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Reliability of R&D capitalization: Evidence from ex post impairment in China

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ABSTRACT

Unlike prior studies that investigate research and development (R&D) accounting as a dichotomous choice between capitalizing vs. expensing, this study identifies low-reliability R&D capitalization by the occurrence of ex post impairment of capitalized R&D costs. I find that low-reliability capitalization is associated with higher discretionary accruals but fails to signal future innovation, whereas normal capitalization without subsequent impairment lacks earnings aggressiveness and predicts future innovation positively, compared to expensing firms. Next, this study shows that Big 4 and industry specialist auditors improve reliability by notably decreasing the likelihood of low-reliability R&D capitalization. The results remain robust after controlling for R&D investment intensity and potential endogeneity in the capitalization decision. Additional tests show that managers strategically time the recognition of impairment for big-bath and earnings-smoothing purposes, and that analyst coverage does not help differentiate between low-reliability and normal R&D capitalization. Collectively, this paper increases our understanding of R&D accounting and auditing and contributes to the debate on the reliability of R&D capitalization.

1. Introduction

Accounting for corporate research and development (R&D) costs is a controversial issue worldwide. While the International Financial Reporting Standards allow the capitalization of R&D costs when they meet certain criteria, claiming that it conveys relevant information about a firm's R&D activities, the U.S. Generally Accepted Accounting Principles mandate the full expensing of all R&D costs for public firms (Lev and

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Sougiannis, 1996), because R&D capitalization, as Healy et al. (2002) emphasize, creates an opportunity for corporate managers to not only discretionarily capitalize the costs of projects that have a low probability of success but also delay the write-down of impaired R&D assets. The lack of real data on R&D capitalization in the U.S. compels researchers to rely on simulation models (e.g. Lev and Sougiannis, 1996; Kothari et al., 2002). As a result, in the debate on relevance vs. reliability in R&D reporting, the reliability side of the trade-off has received far less investigation than relevance.

Recently, however, some empirical evidence on the reliability of R&D capitalization has been provided in a few jurisdictions adopting the International Financial Reporting Standards (IFRS). For example, Prencipe et al. (2008) and Markarian et al. (2008) document that companies in Italy tend to use capitalization for earnings-smoothing purposes; Cazavan-Jeny et al. (2011) find that French firms capitalize R&D outlays when they need to meet or beat earnings thresholds; and Xie et al. (2017) find that firms in China are more likely to capitalize R&D costs when the controlling shareholders' shares are pledged. Overall, these studies suggest that R&D capitalization is driven by management earnings-related incentives and that its reliability is questionable.

However, prior studies on the reliability of R&D capitalization are subject to several limitations. First, the typical key variable, the capitalizing vs. expensing indicator, is somewhat crude. Given that a single accounting choice can be jointly motivated by multiple goals (Fields et al., 2001), the capitalization decision does not necessarily indicate low reliability; rather, it may show faithful information signaling by management. Furthermore, accounting conservatism does not necessarily mean higher reliability or faithful representation (Watts, 2003; Bandyopadhyay et al., 2010); therefore, full expensing is not always more desirable and indicative of better reliability than capitalizing treatment. In this sense, treating all R&D capitalization as homogeneous and lacking reliability could be problematic. Second, prior studies focus mainly on the period of capitalization, but limited attention is paid to the conditions of the R&D assets in subsequent periods after the capitalization decision. Moreover, despite the questionable reliability of R&D capitalization, there has been little exploration of whether external monitoring mechanisms, such as independent auditing, could effectively improve its reliability.

In this paper, I provide a new measure of (low) reliability R&D capitalization, based on the ex post impairment of capitalized R&D costs as the direct economic consequence of poor capitalization decisions. Specifically, I define a capitalization decision as of low reliability if the development project(s) is subsequently impaired, and normal if it is not, and find the following. First, unlike normal capitalization, low-reliability capitalization is positively associated with both concurrent overall earnings aggressiveness and earnings management in other items proxied by abnormal accruals. Second, while normal capitalization positively predicts future innovation, low-reliability capitalization shows merely a marginal or insignificant relation to future innovation, suggesting that ex post impairment is a satisfactory measure of low-reliability R&D capitalization. Next, I investigate the monitoring role of independent auditors and find that firms audited by Big 4 and industry specialists are notably less prone to low-reliability R&D capitalization, whereas the relation is insignificant for normal capitalization. The results hold after several robustness checks. In further analysis, I document some evidence of earnings-smoothing and big-bath behavior in the timing of R&D capital impairment recording after R&D capitalization. Finally, I show that analyst coverage fails to help differentiate between normal and low-reliability R&D capitalization.

This study contributes to the extant literature in the following ways. First, it offers a new way of measuring the reliability of R&D capitalization. The ex post impairment of capitalized R&D is a preferable measure because it unambiguously captures the negative consequence of imprudent capitalization decisions. Once a previously capitalized R&D project has been written down, there is less need to identify low-quality capitalization via indirect references. It thus lowers the Type I error rate caused by mixing faithful vs. opportunistic capitalization. In this way, making a distinction between low-reliability and normal capitalization based on ex post impairment offers a more detailed research perspective.

The findings are also relevant to the auditing literature. First, they add new evidence to the continuing debate on auditor differentiation in an area of high risk of misstatement, and in an emerging market that is quite different from Western markets. More importantly, the evidence indicates that greater size and industry expertise are still useful strategies for auditing firms facing the challenge of R&D audits, and answers the call for more archival evidence on the auditing of complex accounting estimates (Bratten et al., 2013, Defond and Zhang, 2014). In sum, this paper extends the R&D-related accounting and auditing literature and has implications for both regulators and the setters of accounting standards.[1]

The remainder of the paper proceeds as follows. Section 2 describes the accounting of R&D in China. Section 3 reviews the literature and develops the hypotheses. Section 4 describes the research design, while Sections 5 and 6 report the empirical results and additional tests. Section 7 presents the conclusion and discussion.

2. R&D accounting in China

In China, accounting for intangibles, including R&D costs, is regulated by the *Accounting Standard for Business Enterprises No. 6* (*Qiyekuaijizhunze*, ASBE 6). Similar to the IFRS, China's ASBE 6 requires research expenditure to be expensed as incurred, whereas expenditure in the development phase can be capitalized, provided a battery of conditions are met.[2] For multi-period R&D projects that have already entered the development stage but are not yet ready for successful recognition as intangible assets, the costs are booked temporarily as *Development costs*. *Development costs* is an asset account and its year-end balance equals the sum of capitalized in-process development costs. Once a project becomes successful, the balance of *Development costs* is shifted to intangible assets; however, if the project finally fails, all of the previously capitalized amounts must be expensed and impaired.

The increases and decreases in the *Development costs* account for each project are disclosed separately in the accompanying notes of the annual reports, depicting annually when each individual R&D project is started, completed successfully or impaired. Appendix A illustrates a typical example of Development costs disclosure by a Chinses listed firm.

The Chinese regulatory authorities assess substantial risk associated with R&D capitalization. For example, in one of its bulletins, the China Securities Regulatory Commission issued warnings about the premature capitalization of R&D costs.[3] The Shanghai and Shenzhen Securities Exchanges have sent several inquiry letters to listed firms in recent years related to R&D capitalization.[4] In 2016, the Chinese Institute of Certified Public Accountants scheduled an interview with a few accounting firms to warn of the risk associated with R&D capitalization, stating that "audit firms should pay attention to the reliability of *Development costs* and assess the reasonability of the distinction between research phase and development phase made by the clients."[5]

Although the criteria for the capitalization of R&D costs are quite clearly regulated, considerable flexibility is left to the managers. For example, the probability of technical feasibility and future profitability depends on estimation, which is subject to judgmental errors and managerial incentives. In particular, the transitory nature of in-process R&D assets (*Development costs*) makes it potentially an attractive channel to pre-capitalize R&D expenses that should otherwise be expensed, because it avoids a reduction in profit. Besides, even if a write-off of the *Development costs* is needed, it is booked as administration expenses, rather than the more noticeable impairment of long-lived intangible assets. Therefore, managers may have incentives to prematurely capitalize R&D expenditure as *Development costs.* Indeed, some high-profile scandals have caused intense dispute over the issue of capitalizing R&D costs among Chinese stock investors and news media.[6]

[1] See more discussion in Section 7.

[2] The conditions include (1) the technical feasibility of completing the development; (2) the intention to complete the development; (3) the pattern of future economic benefits or the usefulness for internal use; (4) the availability of adequate technical and financial resources to complete the development; and (5) the capability to measure development expenditure separately and reliably.

[3] For example, see http://www.csrc.gov.cn/pub/beijing/xxfw/bjfxjs/201401/t20140112_242418.htm.

[4] For example, see http://www.sse.com.cn/disclosure/credibility/supervision/inquiries/maarao/c/4119227.pdf.

[5] See http://www.cicpa.org.cn/news/201604/t20160419_48542.html.

[6] For example, LeTV, a technology company and one of the largest online video companies in China, is reported to have unduly capitalized large amounts of R&D costs that could have caused losses if expensed in recent years. See http://tech.sina.com.cn/i/2016–06-07/doc-ifxsvenx3606939.shtml.

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3. Literature review and hypothesis development

3.1. Reliability of capitalized R&D costs

As stipulated in ASBE 6, the criteria for capitalizing R&D costs depend heavily on management judgment. It is difficult to verify the reasonableness of capitalization decisions and capitalized R&D amounts, because unlike other tangible capital investments that share common characteristics across firms within an industry, R&D costs can be unique and even confidential to the developing firm. As a result, R&D capitalization is risky with a high potential for misreporting (Aboody and Lev, 2000; Healy et al., 2002).

In contrast with the large body of studies on the relevance of R&D capitalization, based on both simulated (e.g. Lev and Sougiannis, 1996; Boone and Raman, 2001) and real data (e.g. Ahmed and Falk, 2006; Oswald and Zarowin, 2007), investigation into the reliability of R&D capitalization can only be conducted in a few IFRS countries. For example, Markarian et al. (2008) find that R&D capitalization is associated with earnings smoothing in Italy, and Cazavan-Jeny et al. (2011) find that managers use R&D capitalization to meet or beat earnings thresholds in France, indicating that the reliability of R&D capitalization may be distorted by the reporting incentives of managers.

However, previous studies cannot unambiguously clarify whether managements manipulate earnings through R&D capitalization. First, a research design that uses a dichotomous variable coded 1 for capitalizers crudely mixes all capitalization decisions motivated by all sorts of incentives. As a tendency to capitalize R&D does not necessarily suggest lower reliability, the conclusions could be confounded by noise in the measure of reliability, which needs to be captured more precisely. Second, the literature focuses mainly on the decision itself; little is known about the conditions and quality of R&D costs after they are capitalized. In addition, although the internal determinants of the R&D capitalization decision, such as management traits, have been examined, evidence of the role of external monitors in shaping reliability is very limited (e.g. Tutticci et al., 2007).

3.2. Hypothesis development

Based on the discussion above, I measure low-reliability R&D capitalization using the ex post impairment/failure of in-process R&D projects that have entered the development phase and been capitalized. This is a desirable measure of lower reliability because ex post impairment directly reflects the wealth-destroying consequence of a poor R&D capitalization decision, with a lower Type I error rate in the identification of misstatements in R&D capitalization. Specifically, I define capitalization that is later impaired as low reliability, and that without subsequent impairment as normal.

First, I hypothesize on the low-reliability phenomenon and whether ex post impairment fairly represents low-reliability R&D capitalization. As the premature recognition of R&D assets delays the reduction of current earnings, managers are likely to take advantage of their discretion in R&D capitalization to boost earnings. Moreover, in most situations, multiple accounting choices are chosen jointly to achieve earnings goals (Fields et al., 2001) and premature capitalization of R&D expenditure can be one of many channels for income-increasing earnings management. Therefore, low-reliability R&D capitalization is predicted to be concurrent with a firm's earnings aggressiveness. In contrast, for normal capitalization, such a positive association is not expected, because it is presumably less likely to be driven by earnings manipulation incentives.

H1a. Low-reliability R&D capitalization, captured by ex post impairment, is positively associated with (aggressive) earnings management.

H1b. Normal R&D capitalization without ex post impairment is NOT positively associated with (aggressive) earnings management.

Tension remains in the hypotheses, especially in H1a, because the impairment may not be caused by prematurely capitalized costs in previous periods. For example, the occurrence of ex post impairment of capitalized R&D costs could be due to unintentional estimation errors rather than managerial manipulation. Even when the capitalization decision is free from managerial manipulation and estimation errors, ex post impairment can be caused by unexpected changes in the technical environment after the capitalization decision is made. In such cases, one should expect to observe low reliability only for specific R&D projects but not for concurrent general earnings, and should not predict a positive relation between a firm's overall earnings management and ex post failed R&D capitalization. Moreover, supposing a firm controls its overall earnings management, for example, if it chooses to capitalize R&D costs but to report more conservatively on other items to maintain a reasonable level of discretionary accruals, it is possible to observe an insignificant or even negative relation between its R&D capitalization and overall earnings management.

In addition to the earnings effects, another question of interest is whether varied levels of reliability in capitalization reflect the real economics of the firm's R&D activities. According to the proponents of R&D capitalization, capitalization of R&D costs is positive information signaled by the management. The underlying argument is that R&D capitalization is a leading indicator of future innovation outcomes. In this case, one should expect the more faithful normal capitalization to be positively related to future innovation. In contrast, if the capitalization is premature and its reliability is questionable, the positive relation should be tempered. Therefore, I hypothesize as follows:

H2a. Normal capitalization of R&D costs is positively associated with future innovation outcomes.

H2b. Low-reliability R&D capitalization, captured by ex post impairment, is less positively associated with future innovation outcome than normal capitalization.

Next, I ask the question whether independent auditing, an important external monitoring mechanism, improves the reliability of R&D capitalization. As financial reporting is the joint result of management and auditors, whose primary role is to verify the accounting numbers (Antle, 1982), auditors of higher quality, such as the Big 4 and industry specialists, are expected to enhance the reliability of R&D capitalization, because they are usually larger and more economically independent and more competent, and bear greater litigation and reputation risks (e.g. DeAngelo, 1981; Solomon et al., 1999). As discussed, regulatory authorities in China also motivate auditors to pursue a higher level of assurance when auditing R&D capitalization. In this context, the question becomes whether higher-quality auditors can decrease the probability of poor R&D capitalization decisions that are followed by subsequent impairment. In contrast, for normal capitalization, a neutral prediction is made, because although auditors are naturally in favor of accounting conservatism and income-decreasing accounting treatment, it is also reasonable for auditors to act strictly only with riskier low-reliability capitalization, but not with normal capitalization that may even signal lower business risk (Krishnan and Changjiang, 2014).

H3. Auditors of higher quality decrease the probability of low-reliability capitalization of R&D costs.

Nevertheless, there are reasons why these hypotheses regarding the role of auditors may not be supported. To provide reasonable assurance of the reliability of a client's R&D capitalization, which involves complex accounting estimates, auditors are required to obtain not only an assessment of the client's financial and operational conditions, but also an understanding of the related technological advances and future productivity, which is often beyond the expertise of traditional auditors (Griffith et al., 2015). Moreover, they can learn little by observing the R&D performance of industry peers if the knowledge is unique and nontransferable. As a result, when the task difficulty increases dramatically, it is not clear whether the expertise of the Big 4 and industry specialists in verifying historical information is applicable to the auditing of R&D-related estimates.

4. Research design

4.1. Identification of ex post R&D impairment

In this paper, I measure low-reliability R&D capitalization using the ex post impairment of in-process R&D projects that have entered the development phase and been capitalized. The project-specific disclosure of *Development costs* by Chinese firms enables me to identify the cases of full impairment of capitalized costs for each in-process R&D project and to ascertain the exact capitalization decision-making period. Specifically, I define an R&D project as impaired when it meets all of the following criteria: (1) the opening balance of

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Development costs for the project is non-zero; (2) the ending balance for the project is zero; and (3) the full reduction in *Development costs* for the project is due to the permanent expensing of previously capitalized R&D costs rather than the successful transfer to intangible assets or a change in the membership of consolidated subsidiaries. Appendix B provides an example of full R&D impairment and the corresponding low-reliability capitalization of the specific R&D project.

4.2. Model specification

First, I test whether the lower reliability of R&D capitalization captured by the occurrence of ex post impairment of capitalized R&D costs is related to firm earnings management. If low-reliability capitalization reflects opportunistic incentives, it is probably accompanied by several other channels to manage earnings upwards. However, if the impairment merely reflects unintentional estimation errors or unexpected changes, and if the firm maintains a controlled level of earnings management, it is less likely to show a positive association between the R&D capitalization decision and earnings aggressiveness.

To begin with, I follow prior studies that use a capitalizing vs. expensing indicator, as shown in Eq. (1a), where *CAPITAL* equals 1 if a firm capitalizes some portion of its R&D expenditure in the current period, and 0 if it records all of the expenditure as period expenses.[7] The dependent variable *DA* is the signed discretionary accruals calculated following Kothari et al. (2005). I also calculate the adjusted discretionary accruals *DA_OTHER* by subtracting the R&D capitalization component from total accruals to measure the earnings management achieved from items other than R&D capitalization.[8]

$$DA = \alpha_0 + \alpha_1 CAPITAL + Controls + \mu \tag{1a}$$

Next, I take away from prior studies by replacing *CAPITAL* in Eq. (1a) with *CAPITAL_NM* and *CAPITAL_LR*. *CAPITAL_NM* indicates normal capitalization, coded 1 for capitalizers and if none of the R&D projects capitalized in a firm-year suffers impairment in the subsequent three years and 0 otherwise; *CAPITAL_LR* indicates low-reliability capitalization, which equals 1 if at least one R&D project capitalized in a firm-year suffers impairment in the subsequent three years, and 0 otherwise.

$$DA = \alpha_0 + \alpha_1 CAPITAL\_NM + \alpha_2 CAPITAL\_LR + Controls + \mu \tag{1b}$$

Meanwhile, a set of firm characteristic variables are controlled in Eqs. (1a) and (1b), including the natural log of year-end total assets (*LNTA*), total liability to total assets ratio (*LEV*), profitability (*ROA*), number of listing years (*AGE*), state ownership (*SOE*), receivables to total assets ratio (*REC_P*), and inventory to total assets ratio (*INV_P*).[9] As prior studies find that firm managers engage in income-increasing management to meet or beat earnings thresholds, I control for zero earnings threshold beating using *SMALL_PROFIT,* which equals 1 if the final *ROA* falls in the range of [0%, 1%] and 0 otherwise, and *SMALL_GROWTH*, which is coded 1 if current earnings beat last-year earnings by [0%, 1%] and 0 otherwise. I estimate Eqs. (1a) and (1b) using OLS regression, taking expensing firms as the benchmark group and predicting α_2 to be positive.

To examine whether current R&D capitalization signals any difference in future innovation outcome, I use the number of patents approved by authorities as the proxy for innovation. I regress the number of patents approved by authorities in periods *t* + *1*, *t* + *2*, and *t* + *3* following the capitalization decision year on the three types of R&D capitalization, i.e. normal capitalization, low-reliability capitalization, and expensing groups, as shown in Eqs. (2a) and (2b).

$$PATENT_{t+x(1,2,3)} = \beta_0 + \beta_1 CAPITAL + Controls + \mu \tag{2a}$$

$$PATENT_{t+x(1,2,3)} = \beta_0 + \beta_1 CAPITAL\_NM + \beta_2 CAPITAL\_LR + Controls + \mu \tag{2b}$$

[7] In this paper, I treat a firm as an R&D capitalizer if the firm meets one of the criteria in a given year: (1) the firm discloses that it capitalizes a certain amount of R&D expenditure; (2) it reports an increase in *Development cost (assets)* and this increase has no other causes such as the acquisition of other entities.

[8] I also use Jones's (1991) model to calculate discretionary accruals and find similar results.

[9] To avoid mechanical associations, I adjust all control variables that are based on net profit and total assets (*LNTA*, *LEV*, *ROA*, *REC_P*, *INV_P*) for the effect of R&D capitalization by subtracting the amount of R&D capitalized for the period, treating this amount as if it were expensed.

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The experimental and control variables remain the same as in Eqs. (1a) and (1b), except that I do not control for *REC_P, INV_P, SMALL_PROFIT* and *SMALL_GROWTH*, which are not closely related to future patents. As the number of patents granted is a non-negative integral number, I estimate Eqs. (2a) and (2b) using a Poisson regression, with expensing firms as the benchmark group.

Finally, I use the following equations to test whether higher-quality auditors affect the quality of R&D capitalization decisions and increase the reliability of R&D capitalization.

$$CAPITAL = \gamma_0 + \gamma_1 AUD + Controls + \mu \tag{3a}$$

$$CAPITAL\_T = \gamma_0 + \gamma_1 AUD + Controls + \mu \tag{3b}$$

In Eq. (3a), the dependent variable *CAPITAL* equals 1 if a firm capitalizes some portion of its R&D expenditure in the current period, and 0 if the firm fully expenses all R&D costs. In contrast, in Eq. (3b), *CAPITAL_T* is a categorical variable with three outcomes that have no natural ordering. *CAPITAL_T* equals 0 if a firm fully expenses all of its R&D expenditure; it equals 1 for normal capitalization, i.e. when $CAPITAL\_NM = 1$; and it equals 2 if a firm capitalizes at least one R&D project that is fully impaired in the subsequent three periods, i.e. when $CAPITAL\_LR = 1$. I estimate Eq. (3a) using logit regression and Eq. (3b) using multinomial (polytomous) logistic regression.

The key test variable *AUD* in Eqs. (3a) and (3b) denotes higher audit quality. It is proxied by auditor size (*BIG4*) and auditor industry specialization (*SPECIALIST*). *BIG4* is an indicator variable taking the value of 1 if a firm hires a Big 4 auditor,[10] and 0 otherwise. *SPECIALIST* equals 1 if a firm hires an auditor that ranks as a top 2 auditor in an industry in terms of national market share based on audit fees, and 0 otherwise.

4.3. Sample construction

Panel A, Table 1 displays the sample construction procedures. It begins with Chinese listed firms that make R&D investments from 2007 to 2015. Next, I categorize the full sample into three subgroups, i.e. the low-reliability capitalization group ($CAPITAL\_LR = 1$), normal capitalization group ($CAPITAL\_NM = 1$), and benchmark group (expensing firms). After dropping firm-years from the financial sector and those with missing values for variables in the equations, I obtain final regression samples of 626, 2140, and 6171 firm-years for the three subgroups, respectively. Panel B displays the yearly distribution of the final sample, showing that the accounting treatment of R&D capitalization becomes increasingly common among Chinese listed firms throughout the sample period.

In this study, all of the financial and R&D-related data are drawn from the CSMAR and WIND databases.

5. Empirical results

5.1. Descriptive statistics and univariate tests

Table 2 reports the descriptive statistics. The mean of *CAPITAL* is approximately 0.3095, indicating that on average 30.95% of the sample firm-years show capitalization of a portion of the R&D expenditure. While 23.95% of the firm-years capitalize some R&D costs with no impairment of the capitalized R&D projects in the subsequent three years, approximately 7% of the firm-years book R&D assets for R&D projects and subsequently have at least one capitalized project fully impaired, 11.32% demonstrate zero-profit earnings threshold beating, and 3.86% demonstrate last-year earnings threshold beating. Big 4 auditors are used in 5.06% of the sample, while 25.15% are audited by industry specialists. The other control variables are reasonably distributed, consistent with prior studies.

Panel A, Table 3 reports the univariate differences in firm earnings management and innovation across the subgroups. It shows that abnormal accruals (*DA*) is highest at 0.008 for the low-reliability capitalizing group ($CAPITAL\_LR = 1$), followed by −0.0002 for the expensing group ($CAPITAL = 0$) and −0.001 for the normal capitalizing group ($CAPITAL\_NM = 1$). The t-tests show that low-reliability firms differ significantly

[10] i.e. the branches of Ernst & Young (EY), Deloitte, KPMG, and Pricewaterhouse Coopers (PwC) in China.

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Table 1
Sample construction.

Panel A: Sample selection

Sample selection procedure	# Of firm-year observations
Low-reliability capitalization group (CAPITAL_LR = 1)	
Firm-years that capitalize at least one R&D project which is fully impaired within the subsequent 3 years	657
Less: observations from financial industries	(3)
Less: firm years with missing variable values	(28)
Subtotal	626
Normal capitalization group (CAPITAL_NM = 1)	
Firm-years that capitalize at least one R&D project without subsequent impairment	2307
Less: observations from financial industries	(22)
Less: firm-years with missing variable values	(145)
Subtotal	2140
Control group (CAPITAL = 0, i.e. *expensing firms)*	
Firm-years that expense all R&D costs	7119
Less: observations from financial industries	(49)
Less: firm-years with missing variable values in Eqs. (1)-(2)	(899)
Subtotal	6171
Total	8937

Panel B: Distribution of sample by year

Year	$CAPITAL\_LR = 1$	$CAPITAL\_NM = 1$	$CAPITAL = 0$	Total
2007	17	45	78	140
2008	27	70	166	263
2009	38	121	194	353
2010	49	130	281	460
2011	83	192	476	751
2012	101	307	1160	1568
2013	102	427	1183	1712
2014	106	378	1298	1782
2015	103	470	1335	1908
Total	626	2140	6171	8937

from expensing firms (t-stat. = 3.25, $p < 0.01$) and from normal capitalizing firms (t-stat. = −3.39, $p < 0.01$). However, the level of accrual management does not differ between normal capitalizing and expensing firms (t-stat. = −0.29, $p > 0.1$). Ranksum tests for the median values report similar results. However, the mean value of *DA_OTHER* is −0.005 for normal capitalizers but 0.005 for low-reliability capitalizers. Taken together, normal capitalizing firms, despite capitalizing R&D, report other items more conservatively and their overall earnings effect is not aggressive. In contrast, low-reliability firms tend to be aggressive in all reporting items.

In period $t + 1$, while normal capitalizing firms obtain significantly more patents than expensing firms (11.639 vs. 7.195; t = 6.38, $p < 0.01$), the difference is not significant between low-reliability capitalizing firms and the expensing group (8.172 vs. 7.195; t = 0.94, $p > 0.10$), indicating that although the firms in the low-reliability group capitalize R&D in their accounting treatment, the decision does not signal any differential information on future innovation outcomes. The univariate results are similar for periods $t + 2$ and $t + 3$, and for the ranksum tests of median values.

Panel B of Table 3 reports the likelihood of R&D capital impairment by auditor type. It reveals that clients of Big 4 audit firms are more likely to apply normal R&D capitalization, i.e. when $CAPITAL\_NM = 1$ (0.389 vs. 0.231; t-stat. = 7.69, $p < 0.01$). However, when $CAPITAL\_LR = 1$, Big 4 firms are less likely to capitalize R&D projects that subsequently turn out be impaired (0.044 vs. 0.071; t-stat. = −2.20, $p < 0.05$). The results of the ranksum tests of the medians are similar. When it comes to auditor industry expertise, the table reports that although industry specialists are more conservative with normal capitalization when $CAPITAL\_NM = 1,$ the difference is not significant (0.229 vs. 0.242, t = −1.33, $p > 0.1$). The difference is stronger for R&D cap-

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Table 2
Descriptive statistics (N = 8937).

Variables	Mean	S.D.	Min	Median	Max
CAPITAL	0.3095	0.4623	0	0	1
CAPITAL_NM	0.2395	0.4268	0	0	1
CAPITAL_LR	0.0700	0.2552	0	0	1
DA	0.0003	0.0628	−0.2372	−0.0007	0.2526
DA_OTHER	−0.0003	0.0631	−0.2374	−0.0011	0.2526
$PATENT_t$*	8.3276	27.6867	0	0	190
LNTA	21.8530	1.2360	18.8370	21.6583	26.2297
LEV	0.4116	0.2134	0.0505	0.4000	1.3797
ROA	0.0372	0.0581	−0.3148	0.0352	0.2017
AGE	8.3870	6.1687	0.6082	5.9726	25.0493
SOE	0.3642	0.4812	0	0	1
REC_P	0.1295	0.0994	0.0000	0.1110	0.5100
INV_P	0	0.1063	0	0.1244	0.7270
SMALL_PROFIT	0.1132	0.3169	0	0	1
SMALL_GROWTH	0.0386	0.1926	0	0	1
BIG4	0.0506	0.2191	0	0	1
SPECIALIST	0.2515	0.4339	0	0	1

(1) Continuous variables are winsorized at 1% and 99%.
(2) See Section 4.2 for variable definitions.
(3) I only report *PATENT* in period t, to maintain identical sample scope of other variables.

Table 3
Univariate Tests.

Panel A: Earnings management and innovation by capitalization type

Groups	(1) *CAPITAL_NM* = 1 Mean (Median)	(2) *CAPITAL_LR* = 1 Mean (Median)	(3) *CAPITAL* = 0 Mean (Median)	(1) vs. (3) t-stat. (z-stat.)	(2) vs. (3) t-stat. (z-stat.)	(1) vs. (2) t-stat. (z-stat.)
DA	−0.001	0.008	−0.0002	−0.29	3.25***	−3.39***
	(0.0001)	(0.007)	(−0.001)	(−0.36)	(3.06***)	(−2.75***)
DA_OTHER	−0.005	0.005	−0.0002	−3.49***	1.70*	−3.69***
	(−0.004)	(0.005)	(−0.001)	(−3.08***)	(−1.48)	(−3.11***)
$PATENT_{t+1}$	11.639	8.172	7.195	6.38***	0.94	2.28**
	(0.000)	(0.000)	(0.000)	(2.23**)	(0.68)	(0.63)
$PATENT_{t+2}$	13.223	8.413	8.167	6.44***	0.21	2.85***
	(0.000)	(0.000)	(0.000)	(2.84***)	(0.13)	(1.68*)
$PATENT_{t+3}$	14.175	9.639	8.556	5.95***	0.78	2.26**
	(0.000)	(0.000)	(0.000)	(2.82***)	(0.33)	(1.29)

Panel B: Likelihood of R&D capitalization by auditor type

	BIG4 = 1		*BIG4* = 0		*BIG4 = 1* vs. *BIG4 = 0*	
	Mean	Median	Mean	Median	t-stat.	z-stat.
CAPITAL_NM	0.389	0.000	0.231	0.000	7.69***	7.66***
CAPITAL_LR	0.044	0.000	0.071	0.000	−2.20**	2.21**
	SPECIALIST = 1		*SPECIALIST* = 0		*SPECIALIST* = 1 vs. *SPECIALIST* = 0	
	Mean	Median	Mean	Median	t-stat.	z-stat.
CAPITAL_NM	0.229	0.000	0.242	0.000	−1.33	−1.33
CAPITAL_LR	0.053	0.000	0.075	0.000	−3.58***	−3.57***

(1) *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.
(2) t-stats are the results of t-tests of mean values; z-stats are the results of the ranksum test of median values.
(3) See Section 4.2 for variable definitions.

italization that is subsequently impaired, where *CAPITAL_LR = 1* (0.053 vs. 0.075; t = −3.58, p < 0.01). The results of the ranksum tests of the medians are similar.

To sum up, the univariate tests suggest significantly more income-increasing earnings management and reduced innovation outcomes in the low-reliability capitalization group, while the Big 4 auditors and industry specialists suppress low-reliability R&D capitalization. The results are consistent with the hypotheses, and the significant differences highlight the necessity of discriminating between low-reliability and normal R&D capitalization, adding confidence to the validity of my measure of low-reliability R&D capitalization using the occurrence of ex post impairment.

5.2. Regression analysis

Table 4 reports the regression results for Eqs. (1a) and (1b). In column I, Table 4, the coefficient for *CAPITAL* is 0.003, which is not significantly different from zero (t-stat. = 1.61, p > 0.1), suggesting that in China

Table 4
R&D Capitalization and Earnings Management.

Dependent variables	*DA*		*DA_OTHER*	
	I	II	III	IV
	Coef.	Coef.	Coef.	Coef.
Independent variables	(t-stat.)	(t-stat.)	(t-stat.)	(t-stat.)
CAPITAL	0.003		−0.002	
	(1.61)		(−1.04)	
CAPITAL_NM		0.001		−0.004
		(0.33)		(−2.75)***
CAPITAL_LR		0.010		0.006
		(3.31)***		(2.17)**
LNTA	0.001	0.001	0.001	0.001
	(1.42)	(1.51)	(1.28)	(1.79)*
LEV	−0.016	−0.017	−0.015	−0.016
	(−2.84)***	(−2.91)***	(−2.58)***	(−3.23)***
ROA	0.018	0.017	0.027	0.023
	(0.91)	(0.86)	(1.39)	(1.43)
AGE	−0.001	−0.001	−0.001	−0.001
	(−2.88)***	(−2.93)***	(−2.73)***	(−3.68)***
SOE	0.005	0.005	0.005	0.005
	(2.21)**	(2.27)**	(2.21)**	(2.87)***
REC_P	0.079	0.079	0.080	0.084
	(8.26)***	(8.28)***	(8.29)***	(10.41)***
INV_P	0.101	0.102	0.102	0.105
	(11.29)***	(11.33)***	(11.25)***	(13.30)***
SMALL_PROFIT	0.009	0.009	0.010	0.009
	(4.13)***	(4.12)***	(4.40)***	(4.54)***
SMALL_GROWTH	0.000	0.000	0.000	−0.000
	(0.15)	(0.08)	(0.03)	(−0.02)
Constant	−0.059	−0.060	−0.056	−0.061
	(−2.67)***	(−2.76)***	(−2.60)***	(−3.54)***
Industry & year fixed effects	Yes	Yes	Yes	Yes
Observations	8937	8937	8937	8937
R-squared	0.053	0.052	0.054	0.055
Comparison of coefficients within groups (H_o: *CAPITAL_NM = CAPITAL_LR*)				
Chi^2		8.11***		9.04***

(1) *DA* stands for overall signed discretionary accruals calculated following Kothari et al. (2005); *DA _OTHER* is discretionary accrual adjusted for R&D capitalization.
(2) *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.
(3) See Section 4.2 for variable definitions.

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there is no obvious association between the crude R&D capitalize-or-not indicator and firm accrual earnings management. However, looking more closely at column II, Table 4, while the coefficient for *CAPITAL_NM* is not significantly different from zero (t-stat. = 0.33, $p > 0.1$), the coefficient for *CAPITAL_LR* is positive and significant (t-stat. = 3.31, $p < 0.01$), and the difference between the two coefficients is highly significant ($chi^2 = 8.11$, $p < 0.01$). The results mean that overall earnings management does not differ between normal capitalizers and expensers, but is more aggressive among low-reliability capitalizing firms.

Columns III and IV in Table 4 report the results when the dependent variable is *DA_OTHER*, the measure of discretionary accruals caused by items other than R&D capitalization. The coefficient of *CAPITAL_NM* is significantly negative ($t = -2.75$, $p < 0.01$). In combination with the finding that overall earnings management for normal capitalizing firms is no higher than that of expensing firms (column II, Table 4), the inverse relation suggests that normal capitalizing firms seemingly have a controlled budget for overall earnings management, and R&D capitalization and other items are substitutes. In contrast, the coefficient on *CAPITAL_LR* is significantly positive ($t = 2.17$, $p < 0.05$), indicating that low-reliability capitalizing firms engage in income-increasing earnings management not only in R&D accounting, but also in other reporting items, consistent with the notion that multiple accounting choices are chosen jointly for earnings purposes. The evidence in Table 4 suggests that low-reliability R&D capitalization serves as a channel to manage earnings upward.

The control variables show higher levels of accrual earnings management for firms with a larger size, lower leverage ratio, higher *ROA*, higher receivables, higher inventory intensity, and small reported profits, in line with prior studies.

Table 5 reports the regression results for Eqs. (2a) and (2b). It shows that for period *t + 1*, the coefficient for *CAPITAL* is 0.11 (z-stat. = 0.75, $p > 0.1$). The coefficient is positive for *CAPITAL_NM* but negative for *CAPITAL_LR*, although neither differ significantly from zero. For period *t + 2,* the coefficient for *CAPITAL* is 0.21 (z-stat. = 2.29, $p < 0.05$), indicating that R&D capitalization generally predicts a higher level of innovation in the following two years. However, the positive leading predictive power is limited to normal capitalization (*CAPITAL_NM*), with a positive and significant coefficient 0.25 (z-stat. = 2.54, $p < 0.05$), whereas the coefficient on *CAPITAL_LR* is not significant (z-stat. = 0.18, $p > 0.1$), indicating no difference in innovation outcome between low-reliability capitalizing and expensing firms. The results remain similar for period *t + 3*. Table 5 suggests that low-reliability capitalization proxied by ex post impairment also underperforms compared to normal capitalization in terms of future innovation.

Table 5
R&D Capitalization and Innovation Outcome.

Dependent variables	$PATENT_{t+1}$				$PATENT_{t+2}$				$PATENT_{t+3}$			
Independent variables	Coef.	z-stat.	Coef.	z-stat.	Coef.	z-stat.	Coef.	z-stat.	Coef.	z-stat.	Coef.	z-stat.
$CAPITAL_t$	0.11	0.75			0.21	2.29**			0.24	2.53**		
$CAPITAL\_NM_t$			0.14	0.93			0.25	2.54**			0.28	2.79***
$CAPITAL\_LR_t$			−0.11	−0.49			0.03	0.18			0.06	0.34
$LNTA_t$	0.75	12.57***	0.75	12.53***	0.34	8.26***	0.34	8.14***	0.33	7.45***	0.32	7.34***
LEV_t	−0.51	−1.26	−0.50	−1.23	0.02	0.07	0.03	0.10	0.07	0.20	0.07	0.23
ROA_t	1.75	1.06	1.72	1.04	2.71	3.00***	2.72	3.01***	2.84	2.91***	2.85	2.92***
AGE_t	−0.04	−3.18***	−0.04	−3.17***	−0.02	−2.34**	−0.02	−2.31**	−0.02	−2.02**	−0.02	−2.00**
SOE_t	0.38	2.36**	0.38	2.37**	0.35	2.96***	0.35	2.97***	0.30	2.43**	0.30	2.45**
Constant	−15.19	−10.77***	−15.15	−10.73***	−7.32	−7.54***	−7.27	−7.45***	−7.18	−6.47***	−7.14	−6.39***
Industry &year fixed effects	Yes		Yes		Yes		Yes		Yes		Yes	
Observations	8937		8937		8923		8923		7006		7006	
Comparison of coefficients within groups (H_o: *CAPITAL_NM = CAPITAL_LR*)												
Chi^2			1.27				3.75*				3.45*	

(1) *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.
(2) See Section 4.2 for variable definitions.

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Meanwhile the control variables show that larger, more profitable, and younger firms and state-owned enterprises produce more firm innovation.

Table 6 presents the regression results for Eqs. (3a) and (3b). In panel A of Table 6, I first replicate the prior literature by regressing the dichotomous variable *CAPITAL* using a logit model. It shows that the coefficient for *BIG4* is 0.07, not significantly different from zero (z-stat = 0.58, $p > 0.10$), indicating there is no difference in the R&D capitalization tendency of firms audited by Big 4 and non-Big 4 firms, which is consistent with Xie et al. (2017). The coefficient on *SPECIALIST* is −0.12 (z-stat = −2.03, $p < 0.05$), indicating that firms audited by industry specialists are less likely to capitalize R&D costs.

Table 6
Auditor Quality and R&D Capitalization Reliability.

Panel A Full sample

Dependent Var.	*CAPITAL*		*CAPITAL_T*				*Diff.* in Coef.s
			=1		=2		
Independent Var.	Coef.	z-stat.	Coef.	z-stat.	Coef.	z-stat.	
BIG4	0.07	0.58	0.18	1.46	−0.78	−3.14***	14.14***
SPECIALIST	−0.12	−2.03**	−0.04	−0.68	−0.34	−3.10***	6.60***
LNTA	0.28	9.87***	0.33	10.43***	0.30	6.25***	0.50
LEV	−0.84	−5.23***	−0.76	−4.29***	−0.16	−0.58	4.36**
ROA	−4.05	−8.34***	−4.98	−9.48***	−4.41	−5.36***	0.47
AGE	0.03	5.59***	0.01	2.15**	0.02	2.66***	1.47
SOE	0.19	3.08***	0.29	4.20***	0.09	0.77	2.87*
SMALL_PROFIT	0.03	0.35	0.08	0.98	0.12	0.89	0.08
SMALL_GROWTH	0.11	0.90	0.01	0.08	0.43	2.15**	3.85**
Constant	−7.03	−11.26***	−8.18	−11.77***	−9.55	−8.76***	
Industry & year fixed effects	Yes		Yes				
Observations	8937		8937				
Pseudo R^2	0.07		0.06				

Panel B PSM sample based on *BIG4*

Dependent Var.	*CAPITAL_T*				*Diff.* in Coef.s
	=1		=2		
Key Var.	Coef.	z-stat.	Coef.	z-stat.	Chi2
BIG4	0.30	1.88*	−0.84	−2.97***	15.34***
SPECIALIST	−0.20	−0.98	−1.35	−3.00***	6.14**
Controls		Yes			
Observations		878			
Pseudo R^2		0.13			

Panel C PSM sample based on *SPECIALIST*

Dependent Var.	*CAPITAL_T*				*Diff.* in Coef.s
	=1		=2		
Key Var.	Coef.	z-stat.	Coef.	z-stat.	Chi2
BIG4	0.26	1.49	−0.75	−1.88*	6.16**
SPECIALIST	0.01	0.13	−0.47	−3.64***	11.97**
Controls		Yes			
Observations		4490			
Pseudo R^2		0.07			

(1) *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.
(2) Panels B and C report the results of multinomial regressions based on matched samples using propensity score matching (PSM) on *BIG4* and *SPECIALIST*, respectively.
(3) In panela B and C, control variables are not tabulated for brevity.
(4) See Section 4.2 for variable definitions.

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The results of Eq. (3b) show that when *CAPITAL_T* equals 1, that is, normal capitalization without subsequent impairment, the coefficient on *BIG4* is 0.18, positive but not significant at the 10% level (z-stat. = 1.46). By contrast, when *CAPITAL_T* equals 2, that is, low-reliability capitalization followed by subsequent impairment, the coefficient for *BIG4* is −0.78 and significant at the 1% level (z-stat. = −3.14), showing a strong negative relation between low-reliability R&D capitalization and *BIG4*. The difference between the two coefficients for *BIG4* when *CAPITAL_T* equals 1 vs. 2 is highly significant ($chi^2 = 14.14$, $p < 0.01$). However, although the coefficients for *SPECIALIST* show a negative relation between industry specialty auditors and general R&D capitalization, the relation is mostly driven by low-reliability capitalization firms. For firms that capitalize R&D costs normally (*CAPITAL_T = 1*), the coefficient on *SPECIALIST* is −0.04 (z-stat. = −0.68, $p > 0.10$), while for firms that potentially capitalize R&D projects prematurely (*CAPITAL_T = 2*), the coefficient on *SPECIALIST* is −0.34 (*z-stat.* = −3.10, $p < 0.01$). The comparison test also shows a significant difference in the coefficients ($chi^2 = 6.60$, $p < 0.01$).

The control variables show that less leveraged firms and SOEs are more likely to apply normal capitalization, while firms reporting a small increase from the previous year are more likely to apply low-reliability capitalization.

According to Defond and Zhang (2014), a major challenge to the literature on auditor differentiation is self-selection, which means that the superior audit quality of larger audit firms and industry specialists may be attributable to client characteristics (Lawrence et al., 2011; Minutti-Meza, 2013) rather than the effect of the auditors. In other words, the differential probability of normal vs. low-reliability R&D capitalization could be determined by client characteristics potentially omitted from the extant regression models. In an attempt to control for the potential effect of endogeneity in auditor choice, I use propensity-score matching (PSM) models following Lawrence et al. (2011). First, I use a logistic model to estimate the probability of hiring a Big 4 auditor and predict the propensity scores. In the second stage, I match a non-Big 4 auditor client with a Big 4 auditor client having the closest predicted propensity score with a maximum distance of 3% without replacement. To control for potential endogeneity in the choice of an industry specialist auditor, I follow a similar procedure. Using the propensity-score matching method, I match 439 non-Big4 clients one-to-one to Big 4 clients; and 2245 non-industry specialist auditor clients to industry specialist clients,[11] and re-estimate Eqs. (3a) and (3b). The results of the regressions for the matched samples based on *BIG4* and *SPECIALIST* are reported in panels B and C of Table 6, respectively. The results remain robust after using propensity score matching.

Collectively, Table 6 suggests that capitalized R&D costs audited by Big 4 auditors and industry specialists are significantly less likely to be impaired in future periods, reflecting higher reliability, thus supporting my hypothesis that independent auditors serve as external monitors and increase the reliability of R&D capitalization of their clients.

6. Robustness and additional tests

6.1. Controlling for R&D investment

For robustness checks, I incorporate in Eq. (3b) the industry-adjusted level of R&D investment *INTENSITY*, which equals total R&D expenditure divided by total assets minus the industry median for R&D intensity.[12] Alternatively, I include an indicator variable *HIGH_INTENISTY* which equals 1 if a firm's R&D investment is above the industry median, and 0 otherwise. The sample size decreases to 8410 after the inclusion, and Table 7 reports the results.

Table 7 shows that the inclusion of R&D intensity does not change the results. In addition, the coefficient for *INTENSITY* is 17.55 (z-stat. = 10.41, $p < 0.01$) when *CAPITAL_T* equals 1, and 8.46 (z-stat. = 2.82, $p < 0.01$) when *CAPITAL_T* equals 2. The difference between the coefficients is statistically significant

[11] The first-stage models are specified as follows: $BIG4/SPECIALIST = \delta_0 + \delta_1 LNTA + \delta_2 LEV + \delta_3 ROA + \delta_4 SOE + \mu$ In the untabulated results of the first-stage regressions and the t-tests for the explanatory variables, none of the explanatory variables above differs systematically between the treatment and matched samples, indicating that the matched firm-years are satisfactory control samples.

[12] The results (untabulated) of Eqs. (1a)–(1b) and (2a)–(2b) remain robust after controlling for R&D investment.

Table 7
Eq. (3b) Controlling for R&D Intensity.

Dependent Var.	*CAPITAL_T*					
	=1	=2	*Diff.* in Coef.s Chi2	=1	=2	*Diff.* in Coef.s Chi2
Key Var.	Coef. (z-stat.)	Coef. (z-stat.)		Coef. (z-stat.)	Coef. (z-stat.)	
BIG4	0.07	−0.76	8.36***	0.11	−0.74	8.76***
	(0.51)	(−2.74)***		(0.79)	(−2.69)***	
SPECIALIST	−0.05	−0.30	3.79*	−0.06	−0.30	3.59*
	(−0.84)	(−2.53)**		(−0.94)	(−2.53)**	
INTENSITY	17.55	8.46	8.63***			
	(10.41)***	(2.82)***				
HIGH_INTENSITY				0.41	0.16	5.55**
				(7.02)***	(1.56)	
Controls		Yes			Yes	
Observations		8410			8410	
Pseudo R^2		0.09			0.09	

(1) *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.
(2) See Section 4.2 and Section 6.1 for variable definitions.

($chi^2 = 8.63$, $p < 0.01$). The difference is more apparent in the coefficients for *HIGH_INTENSITY*, indicating that a high level of R&D investment is a positive predictor of normal capitalization, but the explanatory power decreases dramatically for low-reliability capitalization. Possible explanations are that high R&D investment represents a stronger commitment to and better capacity for R&D activities, and also that higher R&D investment is likely to be negatively related to managerial opportunism through R&D capitalization, because managers could cut the investment instead of turning to aggressive R&D reporting if they need to manipulate earnings upward.

6.2. Controlling for capitalizing vs. expensing accounting choice

The accounting treatment of capitalizing vs. expensing R&D expenditure is potentially endogenous, in that the evidence may be confounded by existing systematic differences in firm characteristics and managerial incentives between capitalizing vs. expensing firms (Markarian et al., 2008; Cazavan-Jeny et al., 2011). To control for this, I exclude expensing firms from the regressions and focus on capitalizing firms only. For Eqs. (1b) and (2b), the dependent variables remain the same and the key experimental variable is *CAPITAL_LR,* with normal capitalizing firms as the control group. For Eq. (3b), the key experimental variables *BIG4* and *SPECIALIST* remain the same, while the dependent variable is *CAPITAL_LR*, equaling 1 for low-reliability capitalization and 0 for normal capitalization. The results are reported in Table 8.

Table 8 shows that compared to normal capitalizing firms, low-reliability firms report higher discretionary accruals and are associated with fewer patents in the following three years. Also, the capitalized R&D costs audited by Big 4 and industry specialists are notably less likely to be impaired in subsequent periods, all consistent with the main tests. The results remain robust when I replace the *CAPITAL_LR* dummy with a continuous variable equaling the amount of impairment scaled by R&D costs.

6.3. Timing of impairment recording

So far, I have examined the reliability issue during the period of the capitalization decision, i.e. premature capitalization of R&D projects with a low probability of success. Another argument against R&D capitalization is that managers may delay the write-down of impaired R&D assets for earnings purposes (Healy et al., 2002). As estimation involved in R&D capitalization is highly contingent on the manager's judgement and incentives, information uncertainty also applies to the timing of the recording of R&D assets impairment. Corporate managers can strategically select the period when the prematurely capitalized costs are written down. The literature shows that managers are likely to take "big baths" when earnings are surprisingly

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Table 8
Regression Results Within Capitalizing Firms.

	I	II	III	IV	V
Dependent Var.	*DA*	$PATENT_{t+1}$	$PATENT_{t+2}$	$PATENT_{t+3}$	*CAPITAL_LR*
	Coef.	Coef.	Coef.	Coef.	Coef.
Key Var.	(z-stat.)	(z-stat.)	(z-stat.)	(z-stat.)	(z-stat.)
CAPITAL_LR	0.01 (2.72)***	−0.38 (−1.95)*	−0.47 (−2.38)**	−0.55 (−2.58)**	
BIG4					−0.93 (−3.58)***
SPECIALIST					−0.34 (−2.82)***
Controls	Yes	Yes	Yes	Yes	Yes
Observations	2766	2766	2760	2183	2733
Adj./Pseudo R^2	0.13	–	–	–	0.05

(1) *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.
(2) In column I, the control variables are the same as in Eqs. (1a) and (1b); in columns II–IV, the control variables are the same as in Eqs. (2a) and (2b); in column V, the control variables are the same as in Eqs. (3a) and (3b). The control variables are not tabulated for brevity.
(3) The results in columns I to IV remain robust when low-reliability firms are matched one-to-one to normal capitalizing firms that have the closest predicted propensity score for low-reliability capitalization.
(4) See Section 4.2 for variable definitions.

bad, and smooth earnings downwards when they are surprisingly good (Zucca and Campbell, 1992). Accordingly, I examine whether the recording of R&D capital impairment also demonstrates earnings management. I limit the research sample to low-reliability firms and to the periods after the capitalization decision is made. The equation is as follows:

$$WRITEOFF = \theta_0 + \theta_1 SMOOTH + \theta_2 BATH + Controls + \mu \tag{4}$$

The dependent variable *WRITEOFF* in Eq. (4) is an indicator that equals 1 if it is in the year when the prematurely capitalized R&D assets are eventually impaired, and 0 otherwise. Following Francis et al. (1996) and Riedl (2004), the proxy for downward earnings-smoothing reporting (*SMOOTH*) is equal to the change in firm earnings from period t − 1 to t, divided by total assets at the end of t − 1, when the change is above the median of positive values for this variable, and 0 otherwise. The proxy for "big bath" reporting (*BATH*) equals the absolute value of the change in firm earnings from t − 1 to t, divided by total assets at the end of t − 1, when the change is below the median of negative values of this variable, and 0 otherwise.

I incorporate the following control variables in Eq. (4): the natural log of total assets (*LNTA*) and leverage ratio (*LEV*), annual stock returns (*ANNUALRET*), and auditor characteristics *BIG4* and *SPECIALIST*. Meanwhile, I control for the potential effects of a change of auditor (*SWITCH*) and change of CEO and board chairman (*TURNOVER*) on the write-down decision. Eq. (4) is estimated while controlling for firm fixed effects, and the results are reported in Table 9.

Table 9 shows that the coefficient on *SMOOTH* is 12.03 (t-stat. = 2.45, $p < 0.05$), which means that managers tend to book the impairment of R&D costs in periods when earnings are surprisingly good, supporting the "earnings smoothing" hypothesis. Meanwhile, the coefficient for *BATH* is 9.06 (t = 1.81, $p < 0.1$), providing some marginal evidence for a "big bath" approach associated with R&D capital write-offs. The evidence suggests that earnings management exists not only in the period of the capitalization decision, but also in the timing of recording the impairment of the capitalized R&D costs.

6.4. Analyst coverage and R&D capitalization

Financial analysts serve as information intermediaries, although they do not affect the financial reporting process directly, as auditors do. Their monitoring role is supported by some evidence that firms followed by more analysts manage their earnings less (Yu, 2008). For further analysis, I test the association between analyst coverage and R&D capitalization using Eq. (5):

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Table 9
Timing of R&D capital impairment recording.

Dependent Var.	*WRITEOFF*	
Independent Var.	Coef.	z-stat.
SMOOTHING	12.03	2.45**
BATH	9.06	1.81*
LNTA	0.99	0.98
LEV	2.58	0.83
ANRETURN	−0.20	−0.59
BIG4	1.48	0.00
SPECIALIST	1.04	2.02**
SWITCH	−0.17	−0.33
TURNOVER	−0.06	−0.16
Observations	744	

(1) * and ** denote significance at the 10% and 5% levels, respectively.
(2) See Section 6.3 for variable definitions.

$$CAPITAL\_T = \delta_0 + \delta_1 Coverage + Controls + \mu \quad (5)$$

The model specification in Eq. (5) remains the same as for Eq. (3b), except that auditor quality indicators are replaced with analyst coverage. I use the number of following analysts (*ANALYST*) and number of research reports on the followed firm *(REPORT*) to measure the intensity of analyst coverage. Untabulated results show that (*ANALYST*) is positively related to both normal (coef. = 0.01, z-stat. = 3.19, $p < 0.01$) and low-reliability capitalization (coef. = 0.02, z-stat. = 2.99, $p < 0.01$), but the difference is not significantly different from zero ($chi^2 = 0.80$, $p > 0.1$). The results for *REPORT* are similar, suggesting that although analyst coverage is positively related to general capitalization, it fails to discriminate between normal and low-reliability R&D capitalization and provides no differential information on the ex post impairment of current R&D capitalization.

7. Conclusion and discussion

In the debate around the accounting for R&D costs, the central underlying issue is reliability. Opponents of R&D capitalization argue that although the information may be relevant to shareholders, managers can take advantage of the flexibility to manipulate earnings. In addition to the fact that R&D capitalization is forbidden in some countries, such as the U.S., another challenge to progress in R&D accounting research is the difficulty of measuring the reliability of capitalization. Theoretically, capitalizing R&D costs does not necessarily indicate lower reliability, because this decision is driven by various motivations. Similarly, full expensing does not necessarily indicate better reliability, because accounting conservatism does not automatically mean faithful representation. In this sense, the dichotomous classification of capitalizing vs. expensing is somewhat crude and suffers from loss of information.

In this study, I use the occurrence of ex post impairment of capitalized R&D costs to signal lower reliability. Based on such occurrences, capitalizing firms are categorized into low-reliability vs. normal capitalizing firms. The empirical tests support the validity and desirability of this measure. First, a low-reliability R&D capitalization decision is associated with higher concurrent levels of signed discretionary accruals, while normal capitalization is not accompanied by higher earnings aggressiveness. Second, in contrast to normal capitalization that signals better innovation performance, proxied by patents approved in periods $t + 2$ and $t + 3$ after the capitalization period, future innovation in low-reliability capitalizing firms is not significantly different from that of expensing firms. For the monitoring role of external auditing, I find that Big4 and industry specialist auditors noticeably restrain low-reliability capitalization but not normal capitalization. Meanwhile, further analysis finds evidence of earnings management after the capitalization decision, with managers selectively delaying the recording of R&D impairment to certain periods for earnings-smoothing and big-bath

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purposes. In addition, it reveals that analyst coverage does not significantly differentiate the reliability of R&D capitalization.

This study extends the prior R&D literature by presenting a new way of measuring the reliability of R&D capitalization, which is congruous with the hypotheses on both earnings management properties and the real economy of firm innovation. In this way, distinguishing between low-reliability and normal capitalization offers a more detailed perspective for assessing firm capitalization decisions.

This study also contributes to the auditing literature. First, it adds evidence to the continuing debate on auditor differentiation by showing that Big4 and industry specialists maintain higher standards in the auditing of R&D capitalization. More importantly, it suggests that higher quality auditors, defined by traditional dimensions such as size and industry expertise, are still sufficiently prepared for the challenges of auditing R&D capitalization, which features complex accounting estimates.

The findings are also relevant to accounting standard setters internationally. Consistent with prior studies based on IFRS-adopting countries such as France and Italy, I show that in China, low reliability does exist in the capitalization decision. I also document earnings management behavior in the timing of recording the impairment after capitalization. Nonetheless, unlike prior researchers such as Cazavan-Jeny et al. (2011) who conclude that their findings "contrast with the supportive evidence for capitalization" (p. 162), I provide positive evidence that auditors of higher quality notably decrease the likelihood of poor capitalization decisions. This evidence that the monitoring role of auditors can alleviate concerns that R&D capitalization is totally subject to managerial discretion could help to restore confidence in the reliability of R&D capitalization.

One limitation of this study is that the measure used for R&D capitalization reliability, namely ex post R&D impairment, cannot be known to information users such as investors beforehand when faced with corporate R&D capitalization and high information asymmetry. However, as R&D cost impairment offers a preferable measure of R&D capitalization reliability, future studies could investigate the potential determinants of low-quality capitalization and current predictors of future impairment of R&D costs. In addition, I caution that the evidence and conclusions of this study pertain only to R&D accounting and auditing in China. Similar research can be done to study the determinants and consequences of R&D capitalization in other jurisdictions, such as the UK, where the data on the impairment of in-process development is available.

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Appendix A. Typical disclosure of *development costs* (assets) in the accompanying notes of the financial statements.

Project	Opening Balance	Increase		Decrease			Ending Balance
		Development Expenditure	Other	Successful Shift to Intangibles	Expensed	Other	
A							
B							
Total							

Note:
Increase—Development expenditure: increase through internal development.
Increase—Other: increase due to other reasons, such as acquisition of other entities.
Decrease—Recognized as intangible assets: decrease via successful transfer to intangible assets.
Decrease—Expensed: decrease due to impairment (expensing) of failed projects.
Decrease—Other: decrease due to other reasons, such as losing control of other entities.

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Appendix B. Example case of R&D cost impairment

"The patent application for the Fabric Project got denied. Therefore, we expense the R&D asset that was previously capitalized." (Extracted and translated from a real annual report of a Chinese listed firm in Year 2014.)

Project	Opening Balance	Increase		Decrease			Ending Balance
		Development Expenditure	Other	Successful Shift to Intangibles	Expensed	Other	
Fabric Project	1,225,990.47	0.00	0.00	0.00	1,225,990.47	0.00	0.00

Disclosure in Year 2013 after prior capitalization of the Fabric Project.

Project	Opening Balance	Increase		Decrease			Ending Balance
		Development Expenditure	Other	Successful Shift to Intangibles	Expensed	Other	
Fabric Project	0.00	2,673,612.75	0.00		1,447,622.28	0.00	1,225,990.47

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