R&D intensity, development costs' capitalization intensity and stock returns: a variance decomposition analysis

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Abstract

This study examines the value relevance of R&D intensity and development costs' capitalization intensity under IFRS, by gauging their contribution to the informational components of the volatility of unexpected returns. We use a multivariate time-series approach that can be reconciled to a log-linear valuation model by also accommodating time-varying discount rates. Our results show that R&D intensity has a significant positive impact upon the variance contribution of cash flow and accrual news to the variance of unexpected returns. Thus, R&D intensity indeed conveys value relevant information about shocks to both future operating cash flows and accruals. We also show that this association is stronger as the capitalization intensity of development costs increases, but only for accrual news. Overall, the return decomposition that we employ shows the channel through which the return variation related to R&D and development costs' capitalization intensity occurs. Additional analysis shows that our results are not driven by country level growth option risk but are weaker in countries with higher uncertainty avoidance. This study contributes to the R&D and return variance decomposition strands of the literature and raises policy implications by providing evidence in favour of development costs' capitalization.

JEL classifications: G12, G14, M40, M41.

Keywords: R&D intensity, capitalization intensity, IFRS, variance return decomposition.

1. Introduction

Unexpected stock returns are driven by shocks to expected earnings and/or discount rates (Callen & Segal, 2004; Callen, 2009; Callen et al., 2006; Campbell & Shiller, 1988a,b; Clatworthy et al., 2012; Michaely et al., 2021; Vuolteenaho, 2002). These shocks occur due to information that causes investors to revise their expectations regarding firms' future earnings ('earnings news') and/or future discount rates ('discount rate news') (Callen et al., 2006). In this study, we use an international sample of firms that report under International Financial Reporting Standards (IFRS) to examine whether research and development (R&D) intensity (i.e., scaled R&D expenditure) and development costs' capitalization intensity (i.e., the proportion of development costs capitalized over the total R&D expenditure) convey information about shocks to future earnings (earnings news) and/or discount rates (discount rate news).[1]

Evidence from interview-based research shows that investors find R&D expenditure useful for decision making (Mazzi et al., 2022). These findings align with archival studies which show that R&D intensity is value relevant in that it is associated with current or future returns (Chan et al., 2001; Duqi et al., 2015; Hou et al., 2022; Lev, 1999; Lev & Sougiannis, 1996; Sougiannis, 1994). However, as explained by Callen et al. 2005 (pg. 385-6), the association between returns and accounting numbers "is only part of the story in explaining returns" and "[o]ne cannot understand the distribution of returns by focusing merely on the mean of the distribution". The association between returns and accounting numbers offers insights about the "first moment effect" of the accounting numbers, while the variance is insightful with respect to the "second moment effect" (Michaely et al., 2021, p. 406). The variance of unexpected returns is "equally important for determining value relevance" given that it "measures the ex ante likelihood that earnings shocks will occur and generate return shocks" (Callen, 2009; p. 140). This study examines this second moment aspect.

Gauging value relevance by focusing on the variance effect is pertinent in the case of R&D because prior literature documents a positive association between R&D intensity and earnings variability as well as returns variability (Amir et al. 2007; Chan et al. 2001; Dargenidou et al. 2019; Kothari et al. 2002). Motivated by this, our research reflects on Callen's (2009, p. 154) conjecture that evaluating the value relevance of accounting information "based on variances may give a different perspective" to the insights obtained from prior literature. To the best of our knowledge, there is no study that examines the value relevance of R&D information, for

[1] We use "unexpected", "shocks", and "revisions" interchangeably as in Callen (2009).

either US GAAP or IFRS reporting firms, based on the variance decomposition. This study fills this void.

The first research question that we examine is the following: is there a significant association between R&D intensity and the informational components of unexpected equity return volatility: earnings news (and its components) and discount rate news (Callen, 2009; Callen et al., 2006)? We focus on the variance of unexpected returns to directly establish whether any variation in stock returns in association with R&D intensity occurs because of news about future cash flows or discount rates or both (cf. Michaely et al., 2021).

The second research question that we examine is the following: does development costs' capitalization intensity contribute to the informational components of unexpected return volatility, over and above R&D intensity? This research question is informed by the accounting treatment of R&D under IFRS. International Accounting Standard (IAS) 38 Intangible Assets mandates the capitalization of development costs, providing that certain conditions are met (Paragraph 57).[2] Development expenditure not meeting the criteria must be expensed as incurred, along with research costs. Given the stringent capitalization criteria, one would expect that only those development expenditures from R&D projects that are highly likely to be successful are capitalized (e.g., Dargenidou et al., 2021; Mazzi et al., 2019). Such capitalized development costs should reflect investments that will generate future economic benefits, providing a signal for future earnings that arise from successful development expenditure (Lev et al., 2008; Lev, 2019). Therefore, capitalization of development costs should convey information about the potential success of R&D expenditure, which would, in turn, affects investors' expectations about future payoffs (Healy et al., 2002; Lev et al., 2008; Lev, 2019) and could reduce information asymmetry (Mohd, 2005). This is also in line with the International Accounting Standards Committee's (IASC) expectation that the mandatory recognition of investments in intangible assets would *inter alia* send an adequate signal for external purposes (see Mazzi et al., 2022 and IAS 38, BCZ, 39, bii, 40). Indeed, prior literature employing firm year observations that report under IFRS documents that capitalized development costs are value relevant in that they are positively associated with market values (Dinh et al., 2016; Shah et al., 2013; Tsoligkas & Tsalavoutas, 2011; Wang et al., 2017).

[2] The capitalization criteria require firms to demonstrate all of the following: technical feasibility of the asset; intention to complete the asset and use or sell it; ability to use or sell the asset; how the asset will generate future economic benefits; availability of technical, financial and other resources to complete the development of the asset; and ability to measure the expenditure reliably.

To address these questions empirically, we employ the variance decomposition approach outlined in Callen and Segal (2004) and employed in subsequent literature (e.g. Callen et al., 2006; Clatworthy et al. 2012). This framework is based on the premise that a firm's return is the sum of the discounted expected future cash flows over its lifetime. Methodologically, the approach derives from a log-linearized Discounted Cash Flows valuation model (DCF) and decomposes the variance of return revisions into parts coming from news about the components of future earnings (i.e., accruals and operating cash flows) and future discount rates. The decomposition of earnings into accruals and operating cash flows is motivated by the fact that accruals provide investors useful information beyond cash flows since they capture "value-relevant changes in balance sheet components ignored by cash-based accounting" (Clatworthy et al., 2012. p. 420). Further, Callen and Segal (2004) note that the time series of accruals may contain information helpful in predicting future cash flows. Specifically, Callen and Segal (2004, p. 528) explain that "breaking up the net income time series into its accrual and cash flow time series components may yield better predictions of expected future cash flows than either the net income or cash flow series alone".[3]

Beyond this, the return decomposition to accrual and operating cash flow news is particularly relevant for our second research question for a number of reasons. First, R&D expenditure is not only a cash expenditure but it also includes an accrual component. Second, the accounting treatment of R&D under IFRS, which requires the capitalization of development costs, gives rise to an additional accrual component in earnings. The greater the proportion of development costs capitalized, the greater the accrual component in earnings. Additionally, it has been argued that capitalization of development costs "results in accrual information which is richer than cash information" (Dinh & Schultze 2011, p. 251).[4] Further, amortisation of capitalized development costs allows costs to be matched against revenues and could be informative to investors "rendering value-adding earnings from the investment" (Barker et al., 2022; p. 615). Moreover, potential write-offs of these assets are also informative by communicating to "investors that things did not work out as expected" and this "is good information" (Cooper, 2020, p. 356). As such, the research design allows us to examine

[3] As Callen et al. (2006, p. 1039) note, "it is impossible to assess […] whether the decomposition of earnings into cash flows and accruals actually provides more explanatory power than earnings alone for the volatility of unexpected returns".
[4] Dinh and Schultze (2011), using a sample of German firms that voluntarily reported under IFRS between 2001 and 2006, show that capitalization of development costs relative to expensing increases the explanatory power of earnings.

whether development costs' capitalization intensity results in a differential impact on the variance of accrual and operating cash flow news.

We employ a longitudinal sample of 57,615 firm-year observations corresponding to 10,540 firms from 38 countries that have adopted IFRS mandatorily or have had their accounting standards converged to IFRS. Our baseline results show that both earnings components (cash flows and accruals) are significant and dominant drivers of stock returns, with the variance of expected return news (discount rate news) being less important for IFRS reporting firms. This is consistent with prior literature that employs non-IFRS reporting firms (e.g. Callen & Segal, 2004; Callen et al., 2005; Clatworthy et al., 2012; Vuolteenaho, 2002). In relation to our research questions, the results show that R&D intensity is positively associated with the variance of both operating cash flow and accrual news. These findings indicate that R&D intensity indeed conveys value relevant information about shocks to both future operating cash flows and accruals. Further, we show that development costs' capitalization intensity strengthens only the positive impact that R&D intensity has on the variance contribution of accrual news to the variance of unexpected returns. This result suggests that capitalization of development costs conveys value relevant information over and above R&D intensity about shocks to future accruals only. Finally, we find that R&D intensity is also positively associated with the variance of discount rate news, although it is the least influential stock return driver. Nevertheless, the significance of this component is traced back to firms with greater capitalization intensity.

In additional tests, we draw on Hou et al. (2022) who find that the association between R&D intensity and subsequent stock returns is stronger in countries where growth option risk is more likely to be priced. They conclude that the relation between R&D and returns is more likely to be driven by risk premium. On reflection of this, we explore whether country level growth option-induced risks affect our results. The findings from these tests show that the impact of R&D intensity and development costs' capitalization intensity on the variance of cash flow and accrual news are unrelated to country level growth option risk. These findings imply that risk premium is unlikely to affect our conclusions.

Further, we draw on evidence that investors embedded in cultures with higher uncertainty avoidance exhibit a lower under-reaction to earnings information (Dou et al., 2016) and that firms' current returns incorporate less future earnings information in countries with higher uncertainty avoidance (Tsalavoutas & Tsoligkas, 2021). Taken together, these findings imply that uncertainty avoidance affects investors' ability to interpret the implication of earnings news for equity returns (cf., Callen et al., 2016). In turn, this means that investors in countries with higher uncertainty avoidance are less likely to react in revising their equity return expectations to earnings shocks compared to investors from countries with lower uncertainty avoidance.[5] Consistent with this conjecture, we find that the positive effect that R&D intensity has on the variance of operating cash flow news is weaker in countries with higher uncertainty avoidance. Further, we find that this effect is less pronounced as development costs' capitalization intensity increases. Thus, perhaps not surprisingly given the evidence in Dou et al. (2016) and Tsalavoutas and Tsoligkas (2021), these findings indicate that investors' innate characteristics, such as culture, affect how investors "revise their return expectations to cash flow news" (Callen et al., 2016, p. 574).

We make three contributions to the literature. First, this study contributes to the literature examining the valuation consequences of R&D (e.g., Chan et al., 2001; Hou et al., 2022; Lev, 1999; Lev & Sougiannis, 1996). While this literature documents that R&D intensity is value relevant by being associated with higher current or subsequent stock returns, our "alternative and complementary approach over prior literature" (Callen et al., 2005, p. 377) allows us to examine the mechanisms through which information "flows into firm value" (Andronoudis et al., 2024 p. 1,059). Specifically, we document that return revisions associated with R&D intensity occur because of news about both future operating cash flows and accruals, while discount rates play a less dominant role.

Second, this is the first study to examine the valuation implications of development costs' capitalization intensity. Prior literature shows that R&D assets recognized under IFRS are positively associated with market values (e.g., Dinh et al., 2016; Shah et al., 2013; Tsoligkas & Tsalavoutas, 2011; Wang et al., 2017) and that firms that capitalize development costs exhibit positive future abnormal returns (Dargenidou et al., 2021; Mazzi et al., 2019a). Nevertheless, none of these studies examine the valuation implications of capitalization intensity, even though discussions are known to take place between analysts and managers around this issue (see Ding et al., 2013) and there is evidence that investors do consider capitalization ratios (Mazzi et al., 2022). The evidence in this study indicates that capitalization intensity does convey value relevant information, beyond that conveyed by R&D intensity, albeit only about shocks to future accruals, indicating a further positive association with uncertainty. This is consistent with the conclusion in Dargenidou et al. (2021) that investors

[5] Callen et al. (2016) develop a similar argument with respect to investors' financial statement literacy. Specifically, they examine whether foreign equity investors in China, who tend to be more financial statement literate, react differently in revising equity returns to cash flow news (shocks) than domestic equity investors.

experience greater uncertainty regarding the realisation of future economic benefits associated with the development costs capitalised under IFRS.

Finally, this study complements prior literature that applies the variance decomposition methodology to examine the channels through which information drives the volatility of returns (e.g., Andronoudis et al., 2024; Callen et al., 2006; Jacob & Valta, 2023; Michaely et al., 2021). These studies decompose the variance of returns to examine, for example, whether the information in SEC filings (Callen et al., 2006), dividends (Michaely et al., 2021) and repurchases (Jacob & Valta, 2023) convey information about shocks to future earnings and/or discount rates. We extend this literature by demonstrating that R&D intensity and development costs' capitalization intensity under an IFRS reporting regime also convey information about shocks to future earnings.

In terms of policy implications, the findings of the study lend support to the current accounting treatment of R&D under IFRS in that capitalized development costs provide value relevant information about shocks to the components of future earnings and accruals in particular. Thus, the findings provide insights to the current debates in global accounting and regulatory bodies in relation to intangibles. The International Accounting Standards Board (IASB), in April 2024,[6] commenced the project around the accounting for and recognition of intangible assets, following the 2022 decision to add such a project to its work plan for 2022 to 2026. Arguably, the current accounting treatment of development costs need not be a priority for a potential change and thus the IASB's decision to start the project with a focus on disclosures around intangible assets is in the right direction.[7] Moreover, the Financial Accounting Standards Board (FASB) has the Accounting for and Disclosure of Intangibles project ongoing and "will consider potential ways to improve the accounting for and disclosure of intangibles, including internally developed intangibles and research and development".[8] Additionally, the UK Endorsement Board has undertaken a comprehensive research project on intangibles and aims at contributing to future discussions on their accounting treatment.[9]

The rest of the paper is organised as follows. Section 2 outlines the return news variance decomposition model and the hypotheses tested. Section 3 describes the research design including sample selection and model specifications. Section 4 presents and discusses the findings, including those from sensitivity and additional tests. Section 5 concludes the study.

[6] https://www.ifrs.org/news-and-events/updates/iasb/2024/iasb-update-april-2024/
[7] https://www.ifrs.org/news-and-events/updates/iasb/2022/iasb-update-april-2022/#11
[8] https://www.fasb.org/projects/current-projects/objective-research
[9] https://www.endorsement-board.uk/intangibles-project

2. Literature review and hypothesis development

2.1 Return news variance decomposition

Callen and Segal (2004), who extend the Vuolteenaho (2002) model, is the first study to examine the "impact of cash flow earnings news, accrual earnings news, and expected-return news on unexpected changes in current returns" (Callen & Segal, 2004, p.530). This model effectively derives from a log-linearized DCF model equating return news to changes/revisions in the present value of expected cash flows (numerator channel) and discount rates (denominator channel). The methodology traces back to the Campbell and Shiller (1988a,b) and Campbell (1991) definition of unexpected aggregate-level returns as a log-linear function of (a) changes in expectations about the (present-value) future dividend growth and (b) changes in expectations about the (present-value) future discount rates. Returns are pushed away from their expected values (non-zero return news), when the market revises expectations about future cash flows (the numerator DCF channel) and/or future discount rates (the denominator DCF channel). Vuolteenaho (2002) transfers the concept to the firm-level by assuming cross-sectional stationarity in the (log) BE/ME ratio and the accounting clean-surplus equation. He uses earnings over book equity (ROE) as cash flow proxy and adopts the constant log-linear present-value factor, ρ, from Campbell and Shiller (1988a,b).

Callen and Segal (2004) extend the Vuolteenaho (2002) framework to decompose earnings to operating cash flows and accruals. Specifically, they show that unexpected returns can be expressed as a function of changes in expectations of: (a) operating cash flows; (b) accruals; and (c) changes in expected future returns (discount rate) as follows:

$$r_t - E_{t-1}(r_t) = \Delta E_t \sum_{j=0}^{\infty} \rho^j (Ocf_{t+j} - f_{t+j}) + \Delta E_t \sum_{j=0}^{\infty} \rho^j Acc_{t+j} - \Delta E_t \sum_{j=0}^{\infty} \rho^j \, r_{t+j} \qquad (1)$$

$$RetN_{i,t} = OpCFN_{i,t} + AccN_{i,t} - DRN_{i,t}$$

The left-hand-side is the (log) stock return news ($r_t - E_{t-1}(r_t)$i.e., $RetN_{i,t}$); $OpCFN_{i,t}$ is the cash flow news, $AccN_{i,t}$ is the accrual news and $DRN_{i,t}$ is the discount rate news. Equation (1) reflects that: (a) an unanticipated upward (downward) revision in cash flows is good (bad) news about firm prospects and induces a positive (negative) shock to returns and; (b) an unanticipated upward (downward) revision in accruals is good (bad) news about firm prospects and induces a positive (negative) shock to returns and (c) an unanticipated upward (downward) revision in the discount rate triggers a negative (positive) shock to returns. Taking variances of both sides of Equation (1) and considering the covariance yields the variance decomposition of return news is as follows:

$$Var[r_t - E_{t-1}(r_t)] = var(OpCFN_t) + var(AccN_t) + var(DRN_t) - 2\,cov(OpCFN_t,DRN_t) - 2cov(AccN_t,DRN_t) - 2cov(AccN_t,OpCFN_t) \qquad (2)$$

where $Var[r_t - E_{t-1}(r_t)]$ is the variance of stock return news (i.e. *var(Ret)*), $var(OpCFN_t)$ is the variance contribution of cash flow news to return news, $var(AccN_t)$ is the variance contribution of accrual news to return news; $var(DRN_t)$ is the variance contribution of discount rate news to return news, $cov(OpCFN_t,DRN_t)$ is the covariance between cash flow and discount rate news, $cov(AccN_t,DRN_t)$ is the covariance between accruals and discount rate news, $cov(AccN_t,OpCFN_t)$ is the covariance between cash flow and accrual news. Equation (2) depicts that the variability in the return news comes from: (a) the variability in the revisions of expectations about future cash flows; (b) the variability in the revisions of expectations about accruals; (c) the variability in the revisions of expectations about future discount rates; and (d) the covariance of the news.

This method has at least two advantages when assessing the information content of accounting numbers. First, the model allows discount rates to change over time. This is critical because small changes in expected discount rates can have a large impact on stock returns (Campbell et al., 1997). Prior studies assume that returns respond to cash flow news only, imposing inter-temporally invariant discount rates (discount rate news is set to zero). This simplification may understate or overstate the relation of return news with cash flow news, if the omitted relation of return news with discount rate news is, respectively, positive or negative (Callen, 2009). Secondly, the approach considers the variance of unexpected returns, instead of focusing on mean effects as the literature commonly does. This is important because it captures the ex-ante likelihood of earnings shocks occurrence that will generate return shocks (Callen et al. 2005; Callen, 2009).

From Equation (2), it can be inferred that the variance decomposition allows establishing the channel through which information enters into firm returns, that is whether any variation in returns occurs because of news about future operating cash flows, accruals and/or discount rates. Prior literature documents that operating cash flow and accrual news are the significant and dominant informational components of unexpected equity return volatility driving stock returns (Callen & Segal, 2004; Callen et al., 2006; Clatworthy et al., 2012). In fact, in line with Vuolteenaho (2002), Callen et al. (2006) state that "the expected return (risk) news is the least value relevant". Hence, the focal variables of interest in this study are the variance contribution of operating cash flow news to return news ($var(OpCFN_t)$) and the variance contribution of accrual news to return news ($var(AccN_t)$).

2.2. Hypotheses development

Corporate investment in R&D not only facilitates growth but it is also necessary to retain competitiveness. The average proportion of R&D to other investments grew from 9.9% in 1980 to 28.6% in 2016 in the US (Curtis et al., 2020) and similar evidence is documented internationally (Hou et al., 2022). Mazzi et al. (2022) document investor views that confirm the significant importance of R&D investment to them. Specifically, investors are quoted to state that R&D investment is important for the "future pipeline of revenue and growth" and is conceptualised by some as the "future life blood" of the company (Mazzi et al., 2022, p. 10). In fact, some of their interviewees opined the general superiority of investment in R&D compared to that of tangible capital investment (Mazzi et al., 2022). Indeed, prior archival literature documents that R&D intensity is positively associated with future earnings and cash flows (Curtis et al., 2020; Hou et al., 2022;). Not surprisingly, market-based literature documents that the stock markets in aggregate value R&D intensity as this is found to be associated with higher market values (e.g., Sougiannis, 1994) and higher current or subsequent stock returns (Chan et al., 2001; Duqi et al., 2015; Hou et al., 2022; Lev, 1999; Lev & Sougiannis, 1996).

Callen et al. (2006) explain that value-relevant information necessarily causes market participants to revise expectations regarding future cash flows (earnings news), thereby driving the volatility of current period returns. Prior literature shows that investment in R&D is highly uncertain and this is manifested with greater volatility in future earnings (Amir et al., 2005; Chambers et al., 2002; Dargenidou et al., 2021; Kothari et al., 2002) and returns (Amir et al., 2005; Chan et al., 2001).[10] In fact, investors may be pessimistic in assessing the value of R&D activities and thus may discount the future economic benefits associated with R&D (Ciftci et al., 2011; Hou et al., 2022). As Ciftci et al. (2011, 82) note this would cause "mispricing or delayed reaction by investors to R&D outlays", affecting the numerator effect of stock valuation (that is earnings news).

Against this backdrop and the discussion in Section 2.1, the greater the R&D intensity the greater should be the impact on the volatility of unexpected stock returns via both components of earnings news. Thus, we formulate and test the following hypotheses:

[10] The results in Tables A and B in the online Supplement confirm the findings reported in prior literature while using our sample. Specifically, R&D intensity is positively associated with the volatility of future earnings (Table A, Models 1 and 2). Further, R&D intensity is positively associated with future buy-and-hold abnormal returns (Table B, Models 1 and 2).

H1a: *R&D intensity has a positive impact upon the variance contribution of operating cash flow news to the variance of unexpected returns.*

H1b: *R&D intensity has a positive impact upon the variance contribution of accrual news to the variance of unexpected returns.*

We note that whether R&D intensity will exhibit a stronger association with the accrual or the operating cash flow news components of unexpected equity return volatility remains an open empirical question for which insights are provided by testing H1a and H1b. Specifically, R&D expenditure is not only a cash expenditure but it also includes an accrual component. Further, companies reporting under IFRS in particular are required to capitalize development costs meeting the criteria in IAS 38. Thus, R&D intensity comprises of both expensed R&D and capitalized development costs. As such, capitalization of development costs gives rise to an additional accrual component in earnings. Prior literature documents that a large proportion of R&D active companies reporting under IFRS recognize development costs (e.g., Mazzi et al., 2019a,b). This context also motivates the development of our second set of hypotheses regarding the channel through which the variation in returns in relation to development costs' capitalization intensity occurs.

According to the Conceptual Framework for Financial Reporting (2018), an asset "is a present economic resource controlled by the entity as a result of past events" (para. 4.3), with economic resource being defined as "a right that has the potential to produce economic benefits" (para. 4.4). In the context of capitalized development costs, IAS 38 stipulates the criteria firms need to demonstrate in order to recognize such expenditure as an asset. Therefore, by capitalizing development costs managers signal their expectation about the success of such expenditure in generating future economic benefits (Lev et al., 2008; Lev, 2019). Consistently, Kreß et al. (2019) and Mazzi et al. (2019a) use international samples of R&D active firms reporting under IFRS and show that the capitalized portion of R&D costs contributes positively to future earnings.[11] This signal is also costly given that in establishing whether the capitalization criteria are met, management is involved with significant collection of related information (cf., Chen et al., 2017; Mazzi et al., 2019a) and they are also exposed to potential write-offs (Dargenidou et al., 2021). Perhaps not surprisingly, Mazzi et al. (2022, p. 11) report that professional investors use R&D related accounting information for the "evaluation of

[11] Table A (Model 4) in the online Supplement confirms this finding while using our sample.

governance and stewardship and on the quality of management". This background provides insights as to why R&D capitalization constitutes relevant information for investors.

Shah et al. (2013) and Tsoligkas and Tsalavoutas (2011) show that R&D assets under IFRS are positively associated with market values in the UK. Outside the UK, Wang et al. (2017) report similar findings using a sample of Chinese firms. Moreover, this is also shown in Dinh et al. (2016) document that for German firms, albeit when firms have little incentives to manipulate earnings. Further, Dargenidou et al. (2021) and Mazzi et al. (2019a) show that firms capitalizing development costs exhibit significantly positive future abnormal returns, in the UK and internationally, respectively.[12]

Against this backdrop, we conjecture that if development costs' capitalization intensity is relevant and conveys information over and above R&D intensity, this would manifest into investors' pricing process of earnings. Thus, development costs' capitalization intensity should strengthen the positive impact that R&D intensity has upon the variance contribution of operating cash flow (H1a) and accrual news (H1b) to the variance of unexpected returns. Hence, we formulate and test the following hypotheses:

H2a: *Development costs' capitalization intensity strengthens the positive impact that R&D intensity has upon the variance contribution of operating cash flow news to the variance of unexpected returns.*

H2b: *Development costs' capitalization intensity strengthens the positive impact that R&D intensity has upon the variance contribution of accrual news to the variance of unexpected returns.*

While we hypothesize that development costs' capitalization intensity will have a significant impact on both components of earnings, we conjecture that its impact on the variance of accrual news would be stronger than that on the variance of operating cash flow news. This is because the accrual component in earnings would be greater as the proportion of development costs capitalized increases. Additionally, capitalizing development costs, which are subsequently amortised over their useful lives, allows costs to be matched against revenues. Further, while prior literature documents that both accruals and cash flows are value relevant (e.g. Sloan, 1999; Subramanyam, 1996), Dechow (1994, p 4) argues that "realized cash flows have timing and matching problems that cause them to be a 'noisy' measure of firm performance". She

[12] In line with these findings, Table B (Model 3) in the online Supplement shows that capitalized development costs are positively associated with future buy-and-hold abnormal returns for our sample.

shows that, when the magnitude of accruals increases, the association of cash flows with returns declines. These findings indicate that the presence of accruals in earnings can better explain market values relative to cash flows. Finally, in the context of R&D, Dinh and Schultze (2011) document similar findings with respect to firms that capitalize development costs.

3. Research design

3.1 Sample selection process and sample composition

We focus on all countries that adopted IFRS mandatorily or have converged their accounting standards to IFRS in the period from 2005 to 2015 and obtain data for the period between 2006 and 2020.[13,14] For each country, we retrieve data for all firms included in Worldscope's research lists of surviving and non-surviving firms. From these lists, we eliminate instruments which are not classified as equity and, to avoid counting cross-listed firms twice, we only retain primary listings.[15] Then, we exclude firms with missing industry classification and firms in the Energy sector.[16] Subsequently, we retain firm-year observations reporting under IFRS. To identify the latter, we follow Daske et al. (2013), Mazzi et al. (2019a), and Tsalavoutas and Tsoligkas (2021) and rely on Worldscope item "accounting standards followed" (WC07536) to establish a firm's reporting standards. This criterion ensures that firms' earnings are comparable across firms in our sample (Soderstrom & Sun, 2007). We also exclude the first year a firm adopted IFRS to avoid our inferences being influenced by the low familiarity with IFRS (Kvaal & Nobes, 2012). Further, we exclude firm-year observations that changed their financial year end by eliminating those with accounting periods of more than 380 or less than 350 days (García Lara et al., 2005, Dargenidou et al., 2018). This ensures that accounting earnings are reported for periods of similar length. Then, we eliminate firm-year observations with missing data and firms from countries with missing country level data. Subsequently, similar to Vuolteenaho (2002) and Callen and Segal (2004), we eliminate firm-year observations with book value of equity to market value of equity below (above) 0.01 (100) and

[13] As in Dionysiou et al. (2021; 2023), Mazzi et al. (2019a), and Tsalavoutas and Tsoligkas (2021), we consult the guide published by the IFRS Foundation regarding the IFRS use by jurisdiction which is available here: http://www.ifrs.org/use-around-the-world/use-of-ifrs-standards-by-jurisdiction/

[14] This long-time window ensures that we have firm-year observations from countries reporting under the same accounting standards (i.e., IFRS) for at least four years.

[15] For equity instruments, we require Datastream item ''Type" to equal ''EQ". For primary listings, we require Datastream item ''ISINID" to equal ''P".

[16] As in Mazzi et al. (2019a,b) and Dargenidou et al. (2021), we exclude firms in the Energy sector because Datastream may have captured capitalized development costs with regards to exploration and evaluation costs the accounting of which falls under IFRS 6 Exploration for and Evaluation of Mineral Resources. IFRS 6 allows firms significant leeway on how to account for and report such costs (see Constantatos et al., 2021). This contrasts with the accounting for development costs under IAS 38 that we focus on in this study.

market value below €10million. Finally, we retain only R&D active firms, defined as those that either report a non-zero R&D expense in the income statement or report development assets on the balance sheet (e.g., Dargenidou et al., 2021; Kreß et al., 2019; Mazzi et al., 2019a; Oswald, 2007). This process yields a final sample of 57,615 firm-year observations corresponding to 10,540 firms. Of these firm-year observations, 16,937 capitalize development costs during the year (Capitalizers), while the remaining 40,678 do not (Expensers). The smaller number of capitalizers relative to expensers is consistent with prior literature that focuses on R&D active firms under IFRS (e.g., Dinh et al. 2016; Dionysiou et al., 2021; Kreß et al., 2019; Mazzi et al., 2019b). Table 1 summarizes the sample selection process.

TABLE 1 ABOUT HERE

Panels B and C of Table 2 show the distribution of the sample by country and industry respectively. These show a variation of our sample across both countries and industries. Specifically, most of the firms are from China (14,965), Korea (9,683), Taiwan (8,033) and the UK (4,023). This is consistent with prior literature employing international samples (e.g., Dionysiou et al., 2023; Hou et al., 2022; Mazzi et al., 2019b).[17] Further, we observe that most of the firm-year observations in our sample are based in the Industrials (14,336), Technology (11,382), Consumer Discretionary (9,060), Basic Materials (8,139) and Health Care (6,299) industries.

TABLE 2 ABOUT HERE

3.2 Model specification

In the spirit of the tests in Andronoudis et al. (2022), Callen et al. (2006) and those with respect to hypothesis H2 in Callen et al. (2005),[18] to test our hypotheses, we estimate OLS regressions where the dependent variable is the variance of cash flow and accrual news (Section 3.3 discusses in detail the empirical estimation of these variables).[19] Such a multivariate analysis alleviates potential concerns that the importance of cash flows and accruals in driving stock

[17] We note that firm-year observations from China increase significantly over the sample period (e.g., from 109 in 2012 to 2,305 in 2020). This can be explained by a country specific non-IFRS-related regulation. Specifically, as discussed by Dionysiou et al. (2023) and Huang et al. (2023), Article 27I(c) in the 'Standards Concerning the Content and Formats of Information Disclosure by Companies Offering Securities to Public No. 2 – Contents' requires firms to disclose "the total amount of research and development investment and proportion to the operating revenue in the current year" (China Securities Regulation Commission 2017) among other financial and non-financial disclosures). Considering this, in sensitivity tests (see Section 4.3), we check the robustness of our results when excluding China from our sample.

[18] Regarding Callen et al. (2005), see the results of the multivariate analysis in their Tables 5 (Panel C) and 6.

[19] For completeness, we also present the results for the return variance and the third component of the variance of returns (i.e., discount rate news).

returns is driven by factors other than only R&D intensity and its relationship with capitalization intensity and hence have omitted variables bias.

Specifically, to test H1a and H1b (i.e., whether R&D intensity has a positive impact upon the variance contribution of operating cash flow and accrual news to the variance of unexpected returns, respectively), we estimate the following model:

$$RNV = \alpha_0 + \alpha_1 RDI + \alpha_2\, \Sigma controls + Industry\ fixed\ effects + Year\ fixed\ effects + \varepsilon_{i,t} \quad (3)$$

where, following Callen and Segal (2004), *RNV* represents the variance of cash flow news or accrual news; *RDI* is R&D intensity, measured as the total R&D expenditure for the year, scaled by market value (Chan et al., 2001; Dargenidou et al., 2021; Hou et al., 2022; Mazzi et al., 2019a).[20] In line with our hypotheses, the coefficient of *RDI*, α_1, should be positive and significant. With respect to the control variables, we include variables that prior literature identifies as factors impacting firms' returns. Specifically, we include the proportion of capitalized development costs during the year relative to total R&D expenditure for the year (*PCTCAP*). Additionally, we include leverage as a measure of financial health (*LEV*), book to market ratio (*BM*), return to assets (*ROA*) and the natural logarithm of firm age (*LnAGE*), as measures of firm risk and growth. We also include the natural logarithm of market value of equity (*SIZE*) (as measure of a firm's size) and stock market beta (*BETA*) (as a further proxy for risk). Moreover, we control with variables that aim to capture earnings management incentives for capitalizing development costs[21] and may also affect the importance of cash flows and accruals in driving stock returns. Specifically, we include an indicator variable that equals to one if companies capitalize development costs to meet or beat earnings targets (*BENCHBEAT*). We also include an indicator variable that equals to one if companies unexpectedly cut investment in R&D (*REM*). Further, we include a number of variables that control for a firm's level of investment in tangible assets, as these firms are less likely to invest in intangible assets and R&D more generally. Specifically, we include the level of capital expenditures (*CAPEX*) and the sum of net property plant and equipment and inventories (*TANG*). Moreover, we control for a firm's level of investment in intangible assets other than R&D, namely software development costs (*SDASSET*), goodwill (*GOODWILL*) and other intangibles reported on the balance sheet (*OTHERINTA*). We also include the percentage of

[20] Similarly to Hou et al. (2022), we replicate our analysis by scaling R&D expenditure with total assets. Our conclusions remain unchanged. The results are available upon request.

[21] Managers can recognize development expenditure as an asset to meet or beat earnings targets (Cazavan-Jeny & Jeanjean 2006; Cazavan-Jeny et al., 2011; Dinh et al., 2016). In fact, Dinh et al. (2016) and Kreß et al. (2019) show that the value relevance of development costs is impaired for firms with earnings management incentives.

closely held shares (*PCTCLOSE*) because key shareholders in firms with higher closely held ownership are less likely rely on financial reporting for information, given firms' private channels for communicating information to such shareholders and thus affecting the importance of cash flows and accruals in driving stock returns. We also include the percentage of international sales (*INTSALES*) to control for a firm's international exposure an indicator variable that equals one if the financial statements are audited by a Big Four firm and zero otherwise (*BIG4*).

As indicated earlier, although IAS 38 mandates the capitalization of development costs meeting certain criteria, management has significant discretion in applying the capitalization criteria. Thus, firms may capitalize development costs based on factors that affect the earnings-return relation, leading to potential concerns of endogeneity (Dargenidou et al., 2021; Oswald & Zarowin, 2007). To control for this, we apply the estimation technique of Heckman (1979) and Lee (1979) and include the estimated inverse Mills ratio (IMR) from a probit model that estimates the propensity of a firm to capitalize development costs in a given year, as a further control variable.[22]

With respect to country-level variables, and following prior literature (e.g., Mazzi et al., 2019a,b), we include variables that may affect the level of R&D intensity and development costs' capitalization intensity: control of corruption (*CCR*), skilled labor (*LABOR*), health infrastructure (*HEALTH*) and scientific research legislation (*SCIENCE*). We also control for macroeconomic risk factors by including dividend yield (*MRKDY)* (Chui et al., 2010) and market trading volume (*MRKTRAD)* (Chui et al., 2010). To control for financial market development, we include the ratio of market value of listed companies in a country to the GDP of that country (*MRKDEV)* (Tsalavoutas & Tsoligkas, 2021). All variables are defined in Appendix A.

Finally, in all regressions, we add industry fixed effects using ICB Level 1 industry classifications, year fixed effects and cluster standard errors at the firm level. All continuous variables are winsorised at the 1.5% level of their distribution to reduce the effect of outliers.

To test H2a and H2b (i.e., that capitalization intensity strengthens the positive impact that R&D intensity has upon the variance contribution of cash flow and accrual news to the variance of unexpected returns), we run an extended version of Equation (3) by including an interaction

[22] The results of this probit model are presented in Table C in the online Supplement (Model 1). The Table also presents the results of a tobit model examining the determinants of the magnitude of capitalization intensity (Model 2) and a tobit model examining the determinants of the magnitude of development costs capitalized (Model 3). These are presented for completeness and for confirming the findings in prior literature (Kreß et al., 2019; Mazzi et al., 2019a,b).

term between R&D intensity (*RDI*) and the proportion of capitalized development costs during the year relative to R&D expenditure (*PCTCAP*), as follows:

$$RNV = \alpha_0 + \alpha_1 RDI + \alpha_2\ PCTCAP + \alpha_3\ RDI * PCTCAP + \beta_4\ \Sigma controls + Industry\ fixed\ effects + Year\ fixed\ effects + \varepsilon_{i,t}\ (4)$$

In line with our hypotheses, we predict that the coefficient of interaction between *RDI*PCTCAP*, α_3, is positive and significant while the coefficient of R&D intensity α_1 remains positive and significant.

3.3 Estimating the return news variance components

To estimate the firm-level return news variance components, we employ the accounting-based return decomposition in Callen and Segal (2004). More specifically, to estimate the components of an individual firm's stock (earnings news, accrual earnings news and discount rates), we employ a first order vector autoregression [VAR(1)] model in line with prior literature (Andronoudis et al., 2022; Campbell et al., 2010; Callen & Segal, 2004; Callen et al., 2005; 2006; 2010; Clatworthy et al., 2012; Garcia Lara et al., 2010). Specifically, we start by defining $z_{i,t}$ to be a firm-specific vector of cross-sectionally demeaned (market-adjusted) state variables describing a firm *I* at time *t*.[23] The state variables evolve through time following a log-linear auto-regressive process, as follows:

$$z_{i,t} = \Gamma\ z_{i,t-1} + \eta_{i,t}\ (5)$$

where Γ is the coefficient matrix, and $\eta_{i,t}$ is the error vector. The VAR(1) coefficient matrix is constant over time and across firms, and the error vector, $\eta_{i,t}$, has a covariance matrix which is independent of anything known at time t. The state variables that constitute $z_{i,t}$ are log excess returns I, operating cash flows (*Ocf*), accruals (*Acc*) and the log book/market ratio (*BM*) as follows (suppressing firm subscripts):[24]

$$r_t = \beta_1 r_{t-1} + \beta_2 Ocf_{t-1} + \beta_3 Acc_{t-1} + \beta_4 BM_{t-1} + \eta_{1,t'} \qquad (6)$$

$$Ocf_t = \gamma_1 r_{t-1} + \gamma_2 Ocf_{t-1} + \gamma_3 Acc_{t-1} + \gamma_4 BM_{t-1} + \eta_{2,t'} \qquad (7)$$

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[23] The variables are cross-sectionally demeaned (market-adjusted) and transformed. The variable transformations ensure that the theoretical assumptions hold empirically, and they follow the related literature (e.g., Campbell et al. 2010; Vuolteenaho, 2002). Specifically, these transformations aim to increase the possibility that the expected values of the state variables indeed: (a) follow autoregressive processes, justifying the VAR modelling; and (b) are interrelated in ways prescribed by the log BE/ME high stationarity and convergence to zero in the long run. Thus, estimating the parameters of the VAR coefficient matrix Γ for the whole economy is important to ensure that these assumptions hold.

[24] Chen and Zhao (2009) highlight that the selection of VAR(1) state variables affects the unbiased estimation of the residually computed term. However, Campbell et al. (2010) argue that the choice between the direct and the indirect method has no effect on their stock return decompositions (see also Engsted et al., 2012). To report components that do add up to the observed unexpected stock returns and return variances, we follow the standard indirect method by estimating the discount rates and the accrual news directly, while we compute the operating cash flow news residually (i.e., indirectly) as in Callen and Segal (2004).

$$Acc_t= \delta_1 r_{t-1}+ \delta_2 Ocf_{t-1}+ \delta_3 Acc_{t-1}+ \delta_4 BM_{t-1}+ \eta_{3,t'} \qquad (8)$$

$$BM_t= \zeta_1 r_{t-1}+ \zeta_2 Ocf_{t-1}+ \zeta_3 Acc_{t-1}+ \zeta_4 BM_{t-1}+ \eta_{4,t'} \qquad (9)$$

To obtain the estimates of the coefficient in Γ, we use ordinary least squares (OLS) including country fixed effects to account for differences across countries given the international sample we use and year fixed effects to account for time-series effects. We obtain standard errors using the Shao and Rao (1993) jackknife method, which is typically used by prior literature (e.g., Callen & Segal, 2004; Clatworthy et al., 2012).

We then define $e1' \equiv [1,0,0]$ and the impulse response function for discount rates as: $\lambda 1 \equiv e1'\rho\Gamma(I- \rho\Gamma)^{-1}$ with ρ=0.967 being a constant log-linear present-value factor equal to the historical average consumption-to-wealth ratio per annum. Following prior literature (e.g., Callen & Segal, 2004; Clatworthy et al., 2012), we estimate cash flows, accruals and expected future returns (discount rates) news, respectively, from the following equation:

$$r_t - E_{t-1}(r_t)= (e_2'+ \lambda_2')\eta_t +(e_3'+ \lambda_3')\eta_t - \lambda_1'\eta t \qquad (10)$$

Subsequently, we obtain variance and covariance estimates of cash flows, accruals and expected future returns (discount rates) based on the following equation:

$$Var(r_t - E_{t-1}(r_t))= (e_2'+ \lambda_2')\Sigma(e_2+ \lambda_2) + (e_3'+ \lambda_3')\Sigma(e_3+ \lambda_3)+ \lambda_1'\Sigma \lambda_1 - 2\lambda_1'\Sigma(e_2+ \lambda_2) - 2\lambda_1'\Sigma(e_3'+ \lambda_3') + 2(e_2'+ \lambda_2')\Sigma(e_3+ \lambda_3) \qquad (11)$$

Table D in the online Supplement presents the estimated parameters of the VAR coefficient matrix Γ (Panel A), the variance decomposition (Panel B) and the descriptive statistics of the cross-sectionally demeaned (market-adjusted) state variables used (Panel C).[25] Overall, the results are consistent with those reported in prior literature (e.g., Callen & Segal, 2004; Callen et al., 2006; Clatworthy et al., 2012) and thus, our variables have similar properties with those report by prior literature.

4. Results

4.1 Univariate analysis

Panel A of Table 3 presents the descriptive statistics of the variables we used as control variables in the multivariate analysis for the full sample. Focusing on the key variables of interest, the results indicate that the mean (median) R&D intensity (*RDI*) is 3.5% (1.5%) of

[25] Similar to Vuolteenaho (2002) and Callen et al. (2005), we retain the same VAR specification across expensers and capitalizers to avoid inducing complications arising from migration from capitalizers to expensers and *vice versa*. For example, Vuolteenaho (2002, p. 246) states that the "VAR coefficient matrix Γ is common for all stocks" and that permitting matrix Γ "to differ across groups would induce additional complications, because the infinite sum formulas used in the variance decomposition would have to be modified to account for probability of migration from one size-group to another".

market values, in line with prior literature using international samples (Hou et al., 2022; Mazzi et al., 2019a,b). Further, we observe that the mean capitalization intensity (*PCTCAP*) is 13% of the total R&D expenditure for the year.[26] The average firm-year observation in our sample has a book value to market of equity (BM) of 0.764, leverage (*LEV*) of 0.59, stock market beta (*BETA*) of 0.990 and is 16 years old (*AGE*).

Panel B of Table 3 presents the descriptive statistics across capitalizers and expensers along with testing their differences using a T-test and Mann-Whitney test, respectively. These reveal that capitalizers differ significantly from expensers (consistent with prior literature e.g., Dargenidou et al., 2021; Kreß et al., 2019; Mazzi et al., 2019a,b). Specifically, capitalizers exhibit greater R&D intensity (differences in mean and median *RDI* are 0.016 and 0.008), are smaller in size (differences in mean and median *SIZE* are 34.948 and 38.056) and are more leveraged (differences in mean and median *LEV* are 0.070 and 0.058). Additionally, we find that capitalizers tend to report, proportionally to total assets, higher amounts of goodwill (differences in mean and median *GOODWILL* are 0.050 and 0.024), other intangible assets (differences in mean and median *OTHERINTA* are 0.088 and 0.071) and more generally own fewer tangible assets (differences in mean and median *TANG* are 0.068 and 0.080) than expensers. Finally, we find that capitalizers tend to operate in countries with higher levels of scientific legislation (differences in mean and median *SCIENCE* are 0.060 and 0.230).

TABLE 3 ABOUT HERE

Table 4 (Panel A) presents the results of the variance decomposition for the full sample. The results show that all the components of the return news variance are significant in driving market returns, as expected. Specifically, the mean (median) cash flow news variance (*var(OpCFN)*) is 0.184 (0.056) (significantly different from zero at the 1% level), while the mean (median) accrual news variance (*var(AccN)*) is 0.098 (0.016) (significantly different from zero at the 1% level). Further, we find that the mean (median) expected return news (*var(DRN)*) is 0.006 (0.001) (significantly different from zero at the 1% level). Finally, we find that the variances of cash flow and accrual news is larger than the variance of discount rates news consistent with prior literature (Callen & Segal, 2004; Clatworthy et al., 2012; Vuolteenaho, 2002).[27] Taken together, these findings suggest that both earnings components are significant and dominant drivers of stock returns with the variance of expected return news being less

[26] We note that the median value of *PCTCAP* is 0.000. This is expected given the smaller proportion of capitalizers (29%), relative to expensers (71%), in our sample.
[27] In unreported tests, we find that the difference in mean and median between *var(OpCFN)* and *var(DRN)* and the difference between *var(AccN)* and *var(DRN)* are all significant at 1%.

important, consistent with the findings in prior literature (Callen & Segal, 2004; Callen et al., 2005; Clatworthy et al., 2012; Vuolteenaho, 2002).

Panel B of Table 4 presents the results of the variance decomposition across quintiles of R&D intensity. Every year we rank companies based on their R&D intensity and allocate them in five quintiles (about 20% of the sample in each quintile). The low quintile consists of the firm year observations with the lowest R&D intensity, while the top quintile contains firm year observations with the highest R&D intensity. The results show that the differences between the high and low quintile are significant at the 1% level for all return news variance components. Specifically, we find that the mean (median) difference between these two quintiles for the cash flow news variance (*var(OpCFN)*) is 0.022 (0.008), while that for accrual news (*var(AccN)*) is 0.014 (0.002). Further, the results show that the mean (median) difference between high and low quintile for the variance of discount rate news is 0.003 (0.001). Taken together, these results provide evidence consistent with our hypotheses that R&D intensity has a positive impact upon the variance contribution of cash flow and accrual news to the variance of unexpected returns, respectively. Nevertheless, the effect of R&D intensity may not be statistically related to cash flow and accrual news variance (see also Callen et al. (2005, p. 402), with reference to the limitations of the quintile ranking approach). Additionally, these results may be driven by factors other than R&D intensity that the univariate analysis does not control for, unlike the multivariate analysis.

Panel C of Table 4 presents the results of the variance decomposition across capitalizers and expensers. As in Panel A we find that the components of the return news variance are significant factors driving stock returns for both expensers and capitalizers (significantly different from zero at the 1% level). More specifically, the mean (median) cash flow news variance (*var(OpCFN)*) is 0.178 (0.054) level for expensers, while that for capitalizers is 0.198 (0.060). The tests of their differences reveal that the cash flow news variance for capitalizers is significantly larger than that for expensers (difference in mean (median) is 0.009 (0.003), significant at the 1% level for both). Further, the mean (median) accrual news variance (*var(AccN)*) is 0.095 (0.016) and significantly different from zero at the 1% level for expensers, while that for capitalizers is 0.105 (0.017) and significantly different from zero at the 1% level. We also find that the accrual news variance is significantly larger for capitalizers than for expensers (difference in mean (median) is 0.020 (0.006), significant at the 1% level for both). The variance of discount rate news is a significant driver of stock returns for both capitalizers (mean (median) *var(DRN)* is 0.006 (0.001), significantly different from zero at the 1% level for both) and expensers (mean (median) *var(DRN)* is 0.006 (0.001), significantly different from zero at the 1% level for both), although we observe little differences between capitalizers and expensers (mean and median difference is 0.000 significant at the 10% level and insignificant, respectively). Overall, these findings indicate that cash flow and accrual news are more important in driving stock returns for firms capitalizing development costs during the year compared to those expensing R&D. Although these findings suggest that capitalization of development costs plays an influential role on the importance of cash flows and accruals in driving stock returns, these tests ignore the magnitude of R&D intensity for the year and the capitalization intensity. We address these issues in the section discussing the results of the multivariate analysis (Section 4.2).[28]

TABLE 4 ABOUT HERE

4.2 Multivariate analysis

Table 5 reports the results of the multivariate analysis testing our hypotheses. Models 1-4 (5-9) show the empirical implementation of Equation (3) (Equation (4)).[29]

Models 2 and 3 show that the coefficient of R&D intensity (*RDI*) is positive and statistically significant across both components of return news variance of interest to this study (coefficients of 0.272 and 0.179, respectively, significant at the 1% level). Moreover, the coefficient of R&D intensity is significantly higher in Model 2 compared to Model 3 (Wald chi-squared: 5.15, significant at the 5% level). These findings are consistent with those reported in Table 4 earlier and suggest that R&D intensity has a positive impact upon the variance contribution of cash flow and accrual news to the variance of unexpected returns, in line with our hypotheses. Thus, R&D intensity indeed conveys value relevant information about shocks to both future operating cash flows and accruals, consistent with H1a and H1b. Put it simply, R&D intensity conveys information about the second moment of both earnings components (cf. Michaely et al., 2021). In fact, the effect on operating cash flow news is stronger. Finally, we find that the variance contribution of discount rates to the variance of unexpected returns increases with R&D intensity (coefficient of *RDI* is 0.007, significant at the 1% level). Nevertheless, and consistent with prior literature documenting that discount rates play a less dominant role in unexpected equity return volatility (e.g., Callen & Segal, 2004; Callen et al.,

[28] Table E in the online Supplement presents the Pearson correlation matrix across all variables used in our main analysis.

[29] As discussed earlier, we focus on the variance of operating cash flow and accrual news given that the variance contribution of discount rate news to unexpected returns is not as dominant (e.g. Callen & Segal, 2004; Callen et al., 2006; Clatworthy et al., 2012; Vuolteenaho, 2002). However, for completeness, Table 5 includes the results when the dependent variable is the variance of returns (*var(Ret)*) and the discount rate news variance (*var(DRN)*).

2005; Clatworthy et al., 2012; Vuolteenaho, 2002), this effect is much smaller compared to variance of cash flow and accrual news.

Models 6 and 7 show the results of multivariate analysis testing H2a and H2b. First, we find that the coefficient of R&D intensity (*RDI*) remains positive and significant when the dependent variable is the variance of cash flow news (coefficient 0.243, significant at the 1% level) and when the dependent variable is the variance of accrual news (coefficient 0.125, significant at the 1% level). Additionally, we find that the coefficient of the interaction between R&D intensity (*RDI*) and development costs' capitalization intensity (*PCTCAP*) is significant only when the dependent variable is the variance of accrual news (coefficient 0.283, significant at the 1% level). Thus, greater capitalization intensity strengthens the positive impact that R&D intensity has upon the variance contribution of accrual news to the variance of unexpected returns, in line with H2b. This is consistent with our conjecture that development costs' capitalization intensity will have a stronger effect on the variance contribution of accrual news relative to that of operating cash flow news. Stated simply, development costs' capitalization intensity indeed conveys value relevant information about shocks to future accruals, that is the second moment of accruals (beyond that of R&D intensity). In fact, this finding indicates that development costs' capitalisation intensity consists of value relevant information that is positively associated with uncertainty (beyond that of R&D intensity). This is in line with the findings of Dargenidou et al. (2021) that current returns of UK firms capitalising development costs do not exhibit a stronger association with future earnings, relative to those expensing R&D under IFRS. Based on this this, they conclude that investors experience greater uncertainty regarding the realisation of future economic benefits associated with the development costs capitalised under IFRS. This is further supported by their findings that capitalised development costs are positively associated with the volatility of future earnings in the post IFRS period. As far as our sample is concerned, we show that as the intensity of development costs' capitalization increases, the association between R&D intensity and future earnings volatility also increases (Table A, Model 2, online Supplement). This indicates that investors' expectations are indeed mapped to changes in firms' fundamentals.[30]

[30] In additional tests inspired by Nekrasov (2012), we find that investors' expectations are indeed mapped to subsequent changes in cash flow and accruals. Specifically, we replace the dependent variables with the volatility of future cash flows or accruals measured over the subsequent five years, instead of the variance of *cash flow* and *accrual news*. We find that the coefficients of R&D intensity (*RDI*) are positive and statistically significant when the dependent variable is the volatility of future cash flows or accruals. Further, the coefficient of the interaction between R&D intensity (*RDI*) and development costs' capitalization intensity (*PCTCAP*) is significant only when the dependent variable is the volatility of future accruals. We obtain similar results when we use the volatility of future year-on-year cash flow changes or accrual changes, measured over the subsequent five years, instead of

With respect to the control variables, we find that tangibility (*TANG*) has a negative impact upon the variances of cash flow and accrual news to the variance of unexpected returns. This finding is not surprising given that, by definition, such firms invest less in intangible assets and R&D. Thus, revision of expectations triggering the variance of returns would occur less frequently. We also find that firm size has a negative impact upon the variance contribution of cash flow and accrual news to the variance of unexpected returns (*SIZE*). This finding is consistent with the evidence in Callen and Segal (2004) and Callen et al. (2005), and "accords with intuition because larger firms tend to be more stable than smaller firms and, thus, are subject to less variability" (Callen & Segal, 2004, p. 548). Additionally, these firms have richer information environment than smaller firms and, thus, revision of expectations triggering the variance of returns would occur less frequently (see also Andronoudis et al., 2022). Moreover, firms with greater incentives to capitalize development costs in order to meet/beat earnings thresholds (*BENCHBEAT*) exhibit a negative association the variance contribution of cash flow and accrual news to the variance of unexpected returns indicating that investors revise their expectations less frequently for these firms.[31] Further, our results show that firms with fewer growth opportunities, proxied by the book-to-market ratio (*BM*), older firms (*LnAGE*), more profitable firms (*ROA*) and firms with more international exposure (*INTSALES*) exhibit smaller variances of cash flow and accrual news. We also observe that the coefficient of *BIG4* to be negative and significant indicating that being audited by big four has a negative impact upon the variances of cash flow and accrual news to the variance of unexpected returns. While this may be counter intuitive, these firms tend to have a better information environment and revisions of expectations triggering the variance of returns would occur less frequently.[32] Finally, our results show that the percentage of closely held shares have a positive impact upon the variance contribution of cash flow and accrual news to the variance of unexpected returns. Given that more widely held firms have better information environments, this finding is consistent with the intuition in Callen et al. (2005)'s findings that firms with higher presence of sophisticated investors exhibit smaller earnings variances.

TABLE 5 ABOUT HERE

their levels. These results are presented in Tables F and G, respectively, in the online Supplement. We thank an anonymous reviewer for suggesting these alternative tests.

[31] In Section 4.3, we examine the sensitivity of our results when we exclude those firms.

[32] This finding is in line with the intuition in Callen and Segal (2005) that more stable firms are subject to less variability. We also note this finding may contradict that in Clatworthy et al. (2012) using a sample of UK firms prior to the adoption of IFRS. Nevertheless, Clatworthy et al. (2012) acknowledge that these relationships may have changed after the mandatory implementation of IFRS and call for future evidence accordingly and across international boundaries.

4.3 Sensitivity tests

In this section, we discuss a number of sensitivity tests that we perform to ensure that our results are not sensitive to various research design choices and hence are robust. The results of these tests are presented in Table 6.

First, we consider that the subjective nature of the capitalization criteria (Mazzi et al., 2022) may allow managers to recognize development expenditure as an asset to meet or beat earnings targets (Cazavan-Jeny & Jeanjean 2006; Cazavan-Jeny et al., 2011; Dinh et al., 2016; Mazzi et al., 2022). This may impair the ability of capitalized development costs to convey information about the success of R&D projects (i.e., signalling role) and consequently the future economic benefits arising from such expenditure (Dinh et al., 2016). This would effectively affect market revisions of expectations. Thus, we repeat our analysis while we exclude firm year observations that are suspect for earnings management, in terms of having incentives to capitalize development costs for meeting or beating earnings targets (i.e., when *BENCHBEAT* equals to one). Overall, the results presented in Panel A of Table 6 suggest that our inferences are similar when we exclude firms with earnings management incentives.

Second, as indicated in Section 3.1, we consider that firm-year observations from China account for approximately 26% of our sample. To avoid potential concerns that our results are driven by the high representation of firms from China, we re-estimate the results by excluding these firm-year observations. The results of this analysis are presented in Panel B of Table 6. These are qualitatively similar to those presented in relation to the main analysis (Table 5), indicating that our results are unlikely to be driven by the strong presence of firms from China in the sample.

Third, we use an alternative approach to accounting for potential endogeneity concerns regarding a firm’s propensity to capitalize development costs during the year. Specifically, we apply a propensity score matching (PSM) technique to identify a control sample of firms that do not capitalize development costs during the year to the treatment group of firms that capitalize development costs during the year that are similar. This matching reduces observable differences and increases confidence that our results are indeed driven by R&D intensity and capitalization intensity and not by sample heterogeneity. Specifically, we match firms from the treatment group with the nearest neighbouring firm within a caliper distance of 0.03 from the control group (as in DeFond et al. (2017) and Shipman et al. (2017)). This matching is based on the same variables used to estimate the IMR (see Table C in the online Supplement). We rely on matching without replacement as “matching with replacement may lower the representativeness of the control group, and thereby reduce the generalizability of the inferences" (DeFond et al., 2017, p. 3630).[33] We then derive propensity scores (i.e., the likelihood of capitalizing development costs during the year) and match the two samples. Subsequently, we run our main regressions on the matched sample and present them in Panel C of Table 6. Although, as expected, the sample size reduces significantly, given that capitalizers represent 29% of the total sample, the results are similar to those presented in the main analysis (Table 5). Thus, our findings remain robust when we account for potential heterogeneity between firms that capitalize development costs during the year and those that do not using the PSM.

Finally, we examine the sensitivity of our results when considering only firms in industries that invest heavily on R&D. Firms in these industries could be more likely to compete on the basis of innovativeness and technology breakthrough (O'Brien, 2003; Lin et al., 2003). This could subsequently have a large impact on stock returns. To identify such industries, we calculate the median R&D intensity for each ICB Supersector (level 3) and retain in our sample those Supersectors that exhibit R&D intensity above the sample median. Following this process, we re-estimate the results when only using the following Supersectors: Automobiles and Parts, Health Care, Industrial Goods and Services, Technology and Telecommunications. The results, presented in Panel D of Table 6 indicate that our conclusions remain unchanged when we focus on industries that R&D is expected to be more important.

TABLE 6 ABOUT HERE

4.4 Additional analysis

In this section, first, we draw on Hou et al. (2022)'s finding that the relationship between R&D intensity and returns is associated with growth options across countries. More specifically, Hou et al. (2022, p. 1381) argue that, given that innovation generates growth options, "a large dispersion in the market of growth options suggests that the risk premium of growth options is more likely to be priced". They show that the association between R&D intensity and returns is more pronounced in countries with larger dispersions in growth option values. They conclude that this positive association is more likely to be attributed to risk premium.

We follow Hou et al. (2022) and construct a variable that is related to country level growth option-induced risks. Specifically, we measure the country-year-level dispersion of growth option values as the difference between the 75th and 25th percentiles of the price to earnings ratio (PE), which is known to predict future economic growth (Bekaert et al., 2007). Given that

[33] The tests of differences, unreported for the sake of brevity, indicate that the differences between the two groups are significantly reduced in the matching variables, which confirms correct matching (Shipman et al., 2017).

a smaller dispersion is indicative of lower likelihood for the risk of growth options to be priced, we create an indicator variable (*LOW*) that equals to one if a country's yearly dispersion is below the median yearly dispersion of all countries in our sample and zero otherwise. Then, we extend Equation (4) and introduce this variable as a main effect and as interaction effect with R&D intensity (*RDI*) and the interaction between R&D intensity and capitalization intensity (*RDI*PCTCAP*). We present the results of this analysis in Panel A of Table 7.

Models (3) and (4) show that the coefficient of R&D intensity (*RDI*) is positive and statistically significant across both components of return news variance of interest in this study (coefficients of 0.237 and 0.124, respectively, both significant at the 1% level), consistent with the results presented earlier. Further, the coefficient of interaction between *LOW* and *RDI* is insignificant in both models (coefficients of 0.027 and 0.001, respectively). Additionally, we find that the three-way interaction between *LOW*, *RDI* and *PCTCAP* is also insignificant in both models (coefficients of 0.013 and 0.213, respectively). Thus, our findings indicate that risk premium is unlikely to affect our inferences.

Second, we draw on recent literature that examines the significance of national culture on investor decisions and calls for research that includes cultural dimensions '…in cross-country research to account for innate differences among international investors' (Dou et al., 2016, p. 851). Specifically, Dou et al. (2016) show *inter alia* that investors embedded in cultures with higher uncertainty avoidance exhibit a lower under-reaction to earnings information. Further, Tsalavoutas and Tsoligkas (2021) show that firms' current returns incorporate less future earnings information in countries with higher uncertainty avoidance. Nguyen and Truong (2013) show that investors in cultures with higher uncertainty avoidance exhibit more moderate reaction to the arrival of new firm-specific information, affecting how information is incorporated into stock prices. On reflection of this, we consider that if R&D intensity provides relevant information that causes investors to revise their expectations regarding the components of future earnings, we would expect our findings to be weaker for firms in countries with higher uncertainty avoidance. To this end, we create an indicator variable (*HIGH*) that equals to one if a country's uncertainty avoidance index from Hofstede (1980) is above the median uncertainty avoidance index of all countries in our sample and zero otherwise. Subsequently, we extend Equation (4) and introduce this variable as a main effect and as interaction effect with R&D intensity (*RDI*) and the interaction between R&D intensity and capitalization intensity (*RDI*PCTCAP*). We present the results of this analysis in Panel B of Table 7.

Models 3 and 4 show that the coefficient of R&D intensity (*RDI*) is positive and statistically significant across both components of return news variance of interest to this study (coefficients of 0.346 and 0.128, respectively, significant at the 1% level), consistent with the results presented earlier. Further, the coefficient of interaction between *HIGH* and *RDI* is negative and significant only when the dependent variable is the variance of the cash flow news (coefficient of -0.362, significant at the 1% level). This finding suggests that the positive effect that R&D intensity has upon the variance of cash flow news is weaker in countries with higher uncertainty avoidance. Additionally, we find that the three-way interaction between *HIGH, RDI* and *PCTCAP* is positive and significant at marginal levels only when dependent variable is the variance of the cash flow news (coefficient of 0.410, significant at the 10% level). This finding suggests that capitalization intensity decreases the adverse effect that uncertainty avoidance has on the variance of cash flow news associated with R&D intensity. Taken together, these findings are consistent with our conjecture that the under-reaction to earnings information in countries with higher uncertainty avoidance appears to occur for cash flow news only.[34] Further, our findings suggest that cultural differences do play a significant role on how investors "revise their return expectations to cash flow news" (Callen et al., 2016, p. 574). In fact, this evidence responds to Clatworthy et al.'s (2012) call for variance decomposition research across international boundaries and provide evidence that the associations reported in the main tests, although hold on aggregate, vary in magnitude across international boundaries.

TABLE 7 ABOUT HERE

5. Conclusion

Based on a large sample of international IFRS reporting companies from 38 countries, this study examines whether R&D intensity and development costs' capitalization intensity convey information about shocks to future operating cash flows and accruals. Our results show that R&D intensity has a positive impact on the volatility of unexpected stock returns via both components of earnings news. Further, we show that R&D capitalization intensity only strengthens the positive impact that R&D intensity has upon the variance contribution of accrual news to the variance of unexpected returns. These results remain robust to a number of sensitivity tests.

The contribution arising from these findings is the following. There is considerable prior evidence indicating that R&D intensity is value relevant and is associated with higher current and subsequent stock returns (Chan et al., 2001; Hou et al., 2022; Lev, 1999; Lev & Sougiannis,

[34] The lack of a similar finding of under-reaction for accrual news could, arguably, be attributed to investors' trust of accruals in the high uncertainty avoidance countries. There is evidence that firms such countries are less likely to engage in accruals earnings management and report earnings of higher quality (Chaney et al., 2021; Han et al., 2010).

1996). Nonetheless, this strand of the literature relies on mean effects and has not therefore examined whether R&D intensity (and/or R&D capitalization intensity) is associated with revisions in expected future operating cash flows (cash flow news) or accruals (accrual news) in driving equity returns. Our approach complements this literature given that it “measures the ex ante likelihood that earnings shocks will occur and generate return shocks” (Callen et al. 2005; Callen, 2009) which occur frequently in R&D active firms (Amir et al., 2005; Chambers et al., 2002; Dargenidou et al., 2021; Kothari et al., 2002). Further, it allows us to examine the channel through which the variation in returns in relation to R&D intensity and development costs’ capitalization intensity occurs.

Similarly, prior literature documents that R&D assets reported under IFRS are positively associated with market values (Dinh et al., 2016; Shah et al., 2013; Tsoligkas & Tsalavoutas, 2011) and firms capitalizing development costs exhibit positive abnormal returns in subsequent periods. However, none of these studies examines the valuation implications of R&D capitalization intensity, despite its use by practitioners (see Ding et al., 2013; Mazzi et al., 2022). We show that development costs’ capitalization intensity conveys value relevant information, about shocks to future accruals only.

As every study, our study is subject to limitations. First, albeit in different contexts, Chen et al. (2013) and Khimich (2017) rely on the use of analysts’ forecasts as alternative proxies for market expectations when measuring the variance of cash flow and accrual news. Requiring data on analysts’ forecasts would lead to a substantial loss of sample. Hence, we did not pursue this avenue further. Nevertheless, future research could explore it. Additionally, future research could explore whether the findings reported in this study, and in particular with respect to the impact that R&D intensity has on the variance of accrual news, hold in the US where capitalization of developments costs is prohibited (Accounting Standards Codification (ASC) Topic 730), with the exception of software development costs (ASC Topic 985).

References

Amir, E., Guan, Y., & Livne, G. (2007). The association of R&D and capital expenditures with subsequent earnings variability. *Journal of Business Finance & Accounting*, *34*(1-2), 222-246. https://doi.org/10.1111/j.1468-5957.2006.00651.x

Andronoudis, D., Baboukardos, D., & Tsoligkas, F. (2024). How the information content of integrated reporting flows into the stock market. *International Journal of Finance & Economics*. 29(1), https://doi.org/10.1002/ijfe.2721

Barker, R., Lennard, A., Penman, S., & Teixeira, A. (2022). Accounting for intangible assets: suggested solutions. *Accounting and Business Research*, *52*(6), 601-630. https://doi.org/10.1080/00014788.2021.1938963

Bekaert, G., Harvey, C. R., Lundblad, C., & Siegel, S. (2007). Global growth opportunities and market integration. *The Journal of Finance*, *62*(3), 1081-1137. https://doi.org/10.1111/j.1540-6261.2007.01231.x

Callen, J. L. (2009). Shocks to shocks: A theoretical foundation for the information content of earnings, *Contemporary Accounting Research*, 26(1), 135-166. https://doi.org/10.1506/car.26.1.5

Callen, J. L., & Segal, D. (2004). Do accruals drive firm-level stock returns? A variance decomposition analysis. *Journal of Accounting Research*, *42*(3), 527-560. https://doi.org/10.1111/j.1475-679X.2004.t01-1-00140.x

Callen, J. L., Hope, O. K., & Segal, D. (2005). Domestic and foreign earnings, stock return variability, and the impact of investor sophistication. *Journal of Accounting Research*, *43*(3), 377-412. https://doi.org/10.1111/j.1475-679x.2005.00175.x

Callen, J. L., Lai, K. M., & Wei, S. X. (2016). The Volatility of Return Revisions and Financial Statement Literacy in Emerging Markets: The Case of Cross-listed Chinese Firms. *Journal of Business Finance & Accounting*, *43*(5-6), 572-596. https://doi.org/10.1111/jbfa.12180

Callen, J. L., Livnat, J., & Segal, D. (2006). The information content of SEC filings and information environment: A variance decomposition analysis. *The Accounting Review*, *81*(5), 1017-1043. https://doi.org/10.2308/accr.2006.81.5.1017

Callen, J. L., Segal, D., & Hope, O. K. (2010). The pricing of conservative accounting and the measurement of conservatism at the firm-year level. *Review of Accounting Studies*, *15*, 145-178. https://doi.org/10.1007/s11142-009-9087-6

Campbell, J. Y. (1991). A variance decomposition for stock returns. *The Economic Journal*, *101*(405), 157-179. https://doi.org/10.2307/2233809

Campbell, J. Y., & Shiller, R. J. (1988a). Stock prices, earnings, and expected dividends. *The Journal of Finance*, *43*(3), 661-676. https://doi.org/10.1111/j.1540-6261.1988.tb04598.x

Campbell, J. Y., & Shiller, R. J. (1988b). The dividend-price ratio and expectations of future dividends and discount factors. *The Review of Financial Studies*, *1*(3), 195-228. https://doi.org/10.1093/rfs/1.3.195

Campbell, J. Y., Lo, A., W., MacKinlay, A., C. (1997). *The Econometrics of Financial Markets*. Princenton, NJ: Princeton University Press

Campbell, J. Y., Polk, C., & Vuolteenaho, T. (2010). Growth or glamour? Fundamentals and systematic risk in stock returns. *The Review of Financial Studies*, *23*(1), 305-344. https://doi.org/10.1093/rfs/hhp029

Cazavan-Jeny, A., & Jeanjean, T. (2006). The negative impact of R&D capitalization: A value relevance approach. *European Accounting Review*, *15*(1), 37-61. https://doi.org/10.1080/09638180500510384

Cazavan-Jeny, A., Jeanjean, T., & Joos, P. (2011). Accounting choice and future performance: The case of R&D accounting in France. *Journal of Accounting and Public Policy*, *30*(2), 145-165. https://doi.org/10.1016/j.jaccpubpol.2010.09.016

Ciftci, M., Lev, B., & Radhakrishnan, S. (2011). Is research and development mispriced or properly risk adjusted?. *Journal of Accounting, Auditing & Finance*, *26*(1), 81-116. https://doi.org/10.1177/0148558X11400581

Clatworthy, M. A., Pong, C. K., & Wong, W. K. (2012). Auditor quality effects on the relationship between accruals, cash flows and equity returns: a variance decomposition analysis. *Accounting and Business Research*, *42*(4), 419-439. https://doi.org/10.1080/00014788.2012.662791

Cooper, S. (2020). Moving the conceptual framework forward: Accounting for uncertainty. *Contemporary Accounting Research*, *37*(1), 322-357. https://doi.org/10.1111/1911-3846.12585

Constantatos, A., Dionysiou, D., Slack, R., Tsalavoutas, I., & Tsoligkas, F. (2021). The capitalisation of intangibles debate: Accounting for exploration and evaluation expenditure in extractive activities. ACCA and Adam Smith Business School. https://doi.org/10.36399/gla.pubs.234937

Curtis, A., McVay, S., & Toynbee, S. (2020). The changing implications of research and development expenditures for future profitability. *Review of Accounting Studies*, *25*, 405-437. https://doi.org/10.1007/s11142-019-09528-6

Chambers, D., Jennings, R., & Thompson, R. B. (2002). Excess returns to R&D-intensive firms. *Review of Accounting Studies*, *7*(2-3), 133-158. https://doi.org/10.1023/A:1020217817156

Chan, L KC, Lakonishok, J and Sougiannis, T. (2001). The stock market valuation of research and development expenditures. *The Journal of Finance* 56(6), 2431-2456. https://doi.org/10.1111/0022-1082.00411

Chaney, P. K., Lodh, S., & Nandy, M. (2021). How does culture impinge upon managers' demeanor of earnings management? Evidence from cross-country analysis. *The International Journal of Accounting*, *56*(02), 2150009. https://doi.org/10.1142/S1094406021500098

Chen, L., & Zhao, X. (2009). Return decomposition. *The Review of Financial Studies*, *22*(12), 5213-5249. https://doi.org/10.1093/rfs/hhp017

Chen, L., Da, Z., & Zhao, X. (2013). What drives stock price movements?. *The Review of Financial Studies*, *26*(4), 841-876. https://doi.org/10.1093/rfs/hht005

Chui, A. C., Titman, S., & Wei, K. J. (2010). Individualism and momentum around the world. *The Journal of Finance*, *65*(1), 361-392. https://doi.org/10.1111/j.1540-6261.2009.01532.x

Dargenidou, C., Jackson, R. H., Tsalavoutas, I., & Tsoligkas, F. (2021). Capitalisation of R&D and the informativeness of stock prices: Pre-and post-IFRS evidence. *The British Accounting Review*, *53*(4), 100998. https://doi.org/10.1016/j.bar.2021.100998

Dargenidou, C., Tonks, I., & Tsoligkas, F. (2018). Insider trading and the post-earnings announcement drift. *Journal of Business Finance & Accounting*, *45*(3-4), 482-508. https://doi.org/10.1111/jbfa.12305

Daske, H., Hail, L., Leuz, C., & Verdi, R. (2013). Adopting a label: Heterogeneity in the economic consequences around IAS/IFRS adoptions. *Journal of Accounting research*, *51*(3), 495-547. https://doi.org/10.1111/1475-679X.12005

Dechow, P. M. (1994). Accounting Earnings and Cash Flows as Measures of Firm Performance: the Role of Accounting Accruals. *The Accounting Review*. https://doi.org/10.1016/0165-4101(94)90016-7

DeFond, M., Erkens, D. H., & Zhang, J. (2017). Do client characteristics really drive the Big N audit quality effect? New evidence from propensity score matching. *Management Science*, *63*(11), 3628-3649. https://doi.org/10.1287/mnsc.2016.2528

Ding, Y., Jeanjean, T., & Stolowy, H. (2013, May). Accounting for stakeholders or shareholders? The case of R&D reporting. In *Comptabilité sans Frontières... The French Connection*. https://hal.science/hal-01002936/

Dinh, T., Kang, H., & Schultze, W. (2016). Capitalizing research & development: Signaling or earnings management?. *European Accounting Review*, *25*(2), 373-401. https://doi.org/10.1080/09638180.2015.1031149

Dinh Thi, T., & Schultze, W. (2011). Capitalizing research & development and 'other information': the incremental information content of accruals versus cash flows. *Journal of Management Control*, *22*, 241-278. https://doi.org/10.1007/s00187-011-0137-4

Dionysiou, D., Slack, R., Tsalavoutas, I., & Tsoligkas, F. (2023). Reporting of R&D: Disclosure Without Recognition?. ACCA and Adam Smith Business School. https://doi.org/10.36399/gla.pubs.298677

Dionysiou, D., Slack, R., Tsalavoutas, Y., & Tsoligkas, F. (2021). The capitalisation of intangibles debate: software development costs. ACCA and Adam Smith Business School. https://doi.org/10.36399/gla.pubs.244180

Dou, P., Truong, C., Veeraraghavan, M., (2016). Individualism, uncertainty avoidance, and earnings momentum in international markets. *Contemporary Accounting Research*. *33*(2), 851–881. https://doi.org/10.1111/1911-3846.12155

Duqi, A., Jaafar, A. and Torluccio, G. (2015). Mispricing and risk of R&D investment in European firms. *The European Journal of Finance* 21(5), 444-465. https://doi.org/10.1080/1351847X.2013.838185

EFRAG (European Financial Reporting Advisory Group) (2021), Better Information on Intangibles: Which is the Best Way to Go? Discussion Paper (DP). Downloadable from https://www.efrag.org/News/Project-522/EFRAG-Discussion-Paper-Betterinformation-on-intangibles--which-is-the-best-way-to-go, accessed 28 March 2023.

Engsted, T., Pedersen, T. Q., & Tanggaard, C. (2012). Pitfalls in VAR based return decompositions: A clarification. *Journal of Banking & Finance*, *36*(5), 1255-1265. https://doi.org/10.1016/j.jbankfin.2011.11.004

García Lara, J. M., Beatriz García Osma, & Mora A. (2005). The effect of earnings management on the asymmetric timeliness of earnings. *Journal of Business Finance & Accounting* 32.3-4 691-726. https://doi.org/10.1111/j.0306-686X.2005.00610.x

García Lara, J. M., García Osma, B., & Penalva, F. (2011). Conditional conservatism and cost of capital. *Review of Accounting Studies*, *16*, 247-271. https://doi.org/10.1007/s11142-010-9133-4

Han, S., Kang, T., Salter, S., & Yoo, Y. K. (2010). A cross-country study on the effects of national culture on earnings management. *Journal of International Business Studies*, *41*, 123-141. https://doi.org/10.1057/jibs.2008.78

Healy, P. M., Myers, S. C., & Howe, C. D. (2002). R&D accounting and the tradeoff between relevance and objectivity. *Journal of Accounting Research*, *40*(3), 677-710. https://doi.org/10.1111/1475-679X.00067

Heckman, J. J. (1979). Statistical models for discrete panel data. Chicago, IL: Department of Economics and Graduate School of Business, University of Chicago

Hofstede, G., 1980. Culture's consequences: International differences in work related values. Sage, Beverley Hills, CA.

Hou, K., Hsu, P. H., Wang, S., Watanabe, A., & Xu, Y. (2022). Corporate R&D and stock returns: International evidence. *Journal of Financial and Quantitative Analysis*, *57*(4), 1377-1408. https://doi.org/10.1017/S002210902100020X

Huang, D., Liu, B., Chan, K. C., & Chen, Y. (2023). Intended and unintended effects of mandatory R&D disclosure on innovation outcomes. *Economic Modelling*, *119*, 106144. https://doi.org/10.1016/j.econmod.2022.106144

International Accounting Standard 38 Intangible Assets, (2004). Basis for Conclusions. IFRS Foundation.
International Accounting Standards Board (IASB) (2018). Conceptual framework for financial reporting, IFRS Foundation, London
Jakob, S., & Valta, P. (2023). What do market participants learn from share repurchases? Evidence from a return decomposition. *Journal of Corporate Finance*, *82*, 102451. https://doi.org/10.1016/j.jcorpfin.2023.102451
Khimich, N. (2017). A comparison of alternative cash flow and discount rate news proxies. *Journal of Empirical Finance*, *41*, 31-52. https://doi.org/10.1016/j.jempfin.2016.12.002
Kothari, S. P., Laguerre, T. E., & Leone, A. J. (2002). Capitalization versus expensing: Evidence on the uncertainty of future earnings from capital expenditures versus R&D outlays. *Review of accounting Studies*, *7*(4), 355-382. https://doi.org/10.1023/A:1020764227390
Kreß, A., Eierle, B., & Tsalavoutas, I. (2019). Development costs capitalization and debt financing. *Journal of Business Finance & Accounting*, *46*(5-6), 636-685. https://doi.org/10.1111/jbfa.12370
Kvaal, E., & Nobes, C. (2012). IFRS policy changes and the continuation of national patterns of IFRS practice. *European Accounting Review*, *21*(2), 343-371. https://doi.org/10.1080/09638180.2011.611236
Lee, L. F. (1979). Identification and estimation in binary choice models with limited (censored) dependent variables. *Econometrica: Journal of the Econometric Society*, 977-996. https://doi.org/10.2307/1914142
Lev, B. (1999). R&D and capital markets. *Journal of Applied Corporate Finance*, *11*(4), 21-35. https://doi.org/10.1111/j.1745-6622.1999.tb00511.x
Lev, B. (2019). Ending the accounting-for-intangibles status quo. *European Accounting Review*, *28*(4), 713-736. https://doi.org/10.1080/09638180.2018.1521614
Lev, B., & Sougiannis, T. (1996). The capitalization, amortization, and value-relevance of R&D. *Journal of Accounting and Economics*, *21*(1), 107-138. https://doi.org/10.1016/0165-4101(95)00410-6
Lev, B., Nissim, D., & Thomas, J. (2016). On the informational usefulness of R&D capitalization and amortization. In *Visualising intangibles: Measuring and reporting in the knowledge economy* (pp. 97-128). Routledge.
Lin, B. W., Lee, Y., & Hung, S. C. (2006). R&D intensity and commercialization orientation effects on financial performance. *Journal of Business Research*, *59*(6), 679-685. https://doi.org/10.1016/j.jbusres.2006.01.002
Mazzi, F., Slack, R., Tsalavoutas, I., & Tsoligkas, F. (2019a). Country-level corruption and accounting choice: Research & development capitalization under IFRS. *The British Accounting Review*, *51*(5), 100821. https://doi.org/10.1016/j.bar.2019.02.003
Mazzi, F., Slack, R., Tsalavoutas, I., & Tsoligkas, F. (2019b), The Capitalisation Debate: R&D Expenditure, Disclosure Content and Quantity, and Stakeholder Views. ACCA. Available here: https://www.accaglobal.com/lk/en/professional–insights/global–profession/the–capitalisation–debate.html (accessed 24 March 2023)
Mazzi, F., Slack, R., Tsalavoutas, I., & Tsoligkas, F. (2022). Exploring investor views on accounting for R&D costs under IAS 38. *Journal of Accounting and Public Policy*, *41*(2), 106944. https://doi.org/10.1016/j.jaccpubpol.2022.106944
Michaely, R., Rossi, S., & Weber, M. (2021). Signaling safety. *Journal of Financial Economics*, *139*(2), 405-427. https://doi.org/10.1016/j.jfineco.2020.08.013
Mohd, E. (2005). Accounting for software development costs and information asymmetry. *The Accounting Review*, *80*(4), 1211-1231. https://doi.org/10.2308/accr.2005.80.4.1211

Nekrasov, A. (2012). Cost of equity and risk in cash flow and accrual components of earnings. *Working paper*, available at: http://dx.doi.org/10.2139/ssrn.1496566

Nguyen, N. H., & Truong, C. (2013). The information content of stock markets around the world: A cultural explanation. *Journal of International Financial Markets, Institutions and Money*, *26*, 1-29. https://doi.org/10.1016/j.intfin.2013.03.001

O'Brien, J. P. (2003). The capital structure implications of pursuing a strategy of innovation. *Strategic Management Journal*, *24*(5), 415-431. https://doi.org/10.1002/smj.308

Oswald, D. R. (2008). The determinants and value relevance of the choice of accounting for research and development expenditures in the United Kingdom. *Journal of Business Finance & Accounting*, *35*(1-2), 1-24. https://doi.org/10.1111/j.1468-5957.2007.02060.x

Oswald, D. R., & Zarowin, P. (2007). Capitalization of R&D and the informativeness of stock prices. *European Accounting Review*, *16*(4), 703-726. https://doi.org/10.1080/09638180701706815

Patatoukas, P. N. (2014). Detecting news in aggregate accounting earnings: Implications for stock market valuation. *Review of Accounting Studies*, 19, 134-160. https://doi.org/10.1007/s11142-013-9221-3

Shah, S. Z. A., Liang, S., & Akbar, S. (2013). International Financial Reporting Standards and the value relevance of R&D expenditures: Pre and post IFRS analysis. *International Review of Financial Analysis*, *30*, 158-169. https://doi.org/10.1016/j.irfa.2013.08.001

Shao, J., & Rao, J. N. K. (1993). Jackknife inference for heteroscedastic linear regression models. *Canadian Journal of Statistics*, *21*(4), 377-395. https://doi.org/10.2307/3315702

Shipman, J. E., Swanquist, Q. T., & Whited, R. L. (2017). Propensity score matching in accounting research. *The Accounting Review*, *92*(1), 213-244. https://doi.org/10.2308/accr-51449

Sloan, R. G. (1996). Do stock prices fully reflect information in accruals and cash flows about future earnings?. *Accounting review*, 289-315. https://www.jstor.org/stable/248290

Soderstrom, N. S., & Sun, K. J. (2007). IFRS adoption and accounting quality: a review. *European Accounting Review*, *16*(4), 675-702. https://doi.org/10.1080/09638180701706732

Sougiannis, T. (1994). The accounting based valuation of corporate R&D. *The Accounting Review*, 44-68. https://www.jstor.org/stable/248260

Subramanyam, K. R. (1996). The pricing of discretionary accruals. *Journal of Accounting and Economics*, *22*(1-3), 249-281. https://doi.org/10.1016/S0165-4101(96)00434-X

Tsalavoutas, I., & Tsoligkas, F. (2021). Uncertainty avoidance and stock price informativeness of future earnings. *Journal of International Financial Markets, Institutions and Money*, *75*, 101410. https://doi.org/10.1016/j.intfin.2021.101410

Tsoligkas, F., & Tsalavoutas, I. (2011). Value relevance of R&D in the UK after IFRS mandatory implementation. *Applied Financial Economics*, *21*(13), 957-967. https://doi.org/10.1080/09603107.2011.556588

UKEB (UK Endorsement Board) (2023), 'Intangibles Project' [webpage] <https://www.endorsement-board.uk/intangiblesproject>, accessed 28 March 2023.

Vuolteenaho, T. (2002). What drives firm-level stock returns?. *The Journal of Finance*, *57*(1), 233-264. https://doi.org/10.1111/1540-6261.00421

Wang, Y., Du, R., Koong, K. S., & Fan, W. (2017). Effects of R&D policy choice on accounting performance and market value. *R&D Management*, *47*(4), 545-556. https://doi.org/10.1111/radm.12225

Appendix A. Variables' definitions.

Variable	Definition	Source
var(Ret)	Variance of return news.	Self-constructed (see section 3.3)
var(OpCFN)	Variance of operating cash flow news.	Self-constructed (see section 3.3)
var(AccN)	Variance of accrual news.	Self-constructed (see section 3.3)
var(DRN)	Variance of discount rate news.	Self-constructed (see section 3.3)
RDI	R&D expenditure (which is the sum of R&D expense and R&D capitalized in the year) scaled by market value.	Net development costs: WC0250 Amortization of R&D: WC01153 R&D expense: WC01201, Market Capitalization: WC08001
PCTCAP	Percentage of development costs capitalized during the year scaled by the total R&D expenditure for the year.	Net development costs: WC0250 Amortization of R&D: WC01153, R&D expense: WC01201
SIZE	Natural logarithm of a firm's market value (in Euros). The data we have downloaded are not Datastream adjusted and thus the exchange rate used is of the day of the fiscal year end, consistent with what Datastream does.	Market Capitalisation: WC08001
LnAGE	Natural logarithm of firm age	Base date: BDATE
BHR	Annual returns calculated by compounding 12 monthly returns measured from July following the year end of the company.	Return index: RI
ROA	Return on assets.	Net income before extra items: WC01551 Total assets: WC02999
BM	Book to market ratio.	Common equity: WC03501 Market Capitalisation: WC08001
BETA	Firm's beta estimated using 12 months returns over each firm local index.	Datastream regression formula
LEV	Leverage measured as total debt to common equity.	Total debt: WC03255, Common equity: WC03501
CAPEX	Capital expenditure scaled by market value.	Capital Expenditure: WC04601 Market Capitalization: WC08001
TANG	Tangibility measured at the sum of net property plant and equipment and inventories scaled by total assets	Property, plant and equipment (net): WC02501 Total inventories: WC02101, Total assets: WC02999
PCTCLOSE	Percentage of closely held shares	The % of closely held shares: WC08021
SDASSET	Amount of software development costs capitalized in the year scaled by total assets.	Net software development costs: WC18299 Total assets: WC02999
INTSALES	Percentage of foreign (international) sales.	International sales percentage: (WC07101)
GOODWILL	Amount of net goodwill scaled by total assets.	Goodwill: WC18280, Total assets: WC02999
OTHERINTA	Amount of other intangible assets scaled by total assets.	Total intangible other assets net: WC02649. Total assets: WC02999

BIG4	Indicator variable that equals to one for firms audited by a Big-4 auditor and zero otherwise.	TR.BSAuditorCode
BENCHBEAT	Following Mazzi et al. (2019a) and Dargenidou et al. (2021), it is equal to one if both (i) earnings in year t-1 exceed earnings (zero earnings threshold) in year t, assuming full expensing of R&D expenditure, and (ii) earnings in year t exceed earnings (zero threshold) in year t-1, assuming full capitalization of R&D expenditure and zero otherwise.	Income before extraordinary items: WC01551 Net development costs (WC0250) Amortization of R&D (WC01153) R&D expense (WC01201)
REM	Indicator variable that equals to one if for firms which unexpectedly reduced R&D expenditure, and zero otherwise. We follow Bereskin et al. (2018) and identify firms which unexpectedly cut R&D when the residuals from the regression model in Gunny (2010) and Bereskin et al. (2018) are negative. The model includes a scaled constant, market value, Tobins Q, last year's R&D investment and internal funds.	Net development costs: WC0250. Amortization of R&D: WC01153 R&D expense: WC01201, Market Capitalization: WC08001 Total assets: WC02999. Common equity: WC03501 Net income before extra items: WC01551 Depreciation, depletion and amortisation: WC01151
LABOR	Country level skilled labor.	IMD World Competitiveness
HEALTH	Country level of health infrastructure.	IMD World Competitiveness
SCIENCE	Country level scientific research legislation.	IMD World Competitiveness
CCR	Country level control of corruption.	Worldwide Governance Indicators
MRKTRAD	Market trading volume measured as the annual market dollar trading volume of the Datastream Global index of the country divided by this index's market capitalization.	Trading volume of the Datastream Global index of the country: VO Market value of the Datastream Global index of the country: MV
MRKDEV	Market development measured as the market capitalization of the Datastream Global index of the country divded by GDP of the country.	Market value of the Datastream Global index of the country: MV GDP: World Bank
MRKDY	Market level dividend yield of the Datastream global index of the country.	Dividend yield of the Datastream Global index of the country: DY
CAP	Indicator variable that equals to one if for firms that capitalize development costs during the year and zero otherwise.	Net development costs: WC0250 Amortization of R&D: WC01153
RDASSET	Capitalized development costs for the year scaled by market values	Net development costs: WC0250 Amortization of R&D: WC01153 Market Capitalization: WC08001
CUTRD	indicator variable that equals to one for firms that current year's R&D expenditure is less than the previous year's R&D expenditure.	Net development costs (WC0250) Amortization of R&D (WC01153), R&D expense (WC01201)
RDVALUE	R&D value measured as the difference between the market value of equity and book value of equity less amount of R&D capitalized during the year divided by the sum of current and lagged annual R&D expenditure.	Common equity (WC03501), Market Capitalization (WC08001) Net development costs (WC0250) Amortization of R&D (WC01153), R&D expense (WC01201)

Table 1: Sample selection process.

We focus on all countries that adopted IFRS mandatorily or have their accounting standards converged to IFRS from 2005 to 2015 and obtain data between 2006 and 2020.	353,602
Exclude firm-year observations:	
Belonging in the Energy sector or the industry classification is missing	(19,171)
For which the data item indicating the accounting standards following is either missing or yields a non-IFRS code	(44,228)
Reporting under IFRS for the first time	(16,784)
That had their financial year end changed	(2,264)
With missing firm-level data	(107,615)
With missing country level data	(6,586)
Market value is below €10million and the book-to-market is below (above) 0.01 (100)	(33,394)
Which are not R&D active	(65,945)
Final sample of firm year observations (firms)	57,615 (10,540 firms)
Of which:	
Capitalizers	16,937 (29%)
Expensers	40,678 (71%)

Table 2: Sample composition across countries, industries and year.

Panel A: Sample composition by country and year

Country	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total	Total capitalizers
Argentina	0	0	0	0	0	0	0	0	0	1	1	2	3	3	4	14	8 (57%)
Australia	122	133	128	138	135	131	123	99	95	88	84	79	81	87	94	1,617	625 (39%)
Austria	21	23	26	26	26	24	23	17	20	20	19	18	16	17	19	315	103 (33%)
Belgium	25	24	29	28	31	31	21	23	23	25	29	33	34	34	32	422	189 (45%)
Brazil	0	0	0	0	0	27	28	21	29	34	31	29	30	32	32	293	142 (48%)
Canada	0	0	0	0	0	0	31	50	68	74	85	78	80	93	99	658	110 (17%)
Chile	0	0	0	0	0	7	4	0	0	0	0	0	0	0	0	11	11 (100%)
China	0	0	46	54	104	122	109	979	1,364	1,652	1,757	1,846	2,254	2,373	2,305	14,965	3,684 (25%)
Croatia	0	0	0	0	0	0	0	0	1	3	0	1	1	1	0	7	6 (86%)
Czech Republic	4	0	1	1	1	0	0	0	0	0	0	2	2	2	1	14	4 (29%)
Denmark	27	26	29	33	32	34	26	19	22	26	28	28	27	25	24	406	213 (52%)
Finland	60	54	58	59	53	58	45	43	52	50	48	36	47	50	49	762	171 (22%)
France	125	139	149	142	154	143	111	105	126	138	145	139	153	153	140	2,062	987 (48%)
Germany	133	146	156	158	154	157	128	134	119	150	163	170	177	174	177	2,296	893 (39%)
Greece	11	10	18	19	21	25	18	19	17	25	28	30	27	28	25	321	83 (26%)
Hong Kong	108	123	128	135	131	140	142	150	163	176	197	218	267	292	311	2,681	575 (21%)
Hungary	1	1	4	2	3	4	3	1	1	2	2	4	2	3	2	35	13 (37%)
India	0	0	0	0	0	0	0	0	311	310	314	346	362	442	462	2,547	144 (6%)
Ireland	3	6	10	13	14	8	8	8	8	8	10	9	10	9	9	133	41 (31%)
Israel	0	0	0	11	13	17	18	21	44	52	60	56	52	57	59	460	73 (16%)
Italy	49	48	57	65	58	57	44	42	43	53	55	61	62	77	72	843	628 (75%)
Korea	0	0	0	0	0	0	552	601	934	1,077	1,120	1,187	1,302	1,425	1,485	9,683	2,486 (26%)
Luxembourg	1	0	1	0	1	1	0	0	1	1	2	2	1	1	1	13	4 (31%)
Malaysia	0	0	0	0	0	0	0	1	5	50	40	34	44	39	53	266	136 (51%)
Mexico	0	0	0	0	0	0	0	6	6	8	9	9	12	10	8	68	52 (76%)
Netherlands	27	27	27	30	34	38	28	19	19	22	22	27	25	28	26	399	213 (53%)
Norway	20	20	19	21	21	24	15	17	21	23	23	22	22	27	21	316	150 (47%)
Peru	0	0	0	0	0	0	0	2	2	2	1	2	2	2	4	17	17 (100%)
Poland	18	15	21	31	29	25	31	33	38	68	75	76	83	79	72	694	545 (79%)
Portugal	7	4	7	8	4	7	1	0	0	0	1	1	1	1	1	43	36 (84%)
Russian Federation	0	0	0	0	0	0	0	12	8	11	12	10	13	13	8	87	55 (63%)
Singapore	8	9	10	10	8	6	8	7	8	3	4	6	6	29	36	158	63 (40%)
South Africa	12	33	33	35	39	28	29	18	31	25	23	25	23	23	26	403	91 (23%)
Spain	23	20	25	24	24	25	20	18	22	20	30	25	27	36	26	365	261(72%)

Sweden	60	66	68	74	76	71	64	74	68	86	86	95	120	126	140	1,274	786 (62%)
Taiwan	0	0	0	0	0	0	0	0	1,078	1,094	1,094	1,145	1,174	1,222	1,226	8,033	1,070 (13%)
Turkey	29	44	56	69	72	78	22	18	22	75	81	86	82	91	86	911	236 (26%)
UK	96	209	287	351	349	335	299	265	284	261	258	266	252	252	259	4,023	2,033 (51%)
Total	*990*	*1,180*	*1,393*	*1,537*	*1,587*	*1,623*	*1,951*	*2,822*	*5,053*	*5,713*	*5,937*	*6,203*	*6,876*	*7,356*	*7,394*	*57,615*	*16,937 (100%)*

Panel B: Sample composition by ICB industry and year

ICB Industry	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total	Total capitalizers
Basic Materials	116	132	149	162	182	205	261	476	775	864	881	895	964	1,043	1,034	8,139	1,330 (16%)
Consumer Discretionary	149	177	214	223	243	251	317	434	717	876	912	1,014	1,127	1,199	1,207	9,060	2,791 (31%)
Consumer Staples	74	93	101	100	106	105	137	185	306	348	370	394	416	445	456	3,636	594 (16%)
Financials	19	27	27	31	31	33	34	26	29	28	44	51	63	70	66	579	296 (51%)
Health Care	112	134	165	191	195	186	231	309	510	602	626	665	731	806	836	6,299	2,379 (38%)
Industrials	256	290	365	409	414	420	462	738	1,243	1,408	1,467	1,508	1,727	1,819	1,810	14,336	4,449 (31%)
Real Estate	5	6	8	11	8	12	11	14	28	34	40	46	57	60	62	402	133 (33%)
Technology	185	220	260	298	297	290	339	451	1,117	1,197	1,217	1,253	1,354	1,456	1,448	11,382	3,828 (34%)
Telecommunications	49	66	67	72	71	72	101	137	248	261	266	255	304	303	314	2,586	836 (32%)
Utilities	25	35	37	40	40	49	58	52	80	95	114	122	133	155	161	1,196	301 (25%)
Total	*990*	*1,180*	*1,393*	*1,537*	*1,587*	*1,623*	*1,951*	*2,822*	*5,053*	*5,713*	*5,937*	*6,203*	*6,876*	*7,356*	*7,394*	*57,615*	*16,937 (100%)*

Table 3: Summary statistics.

Panel A: Descriptive statistics for the full sample (57,615)					
	Mean	Median	SD	Min	Max
RDI	0.035	0.015	0.058	0.000	0.670
PCTCAP	0.130	0.000	0.297	0.000	1.000
SIZE	17.965	17.656	4.795	4.745	34.226
LnAGE	2.638	2.708	0.572	0.693	4.025
BHR	0.147	0.016	0.577	-0.853	4.231
ROA	0.056	0.058	0.114	-0.537	0.481
BM	0.764	0.590	0.580	0.148	4.797
BETA	0.990	0.978	0.507	-0.399	2.905
LEV	0.590	0.352	0.743	0.000	5.106
CAPEX	0.063	0.029	0.092	0.000	0.977
TANG	0.386	0.388	0.208	0.006	0.821
PCTCLOSE	43.043	44.920	23.929	0.000	96.100
SDASSET	0.001	0.000	0.003	0.000	0.034
INTSALES	33.559	19.430	35.610	0.000	100.000
GOODWILL	0.061	0.002	0.113	0.000	0.639
OTHERINTA	0.110	0.042	0.155	0.000	0.756
AGE	16.244	15.000	8.732	3.000	48.000
BIG4	0.492	0.000	0.500	0.000	1.000
BENCHBEAT	0.227	0.000	0.419	0.000	1.000
REM	0.380	0.000	0.485	0.000	1.000
LABOR	5.799	5.835	0.639	1.877	8.275
HEALTH	6.529	7.021	1.577	0.935	9.529
SCIENCE	6.032	6.014	0.913	2.448	8.692
CCR	71.384	75.962	19.360	15.385	100.000
MRKTRAD	0.308	0.085	0.434	0.000	5.013
MRKDEV	145.344	0.610	395.171	0.167	1282.576
MRKDY	2.721	2.530	0.956	0.980	6.640

Panel B: Descriptive statistics across expensers and capitalizers														
	Expensers (40,678)					Capitalizers (16,937)					Test of differences			
	Mean	Median	SD	Min	Max	Mean	Median	SD	Min	Max	Mean diff.	t-stat	Median diff.	z-stat
RDI	0.031	0.013	0.051	0.000	0.670	0.047	0.020	0.072	0.000	0.670	-0.016	29.979***	-0.008	31.326***
PCTCAP	0.000	0.000	0.000	0.000	0.000	0.444	0.290	0.401	0.000	1.000	-0.444	220.00***	-0.290	235.365***
SIZE	18.410	17.855	4.562	4.745	31.917	16.894	16.866	5.156	5.425	34.226	1.516	34.948***	0.989	38.056***
LnAGE	2.633	2.708	0.573	0.693	4.025	2.648	2.708	0.571	0.693	4.025	-0.015	2.784***	0.000	0.903
BHR	0.152	0.017	0.580	-0.853	4.231	0.136	0.013	0.570	-0.853	4.231	0.016	3.042***	0.004	2.656***
ROA	0.055	0.058	0.115	-0.537	0.481	0.058	0.060	0.112	-0.537	0.481	-0.003	2.977***	-0.003	2.467***
BM	0.770	0.595	0.579	0.148	4.797	0.749	0.576	0.582	0.148	4.797	0.021	4.015***	0.019	4.951***
BETA	1.002	0.990	0.506	-0.399	2.905	0.959	0.942	0.506	-0.399	2.905	0.043	9.361***	0.048	9.739***
LEV	0.569	0.336	0.726	0.000	5.106	0.639	0.394	0.782	0.000	5.106	-0.070	10.251***	-0.058	11.319***
CAPEX	0.062	0.029	0.089	0.000	0.977	0.066	0.030	0.099	0.000	0.977	-0.005	5.534***	-0.001	4.061***
TANG	0.406	0.410	0.207	0.006	0.821	0.338	0.330	0.203	0.006	0.821	0.068	35.964***	0.080	35.464***
PCTCLOSE	44.225	46.450	23.610	0.000	96.100	40.205	41.150	24.448	0.000	96.100	4.021	18.427***	5.300	18.645***
SDASSET	0.001	0.000	0.003	0.000	0.034	0.001	0.000	0.003	0.000	0.034	0.000	18.474***	0.000	16.139***
INTSALES	31.203	14.585	35.231	0.000	100.000	39.219	32.980	35.880	0.000	100.000	-8.016	24.746***	-18.395	25.899***
GOODWILL	0.046	0.000	0.098	0.000	0.639	0.096	0.024	0.136	0.000	0.639	-0.050	49.103***	-0.024	58.580***
OTHERINTA	0.085	0.028	0.134	0.000	0.756	0.172	0.099	0.181	0.000	0.756	-0.088	64.022***	-0.071	72.135***
AGE	16.164	15.000	8.591	3.000	48.000	16.437	15.000	9.058	3.000	48.000	-0.272	3.413***	0.000	0.909
BIG4	0.473	0.000	0.499	0.000	1.000	0.538	1.000	0.499	0.000	1.000	-0.064	14.113***	-1.000	14.089***
BENCHBEAT	0.189	0.000	0.392	0.000	1.000	0.319	0.000	0.466	0.000	1.000	-0.130	34.264***	0.000	33.920***
REM	0.394	0.000	0.489	0.000	1.000	0.347	0.000	0.476	0.000	1.000	0.047	10.646***	0.000	10.636***
LABOR	5.797	5.835	0.623	1.877	8.275	5.804	5.835	0.677	1.877	8.275	-0.007	1.268	0.000	1.874*
HEALTH	6.522	7.021	1.594	0.935	9.529	6.547	6.889	1.535	0.935	9.529	-0.026	1.790**	0.132	0.868
SCIENCE	6.014	5.933	0.857	3.028	8.692	6.074	6.163	1.035	2.448	8.692	-0.060	7.161***	-0.230	11.967***
CCR	69.930	72.115	19.040	15.385	100.000	74.875	76.923	19.674	15.385	100.000	-4.945	28.123***	-4.808	28.740***
MRKTRAD	0.289	0.066	0.411	0.000	5.013	0.352	0.160	0.483	0.000	5.013	-0.063	15.981***	-0.094	16.651***
MRKDEV	177.796	0.612	430.617	0.167	1282.576	67.404	0.599	277.959	0.167	1282.576	110.392	30.798***	0.013	12.715***
MRKDY	2.667	2.410	0.938	0.980	6.640	2.850	2.770	0.985	0.980	6.640	-0.184	21.086***	-0.360	20.303***

See Appendix A for all variables' definitions. *, ** and *** denote significance at the 10%, 5% and 1%, respectively.

Table 4: Variance decomposition results.

Panel A: Variance decomposition results for the full sample

	Full Sample				
	Mean	Median	SD	Min	Max
var(Ret)	0.160***	0.056***	0.265	0.000	2.326
var(OpCFN)	0.184***	0.056***	0.351	0.000	2.923
var(AccN)	0.098***	0.016***	0.267	0.000	3.174
var(DRN)	0.006***	0.001***	0.013	0.000	0.174

Panel B: Variance decomposition results across quintiles of R&D intensity

		R&D Intensity quintile					High - Low	
		Low[a] (11,527)	2[a] (11,518)	3[a] (11,522)	4[a] (11,518)	High[a] (11,530)	Diff	stat
var(Ret)	Mean	0.155	0.156	0.151	0.150	0.186	0.031***	8.422
	Median	0.053	0.054	0.054	0.053	0.065	0.013***	8.390
var(OpCFN)	Mean	0.191	0.173	0.167	0.174	0.213	0.022***	4.377
	Median	0.056	0.054	0.054	0.052	0.064	0.008***	5.097
var(AccN)	Mean	0.105	0.086	0.085	0.094	0.119	0.014***	3.640
	Median	0.018	0.016	0.015	0.015	0.020	0.002***	3.356
var(DRN)	Mean	0.005	0.005	0.005	0.005	0.008	0.003***	15.231
	Median	0.001	0.001	0.001	0.001	0.002	0.001***	18.609

Panel C: Variance decomposition results across expensers and capitalizers

	Expensers (40,678)					Capitalizers (16,937)					Test of differences			
	Mean	Median	SD	Min	Max	Mean	Median	SD	Min	Max	Mean diff	t-stat	Median diff	z-stat
var(Ret)	0.157***	0.055***	0.262	0.000	2.326	0.166***	0.058***	0.271	0.000	2.326	-0.009***	3.585	-0.003***	3.923
var(OpCFN)	0.178***	0.054***	0.341	0.000	2.923	0.198***	0.060***	0.373	0.000	2.923	-0.020***	6.0982	-0.006***	4.939
var(AccN)	0.095***	0.016***	0.256	0.000	3.174	0.105***	0.017***	0.290	0.000	3.174	-0.010***	4.2118	0.000	1.539
var(DRN)	0.006***	0.001***	0.013	0.000	0.174	0.006***	0.001***	0.013	0.000	0.174	0.000*	1.3254	0.000	0.437

[a]Variances significant in driving unexpected stock returns at the 1% level. See Appendix A for all variables' definitions. *, ** and *** denote significance at the 10%, 5% and 1%, respectively.

Table 5: R&D intensity, development costs' capitalization intensity and news' variances.

VARIABLES	(1) var(Ret)	(2) var(OpCFN)	(3) var(AccN)	(4) var(DRN)	(5) var(Ret)	(6) var(OpCFN)	(7) var(AccN)	(8) var(DRN)
RDI	0.244***	0.272***	0.179***	0.007***	0.170***	0.243***	0.125***	0.002
	(6.80)	(5.89)	(4.93)	(3.21)	(4.30)	(4.77)	(3.17)	(0.87)
PCTCAP	0.007	0.020***	0.007	-0.001***	-0.005	0.016*	-0.002	-0.002***
	(1.38)	(2.67)	(1.09)	(-3.48)	(-0.95)	(1.82)	(-0.28)	(-5.96)
RDI*PCTCAP					0.383***	0.152	0.283***	0.024***
					(3.58)	(1.24)	(2.98)	(3.75)
BENCHBEAT	-0.046***	-0.034***	-0.053***	-0.002***	-0.046***	-0.034***	-0.053***	-0.002***
	(-8.20)	(-4.65)	(-9.34)	(-6.05)	(-8.22)	(-4.66)	(-9.37)	(-6.08)
REM	0.001	0.005	0.010***	0.000**	0.001	0.005	0.010***	0.000**
	(0.48)	(1.16)	(3.38)	(2.10)	(0.47)	(1.16)	(3.39)	(2.10)
SIZE	-0.000	-0.004***	-0.002**	-0.000***	-0.001	-0.004***	-0.002***	-0.000***
	(-0.67)	(-4.04)	(-2.53)	(-2.98)	(-0.84)	(-4.09)	(-2.64)	(-3.20)
LnAGE	-0.036***	-0.030***	-0.008***	-0.001***	-0.036***	-0.030***	-0.009***	-0.001***
	(-14.70)	(-9.51)	(-3.46)	(-8.88)	(-14.75)	(-9.52)	(-3.48)	(-8.92)
ROA	-0.227***	-0.265***	-0.294***	-0.024***	-0.230***	-0.267***	-0.296***	-0.024***
	(-14.61)	(-11.99)	(-14.81)	(-26.36)	(-14.81)	(-12.05)	(-14.92)	(-26.57)
BM	-0.011***	-0.062***	-0.043***	0.004***	-0.011***	-0.062***	-0.043***	0.004***
	(-3.07)	(-14.03)	(-12.04)	(18.30)	(-3.21)	(-14.06)	(-12.13)	(18.25)
BETA	0.021***	0.019***	0.001	0.001***	0.021***	0.019***	0.001	0.001***
	(7.56)	(5.20)	(0.27)	(5.22)	(7.58)	(5.21)	(0.29)	(5.24)
LEV	0.007***	0.110***	0.113***	0.002***	0.007***	0.110***	0.113***	0.002***
	(2.69)	(23.12)	(27.02)	(13.50)	(2.75)	(23.14)	(27.06)	(13.57)
CAPEX	0.094***	0.037	0.034	0.005***	0.095***	0.037	0.035	0.005***
	(4.55)	(1.27)	(1.39)	(3.67)	(4.58)	(1.28)	(1.41)	(3.71)
TANG	-0.043***	-0.154***	-0.130***	-0.005***	-0.043***	-0.154***	-0.130***	-0.005***
	(-5.61)	(-13.53)	(-13.67)	(-11.40)	(-5.61)	(-13.54)	(-13.67)	(-11.39)
PCTCLOSE	0.000	0.000***	0.000***	0.000	0.000	0.000***	0.000***	-0.000
	(0.43)	(4.29)	(3.73)	(0.06)	(0.35)	(4.26)	(3.67)	(-0.05)
INTSALES	-0.000	-0.000***	-0.000***	-0.000	-0.000	-0.000***	-0.000***	-0.000
	(-1.31)	(-2.95)	(-3.19)	(-1.21)	(-1.32)	(-2.95)	(-3.20)	(-1.21)
SDASSET	0.199	0.591	0.472	-0.001	0.256	0.613	0.514	0.002
	(0.42)	(0.75)	(0.78)	(-0.07)	(0.54)	(0.77)	(0.85)	(0.12)
GOODWILL	-0.082***	-0.207***	-0.124***	-0.002	-0.070***	-0.202***	-0.115***	-0.001
	(-3.38)	(-6.22)	(-5.14)	(-1.29)	(-2.87)	(-6.03)	(-4.73)	(-0.72)

OTHERINTA	-0.012	-0.038	-0.039**	-0.003***	-0.023	-0.043	-0.047**	-0.004***
	(-0.66)	(-1.48)	(-2.06)	(-3.65)	(-1.24)	(-1.64)	(-2.47)	(-4.28)
BIG4	-0.022***	-0.027***	-0.017***	-0.001***	-0.021***	-0.026***	-0.016***	-0.001***
	(-5.88)	(-5.15)	(-4.35)	(-5.66)	(-5.56)	(-5.06)	(-4.13)	(-5.29)
LABOR	0.005*	0.004	0.003	0.001***	0.005*	0.004	0.003	0.001***
	(1.75)	(1.06)	(0.88)	(6.57)	(1.75)	(1.06)	(0.88)	(6.58)
HEALTH	-0.017***	-0.013***	-0.004**	-0.001***	-0.017***	-0.013***	-0.004**	-0.001***
	(-10.59)	(-5.85)	(-2.48)	(-14.25)	(-10.44)	(-5.80)	(-2.38)	(-14.11)
SCIENCE	-0.015***	-0.023***	-0.010***	-0.001***	-0.015***	-0.023***	-0.010***	-0.001***
	(-6.05)	(-6.36)	(-3.29)	(-5.57)	(-6.19)	(-6.39)	(-3.38)	(-5.75)
CCR	0.002***	0.003***	0.001***	0.000***	0.002***	0.003***	0.001***	0.000***
	(13.46)	(12.30)	(6.46)	(12.70)	(13.43)	(12.29)	(6.44)	(12.64)
MRKTRAD	-0.027***	-0.017***	-0.018***	-0.001***	-0.028***	-0.018***	-0.019***	-0.001***
	(-7.87)	(-3.35)	(-4.53)	(-6.50)	(-8.11)	(-3.41)	(-4.68)	(-6.89)
MRKDEV	-0.000***	-0.000***	-0.000	-0.000	-0.000***	-0.000***	-0.000	-0.000
	(-3.27)	(-2.95)	(-0.89)	(-0.36)	(-3.35)	(-2.97)	(-0.94)	(-0.46)
MRKDY	0.007***	-0.006*	-0.005*	-0.000***	0.007***	-0.006*	-0.005*	-0.000***
	(3.10)	(-1.81)	(-1.72)	(-2.93)	(3.11)	(-1.81)	(-1.70)	(-2.90)
IMR	-0.014	0.019	-0.004	-0.001	-0.014	0.020	-0.003	-0.001
	(-0.76)	(0.76)	(-0.20)	(-0.57)	(-0.73)	(0.77)	(-0.18)	(-0.53)
Constant	0.274***	0.373***	0.242***	0.010***	0.278***	0.375***	0.245***	0.010***
	(9.66)	(9.49)	(7.70)	(7.09)	(9.78)	(9.52)	(7.80)	(7.27)
Industry/year FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	57,615	57,615	57,615	57,615	57,615	57,615	57,615	57,615
Adj. R^2	0.0807	0.107	0.148	0.199	0.0814	0.107	0.148	0.200
F	62.18	48.44	38.62	69.61	60.99	47.53	38.10	68.53

See Appendix A for all variables' definitions. Standard errors are clustered at the firm level. *, ** and *** denote significance at the 10%, 5% and 1%, respectively. *t*-statistic in brackets.

Table 6: Summary of sensitivity tests.

VARIABLES	(1) var(Ret)	(3) var(OpCFN)	(4) var(AccN)	(5) var(DRN)
Panel A: R&D intensity and news variances for Earnings Management non-suspect firm-years (*N=44,517*).				
RDI	0.252***	0.249***	0.183***	0.004
	(4.24)	(3.47)	(3.18)	(1.19)
PCTCAP	-0.013**	0.012	-0.002	-0.002***
	(-2.09)	(1.22)	(-0.19)	(-4.98)
RDI*PCTCAP	0.720***	0.121	0.299**	0.024**
	(3.91)	(0.66)	(2.18)	(2.20)
Constant	0.274***	0.371***	0.258***	0.011***
	(8.49)	(8.30)	(7.03)	(6.81)
Firm/country controls	YES	YES	YES	YES
Industry/year FE	YES	YES	YES	YES
Adj. R^2	0.0802	0.108	0.151	0.195
F	47.13	38.28	32.45	54.18
Panel B: R&D intensity and news variances excluding firms from China (*N=42,650*).				
RDI	0.129***	0.201***	0.108***	-0.000
	(3.13)	(3.80)	(2.65)	(-0.06)
PCTCAP	-0.009	0.014	-0.004	-0.002***
	(-1.51)	(1.55)	(-0.47)	(-6.79)
RDI*PCTCAP	0.348***	0.097	0.238**	0.023***
	(3.24)	(0.79)	(2.50)	(3.50)
Constant	0.399***	0.473***	0.293***	0.014***
	(12.43)	(10.98)	(8.56)	(9.16)
Firm/country controls	YES	YES	YES	YES
Industry/year FE	YES	YES	YES	YES
Adj. R^2	0.09	0.11	0.14	0.21
F	0.0924	0.111	0.142	0.208
Panel C: R&D intensity and news variances using propensity score matching (*N=31,914*).				
RDI	0.187***	0.282***	0.084*	0.001
	(3.91)	(4.41)	(1.88)	(0.25)
PCTCAP	-0.000	0.022**	-0.000	-0.002***
	(-0.03)	(2.42)	(-0.06)	(-5.28)
RDI*PCTCAP	0.329***	0.023	0.222**	0.021***
	(2.75)	(0.16)	(2.44)	(3.14)
Constant	0.206***	0.358***	0.231***	0.008***
	(7.04)	(8.22)	(6.42)	(5.83)
Firm/country controls	YES	YES	YES	YES
Industry/year FE	YES	YES	YES	YES
Adj. R^2	0.0804	0.106	0.15	0.21
F	36.25	29.39	26.1	46.66
Panel D: R&D intensity and news variances focusing on high tech industries (*N=34,465*).				
RDI	0.153***	0.210***	0.125***	0.000
	(3.33)	(3.61)	(2.87)	(0.14)
PCTCAP	-0.010	0.002	-0.015*	-0.002***
	(-1.36)	(0.15)	(-1.83)	(-6.55)
RDI*PCTCAP	0.387***	0.247*	0.340***	0.030***
	(3.22)	(1.70)	(2.88)	(4.09)
Constant	0.275***	0.334***	0.240***	0.008***
	(7.72)	(6.54)	(5.93)	(4.84)
Firm/country controls	YES	YES	YES	YES
Industry/year FE	YES	YES	YES	YES
Adj. R^2	0.0818	0.104	0.144	0.209
F	41.35	33.64	26.73	52.71

See Appendix A for all variables' definitions. Standard errors are clustered at the firm level. *, ** and *** denote significance at the 10%, 5% and 1%, respectively. *t*-statistic in brackets.

Table 7: Summary results of additional analysis.

VARIABLES	(1) var(Ret)	(3) var(OpCFN)	(4) var(AccN)	(5) var(DRN)
Panel A: R&D intensity and news variances: The effect of growth options				
RDI	0.130***	0.237***	0.124***	0.000
	(3.27)	(4.27)	(2.99)	(0.16)
PCTCAP	0.006	0.019**	-0.004	-0.001***
	(1.00)	(2.16)	(-0.54)	(-4.32)
RDI*PCTCAP	0.426***	0.151	0.344***	0.018***
	(3.89)	(1.12)	(3.07)	(3.09)
RDI*LOW	0.149*	0.027	0.001	0.006
	(1.96)	(0.29)	(0.02)	(1.36)
PCTCAP*LOW	-0.052***	-0.014	0.008	-0.002***
	(-4.04)	(-0.72)	(0.56)	(-2.63)
RDI*PCTCAP*LOW	-0.104	0.013	-0.213	0.021
	(-0.41)	(0.05)	(-1.12)	(1.33)
LOW	0.021***	0.019***	0.017***	0.001***
	(4.31)	(3.15)	(3.65)	(5.53)
Constant	0.278***	0.369***	0.239***	0.010***
	(9.75)	(9.35)	(7.59)	(6.98)
Firm/country controls	YES	YES	YES	YES
Industry/year FE	YES	YES	YES	YES
Observations	57,615	57,615	57,615	57,615
Adj. R^2	0.0827	0.108	0.148	0.202
F	56.92	44.30	35.73	64.23
Panel B: R&D intensity and news variances: The effect of country level uncertainty avoidance				
RDI	0.313***	0.346***	0.128***	0.002
	(6.15)	(5.51)	(2.73)	(0.92)
PCTCAP	0.014*	0.029***	-0.004	-0.001***
	(1.89)	(2.62)	(-0.44)	(-2.91)
RDI*PCTCAP	0.323**	0.044	0.297**	0.029***
	(2.21)	(0.29)	(2.50)	(3.40)
RDI*HIGH	-0.410***	-0.362***	-0.066	-0.001
	(-6.40)	(-4.17)	(-0.95)	(-0.21)
PCTCAP*HIGH	-0.047***	-0.054***	-0.009	-0.001**
	(-4.41)	(-3.20)	(-0.66)	(-2.11)
RDI*PCTCAP*HIGH	0.170	0.410*	0.033	-0.018
	(0.90)	(1.68)	(0.17)	(-1.53)
HIGH	0.010*	0.051***	0.030***	-0.000
	(1.74)	(6.19)	(4.73)	(-1.51)
Constant	0.302***	0.356***	0.225***	0.012***
	(10.43)	(8.78)	(7.05)	(8.57)
Firm/country controls	YES	YES	YES	YES
Industry/year FE	YES	YES	YES	YES
Observations	57,508	57,508	57,508	57,508
Adj. R^2	0.0836	0.109	0.149	0.201
F	57.12	44.77	35.74	65.15

See Appendix A for all variables' definitions. Standard errors are clustered at the firm level. *, ** and *** denote significance at the 10%, 5% and 1%, respectively. *t*-statistic in brackets.