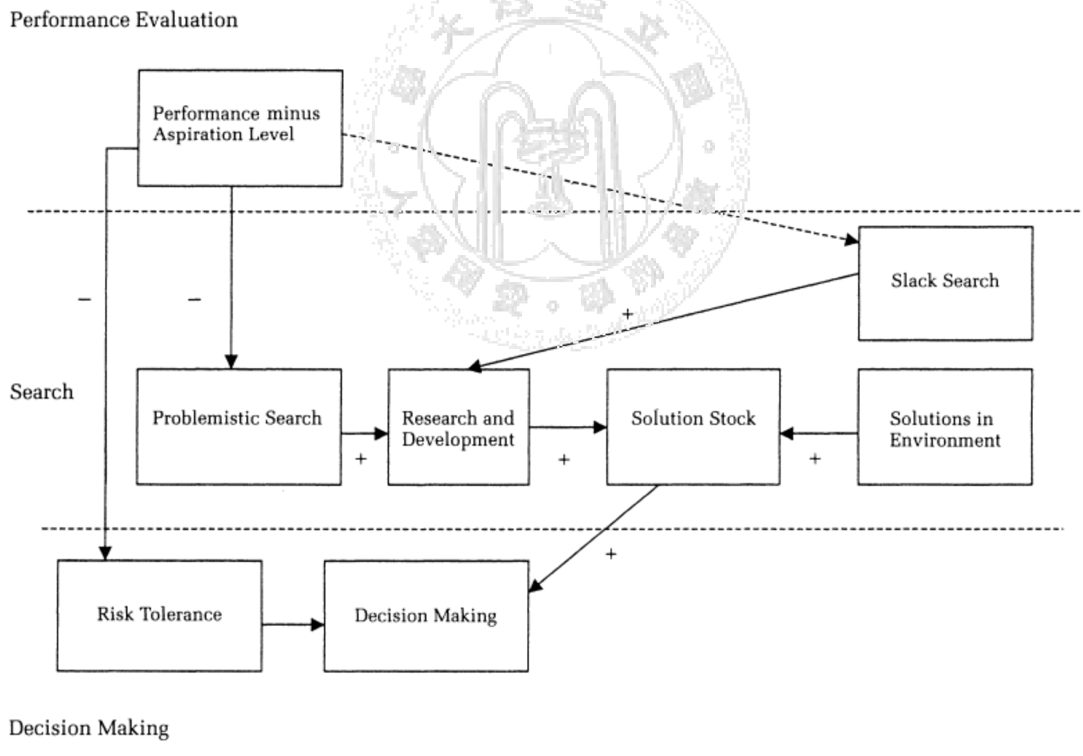

Figure 1: The conceptual model of the behavioral theory. **Source:** Greve (2003).

Except for the previous question I raised on BT, I have two additional concerns for the argument of problem-solving incentive. First, to my knowledge, the role of problem-solving incentive in the schema of loss-induced R&D is given and predetermined, that means researchers following BT usually do not test either the argument of problem-solving incentive is correct or its quantitative impact on R&D or future earnings. One of the reasons for this problem could be that problem-solving incentive lacks theoretical support, or at least such theory has not yet been referred, and it thus makes problem-solving incentive immeasurable compared with the incentive derived by firm's endowment (slack search). Second, the lack of theoretical support for problem-solving incentive limits the scope of research following BT and yields limited implications for problem-solving incentive. For example, given the great interest in the future performance of R&D (either earnings or its variability) in accounting and economic academy, researchers cannot make any prediction on the future earnings or its variability of loss-induced R&D since there are no theory examining the association between such incentive and future performance.

I organize the above problems in BT to a simpler representation: the overemphasis on problem-solving incentive, which can be problematic, lead to overlooking on risk seeking incentive when analyzing loss-induced R&D. To address this problem, I first introduce Prospect theory (hereafter PT; Kahneman and Tversky, 1979) and incorporate it into BT[9] subsequently.

To illustrate, PT distinguishes two phases in the decision process: an early phase of editing and a subsequent phase of evaluation. In the first phase, once people receive different prospects (or gambles, investment projects) to choose, they start to form a reference point, consisting of the factors from past and present related context of experience[10], and then translate each prospect to a simpler representation. In the second phase, the edited prospects are evaluated and the prospect of highest value is chosen. Since the value function used by people to evaluate prospects in phase 2 is the core argument in PT, I show this function in Figure 2 and provide a further explanation on its key properties as follows. First, it contains a reference point, derived from phase 1 and separating the outcome of each prospect into gains and losses region which is perceived by the individual. Simply speaking, reference point is

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[9] PT is originally developed to explain individual decision making under uncertainty that cannot be explained by expected utility theory (Von Neumann and Morgenstern, 1944); however, it is well documented that PT also works at firm level (e.g., Fiegenbaum and Thomas, 1988; Chang and Thomas, 1989; Miller and Bromiley, 1990; Jegers, 1991; Sinha, 1994; Johnson, 1994; Gooding et al., 1996).

[10] In PT, reference point is the status quo or a value of zero (Kahneman and Tversky, 1979) basically; however, it is also consisted of multiple factors like aspiration level, and there is no general rule for deciding on such a definition. Most researchers assume a common reference point by measuring industry median or mean of returns over the time period (Fiegenbaum and Thomas, 1988; Fiegenbaum, 1990; Miller and Bromiley, 1990; Jegers, 1991; Sinha, 1994; Johnson, 1994).

equal to the aspiration level in BT. Second, the carriers of value are changes in wealth, rather than final states. That is, I can see a given point on the x-axis as “earning 10 dollars”, which shows a certain performance level. Third, the value function is concave for gains, convex for losses, being steeper for losses than for gains.

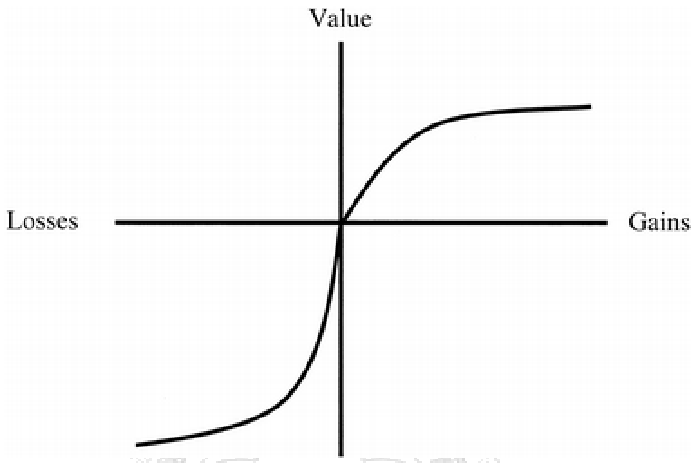

Figure 2: The value function of the prospect theory. **Source:** Kin Fai Ellick and Jessica Y.Y. (2005).

The above properties of value function jointly yield a critical implication for my study, a fourfold pattern of individual’s (firm’s) risk attitudes, derived from twofold risk attitudes. Specifically, firm is risk seeking (averse) when it perceives that its performance level is in the losses (gains) region, and its risk attitudes keep varying among each region, i.e., firm in big losses (small gains) is more risk seeking than that in small losses (big gains). I first explain the reason of twofold risk attitudes by showing the risk seeking side. When firm fails to attain its aspiration level (reference point), it falls in the losses region and the discrepancy (between its performance and reference point) will persists until firm adapts to this downward shock. It consequently induces two results. First, the perceived losses situation will affect firm's way to code the prospect[11], which in turn leads firm to adopt riskier prospect. Second, since the marginal benefit (in terms of individual's psychological value) at any given point of the value function always outperforms marginal cost in losses region, firm has strong incentive to increase their performance by taking riskier prospect. To further explain fourfold risk attitudes, I refer to the value function's convex and concave characteristics. When firm falls in the region of big loss, taking more risk incurs little, close to zero, marginal losses (in terms of individual's psychological value), therefore, firm in big losses is more likely to adopt risky prospect than firm in small losses. As for firm in big gains region, taking more risk incurs little, close to zero, marginal gains (in terms of individual's psychological value), therefore, firm in big gains is less likely to adopt risky prospect than firm in small gains.

Supporting fourfold risk attitudes, Greve's empirical studies (1998, 2003b, 2003c), which is based on US radio industry, Japanese shipbuilding industry and cross-section data respectively, show a kinked curve which illustrates that the relationship between firm performance and the probability of strategy (risky) change has a tipping point at the aspiration level (as shown in Figure 3, from Greve (1998)).

[11] To see a complete example, please check Kahneman and Tversky (1979), p.286.

This downward sloping curve shows that firms at different performance level do risky changes, defined as format change, facility and innovation investment respectively, different in magnitude. Specifically, firms in losses take more risk than those in gains, and among each region, firms in big losses (small gains) take more risk than those in small losses (big gains). His proxy for risky change is very similar with R&D, of my main interest, since R&D is also an investment with high risk (Kothari et al., 2002). Hence, based on fourfold risk attitudes framework and Greve's empirical evidence, I hypothesize that firms with increased risk seeking incentive (in my term, prospect incentive) invest more in R&D. Such hypothesis thus incorporates PT into BT automatically since it extends the twofold risk attitudes assumption. My hypothesis is as follows:

H2. Prospect incentive (based on fourfold risk attitudes framework) drives loss firms to invest more on R&D.

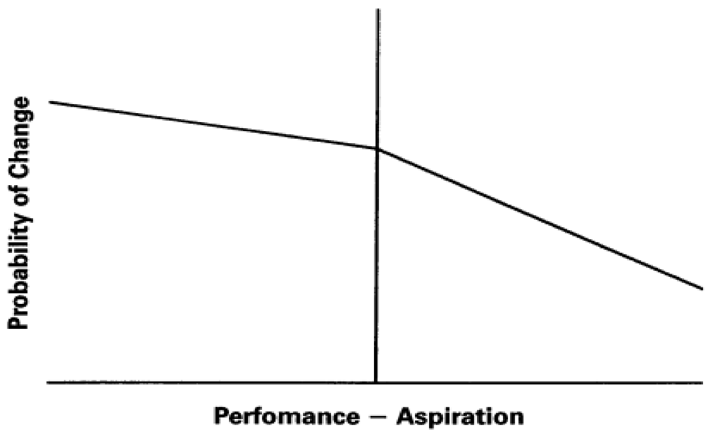

Figure 3: Relation between performance level and probability of change. **Source:** Greve (1998).

2.3 Future financial performance of loss-induced R&D

Though R&D investments do benefit firms on average according to a variety of literature no matter from accounting perspective or economic perspective (e.g., Lev and Sougiannis, 1996; Eberhart et al., 2004; Lev et al., 2006; Long and Ravenscraft, 1993; Vivero, 2002; Branch, 1974; Tassey, 1983; Morbey and Reithner, 1990; Doukas, 1991; Erickson and Jacobson, 1992; Ito and Pucik, 1993; Johnson and Pazderka, 1993; Lee and Shim, 1995), when I look specifically at loss firms, situation seems change. Accounting literature has shown some clues, for example, based on Hayn (1995), proposing that loss itself could persist for several years, Joos and Plesko (2004) further shows that persistent loss firms have more R&D. The association between loss and R&D is tested informally until Li (2011) showing that R&D is negatively associated with forecast earnings.

Based on my H2, I further argue that prospect incentive may lead loss firms to invest in unproductive R&D, i.e., it has negative impact on future earnings, according to PT. Under PT's assumptions, loss firms will choose investment projects with high risk (e.g. R&D, Kothari et al., 2002) to bet on the probability of reversing from losses rapidly. In other words, they care variance in returns more than expected returns. Research following PT has found that firms with unbalanced risk-return preference presented above, i.e., prospect incentive, perform worse in future. For example, following Bowman's finding (1980) which shows a negative association between organizational risk and future return, researchers (Fiegenbaum and Thomas, 1988; Chang and Thomas, 1989; Fiegenbaum, 1990; Jegers, 1991; Sinha, 1994; Gooding et al., 1996; Lehner, 2000) further extend that firms below (above) the reference point exhibited a negative (positive) relationship between risk and future return. Accordingly, I infer that prospect incentive on R&D may have negative impact on future earnings. My hypothesis is as follows:

H3. Prospect (incentive)-based R&D of loss firms has negative impact on future earnings.

2.4 The role of financial reporting quality

Based on H2 and H3, hypothesizing that prospect incentive drives loss firms to invest more in R&D and thus deteriorates future earnings, I subsequently consider whether there exists mechanism to curb such undesirable and inefficient activity. To address this problem, I first presume that moral hazard induces such unproductive activities based on prior research (Jensen and Merckling, 1976; Jensen, 1986), stating that managers may undertake suboptimal investments that maximize their own benefits at the expense of shareholders, and then examine the following two factors in my study that leads to moral hazard. First, losses increase the likelihood of moral hazard in which firms engage. For example, management may initiate an audit firm change in an attempt to suppress or delay the release of unfavorable information (Kluger and Shields, 1991) or manipulate firms' discretionary accruals (e.g., Hansen, 2010) and real activities (Baber et al., 1991; Burgstahler and Dichev, 1997; Gunny, 2010) to meet/beat zero earnings benchmark. Second, investments in R&D exacerbate the degree of information asymmetry between firms and their shareholders/debtholders (Clinch, 1991; Myers and Majluf, 1984; Aboody and Lev, 2000), which in turn increase the likelihood of moral hazard in which firms engage (Arrow, 1971; Pauly, 1974; Holmstrom, 1979; Healy and Palepu, 2001). Moral hazard may thus lead loss firms to engage in unproductive activities by driving them to overinvest R&D since their inclination to take undue risk increases. To illustrate, Ming-Liang et al. (2010) shows that there is an inverted-U correlation between R&D intensity and firm performance, indicating that R&D overinvestments do harms future earnings.

To address the problem of moral hazard presented above, I introduce financial reporting quality. Since high quality financial reporting conveys more precise information about the future cash flows of firms' investment projects, facilitates efficient contracting, and improves investors' ability to monitor managers' investment decisions thus mitigates the information asymmetry and moral hazard (Kanodia and Lee, 1998; Healy and Palepu, 2001), I have the following hypothesis:

H4. Reporting quality curbs unproductive R&D activities of loss firms.

3. Research design

3.1 R&D levels analyses

I investigate H1 concerning how the level of R&D varies with reporting losses by estimating the following pooled cross-sectional regressions:

$$\begin{aligned} RDE_{it} = {} & \beta_0 + \beta_1 LOSS_{it} + \beta_2 Z\ SCORE_{it-1} + \beta_3 TANG_{it-1} + \beta_4 RDE_{it-1} + \\ & \beta_5 TOBINQ_{it-1} + \beta_6 LEV_{it-1} + \beta_7 OCF_{it} + \beta_8 SIZE_{it-1} + \\ & Industry\ \&\ Year\ Indicators + \varepsilon_{it} \end{aligned} \quad (1)$$

where

RDE	is R&D expense (XRD from Compustat) to sales revenue (SALE from Compustat) in year t. For firms with zero or missing R&D expenditures, RDE equals 0.
LOSS	is a dummy variable equal to one, if the sum of income before interest and tax (EBIT) and the lagged R&D (abbreviated as earnings, hereafter) is negative in year t, and zero otherwise.
Z SCORE	I use Altman's (1983) Z, which is defined as (1.2 × (ACT – LCT) + 1.4 × RE + 3.3 × EBIT + SALE) / AT + 0.6 × (CSHO × PRCC_F / LT) of firm i at the end of year t-1.
TANG	is the net book value of property plant and equipment (PPENT from Compustat), scaled by total assets (AT from Compustat) of firm i at the end of year t-1.
TOBINQ	is the ratio of market value of total assets (PRCC_F × CSHO + AT – CEQ – TXDB) to book value of total assets (AT) of firm i at the end of year t-1.
LEV	is the ratio of long-term debt (DLTT from Compustat) to the sum of long-term debt plus the market value of equity (DLTT + CSHPRI ×

PRCC_F) of firm i at the end of year t-1.

OCF is net cash flow from operating activities (OANCF from Compustat) divided by sales revenue in year t.

SIZE is the natural logarithm of total assets of firm i at the end of year t-1.

Industry indicators are created using 48-industry groups by Fama and French (1997).

My H1 argues that BT could be applied with a simple zero earnings, rather than a mixture historical and social aspiration level, thus I expect that firms increase their R&D spending as they fall to into losses. As such, the term LOSS is of primary interest in my analysis. Its coefficient reflects how the level of R&D varies with reporting loss. If zero earnings point does serve as an aspiration for management (H1), then the coefficient of LOSS should be positive in Eq. (1).

I expect a negative coefficient on Z SCORE according to the ‘threat-rigidity’ hypothesis (Staw et al., 1981). This hypothesis states that stress and anxiety under threatening situation will disable management to launch new activities, conserve resources, and seek to keep existing production activities lean (March and Shapira, 1987, 1992; Ketchen and Palmer, 1999). I also expect a negative coefficient on TANG since firms with a high level of investment in physical capital face more financial constraints (Aghion et al., 2004; Hsiao and Tahmiscioglu, 1997; Fazzari et al., 1988), which in turn affects their ability to invest in R&D. Following Lev and Sougiannis (1996) and Dunlap-Hinkler et al. (2007), I expect a positive coefficient on lagged R&D since strong returns on R&D would encourage future R&D investment. I also expect a positive coefficient on lagged TOBINQ, as (Lach and Schankerman, 1989; Bhagat and Welch, 1995) document that an increase in R&D might help firm take advantage of growth opportunities. As for the financing aspect of firms, I include LEV and OCF as control variables. I expect a negative coefficient on LEV and a positive coefficient on OCF since R&D activity involves severe information asymmetry, moral hazard risk and transaction cost of negotiation between managers and outsiders, which in turn leads outsiders' reluctance to finance firm's R&D project (Smith and Warner, 1979; Williamson, 1988) and firm's heavy reliance on internal financing (Myers and Majluf, 1984). I control SIZE but have no expectation for its coefficient because a variety of researchers have stressed its importance on R&D; however, there is no consensus on its directional effect.[12] Finally, to ensure that my results are not driven by differences across industries, I include an indicator variable for each of the Fama and French (1997) industries in my all equations.

I investigate H2 concerning how the level of R&D varies with prospect incentive by estimating the following pooled cross-sectional regression:

$$RDE_{it} = \beta_0 + \beta_1 BIG_{it} + \beta_2 BIG_{ijt} \times LOSS_{it} + \beta_3 LOSS_{it} + \beta_4 Z\ SCORE_{it-1} + \beta_5 TANG_{it-1} + \beta_6 RDE_{it-1} + \beta_7 TOBINQ_{it-1} + \beta_8 LEV_{it-1} + \beta_9 OCF_{it} + \beta_{10} SIZE_{it-1} + Industry\ \&\ Year\ Indicators + \varepsilon_{it} \quad (2)$$

[12] Some research suggests a linear and positive relationship (Schumpeter, 1942; Cohen and Levin, 1989); whereas others suggest that R&D and firm size are independent (e.g., Lee and Sung, 2005) or even inverse (Holmström, 1989; Cohen and Klepper, 1996).

Where

BIG is a dummy variable equal to one, if the earnings to one-year lagged total assets is above (below) the median value of profit (loss) firms' earnings to one-year lagged total assets in year t and industry j, and zero otherwise.

Researchers under the organization stream usually use the absolute difference between firm's ROE and its industry's contemporaneous median ROE as the measure of firm's risk taking behavior (Miller and Bromiley, 1990; Fiegenbaum, 1990; Jegers, 1991; Sinha, 1994; Gooding et al., 1996). However, since my hypothesized reference point (aspiration level) is zero earnings point, which is different from traditional organization studies using a mixture of historical aspiration and social aspiration, I do not follow this approach in my study in case it complicates my research design accompanied by the confusing results.

As such, I create a simpler proxy based on the fourfold risk attitudes proposed by PT rather than ROE approach to capture firm's risk taking incentive (prospect incentive). To illustrate, I presume the prospect incentive of firm increases as firm's earnings shift from small loss (big profit) to big loss (small profit), as per PT which is already explained in section 2, thereby adding the dummy variable, BIG, and interact it with LOSS to form four-region performance levels enabling us to capture the prospect incentive. My approach yields four advantages. First, unlike problem-solving incentive, lacking a formal theoretical support or at least lacking a clear reference in the stream of BT, prospect incentive is clearly based on PT and its reference is also clearly shown in the empirical studies following BT. Second, based on the first one, the measurability of prospect incentive is better than problem-solving incentive accordingly. Specifically, PT gives us a clear indication that prospect incentive varies with firm's performance; however, no theory, to my knowledge, proposes that problem-solving incentive performs the same way. I therefore assume that problem-solving incentive holds constant or at least varies relatively small to firm's performance in contrast with prospect incentive, making my proxy, BIG, works to capture prospect incentive and differentiate it from problem-solving incentive. Third, BT proposes that problem-solving incentive rises as firm performs worse than its aspiration level; however, it does not propose that firm performing better than its aspiration level does the same way. My proxy, BIG, thus will not be confounded by the factor of problem-solving incentive based on BT, i.e., it is purer for β_1 than $(\beta_1+\beta_2)$ when measuring prospect incentive. Forth, interacting these two indicator variables expands traditional ROE approach by enabling the multiple comparisons among four groups. To sum up, I expect a negative sign on β_1 and a positive sign on $(\beta_1+\beta_2)$, since I hypothesize that the high-risk feature of R&D (Kothari et al., 2002) fits the needs of the firm with prospect incentive. Given my study is focus on loss firms, the sign of $(\beta_1+\beta_2)$, would be of my primary interest.

3.2 Earnings analyses

I further test H3 concerning how prospect incentive on R&D influences future earnings by estimating the following pooled cross-sectional regression:

$$EARN5_{it} = \beta_0 + \beta_1 BIG_{it} + \beta_2 LOSS_{it} + \beta_3 RDE_{it} + \beta_4 BIG_{it} \times LOSS_{it} + \beta_5 BIG_{it} \times RDE_{it} + \beta_6 LOSS_{it} \times RDE_{it} + \beta_7 BIG_{it} \times LOSS_{it} \times RDE_{it} + \beta_8 SIZE_{it} + \beta_9 BM_{it} + \beta_{10} TANG_{it-1} + \beta_{11} ADEX_{it} + Industry \,\&\, Year\ Indicators + \varepsilon_{it} \quad (3)$$

Where

EARN5	is the average earnings over five subsequent years from t+1 to t+5 divided by sales revenue in year t. I use income before interest and tax (EBIT) plus R&D expenditures (XRD) for earnings.
BM	is the stockholders' equity (SEQ from Compustat) divided by market value of equity (CSHPRI times PRCC_F from Compustat).
ADEX	is advertising expenditures (XAD from Compustat) to sales ratio. For firms with zero or missing advertising expenditures, ADEX equals 0.

I follow the model used by Ciftci and Cready (2011) to reduce the complexity of R&D's long-lived effect on subsequent earnings. This approach simplifies the procedure required to estimate and aggregate multiple R&D terms and R&D interaction terms as well as the associated standard errors, therefore provides a parsimonious estimate of the marginal explanatory impact of prospect incentive on the R&D relation. To address the potential disadvantage stems from the windows-overlapping feature of average earnings, I conduct a supplemental analysis to Eq. (3) and (5) in which I replace RDE with RDC (i.e., R&D capital), which is a weighted average of past R&D investment numbers as per Lev and Sougiannis (1996).

To calculate RDC, I assume 20% amortization rate. I also follow Ciftci and Cready (2011) to use one year ahead earnings (i.e., EARN1) as an alternative to EARN5.

I follow Fama and French (1995) to include book-to-market ratio (BM) and size (SIZE) as control variables, as they suggest a negative coefficient for the former and a positive coefficient for the latter. I also follow Lev and Sougiannis (1996) to include advertising expenditures (ADEX) and tangible assets (TANG) as control variables and expect them with positive coefficient.

I expect a negative sign on $(\beta_1+\beta_4)$ since Bowman (1980) has shown a negative association between organizational risk and future return when firms are in loss. While I expect a positive sign on β_3, as Lev and Sougiannis (1996) document that current earnings is positively related to past R&D which implicitly indicate that current R&D benefits future earnings. My control variables include SIZE, BM, ADEX and TANG as per Fama and French (1995) and Lev and Sougiannis (1996). The prediction on the coefficients of above control variables are mentioned in prior paragraph. The sign of $(\beta_1+\beta_4+\beta_5+\beta_7)$ is of primary interest in my analysis. It reflects how the association between R&D intensity and the level of future earnings varies with loss firms' prospect incentive. Simply speaking, the sum of the coefficient β_1, β_4, β_5 and β_7 shows the incremental R&D intensity switched from firms in the sample of small loss to big loss, and I presume that such R&D is driven largely by prospect incentive (prospect-based R&D) rather than problem-solving incentive as mentioned before. If prospect incentive decreases payoffs to R&D investment (H3), then the sign of $(\beta_1+\beta_4+\beta_5+\beta_7)$ should be negative.

3.3 Further analyses—The role of financial reporting quality

To examine how financial reporting quality (RQ) curbs the unproductive R&D activities of loss firms (H4), I finally estimate the following regression model:

$$\begin{aligned} RDE_{it} = {} & \beta_0 + \beta_1 BIG_{it} + \beta_2 LOSS_{it} + \beta_3 RQ_{it} + \beta_4 BIG_{it} \times LOSS_{it} + \beta_5 RQ_{it} \times \\ & BIG_{it} + \beta_6 RQ_{it} \times LOSS_{it} + \beta_7 RQ_{it} \times BIG_{it} \times LOSS_{it} + \\ & \beta_8 Z\ SCORE_{it-1} + \beta_9 TANG_{it-1} + \beta_{10} RDE_{it-1} + \beta_{11} TOBINQ_{it-1} + \\ & \beta_{12} LEV_{it-1} + \beta_{13} OCF_{it} + \beta_{14} SIZE_{it-1} + \\ & Industry \,\&\, Year\ Indicators + \varepsilon_{it} \qquad (4) \end{aligned}$$

Where

RQ — I use the negative value of the standard deviation of regression residuals from the modified Dechow and Dichev (2002) model by McNichols (2002). I follow Francis et al. (2005) and estimate the model cross-sectionally for each industry (defined using Fama and French (1997) industry classification) and year. I require a minimum of 20 observations for each industry-year. I take the negative value of the standard deviation so that higher RQ indicates higher reporting quality.

Based on the assumption that moral hazard deteriorates future earnings by driving loss firms to overinvest R&D, i.e., take undue risk, I adopt the measure of RQ, which is capable of mitigating moral hazard problem and has been used by several studies (e.g., Aboody et al., 2005; Francis et al., 2004, 2005; Biddle et al., 2009), and interact it with the main variable in Eq. (2) to derive Eq. (4). If reporting quality does works to mitigate moral hazard, it would be reasonable to see loss firms alleviate their R&D spending.

I applied Eq. (4), rather than traditional expected-level approach (e.g., Biddle et al., 2009), to test whether firms with big loss overinvest in R&D because it simplifies my research design in sacrifice of limited validity. To illustrate, since it is conceivable that moral hazard problem increases as firms' losses become larger; I use a different way to interpret variables capturing the shift from small loss to big loss and redefine it as a measure of moral hazard problem. Therefore, $(\beta_1+\beta_4)$ represents the magnitude of moral hazard-induced R&D. Given the fact that moral hazard is a critical driver of overinvestment of R&D as mentioned in section 2.4; I use a parsimonious way to measure the overinvested part of R&D: the magnitude of $(\beta_1+\beta_4)$. As such, a negative sign on $(\beta_5+\beta_7)$ would provide support for my H4, indicating that the magnitude of overinvested R&D decreases for firms with higher financial reporting quality than for firms with lower financial reporting quality. In other words, a negative sign for $(\beta_5+\beta_7)$ would be consistent with higher financial reporting quality mitigating the overinvestment in R&D.

4. Sample selection and firm characteristics

4.1. Sample selection

I start my sample selection by retaining all firm-years with listed common stock in the Compustat annual file over years 1993 to 2006. My sample period starts from 1993 because it is the first year data from the statement of cash flows are available to compute my reporting quality (RQ) measure at the beginning of the year.[13] Following prior literature (e.g., Richardson, 2006; Biddle and Hillary, 2006) I exclude financial and utility firms (SIC codes 6000-6999; 4900-4949). After I remove firm-years with insufficient data to measure my test and control variables, my final sample consists of 19,788 firm-years over 1993 to 2006. In my robustness tests, I further reduce my sample to 11,781 observations to examine specifically at "R&D firms" as suggested by Ciftci and Cready (2011) by excluding firms with missing R&D expenditure instead of setting them to zero. Additionally, my dependent variable, EARN5,calculated over five subsequent years (i.e., from years t+1 to t+5), restricts my analyses to ends with fiscal 2006 independent variables.

Table 1

Descriptive statistics.

	N	Mean	Med	Std Dev
RDE	19,788	0.1185	0.0011	0.5123
RDC	19,788	0.3337	0.0077	1.3923
LOSS	19,788	0.1633	0.0000	0.3697
BIG	19,788	0.4835	0.0000	0.4997

[13] Since SFAS 95 requires companies to report cash flow from operations (CFO) in the statement of cash flows from 1988, we can compute unexpected working capital starting from year 1989. Since we need past five years of working capital (and other variables) to compute reporting quality (RQ), the first year with the beginning-of-year value of RQ is 1994.

Z SCORE	19,788	5.1597	3.6694	6.5631
TANG	19,788	0.3224	0.2512	0.2609
RDE_1	19,788	0.1141	0.0010	0.4811
TOBINQ	19,788	1.9526	1.4389	1.5465
LEV	19,788	0.1622	0.0852	0.1949
OCF	19,788	-0.0329	0.0695	0.7006
SIZE	19,788	5.1957	5.1634	2.1665
BM	19,788	0.6834	0.5148	0.5934
ADEX	19,788	0.0085	0.0000	0.0224
EARN5	19,788	-0.1062	0.1023	31.2143
EARN1	19,788	-0.2788	0.0912	13.4082
RQ	19,788	-0.1269	-0.0758	0.2279

This table reports descriptive statistics (Panel A) and correlations (Panel B) for the main and control variables in my all equations. The sample contains 19,788 firm-year observations over 1993-2006. R&D is either **RDE** or **RDC**. The former is the R&D expense (XRD from Compustat) to sales revenue (SALE from Compustat) in year t, the latter is R&D capital to sales ratio. R&D capital is calculated assuming 20% amortization rate. For firms with zero or missing R&D expenditures, RDE (RDC) equals 0. **LOSS** is a dummy variable equal to 1, if the sum of income before interest and tax (EBIT from Compustat) and the lagged R&D is negative in year t, and 0 otherwise. **BIG** is a dummy variable equal to one, if the earnings to one-year lagged total assets is above (below) the median value of profit (loss) firms' earnings to one-year lagged total assets in year t and industry j, and zero otherwise. **Z SCORE** is bankruptcy risk as in Altman's Z-score of firm i at the end of year t-1. **TANG** is the net book value of property plant and equipment (PPENT from Compustat), scaled by total assets (AT from Compustat) of firm i at the end of year t-1. **RDE_1** is R&D expense (XRD from Compustat) to sales revenue (SALE from Compustat) in year t-1. **TOBINQ** is the ratio of the market value to the book value of total assets of firm i at the end of year t-1. **LEV** is the ratio of long-term debt (DLTT from Compustat) to the sum of long-term debt plus the market value of equity (DLTT + CSHPRI × PRCC_F) of firm i at the end of year t-1. **OCF** is net cash flow from operating activities (OANCF from Compustat) divided by sales revenue in year t. **SIZE** is the natural logarithm of total assets of firm i at the end of year t-1. **BM** is calculated as stockholders' equity (SEQ from Compustat) divided by market value of equity (CSHPRI × PRCC_F from Compustat). **ADEX** is advertising expenditures (XAD from Compustat) to sales ratio. For firms with zero or missing advertising expenditures, ADEX equals 0. **EARN5** is the average earnings (EBIT + XRD) over five subsequent years from t+1 to t+5 divided by sales revenue in year t. **EARN1** is the earnings before interest, tax and R&D in year t+1 divided by sales revenue in year t. If a firm is delisted in any of the years t+1 to t+5, EARN5 or EARN1 is set to the mean value in the firm's Altman Z-score decile portfolio. **RQ** is financial reporting quality derived by Dechow and Dichev (2002) and modified by Mc Nichols (2002) of firm i at the end of year t-1.

4.2. Sample characteristics

Among the 140,378 observations, I find that 23,573 (16.79%) observations have LOSS=1, as their annual income before interest and tax (EBIT) and the lagged R&D is negative. The remaining 116,805 observations have LOSS=0, because their EBIT and the lagged R&D is positive.[14] Normal management in the final sample accepts positive net present-value opportunities since doing so is irrelevant to the predicted sign of reported income. Table 1 reports descriptive statistics for the sample. To mitigate the influence of potential outliers, I winsorize all continuous variables at the 1% and 99% levels. Respecting my dependent variables, the mean and median values of RDE are 0.12 and 0 respectively, while RDC are 0.33 and 0.01 respectively. The mean and median of EARN5 are -0.11 and 0.10 respectively, while EARN1 are -0.28 and 0.09. Respecting my primary independent variables, the mean and median values of LOSS dummy are 0.16 and 0 respectively, implying that losses are relatively infrequent and transient as per Hayn (1995). As mentioned earlier, I create a dummy variable, BIG, and incorporate it with LOSS to capture firms' risk seeking incentive instead of traditional median ROE approach (e.g., Miller and Bromiley, 1990;

[14] To avoid biases favor my hypotheses, I discard 6,983 observations. These observations have positive income before tax and the lagged R&D but their income becomes negative once the lagged R&D expenditures are deducted from the income. Baber et al. (1991) show that management in these observations tend to reject some positive net present value opportunities since doing so yields positive income.

Fiegenbaum, 1990; Jegers, 1991; Sinha, 1994; Gooding et al., 1996), thereby yielding 0.48 and 0 for the mean and median respectively. As for RQ, I multiply it by negative one so that higher RQ indicates higher reporting quality. As a result, RQ has negative values with the mean and median of -0.13 and -0.08 respectively. The distribution of RQ is similar Biddle et al. (2009).

Table 2 reports the Pearson and Spearman correlations among my variables. Consistent with my predictions, I find that there is a positive and significant correlation between LOSS, BIG and RDE. It therefore provides us preliminary evidence on my hypotheses (1) and (2) stating that losses drive firms to invest more in R&D and prospect incentive strengthen this inclination even more. As for hypotheses (3), I find that LOSS is significantly negative associated with EARN5 and EARN1, and significantly positive associated with R&D, which is consistent with Hayn (1995) and Joos and Plesko (2005). However, it is difficult to explain the association among BIG and R&D, LOSS, EARN5, EARN1 since there exists opposite correlations between BIG and the others and some of these correlations are insignificant. It also yields little information for us to explain BIG alone since it captures profit firms' prospect incentive and that is not of my main interest. Finally, respecting hypotheses (4), I find that RQ is negatively associated with LOSS, which induces prospect incentive, and positively associated with EARN5 and EARN1. Again, since my main interest is “loss firms’ prospect incentive”, I cannot refer to BIG alone and therefore cannot observe whether the prospect-based R&D is negatively associated with RQ. My correlation results for other control variables are substantially consistent with prior studies mentioned before. For example, a positive and significant correlation between Z SCORE, lagged R&D, TOBINQ and RDE; a negative and significant correlation between TANG, LEV and RDE. There is also a high correlation between SIZE, BM, TANG and EARN5.

Table 2

Pearson (top) and Spearman (bottom) Correlations.

Variable	RDE	RDC	LOSS	BIG	Z SCORE	TANG	RDE_1	TOBINQ	LEV	OCF	SIZE	BM	ADEX	EARN5	EARN1	RQ
RDE		0.96530	0.26919	**0.01053**	0.14696	-0.14844	0.87529	0.28614	-0.13956	-0.74767	-0.14340	-0.10295	-0.01785	-0.04702	-0.19369	-0.07140
RDC	0.97843		0.26749	**0.00924**	0.11715	-0.15824	0.88080	0.26917	-0.14245	-0.75489	-0.15663	-0.09328	-0.01990	-0.04750	-0.19173	-0.07985
LOSS	0.11119	0.13193		-0.12604	-0.03067	-0.09318	0.22747	0.09872	-0.05834	-0.32569	-0.33185	0.12753	0.02796	-0.03214	-0.06433	-0.14421
BIG	0.07797	0.06848	-0.12604		0.16877	0.03072	**0.01163**	0.29099	-0.25917	**-0.00614**	0.04558	-0.30827	0.05411	**-0.00943**	**-0.01007**	**0.00330**
Z SCORE	0.14613	0.11939	-0.15841	0.28519		-0.12229	0.15486	0.61590	-0.35952	-0.08384	-0.05180	-0.27307	0.01951	-0.01998	-0.03208	0.02593
TANG	-0.34360	-0.36197	-0.13974	0.04619	-0.13343		-0.14974	-0.10443	0.28600	0.14986	0.22717	-0.02119	-0.04117	**0.00540**	0.02021	0.09529
RDE_1	0.97778	0.97784	0.09586	0.08227	0.13631	-0.34294		0.29655	-0.14055	-0.83828	-0.14368	-0.10493	-0.02441	-0.02832	-0.14639	-0.06990
TOBINQ	0.31575	0.30419	-0.01990	0.40448	0.51592	-0.06388	0.31154		-0.38507	-0.25621	-0.06743	-0.51532	0.06777	-0.02464	-0.04301	-0.10892
LEV	-0.34415	-0.34438	-0.11057	-0.22208	-0.60965	0.36016	-0.33979	-0.46442		0.09823	0.22826	0.39389	-0.04992	**0.00480**	0.01952	0.10431
OCF	-0.12579	-0.14497	-0.33976	0.18994	0.17215	0.30574	-0.13356	0.13446	**0.00578**		0.21215	0.04944	**-0.00886**	0.04396	0.17574	0.08643
SIZE	-0.16343	-0.18905	-0.33518	0.04952	-0.01996	0.27170	-0.16422	0.06248	0.31910	0.35640		-0.17653	0.06430	**0.01009**	0.03565	0.18533
BM	-0.25170	-0.23930	0.05572	-0.38131	-0.38451	**0.00760**	-0.24843	-0.93829	0.32314	-0.14925	-0.14710		-0.04874	0.02569	**0.01030**	0.03152
ADEX	-0.04676	-0.05097	-0.02675	0.06025	0.05448	-0.03432	-0.04954	0.05433	-0.02570	**0.00258**	0.07947	-0.05228		**-0.00117**	**-0.00122**	**-0.01335**
EARN5	0.19134	0.16725	-0.35938	0.25294	0.18714	0.08001	0.19184	0.26086	-0.08086	0.44783	0.28338	-0.25763	**-0.01157**		0.54934	**0.00674**
EARN1	0.19138	0.16851	-0.45632	0.32042	0.20838	0.08460	0.19654	0.28394	-0.09293	0.48601	0.27466	-0.28230	**-0.00377**	0.76823		**0.01201**
RQ	-0.15363	-0.16753	-0.21206	0.02643	**-0.00339**	0.34307	-0.15335	-0.09436	0.22952	0.20937	0.38508	0.05134	0.01454	0.15436	0.14528	

Bold correlations are NOT significant at 5%. R&D is either **RDE** or **RDC**. The former is the R&D expense (XRD from Compustat) to sales revenue (SALE from Compustat) in year t, the latter is R&D capital to sales ratio. R&D capital is calculated assuming 20% amortization rate. For firms with zero or missing R&D expenditures, RDE (RDC) equals 0. **LOSS** is a dummy variable equal to 1, if the sum of income before interest and tax (EBIT from Compustat) and the lagged R&D is negative in year t, and 0 otherwise. **BIG** is a dummy variable equal to one, if the earnings to one-year lagged total assets is above (below) the median value of profit (loss) firms' earnings to one-year lagged total assets in year t and industry j, and zero otherwise. **Z SCORE** is bankruptcy risk as in Altman's Z-score of firm i at the end of year t-1. **TANG** is the net book value of property plant and equipment (PPENT from Compustat), scaled by total assets (AT from Compustat) of firm i at the end of year t-1. **RDE_1** is R&D expense (XRD from Compustat) to sales revenue (SALE from Compustat) in year t-1. **TOBINQ** is the ratio of the market value to the book value of total assets of firm i at the end of year t-1. **LEV** is the ratio of long-term debt (DLTT from Compustat) to the sum of long-term debt plus the market value of equity (DLTT + CSHPRI × PRCC_F) of firm i at the end of year t-1. **OCF** is net cash flow from operating activities (OANCF from Compustat) divided by sales revenue in year t. **SIZE** is the natural logarithm of total assets of firm i at the end of year t-1. **BM** is calculated as stockholders' equity (SEQ from Compustat) divided by market value of equity (CSHPRI × PRCC_F from Compustat). **ADEX** is advertising expenditures (XAD from Compustat) to sales ratio. For firms with zero or missing advertising expenditures, ADEX equals 0. **EARN5** is the average earnings (EBIT + XRD) over five subsequent years from t+1 to t+5 divided by sales revenue in year t. **EARN1** is the earnings before interest, tax and R&D in year t+1 divided by sales revenue in year t. **RQ** is financial reporting quality derived by Dechow and Dichev (2002) and modified by Mc Nichols (2002) of firm i at the end of year t-1.

Table 3

R&D levels analyses.

$$RDE_{it} = \beta_0 + \beta_1 LOSS_{it} + \beta_2 Z\ SCORE_{it-1} + \beta_3 TANG_{it-1} + \beta_4 RDE_{it-1} + \beta_5 TOBINQ_{it-1} + \beta_6 LEV_{it-1} + \beta_7 OCF_{it} + \beta_8 SIZE_{it-1} + Industry\ \&\ Year\ Indicators + \varepsilon_{it} \quad (1)$$

$$RDE_{it} = \beta_0 + \beta_1 BIG_{it} + \beta_2 BIG_{it} \times LOSS_{it} + \beta_3 LOSS_{it} + \beta_4 Z\ SCORE_{it-1} + \beta_5 TANG_{it-1} + \beta_6 RDE_{it-1} + \beta_7 TOBINQ_{it-1} + \beta_8 LEV_{it-1} + \beta_9 OCF_{it} + \beta_{10} SIZE_{it-1} + Industry\ \&\ Year\ Indicators + \varepsilon_{it} \quad (2)$$

Variable	**Pred**	**Eq. (1)**		**Pred**	**Eq. (2)**	
BIG					-0.0137	***
					(-3.37)	
BIG×LOSS				+	0.1259	***
					(12.29)	
LOSS	+	0.1022	***	+	0.0653	***
		(19.30)			(10.62)	
Z SCORE	-	0.0001		-	0.0006	*
		(0.39)			(1.66)	
TANG	-	-0.0247	***	-	-0.0229	**
		(-2.62)			(-2.43)	
RDE_1	+	0.8497	***	+	0.8615	***
		(116.74)			(117.78)	
TOBINQ	+	0.0056	***	+	0.0033	**
		(3.61)			(2.03)	
LEV	-	-0.0064		-	-0.0103	
		(-0.60)			(-0.95)	
OCF	+	-0.0207	***	+	-0.0072	
		(-4.29)			(-1.46)	
SIZE		0.0022	**		0.0034	***
		(2.39)			(3.66)	
Adjusted R-squared		0.7748			0.7765	
N		19,788			19,788	

The table reports results of estimating Equation (1) and (2) using pooled OLS regressions. The sample contains 19,788 firm-year observations over 1993-2006. *, **, *** statistically significant at 10%, 5%, 1%, respectively. T-Statistics are reported in parenthesis. P-values are one-tailed for statistical tests with directional predictions and two-tailed otherwise. All continuous variables are winzorized at 1% and 99%. **RDE** is R&D expense (XRD from Compustat) to sales revenue (SALE from Compustat) in year t. For firms with zero or missing R&D expenditures, RDE equals 0. **BIG** is a dummy variable equal to one, if the earnings to one-year lagged total assets is above (below) the median value of profit (loss) firms' earnings to one-year lagged total assets in year t and industry j, and zero otherwise. **LOSS** is a dummy variable equal to 1, if the sum of income before interest and tax (EBIT from Compustat) and the lagged R&D is negative in year t, and 0 otherwise. **Z SCORE** is bankruptcy risk as in Altman's Z-score of firm i at the end of year t-1. **TANG** is the net book value of property plant and equipment (PPENT from Compustat), scaled by total assets (AT from Compustat) of firm i at the end of year t-1. **RDE_1** is R&D expense (XRD from Compustat) to sales revenue (SALE from Compustat) in year t-1. **TOBINQ** is the ratio of the market value to the book value of total assets of firm i at the end of year t-1. **LEV** is the ratio of long-term debt (DLTT from Compustat) to the sum of long-term debt plus the market value of equity (DLTT + CSHPRI × PRCC_F) of firm i at the end of year t-1. **OCF** is net cash flow from operating activities (OANCF from Compustat) divided by sales revenue in year t. **SIZE** is the natural logarithm of total assets of firm i at the end of year t-1.Industry indicators are created based on Fama and French 48-industry definitions.

Table 4

Earnings analyses.

$$EARN_{it} = \beta_0 + \beta_1 BIG_{it} + \beta_2 LOSS_{it} + \beta_3 RD_{it} + \beta_4 BIG_{it} \times LOSS_{it} + \beta_5 BIG_{it} \times RD_{it} + \beta_6 LOSS_{it} \times RD_{it} + \beta_7 BIG_{it} \times LOSS_{it} \times RD_{it} + \beta_8 SIZE_{it} + \beta_9 BM_{it} + \beta_{10} TANG_{it-1} + \beta_{11} ADEX_{it} + Industry \,\&\, Year\ Indicators + \varepsilon_{it} \quad (3)$$

Panel A: Regressions of average earnings over years t+1 to t+5 (EARN5)

Variable	**Pred**	**Eq. (3)**	
BIG		1.5009	***
		(2.88)	
LOSS		0.8316	
		(1.02)	
RDE	+	19.4306	***
		(15.16)	
BIG×LOSS	-	-0.7988	
		(-0.59)	
BIG×RDE		-19.8919	***
		(-9.62)	
LOSS×RDE	-	-22.4901	***
		(-15.74)	
BIG×LOSS×RDE		14.7276	***
		(6.39)	
SIZE	+	0.0665	
		(0.55)	
BM	-	1.5506	***
		(3.65)	
TANG	+	1.2144	
		(1.02)	
ADEX	+	5.0015	

		(0.47)	
Adjusted R-squared		0.0206	
N		19,788	
Panel B: Regressions of earnings in year t+1 (EARN1)			
Variable	**Pred**	**Eq. (3)**	
BIG		-0.0783	
		(-0.36)	
LOSS		-0.1517	
		(-0.44)	
RDC	+	-1.5208	***
		(-8.11)	
BIG×LOSS	-	0.6360	
		(1.10)	
BIG×RDC		1.2968	***
		(4.60)	
LOSS×RDC	-	0.5122	**
		(2.40)	
BIG×LOSS×RDC		-3.5187	***
		(-10.82)	
SIZE	+	0.0296	
		(0.58)	
BM	-	-0.0439	
		(-0.24)	
TANG	+	0.2345	
		(0.47)	
ADEX	+	-0.8294	
		(-0.19)	
Adjusted R-squared		0.0497	
N		19,788	

This table presents the coefficient estimates from pooled cross-section regressions of Eq. (3). The sample contains 19,788 firm-year observations over 1993-2006. *, **, *** statistically significant at 10%, 5%, 1%, respectively. T-Statistics are reported in parenthesis. P-values are one-tailed for statistical tests with directional predictions and two-tailed otherwise. All continuous variables are winzorized at 1% and 99%. **EARN5** is the average earnings before interest, tax and R&D (EBIT plus XRD from Compustat) over five subsequent years from t+1 to t+5 divided by sales revenue (SALE from Compustat) in year t. **EARN1** is the earnings before interest, tax and R&D in year t+1 divided by sales revenue in year t. **BIG** is a dummy variable equal to one, if the earnings to one-year lagged total assets is above (below) the median value of profit (loss) firms' earnings to one-year lagged total assets in year t and industry j, and zero otherwise. **LOSS** is a dummy variable equal to 1, if the sum of income before interest and tax (EBIT from Compustat) and the lagged R&D is negative in year t, and 0 otherwise. **RDE** is R&D expense (XRD from Compustat) to sales revenue in year t. **RDC** is R&D capital to sales ratio. R&D capital is calculated assuming 20% amortization rate. For firms with zero or missing R&D expenditures, RDE (RDC) equals 0. **SIZE** is the natural logarithm of total assets of firm i at the end of year t-1. **BM** is the stockholders' equity (SEQ from Compustat) divided by market value of equity (CSHPRI times PRCC_F from Compustat). **TANG** is the net book value of property plant and equipment (PPENT from Compustat), scaled by total assets (AT from Compustat) of firm i at the end of year t-1. **ADEX** is advertising expenditures (XAD from Compustat) to sales ratio. For firms with zero or missing advertising expenditures, ADEX equals 0. Industry indicators are created based on Fama and French 48-industry definitions.

Table 5

Further analyses.

$$\begin{aligned} RDE_{it} = {} & \beta_0 + \beta_1 BIG_{it} + \beta_2 LOSS_{it} + \beta_3 RQ_{it} + \beta_4 BIG_{it} \times LOSS_{it} + \beta_5 RQ_{it} \times BIG_{it} + \\ & \beta_6 RQ_{it} \times LOSS_{it} + \beta_7 RQ_{it} \times BIG_{it} \times LOSS_{it} + \beta_8 Z\ SCORE_{it-1} + \beta_9 TANG_{it-1} + \\ & \beta_{10} RDE_{it-1} + \beta_{11} TOBINQ_{it-1} + \beta_{12} LEV_{it-1} + \beta_{13} OCF_{it} + \beta_{14} SIZE_{it-1} + \\ & Industry\ \&\ Year\ Indicators + \varepsilon_{it} \qquad (4) \end{aligned}$$

Variable	**Pred**	**Eq. (4)**	
BIG		-0.0091	*
		(-1.88)	
LOSS	+	0.0644	***
		(9.34)	
RQ		0.0044	
		(0.23)	
BIG×LOSS	+	0.1135	***
		(9.25)	
RQ×BIG		0.0405	*
		(1.74)	
RQ×LOSS	-	-0.0017	
		(-0.08)	
RQ×BIG×LOSS	-	-0.0713	**
		(-1.99)	
Z SCORE	-	0.0006	*
		(1.67)	
TANG	-	-0.0229	**
		(-2.44)	
RDE_1	+	0.8613	***

		(117.72)	
TOBINQ	+	0.0034	**
		(2.07)	
LEV	-	-0.0093	
		(-0.85)	
OCF	+	-0.0070	
		(-1.42)	
SIZE		0.0031	***
		(3.20)	
Adjusted R-squared		0.7766	
N		19,788	

This table presents the coefficient estimates from pooled cross-section regressions of Eq. (4) and (5). The sample contains 19,788 firm-year observations over 1993-2006. *, **, *** statistically significant at 10%, 5%, 1%, respectively. T-Statistics are reported in parenthesis. P-values are one-tailed for statistical tests with directional predictions and two-tailed otherwise. All continuous variables are winzorized at 1% and 99%. **RDE** is R&D expense (XRD from Compustat) to sales revenue in year t. **RDC** is R&D capital to sales ratio. R&D capital is calculated assuming 20% amortization rate. For firms with zero or missing R&D expenditures, RDE (RDC) equals 0. **BIG** is a dummy variable equal to one, if the earnings to one-year lagged total assets is above (below) the median value of profit (loss) firms' earnings to one-year lagged total assets in year t and industry j, and zero otherwise. **LOSS** is a dummy variable equal to 1, if the sum of income before interest and tax (EBIT from Compustat) and the lagged R&D is negative in year t, and 0 otherwise. **RQ** is financial reporting quality derived by Dechow and Dichev (2002) and modified by Mc Nichols (2002) of firm i at the end of year t-1. **Z SCORE** is bankruptcy risk as in Altman's Z-score of firm i at the end of year t-1. **TANG** is the net book value of property plant and equipment (PPENT from Compustat), scaled by total assets (AT from Compustat) of firm i at the end of year t-1. **RDE_1** is R&D expense (XRD from Compustat) to sales revenue (SALE from Compustat) in year t-1. **TOBINQ** is the ratio of the market value to the book value of total assets of firm i at the end of year t-1. **LEV** is the ratio of long-term debt (DLTT from Compustat) to the sum of long-term debt plus the market value of equity (DLTT + CSHPRI × PRCC_F) of firm i at the end of year t-1. **OCF** is net cash flow from operating activities (OANCF from Compustat) divided by sales revenue in year t. **SIZE** is the natural logarithm of total assets of firm i at the end of year t-1.

5. Results

5.1 R&D levels analyses

Before I examine the role of prospect incentive in loss-induced R&D relationship, I first examine the effect of losses on R&D investments without conditioning on prospect incentive (i.e., estimate Eq. (1) without BIG and the interaction term, BIG×LOSS). The second column of table 3 reports the estimates of Eq. (1) when the dependent variable is R&D intensity, calculated as R&D expense divided by sales revenue. My result shows a positive and significant (1% level) coefficient of LOSS, indicating that R&D intensity increases when the performance of firm fails below zero earnings point. The sign and significance do not change after another explanatory variable (BIG) in Eq. (2) is included. In other words, the "failure-induced" model of R&D proposed by BT can be modified to "loss-induced" model of R&D, which in turn support my H1, arguing that zero earnings point also serve as an aspiration level for firms.

To extend my results from H1, I add the dummy variable, BIG, to further separate losses (gains) region into two sub-regions, small loss (profit) and big loss (profit). By doing this, I can capture the effect of loss firms' prospect incentive on R&D by examining the sign of $(\beta_1+\beta_4)$ since firms increase their prospect incentive as their losses become larger according to PT. My estimates result for Eq. (2) shows a positive and significant (1% level) sign of $(\beta_1+\beta_4)$, indicating that loss firms with greater risk-seeking intention prefer to choose R&D investments as my H2 predicts.

The results for the control variables in Eq. (1) and (2) are largely consistent with prior research. I find that R&D investments decreases in firm’s physical assets (TANG), which is consistent with Aghion et al. (2004), Hsiao and Tahmiscioglu (1997) and Fazzari et al. (1988), but increases in lagged R&D (R&D_1) and investment opportunities (TOBINQ), which are consistent with Lev and Sougiannis (1996), Dunlap-Hinkler et al. (2007), Lach and Schankerman (1989) and Bhagat and Welch (1995). While the sign of the LEV's coefficient supports prior studies (Smith and Warner, 1979; Williamson, 1988), it is insignificant. Finally, my results for the rest control variables (Z SCORE and OCF) are contradicted with literature.

5.2 Earnings analyses

Panel A of table 4 reports the estimates of Eq. (3) when the dependent variable is EARN5, average earnings over five years. This table reports earnings level estimates for all firm-years in the sample. The positive coefficient of SIZE is consistent with Fama and French (1995), however, it is insignificant in both specification of Eq. (3) estimations. My results for the coefficient of R&D, tangible assets and advertising expenditures are Consistent with Lev and Sougiannis (1996), they are all positive and the coefficient of R&D is significant at 1% level in these estimations.

To judge the effect of prospect-based R&D on future earnings, I refer to the sign of $(\beta_1+\beta_4+\beta_5+\beta_7)$, reflecting the marginal effect of the shift from small loss firms' R&D to big loss firms' R&D on future earnings, since I presume that prospect incentive, rather than problem-solving incentive, is an important driver of loss-induced R&D, especially big loss. My results from panel A support H3, proposing that prospect-based R&D of loss firms deteriorates future earnings, and the combined coefficient, $(\beta_1+\beta_4+\beta_5+\beta_7)$, is negative

(-4.4622) and highly significant (0.001 level). Comparing with firms with positive earnings, whose R&D benefits future earnings (a positive and significant coefficient on R&D), my results not only show that loss firms' R&D decreases future earnings (a negative sign on (β_3+β_6)), but also show that this negative effect increases as losses become larger (a much more negative sign on (β_1+β_4+β_5+β_7)). These results strongly supports the proposition that loss firms' betting on R&D substantially decreases future earnings, and could be seen as a proof of research (e.g., Bowman, 1980) focusing on a negative association between firms', which are below the reference point, risk taking behavior and future return.

Panel B of Table 4 reports the results when I replace the dependent variable average future earnings over next five years (EARN5) with one-year-ahead earnings (EARN1), and R&D intensity is measured with R&D capital to sales (RDC) rather than with R&D expense to sales (RDS) as per Panel A. Relative to the Panel A approach, this specification is much more robust to dependent variable survivorship biases, as the dependent variable requires data for one rather than for five years. Consistent with Panel A, the combined coefficient, (β_1+β_4+β_5+β_7), is negative (-1.6642) and highly significant (0.001 level). Results for the other variables in this specification are also broadly similar to those reported in Panel A, except that BM coefficient becomes negative and ADEX coefficient becomes negative. The former is consistent with Fama and French (1995) and the latter contradicts Lev and Sougiannis (1996) while they are both insignificant.

5.3 Further analyses

Given the argument that prospect-based R&D deteriorate future earnings is verified in H3, I perform an additional tests to see whether higher financial reporting quality curb this unproductive activity by reducing firms' inclination to overinvest in R&D (appropriateness of R&D intensity).

To examine whether reporting quality curbs loss firms' inclination to overinvest in R&D, I first add a new variable, RQ, to Eq. (2) and interact it with the main variables in Eq. (2), thereby giving my Eq. (4) and its estimates results are shown in table 5. The combined coefficient, $(\beta_5+\beta_7)$, in Eq. (4) is of my primary interest. My results show a significant negative sign (-0.0308) on $(\beta_5+\beta_7)$, indicating that the effect of prospect incentive on R&D is less positive for firms with higher quality financial reporting, providing support for H4. In other words, high reporting quality mitigates the magnitude of moral hazard-induced R&D (the combined coefficient, $(\beta_1+\beta_4)$), of which is likely to be overinvested, and thus improving loss firms future earnings, providing support for H4.

5.4 Robustness tests

In further untabulated analyses I conducted several robustness tests for the results documented in Tables 3 to 5. To illustrate, I follow Eberhart et al. (2008) to use total assets and market capitalization of common stock to scale R&D (either RDE or RDC). The sign and significance of coefficients of my main variables in Eq. (1) to (4) remains stable. With respect to Table 4, I follow Ciftci and Cready (2011) to use operating income before depreciation (OPBDP from Compustat), advertising (XAD from Compustat) and R&D expenditures (XRD from Compustat) as an alternative to earnings. The combined coefficient, representing prospect-based R&D is negative and remains highly significant.

Since my sample includes firms with missing value of R&D, I could suffer potential sample selection bias. To address this problem, I exclude those observations instead of resetting them to zero, as Ciftci and Cready (2011) name this sample "R&D firms". With the new sample I used, my untabulated results show that all of the hypotheses are still validated.

6. Conclusion

Researchers following BT (e.g., Chen and Miller, 2007; Chen, 2008) document that failure to attain the aspiration level of performance generates R&D activities, while others (Bowman, 1980; Fiegenbaum and Thomas, 1988; Chang and Thomas, 1989; Fiegenbaum, 1990; Jegers, 1991; Sinha, 1994; Gooding et al., 1996; Lehner, 2000) following PT show that risk seeking behavior due to losses situation deteriorate future financial performance. In my study, I build a framework to combine the above two theories, and then show that: (1) It is prospect incentive that drives loss firms to invest R&D. (2) The prospect incentive reduces the positive association between R&D activities and subsequent accounting performance. (3) Higher financial reporting quality curbs such unproductive activities by reducing loss firms' inclination to overinvest in R&D. My evidence complements studies reporting in industry-specific level, employing an aspiration level that is the industry median ROE such as Greve (1998), and studies following either BT or PT. Distinct from these studies, I use a cross-section set of sample, a simpler aspiration level that is zero earnings point and a special-designed model accommodating BT and PT, to explain the reason of loss-induced R&D and its implication on future accounting performance. That is, my analysis demonstrates that both loss-induced R&D are broadly present across a wide spectrum of firms, and substantially impact on the fundamental properties of bottom-line earnings.

Following Pandit et al. (2009), which suggests that R&D productivity varies considerably across firms, I find a new driver, prospect incentive, of such variation. Furthermore, to address the problem resulted from prospect-based R&D; my analysis introduces financial reporting quality and thus adds to the growing interest of reporting quality-investments relationship. Distinct from prior studies, which examine the effect of reporting quality on the efficiency of "total investment" or "capital investment" (e.g., Biddle and Hillary, 2006; Biddle et al., 2009), my study examines the effect of reporting quality on the efficiency of "R&D". To illustrate, my evidence shows that higher reporting quality alleviate firms' (those with higher prospect incentive) inclination to overinvest in R&D, which in turn leads to worse future financial results as Ming-Liang et al. (2010) suggested.

Finally, while my findings suggest that prospect incentive drives loss firms to invest more in R&D and thus deteriorate future earnings; an opportunity exists to extend my findings in several ways. First, one could build a model to accommodate both prospect incentive and problem-solving incentive and thus re-perform my study. Specifically, it will consist of two phases. (1) Find a formal theory to support problem-solving incentive argument and proxy it. (2) Make sure such proxy is not confounded by prospect incentive and thus put them into one regression. Second, one could further explore the link between reporting quality and the performance of prospect-based R&D. For example, one could examine how higher reporting quality improves the quality of R&D investment, ceteris paribus. Third, one could explore the possibility of building a new theory, based on my framework, to explain how firms choose among different investment project (in terms of risk feature) as their performance level varies, and how these portfolios in turn lead to different financial results. Specifically, it at least consists of the following issues. (1) The optimal level of both investment projects with higher risk (e.g., R&D) and those with lower risk (e.g., physical investment). (2) Since optimal at individual investment level may not necessarily lead to optimal at integral level, the balance between riskier and non-riskier investment project should be considered. (3) Firms with financing constraint may inevitably face the choice among different investment projects, i.e., the competing effect among projects with different risk feature will occur. Finally, there are some ways to improve my regression model. For example, one could change the dependant variable of Eq. (1), (2) and (4) with "change in R&D", measured as the difference between RD_{it} and RD_{it-1}, to have a more direct representation of the empirical results. In addition, the control variables I used may also incur potential linear hypothesis problem. To get more robust results, one could perform Fama and MacBeth (1973) cross-sectional regressions instead of pooled regression and set EARN5 or EARN1 to the mean value in the firm's Altman Z-score decile portfolio, as Ciftci and Cready (2011). I leave these issues for future research.

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