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# ACCA AND ADAM SMITH BUSINESS SCHOOL RESEARCH REPORT

## The capitalisation of intangibles debate: software development costs

**Dionysia Dionysiou (University of Stirling)**

**Richard Slack (Durham University)**

**Ioannis Tsalavoutas (University of Glasgow)**

**Fanis Tsoligkas (University of Bath)**

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## Acknowledgements

The authors would like to thank ACCA and the Adam Smith Observatory of Corporate Reporting Practices for providing the funding for this project. We are grateful to Richard Martin (ACCA) for his valuable suggestions, support and advice during the project. We thank Evangelos Seretis for his excellent research assistance with some of the data collected.

# 1. Introduction

### *1.1 Background and objectives*

There have been concerns that financial statements do not reflect adequately the underpinning drivers of value in modern business (Bernanke 2011; Haskel and Westlake 2017; Lev and Gu 2016). Additionally, International Accounting Standard (IAS) 38 Intangible Assets, which governs the treatment of intangible assets, has been criticised for reflecting prudence and conservatism and encourages the expensing of internally generated intangible assets (Mazzi et al. 2019b). This implies that the accounting treatment of internally generated intangible assets, as prescribed by the standard, exacerbates the perceived lack of intangible assets in companies' balance sheets.

To shed more light on these conjectures, a study by Mazzi et al. (2019b) has among other things examined the relevant amounts and firm characteristics of a very large sample of firms across the world that capitalise and/or expense research and development (R&D) expenditure, specifically under International Financial Reporting Standards (IFRS). However, in today's economies, companies increasingly invest in software, develop websites as well as other software (eg applications for mobile phones) for use as part of their operations, but that are not necessarily heavily involved in R&D activities. Thus firms could find themselves spending significant software-related amounts. Such expenditure should be capitalised, subject to meeting the criteria, and shown as a separate category of intangible assets. As such, prior literature that has examined the capitalisation of development costs more broadly has not separately analysed the relevant costs recognised on companies' financial statements.

The present study complements and extends the study by Mazzi et al. (2019b) by focusing particularly on software development costs (SDCs), which are governed by the same accounting standard (ie IAS 38). To the best of the authors' knowledge, research on the frequency and likelihood of SDC capitalisation and relevant amounts capitalised on companies' balance sheets under IFRS is not available. Furthermore, there is an absence of evidence on the characteristics of firms that are more likely to capitalise such expenditure and on the determinants of the amounts of SDC capitalised. The overall objective of the present research is to shed light on these areas.

### *1.2 Method*

By drawing on listed companies from 39 countries (40,241 firm-year observations) that have either converged their national standards to IFRS or adopted IFRS, for the five-year period 2015 to 2019, we have collected and summarised evidence on how many companies capitalise SDCs during the year (capitalisers) and how many report R&D costs in the income statement but do not capitalise SDCs during the year (non-capitalisers). This evidence is provided in aggregate and on a country and industry level. We also provide descriptive statistics of the amounts of SDC capitalised in a given year relative to market values and the net amounts of SDC that feature on companies' balance sheets, relative to total assets, at the end of the year. We then provide results from multivariate regression analysis to identify the country- and firm-level determinants influencing the decision of companies to capitalise SDC and identifying the factors affecting the magnitude of SDC capitalised in a given year.

In additional analysis with a separate sample, we explored any differences in the determinants influencing the decision of companies to capitalise SDCs and the factors affecting the magnitude of SDCs capitalised for a sample period that covers the same number of years before and after the implementation of IFRS 3 Business Combinations (Revised) in 2009. Finally, for a relatively small number of firms, we collected companies' most recent annual reports and, from those, we manually extracted examples of voluntary disclosure and accounting policy notes about capitalisation or expensing of SDCs.

### *1.3 Main findings*

- The data shows that 62.2% of the firm-year observations in the sample capitalise SDCs. This suggests that companies very frequently recognise and report SDCs separately. Moreover, from the multivariate analysis we conducted, we identified a significant number of non-capitalisers that, given their firm- and country-level characteristics, one would have expected to capitalise SDCs. This would increase the percentage of capitalisers of SDCs even further.
- In Argentina, Brazil, Chile, Colombia, India, Ireland, Japan, Mexico, New Zealand, Peru, Philippines, Portugal, South Africa and Spain, more than 80% of the firm-year observations are of firms that are capitalisers. In fact, all firm-year observations from Colombia and Philippines are capitalisers.

- The constituents of Consumer Discretionary, Financials, Real Estate and Utilities Sectors exhibit the largest proportion of capitalisers (the proportion of capitalisers is greater than 70%).
- The high frequency of SDC capitalisation identified holds, even though the amounts involved can be considered immaterial relative to companies' total assets and/or market values. Specifically, we note that the mean (median) SDC asset intensity on the balance sheet is 0.6% (0.2%) of capitalisers' total assets. Further, the mean (median) SDC asset capitalised in the year is 0.04% (0.1%) of capitalisers' market values. However, the large proportion of firms from Asia, which exhibit the lowest net SDCs intensity (mean (median) 0.32% (0.11%) of total assets), distorts the picture in relation to the SDC asset intensity of the overall sample.
- Firms from Oceania (represented by firms from New Zealand and Australia) exhibit the highest intensity (mean (median) 2.22% (1.32%) of total assets). European firms and South African firms tend to present the second highest values of SDC assets as a proportion of total assets (mean (median) for Europe: 1.51% (0.73%); mean (median) for South Africa: 1.28% (0.66%)).
- Firms in the Telecommunications industry exhibit the highest net SDC asset intensity (mean (median) 1.26% (0.37%) of total assets), followed by firms in Technology and Consumer Discretionary (mean (median) is 1.06% (0.28%) and 0.80% (0.26%) of total assets, respectively). Although firms in the Financials Sector have the highest proportion of capitalisers, net SDC asset intensity is of intermediate level when compared with other industries.
- In particular, of the firm-year observations that complete material business combinations in a given year (4,076), a large proportion (3,115 firm-year observations – 76.4%) capitalise SDCs during the year (this represents 12.06% of the firms that capitalise SDCs in the entire sample). Additionally, we identify 1,028 firm-year observations that capitalise research and development (R&D) in the year (this represents 13.80% of the firm-year observations that capitalise R&D in the year in the entire sample). Moreover, for the firms that capitalise SDCs during the year, the mean (median) SDC intensity is 1.1% (0.3%) of total assets, while the mean (median) SDC capitalised in the year is 0.5% (0.1%) of market values.

- Compared with those that do not capitalise SDCS, companies that take the decision to capitalise SDCs tend to be larger, riskier, with higher leverage, to have more international sales, to have incentives to capitalise SDCs to meet their earnings targets, to capitalise other development costs and to have concluded material business combinations during the year. They are also more likely to employ one of the Big Four auditors. The same characteristics associate positively with the magnitude of the amounts capitalised.
- Nonetheless, firm size, employing a Big Four auditor, and international sales are not significant factors affecting the decision to capitalise SDCs for the sub-sample of firms that have material business combinations. Further, book to market, firm size, having a Big Four auditor, international sales, and frequency of R&D capitalisation and being headquartered in a civic-law country or a country with highly skilled labour and better health infrastructure are not significant determinants of the amounts of SDCs capitalised in the sub-sample with material business combinations. Hence, these factors are significant determinants of SDC capitalisation only for the sub-sample of firms that do *not* have material business combinations.
- The results from the separate sample focusing on the years before and after the implementation of IFRS 3 (R) in 2009 suggest that the implementation of the revised standard does not influence a firm's decision about capitalising SDCs or the magnitude of SDC capitalisation, even if it has conducted material business combinations.

### *1.4 Policy implications and recommendations*

The issue of intangible assets has been on the agenda of standard setters and regulators for some time and it is increasingly gaining momentum. For example, in 2015, as a response to the request for views on the Agenda Consultation of the International Accounting Standards Board (IASB), the European Securities and Markets Authority (ESMA) agreed that there is a need for a review of the guidance for intangible assets and R&D. Moreover, in the UK in 2019, the Financial Reporting Council (FRC), following a project it had carried out and a request for feedback from stakeholders, published proposals for business reporting of intangibles (FRC 2019). Additionally, in late 2019, the intangibles research unit within the European Financial Reporting Advisory Group (EFRAG) held discussions on intangibles in relation to the IASB's forthcoming Agenda Consultation and, 'at the meeting, IFRS IC [Interpretations Committee]

members noted that a fundamental overhaul of the Standard was necessary' (EFRAG 2019: 2). In response to these voices, the IASB, in its request for information on what its priorities should be over the following five years, included revisiting IAS 38 as one of its potential projects (IASB 2021: Table 5). Further, even though in 2017 the Financial Accounting Standards Board (FASB) reported that it was undertaking a project aiming to review, among other things, the mandatory disclosures for intangibles (FASB 2018), it has now initiated a project on accounting for and disclosure of intangibles, including internally developed intangibles and R&D (FASB 2021). Against this backdrop, the findings of the present research are very timely and speak directly to these projects. The findings should also be relevant to regulators more broadly, and to companies and auditors. With regard to SDCs in particular, the key recommendations arising from our findings are summarised as follows.

(i) Our findings of high frequency of capitalisation of SDCs, even though the amounts involved can be considered relatively small, are in direct contrast to the prior evidence of relative lack of capitalisation of development costs of new products and processes (ie R&D-related costs) under IAS 38. We conjecture that such costs can be more reliably estimated at the time when the related projects are undertaken. Further, the SDCs' duration of development can also be estimated with relative reliability over a shorter time period. These two features allow companies to establish their internal use, rather than applying an external market condition for product development, with greater relative reliability and this enables capitalisation of such costs. Along these lines, a relevant method of amortisation or monitoring for impairment can be established. Nonetheless, the stringent criteria for the recognition of development costs deter companies from capitalising other development costs equally frequently. Thus, if the IASB proceeds by revising/replacing IAS 38, reconsideration of the conditions of capitalising developments costs is pertinent. This would improve the accounting treatment and comparability of other intangible assets.

(ii) Our findings on the frequency of SDC capitalisation and magnitude of related amounts capitalised for the periods before and after IFRS 3 (R) reveal that the IASB's expectation for 'an increase in the intangible assets recognised as a result of business combinations' (IASB, 2014: 13) following the implementation of IFRS 3 (R) did not materialise. This holds for all firms conducting business combinations and for those for

which the combinations were material. Further, our findings for the companies that have conducted material business combinations in the most recent sample period suggest that the majority of these firms do recognise SDC (and even other development assets) separately. In fact, the corresponding amounts appear to be higher than those from all SDC capitalisers in the sample. This suggests that companies do follow IFRS 3 and recognise separately such assets upon material business combinations. The finding also reinforces views regarding the differential treatment and resultant influence in the frequency of recognition of intangible assets on companies' balance sheets (see in IASB 2021). In combination, this suggests that the generally perceived lack of recognition of intangible assets more broadly lies with IAS 38.

(iii) Our findings indicate significant differences between the percentage of SDC-capitalising firms and SDC asset intensity on companies' balance sheets across countries/regions. While firms from Asia demonstrate a clear tendency to recognise SDCs separately on the balance sheet, the SDC asset intensity is far smaller than for firms in those regions, such as Oceania and Europe, where capitalisation is less frequent. Given this, users of financial statements, preparers, auditors and/or enforcers of financial information should be alerted of the differential reporting incentives and contextual, or cultural, influential factors across different countries, which result in significant variations in reporting practices. The concept of materiality for triggering separate disclosure of SDC assets and the perceived importance of SDCs evidently have different weight across different jurisdictions. On the other hand, SDC intensity across different sectors appears less variable and percentage of capitalisers is more explicable/less unexpected.

(iv) Finally, in contrast to the evidence about lack of disclosures in relation to R&D, our findings from reviewing the disclosures in companies' annual reports indicate some good disclosure practice for SDCs. Given the lack of mandatory disclosures for either topic in IAS 38, the good practice we have observed rests on companies' voluntary disclosure behaviour. Arguably, the higher frequency of recognition of SDCs 'forces' companies to 'talk' about the amounts recognised, despite the relative lack of materiality. Even so, in the cases where business combinations are not present, we have observed that companies do not explicitly explain how much of the cost capitalised relates to in-house development or externally acquired software. Arguably, IAS 38,

enforcing bodies and auditors could be encouraged to support more transparent disclosures by assisting firms to distinguish how much of the capitalised amounts relates to externally acquired or internally developed software.

### *1.5 Report outline*

The next chapter describes the accounting for SDCs and an overview of the relevant accounting standards and literature. The research design is outlined in Chapter 3. We then present and discuss our results in Chapter 4. Conclusions are set out in Chapter 5.

## 2. Accounting for Software Development Costs – overview of relevant accounting standards and literature

### *2.1 Overview of relevant accounting standards*

Under an IFRS reporting regime, accounting for SDCs and associated capitalisation of relevant expenditure is governed primarily by IAS 38 Intangible Assets and less so by IFRS 3 Business Combinations.

IAS 38 prescribes (paragraph 21) that an intangible asset shall be recognised if, and only if:

(a) it is probable that the expected future economic benefits that are attributable to the asset will flow to the entity; and

(b) the cost of the asset can be measured reliably.

Second, paragraphs 25 and 26 explain, 'the probability recognition criterion in paragraph 21(a) is always considered to be satisfied for separately acquired intangible assets' and 'the cost of a separately acquired intangible asset can usually be measured reliably'.

IAS 38 further covers the accounting for internally generated intangible assets, including R&D costs, of which SDCs form a constituent element. All research costs are expensed. Development costs must be capitalised on meeting the six conditions specified in paragraph 57 of the standard; all other costs are expensed. The six conditions can be applied to cover those costs incurred in relation to the internal development and use of software or its development for sale, as set out below.

'An intangible asset arising from development (or from the development phase of an internal project) shall be recognised if, and only if, an entity can demonstrate all of the following:

'(a) the technical feasibility of completing the intangible asset so that it will be available for use or sale;

'(b) its intention to complete the intangible asset and use or sell it;

'(c) its ability to use or sell the intangible asset;

'(d) how the intangible asset will generate probable future economic benefits. Among other things, the entity can demonstrate the existence of a market for the output of the intangible asset or the intangible asset itself or, if it is to be used internally, the usefulness of the intangible asset;

‘(e) the availability of adequate technical, financial and other resources to complete the development and to use or sell the intangible asset;

‘(f) its ability to measure reliably the expenditure attributable to the intangible asset during its development’.

Within IAS 38, specific guidance is also provided in relation to software (including that developed internally) that is integral to the use of property, plant and equipment. Specifically, ‘computer software for a computer-controlled machine tool that cannot operate without that specific software is an integral part of the related hardware and it is treated as property, plant and equipment. The same applies to the operating system of a computer. When the software is not an integral part of the related hardware, computer software is treated as an intangible asset’ (IAS 38, para 4).

Recognising the growing importance of website development for internal use and as a sales platform, SIC-32 Intangible Assets – Web Site Costs was issued in March 2002. This confirms that a website developed by an entity using internal expenditure, whether for internal or external access, is an internally generated intangible asset that is subject to the requirements of IAS 38, and specifically those conditions specified in para 57 for capitalisation. SIC-32 identifies four stages of website development. Firstly, ‘planning application and infrastructure development’, which is akin to the research phase, so all costs are expensed. Secondly, ‘graphical design development’ is akin to the development stage and costs are to be capitalised if they meet the conditions specified in IAS 38. Owing to websites’ susceptibility to technological obsolescence, SIC 32 specifies that where costs are capitalised, the expected amortisation period should be short, consistent with that set out in IAS 38 para 92. Finally, for ‘content development’ that is developed to advertise and promote an enterprise's own products and services and costs in the ‘operating phase’ are expensed.

In addition to these considerations, as part of a business combination, as of the acquisition date, the acquirer must, among other things, recognise, separately from goodwill, the identifiable assets acquired (IFRS 3, para 10). Specifically, the acquirer’s application of this recognition principle and conditions may result in recognising some assets (including software) that the acquiree had not previously recognised as assets in its financial statements because it developed them internally and charged the related costs to expense (IFRS 3, para 13). As a result, while consolidating subsidiaries, SDCs’ value on a company’s balance sheet would

increase, not only because of recognising SDCs already on the balance sheet of the acquiree but also because of the newly recognised SDCs on consolidation.

In this study, we shed light to all relevant costs recognised on companies' balance sheets.

### *2.2 Related literature*

Despite the plethora of literature about general R&D costs and associated capitalisation (see in Mazzi et al. (2019a; 2019b) and Dargenidou et al. (2021) for relevant references), there is a sparsity of literature on accounting for SDCs under IAS 38. This is despite the growth in importance of automated systems and production planning, the development of apps, cybersecurity challenges and risks, artificial intelligence and big data analytics (Morgan Stanley 2017). Indeed, the body of literature relevant to SDCs has been confined to US-based studies (Aboody and Lev 1998; Ciftci 2010; Dinh et al. 2019; Givoly and Shi, 2008; Krishnan and Wang 2014; Mohd 2005).

This is motivated by the different accounting treatments, under US Generally Accepted Accounting Principles (GAAP), for R&D and SDCs. Statement of Financial Accounting Standard (SFAS) No. 2 requires immediate expensing of R&D costs. Significantly, in contrast to this, capitalisation (and subsequent amortisation) of development costs of software intended for sale is mandated by SFAS No. 86 (effective from 31 December 1985), once technological feasibility has been established for a computer software product. Further to this, SOP 98-1 (effective from 15 December 1998) similarly requires capitalisation of SDCs related to software for internal use during the application development stage (Para 21), where it is 'probable that the project will be completed and the software will be used to perform the function intended' (Para 27b). All other costs are expensed. The different accounting treatments of SDCs and R&D have been attributed to the strength of lobbying from the software industry to recognise assets rather than expensing all costs (Kaplan and Sandino, 2001). As noted earlier, under IAS 38 the accounting for SDCs is the same whether the software is developed for internal use or for sale.

Within the extant literature, the focus of the majority of the US-based studies, in the post SFAS 86 era, has been to examine the value relevance of SDC capitalisation. Aboody and Lev (1998: 162–3) find that 'annually capitalized development costs are positively associated with stock returns and the cumulative software asset reported on the balance sheet is associated with stock prices'. Further, they find no support for the view that the judgement involved in software

capitalisation decreases the quality of reported earnings. Mohd (2005) finds that within the software industry information asymmetry is significantly lower for capitalisers than for those that expense SDCs and capitalisers have a resultant lower cost of capital. Indeed, he argues that expensing leads to ambiguity about the value of R&D and hence greater information asymmetry for investors. Consistent with this reasoning, Givoly and Shi (2008) similarly report that capitalising SDCs reduces information asymmetry and the under-pricing of IPOs and consequently lowers cost of capital. These findings are in stark contrast to Ciftci, who reports that 'capitalization of software costs does not improve earnings quality' and that the findings 'suggest that investors' perception of earnings quality is higher for firms that make a conservative reporting choice' (Ciftci 2010: 429). He concludes that the earnings quality of the firms that expense all R&D is greater than that of those that capitalise, recognising the possibility of earnings management.

In another study, revealing more positive evidence of SDC capitalisation, Krishnan and Wang (2014) find that SDC capitalisation sends a positive signal of a reduction of business risk to auditors, with a consequent decrease in audit fee. Nonetheless, this is where such capitalisation is inconsequential for beating analysts' forecasts and also for firms with a low level of following by analysts. Finally, Dinh et al. (2019) contrasting the accounting for SDCs versus R&D in other industries found that capitalisation mitigated the likelihood of under-investment and similarly mitigated the likelihood of a cut in discretionary spend.

Overall, these studies highlight the generally positive evidence of the value relevance and signalling of SDC capitalisation. While there is some contrary evidence, and the possibility that capitalisation will be used as an earnings management tool, nonetheless the literature supports the asset recognition of appropriate SDCs.

In a non-US context, to our knowledge the only study of accounting for SDCs in other jurisdictions is that of Walker and Oliver (2005). Their research examined the differences and inconsistencies in capitalisation and asset recognition between US, UK, Australian and IAS accounting treatments of development costs of software intended for internal use, before the adoption of IAS 38. IAS 38 and the US accounting treatment have already been covered in this review: both mandate capitalisation on meeting specified, although different, conditions. In contrast, the UK accounting standard SSAP 13 Accounting for Research and Development (1989) allowed, but did not require, this treatment on meeting conditions for asset recognition. Similarly, Australian Accounting Standard AAS 13 Accounting for Research and Development

Costs (1983), and the identically titled AASB 1011 (1987) permitted capitalisation of expenditure on the development of a 'new product', to the extent that such costs 'are expected beyond reasonable doubt to be recoverable', given future (uncertain) projections. To remove these inconsistencies in accounting treatments, Walker and Oliver (2005: 67) argue for 'clarity in accounting rules governing the treatment of software expenditure'.

Further to this divergence of treatments, they argue more widely that the application of capitalisation through the relevant accounting standards is reliant on a series of subjective judgements, such as those about technological feasibility, commercial viability and economic life. This in turn may be susceptible to earnings management owing to pressures on earnings performance or internal bonus incentive structures. In conclusion, Walker and Oliver (2005: 88) advocate '(a) the immediate expensing of internally developed software; (b) reporting of this expense as a line item where software expenditure is material; and (c) disclosing, in notes to the financial statements, information about major software development projects'. Such a conclusion is counter to IAS 38, the focus of this research, and widely adopted after 2005 outside the US, where capitalisation of SDCs remains mandated where the specified conditions are met.

As a summary, no research exists on the capitalisation of SDCs under IFRS or outside the US. Therefore, this is the first study to examine the frequency and magnitude of SDC capitalisation of IFRS reporting firms, the factors associated with such practices and the amounts involved.

## 3. Research approach

### *3.1 Sample selection*

Given that we are interested in exploring companies' relatively recent practices in relation to the objectives of the study and that we wanted to involve as many countries as possible that have adopted IFRS or converged their accounting standards to IFRS or permit listed companies to report under IFRS, the sample selection started by identifying all countries that met these conditions as of 2015, and we then included all periods between 2015 and 2019 in our analysis. To identify these countries, we relied on the relevant guide published by the IFRS Foundation on the use of IFRS by jurisdiction.[1] For each of those countries, we obtained the research lists constructed by Worldscope containing all active and dead firms for the years 2015 to 2019. From these lists, we eliminated instruments not classified as equity.[2] As far as cross-listed firms were concerned, we retained only those firms based on the country of primary listing. Subsequently, we eliminated 33,402 firm-year observations of firms not reporting under IFRS (or local GAAP, for those countries that had converged their accounting standards with IFRS).[3] To avoid the influence of potential transition effects on our findings (Mazzi et al. 2019b), we eliminated any observations of firms that appeared to have adopted IFRS for the first time in a given year (mostly 2015 (31%) and 2016 (28%): 4,141 firm-year observations). Further, we eliminated 949 firm-year observations because the reporting period of the firms concerned was more than 380 or less than 350 days (García Lara, García Osma and Mora 2005; Dargenidou et al. 2021). Then, we eliminated 6,960 firm-year observations because either the firms' industry classification information was missing or they were in the Energy industry.[4]

Subsequently, given the objectives of the study (ie to focus on firms that have recognised SDCs on the balance sheet in a given year), we considered the following aspects. According to IAS 38, and assuming that the firm considers the relevant amounts to be sufficiently material, such expenditure that is capitalised should be shown as a separate category of intangible assets. Further, SDCs could be part of what a company could define as R&D and thus the SDC-related amount expensed in the income statement might be 'badged' as R&D expenses. Hence, in a

[1] See <https://www.ifrs.org/use-around-the-world/use-of-ifrs-standards-by-jurisdiction/>, accessed 16 April 2021
[2] We require the Datastream item TYPE to be equal EQ, indicating an equity instrument.
[3] As in Schleicher et al. (2010) and Daske et al. (2013) and Mazzi et al. (2019a), we rely on the Worldscope item 'accounting standards followed (WC07536) to identify the accounting standards that a company reports.
[4] As explained by Mazzi et al. (2019a), exploration and evaluation expenses could be recorded as research and development expenses in the database for companies in this industry. It is noted that in previous ICB Industry namings (and hence earlier literature which used those) this industry was titled 'Oil and Gas'.

given year, we required our sample firms to have either an SDC asset recognised on the balance sheet and/or an R&D expense in the income statement. Because of this requirement, we eliminated 67,378 firm-year observations that did not report R&D expense or recognise an SDC asset in a given year. Additionally, we eliminated 12,872 firm-year observations with missing firm-specific data and/or negative book value of equity, and 2,739 for which we could not identify whether the company had concluded business combinations in a given year. Finally, we deleted 1,041 firm-year observations because of missing country-specific data. The final sample consists of 40,241 firm-year observations, corresponding to 12,239 firms across 39 countries. The sample selection process is summarised in Table 3.1.

**Table 3.1: Sample selection**

| | Firm-year observations |
|---|---|
| We focus on the countries that, as of 2015, had adopted IFRS or had converged their accounting standards to IFRS, or permitted listed companies to report under IFRS. Our sample begins in 2015 and ends in 2019. | 169,723 |
| Excluding companies that do not report under IFRS (or local standards that have converged with IFRS) | (33,402) |
| Excluding firm-year observations that relate to a firm that adopted IFRS for the first time in a given year | (4,141) |
| Excluding firm-year observations of firms that changed their reporting period | (949) |
| Excluding firms in the energy sector or that have missing industry classification information | (6,960) |
| Excluding firm-year observations of firms with no R&D expense or SDC asset recognised in a given year | (67,378) |
| Excluding firm-year observations of firms with negative book value of equity and/or missing firm-specific data | (12,872) |
| Excluding firm-year observations of firms with missing information on whether they had concluded business combinations | (2,739) |
| Excluding firm-year observations of firms with missing country-specific data | (1,041) |
| **Final sample [t=2015, 2019][12,239 firms]** | **40,241** |

Before discussing the sample distribution by country and year, we note the following. Appendix A presents tabulated information and discussion about the firm-year observations with no R&D expense or SDC asset recognised in a given year that we have excluded, after we have eliminated firm-year observations with missing firm or country-specific data (ie 37,438 firm-year observations). This information indicates that among all the firm-year observations with available data (ie 77,679 – calculated as the sum of total excluded (ie 37,438 firm-year observations) and total included (ie 40,241 firm-year observations) in the analysis) and thus we could have analysed, approximately 52% report an R&D expense in the income statement

and/or recognise an SDC asset in a given year and hence are included in the study. This 52% or 'retention rate' indicates that, overall, we include in our sample a large number of firms from a large number of IFRS reporting countries. Even so, we note that for 11 (5) countries the retention rate is below 30% (20%). On the other hand, for China and Japan (Korea and Taiwan) the retention rate is above 90% (80%). This suggests that, compared with other countries, a significant majority of firms in these countries report an R&D expense in the income statement and/or recognise an SDC asset in the year. Further, from descriptive statistics for key firm-level variables, we observe that, on average, firms excluded from the analysis (ie firms that do not report R&D expense in the income statement and did not recognise an SDC asset on the balance sheet) are smaller in size and more leveraged, have significantly lower levels of international sales, and invest more in capital expenditure; a lower percentage of them are audited by a Big Four auditor.

Tables 3.2 and 3.3 show the sample distribution by country and year, and industry and year, respectively. The latter classification is based on the 10 industries specified by the Industry Classification Benchmark. These tables indicate that our sample is heavily populated by Asian firms (63.89%) and in particular firms from China (11,058 firm-year observations), Taiwan (6,481 firm-year observations), Korea (4,986 firm-year observations) and India (3,184 firm-year observations). The high 'retention rate' for China, Korea and Taiwan (see earlier discussion) and the fact that there are a very large number of firms listed in China, Korea and Taiwan, explains why our sample heavily represents firms in the Asian region. The next country with a large representation in the sample which is not in Asia is the UK, with 2,094 firm-year observations.[5] The remaining countries all have fewer than 2,000 firm-year observations and the weight of some countries is much smaller, reflecting the comparable sizes of equity markets.

As regards industry representation, the sample consists primarily of firms in the in the Industrials (9,056 firm-year observations), Consumer Discretionary (7,449 firm-year observations), Technology (6,401 firm-year observations), Basic Materials (5,101 firm-year observations) and Health Care (3,808 firm-year observations). The remaining industries are also well represented in our sample. The exceptions are Real Estate and Utilities, which have the lowest number of firm-year observations in our sample (915 and 991 firm-year

[5] 49% retention rate as per Appendix A (Table A1).

observations, respectively). We note that, in Appendix A (Table A2), our sample includes the majority of potential firms (ie high retention rate) in the Health Care (76%), Technology (74%) and Telecommunications (69%) industries from the countries we analyse. Hence, it is not surprising these are the most represented in our overall sample.

The firm-year observations across years range from the lowest of 6,528 in 2015 to the highest of 9,021 in 2018. The lower numbers for 2015 and 2016 can be explained by the fact that we have excluded many firms for which this was the first year of IFRS adoption (see earlier discussion and in Table 3.1).

**Table 3.2: Sample distribution by country and year**

| Country | Region | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|---|---|---|---|---|---|---|---|
| **Argentina** | America | 15 | 15 | 18 | 20 | 16 | **84** |
| **Australia** | Oceania | 216 | 253 | 264 | 285 | 308 | **1,326** |
| **Austria** | Europe | 24 | 25 | 22 | 21 | 21 | **113** |
| **Belgium** | Europe | 39 | 44 | 40 | 40 | 41 | **204** |
| **Brazil** | America | 93 | 93 | 90 | 98 | 107 | **481** |
| **Canada** | America | 223 | 201 | 201 | 190 | 215 | **1,030** |
| **Chile** | America | 46 | 57 | 60 | 71 | 73 | **307** |
| **China** | Asia | 1,868 | 2,117 | 2,392 | 2,601 | 2,080 | **11,058** |
| **Colombia** | America | 0 | 5 | 4 | 5 | 4 | **18** |
| **Denmark** | Europe | 25 | 31 | 39 | 38 | 35 | **168** |
| **Finland** | Europe | 47 | 51 | 48 | 59 | 52 | **257** |
| **France** | Europe | 167 | 182 | 184 | 203 | 166 | **902** |
| **Germany** | Europe | 171 | 182 | 193 | 209 | 205 | **960** |
| **Greece** | Europe | 51 | 57 | 57 | 56 | 26 | **247** |
| **Hong Kong** | Asia | 247 | 260 | 311 | 367 | 306 | **1,491** |
| **India** | Asia | 398 | 569 | 631 | 697 | 889 | **3,184** |
| **Indonesia** | Asia | 64 | 68 | 80 | 93 | 78 | **383** |
| **Ireland** | Europe | 17 | 19 | 11 | 16 | 16 | **79** |
| **Israel** | Asia | 96 | 100 | 96 | 103 | 100 | **495** |
| **Italy** | Europe | 47 | 60 | 58 | 70 | 65 | **300** |
| **Japan** | Asia | 23 | 55 | 79 | 117 | 140 | **414** |
| **Jordan** | Asia | 20 | 22 | 14 | 11 | 7 | **74** |
| **Korea** | Asia | 561 | 1,046 | 1,073 | 1,156 | 1,150 | **4,986** |
| **Malaysia** | Asia | 72 | 69 | 66 | 69 | 49 | **325** |
| **Mexico** | America | 21 | 27 | 18 | 20 | 3 | **89** |
| **Netherlands** | Europe | 39 | 49 | 51 | 49 | 48 | **236** |
| **New Zealand** | Oceania | 41 | 46 | 50 | 49 | 42 | **228** |
| **Norway** | Europe | 36 | 41 | 40 | 46 | 41 | **204** |
| **Peru** | America | 17 | 12 | 16 | 14 | 1 | **60** |
| **Philippines** | Asia | 2 | 2 | 2 | 3 | 3 | **12** |
| **Portugal** | Europe | 10 | 11 | 16 | 15 | 8 | **60** |
| **Singapore** | Asia | 11 | 11 | 10 | 10 | 51 | **93** |
| **South Africa** | Africa | 78 | 84 | 88 | 89 | 91 | **430** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Spain** | Europe | 45 | 59 | 56 | 60 | 61 | **281** |
| **Sweden** | Europe | 90 | 100 | 105 | 127 | 125 | **547** |
| **Switzerland** | Europe | 1 | 2 | 3 | 4 | 2 | **12** |
| **Taiwan** | Asia | 1,132 | 1,262 | 1,317 | 1,371 | 1,399 | **6,481** |
| **Turkey** | Europe | 93 | 99 | 107 | 105 | 124 | **528** |
| **United Kingdom** | Europe | 382 | 419 | 435 | 464 | 394 | **2,094** |
| ***Total*** | | ***6,528*** | ***7,805*** | ***8,345*** | ***9,021*** | ***8,542*** | ***40,241*** |

**Table 3.3: Sample distribution by industry and year**

| **Industry** | **2015** | **2016** | **2,017** | **2,018** | **2,019** | **Total** |
|---|---|---|---|---|---|---|
| **Basic Materials** | 881 | 988 | 1,026 | 1,111 | 1,095 | **5,101** |
| **Consumer Discretionary** | 1,202 | 1,456 | 1,568 | 1,687 | 1,536 | **7,449** |
| **Consumer Staples** | 440 | 525 | 576 | 605 | 564 | **2,710** |
| **Financials** | 284 | 403 | 449 | 478 | 486 | **2,100** |
| **Health Care** | 632 | 731 | 769 | 842 | 834 | **3,808** |
| **Industrials** | 1,459 | 1,750 | 1,898 | 2,048 | 1,901 | **9,056** |
| **Real Estate** | 146 | 186 | 194 | 197 | 192 | **915** |
| **Technology** | 1,046 | 1,245 | 1,301 | 1,438 | 1,371 | **6,401** |
| **Telecommunications** | 271 | 327 | 364 | 393 | 355 | **1,710** |
| **Utilities** | 167 | 194 | 200 | 222 | 208 | **991** |
| ***Total*** | ***6,528*** | ***7,805*** | ***8,345*** | ***9,021*** | ***8,542*** | ***40,241*** |

Industry classification is based on the 10 industries specified by the Industry Classification Benchmark (FTSE Russell 2020).

## *3.2 Econometric analysis*

### *3.2.1 Determinants of the decision to capitalise SDCs, and amounts of SDC capitalised*

One of the primary aims of this project is to identify the factors that affect a firm's decision to capitalise SDCs and the magnitude of SDCs capitalised in a given year. For the former, we used multivariate Probit analysis with the dependent variable being an indicator variable (*SDCAPD*). This is equal to one (1) when a company capitalises SDCs during the year and zero (0) otherwise. For the latter, we used multivariate Tobit models (left censored) with the dependent variable being the amount of SDCs capitalised during the year, scaled by the market value of the firm (*SDAsset*). Given the absence of previous research in this area under IFRS, we followed existing literature that examines the capitalisation of R&D-related assets in choosing firm-level factors that may affect the decision or magnitude of SDCs' capitalisation (see Dargenidou et al. 2021 and Mazzi et al. 2019b).

Following that literature, the factors that we considered for capturing a firm's life cycle and risk were: book to market (*BM*), size (SIZE), beta (*BETA*), leverage (*LEV*) and age (*AGE*). We also included a binary variable that is equal to one (1) if the financial statements are audited by a Big Four firm (*Big4*) and zero (0) otherwise. We also included the level of investment in tangible fixed assets (*CAPEX*). Additionally, we controlled for a firm's international exposure by including the percentage of international sales (*INTSALES*). Moreover, we included the magnitude of total R&D expenditure relative to total assets (*RDInt*) and the market value of the firm generated in relation to R&D (*RDValue*). We also included variables that capture a firm's incentives for manipulating earnings to meet or beat the previous year's earnings (*PAST_BEAT*) or a zero-earnings threshold benchmark (*ZERO_BEAT*). We also included an indicator variable that is equal to one (1) if a company capitalises other development costs during the year (*CAP*) and zero (0) otherwise, and an indicator variable that is equal to one (1) if the company concluded material combinations (individually or collectively) during the year (*BC*)[6] and zero (0) otherwise.

We also controlled for institutional influences in the country of domicile with the following variables: anti-self-dealing index (*ANTISELF*), control of corruption (*CORR*) and an indicator variable that is equal to one (1) if a country is classified as having a civil law system and zero (0) if it has a common law system (*CIV_COM*). Additionally, we considered the following potential factors that may affect the overall levels and productivity of R&D in the economy: health infrastructure (*Healthinfrastructure*), skilled labour (*Skilledlabour*), scientific research legislation (*Scientificresearchlegislation*) and GDP growth (*GDPGrowth*). Finally, all our multivariate tests included industry and year fixed effects, and standard errors are clustered at the firm level. Detailed variable definitions are presented in Appendix B[7] and a generic representation of the models we applied is expressed in Equation 3.1.

**Equation 3.1**

*SDCAPD* or *SDAsset* = f(*BM, SIZE, BETA, LEV, BIG4, CAPEX, INTSALES, RDValue, RDInt, PAST_BEAT, ZERO_BEAT, CAP, BC, AGE, ANTISELF, CIV_COM, CORR,*

[6] The consideration accounts for 5% of the previous year's book value of equity.

[7] All continuous variables in all descriptive statistics presented and in the regressions are winzorised in the ±1 percentile.

*Healthinfrastructure, Skilledlabour, Scientificresarchlegislation, GDPGrowth*)

### *3.2.2 Expected vs unexpected treatment of SDCs*

Subsequently, in the spirit of the analysis in Mazzi et al. (2019b) and Kreß et al. (2019), we investigated whether firms follow the expected accounting treatment of capitalising or not SDCs. This analysis involved two stages.

In the first stage, we identified as 'mandatory non-capitalisers' firms that do not have SDC capitalised and we would anticipate that they would not have capitalised such costs in the following circumstances.

a) The firm does not capitalise SDCs or other development costs and all other firms in the same industry and in the same year do the same. This provides a signal that firms in this industry-year cluster would not capitalise SDCs.
b) The firm's *RDValue* is negative; this is a signal that R&D and SDC expenditure are perceived by the market (and the companies themselves) as having no future economic benefit and thus should not be capitalised.[8]
c) The *RDValue* of a non-capitaliser is lower than the minimum *RDValue* of a capitaliser[9] in the same industry-year. This criterion ensures that the remaining non-capitalisers are at least as successful in R&D and SDC expenditure as the least successful capitaliser.

In the second stage, we examined whether the remaining firms (ie capitalisers and non-capitalisers, excluding 'mandatory non-capitalisers') could be classified in the alternative category. To address this, we relied on equation (3.1), used earlier to examine the determinants of each firm's decision about capitalising SDCs. Subsequently, we measured the probability that a firm would be a capitaliser, given the control variables in place, by obtaining the fitted values from this regression. If the predicted probability is higher than 50% then the firm is considered to be following the expected method.

[8] It is noted that *RDvalue* is measured as the difference between the market value of equity and book value of equity less the amount of R&D and SDC capitalised during the year, divided by the sum of current and lagged annual R&D expenditure.
[9] As also explained in the next section, for firm-year observations that capitalise SDCs during the year, the firms are classified as 'capitalisers' and the remaining firms are classified as 'non-capitalisers'.

# 4. Findings and discussion

### *4.1 Capitalisers of software development costs*

Our sample comprises 40,241 firm-year observations across 39 countries (see section 3.1). For firm-year observations that capitalise SDCs during the year, the firms are classified as 'capitalisers' and the remaining firms are classified as 'non-capitalisers'. In total, we have 14,422 non-capitalisers (36%) and 25,819 (64%) capitalisers. Within the capitalisers, 10,818 recognise only an SDC asset on the balance sheet and no R&D expense in the income statement in a given year. This information is shown in Table 4.1.

The significantly large number of SDC capitalisers is striking when compared with previous literature examining the capitalisation of R&D under IFRS among large international samples. More specifically, from their international sample with almost 21,000 firm-year observations, Mazzi et al. (2019b) identify approximately 38% of their sample as capitalising R&D costs. Similarly, Kreß et al. (2019) identify about 33% of their international sample of firm-year observations as being capitalisers of R&D costs. This initial finding indicates that companies do capitalise SDCs relatively frequently. In fact, they are more likely to report an SDC asset and less likely to report other types of development assets on the balance sheet. Consistent with this, we have identified only 7,449 of the 40,241 firm-year observations as recognising an R&D asset in the year.

**Table 4.1: Sample composition of capitalisers and non-capitalisers**

| **Final sample [t=2015, 2019][12,239 firms]** | **40,241 (100.00%)** |
|---|---|
| 1. Reporting expensed R&D in the income statement and no SDC capitalised in the balance sheet in a given year (non-capitalisers) | 14,422 (35.84%) |
| 2. Reporting SDC capitalised in the year (capitalisers) | 25,819 (64.16%) |
| 2.1 Capitalising SDC in the balance sheet and recognising no R&D expense in the income statement in a given year | 10,818 (26.88%) |
| 2.2 Reporting both SDC capitalised in the balance sheet and R&D expense in the income statement in the year | 15,001 (37.28%) |
| 3. Capitalising R&D in the year | 7,449 (18.51% of full sample) |
| 3.1 Capitalising SDC and R&D in the balance sheet in the year | 4,963 (12.33% of full sample) |

The data reveals the frequency with which companies capitalise such costs across the five-year sample period. Specifically, Table 4.2 shows that 20.96% of the capitalisers capitalise SDCs every year, while 17.70% of the capitalisers capitalise such costs in four of the five-year sample

periods. The observations in our sample of firms that capitalise SDCs in only one year is only a very small proportion of the total sample (4.89%).

**Table 4.2: Firm-year observations of firms capitalising SDCs by year**

| | |
|---|---|
| Capitalisers | 25,819 (64.1%*) |
| Capitalisers in one year of the sample period only | 1,966 (4.89%*) |
| Capitalisers in two years of the sample period only | 3,338 (8.30%*) |
| Capitalisers in three years of the sample period only | 4,956 (12.32%*) |
| Capitalisers in four years of the sample period | 7,124 (17.70%*) |
| Capitalisers in all five years of the sample period | 8,435 (20.96%*) |

*of the full sample of 40,241 (100.00%) firm-year observations

Figure 4.1 plots the percentage of firm-year observations capitalising SDCs by country. We note that in Argentina, Brazil, Chile, Colombia, India, Ireland, Japan, Mexico, New Zealand, Peru, Philippines, Portugal, South Africa and Spain more than 80% of the firm-year observations are capitalisers. In fact, all firms from Colombia and Philippines are capitalisers. This indicates a significantly large proportion of SDC capitalisers for IFRS reporters in these countries in a given year. At the other end of the spectrum, in Austria, Finland, Jordan, Switzerland and Turkey, fewer than 40% of the firm-year observations in our sample capitalise SDCs. Switzerland has the lowest percentage of capitalisers (17%). Canada, Germany, Hong Kong, Jordan, Korea, Sweden, Taiwan and China exhibit intermediate proportions of capitalisers but they generally have higher proportions of non-capitalisers (ranging between 40% and 50%). On reviewing the 'retention rates' shown in Appendix A (Table A1), we note that the sample 'retention rate' for China and (Korea and Taiwan) is above 90% (80%). This and the data shown in Figure 4.1 allow us to say with confidence that about half of the listed companies in China recognise an SDC asset across the sample period, while this percentage is much lower for Korea and Taiwan.

Figure 4.2 plots the percentage of firm-year observations capitalising SDCs by industry. We note that all industries exhibit more capitalisers than non-capitalisers. The constituents of Consumer Discretionary, Financials, Real Estate and Utilities exhibit the largest proportion of capitalisers (the proportion of capitalisers in these is greater than 70%). Firms in the Technology, Health Care and Basic Materials industries have the lowest proportion of capitalisers (56%, 52% and 51%, respectively). Nevertheless, these percentages can be

considered relatively high if one considers the data in Appendix A (Table A2), where we show that our sample includes the majority of potential firms in the Health Care (76%) and Technology (74%) industries.

In order to delve further into the proportion of capitalisers across industries, we have also relied on the Industry Classification Benchmark (ICB) Sectors (ie more refined sub-categories of industries) in which the companies operate. Figure 4.3 shows that in those Sectors the proportion of capitalisers exceeds 70%. Notably, all firms in Banks, Insurance (Life & Non-life) and Real Estate Investment Trusts (REITS) capitalise SDCs. The Sectors with the next highest proportions of capitalisers are Finance & Credit Services (98%), Travel & Leisure (93%), Real Estate, Investment & Services (93%) and Investment Banking & Broker (91%). In untabulated descriptive statistics, we see that Sectors with the lowest proportion of capitalisers include: Medical Equipment Services (47%), Pharmaceutical & Biotech (50%) and Leisure Goods (50%). The remaining Sectors have a higher proportion of non-capitalisers relative to capitalisers. Overall, these results confirm the earlier findings shown in Figure 4.2 that firms in Financials exhibit the highest proportion of capitalisers.

**Figure 4.1: Proportion of capitalisers and non-capitalisers across countries**

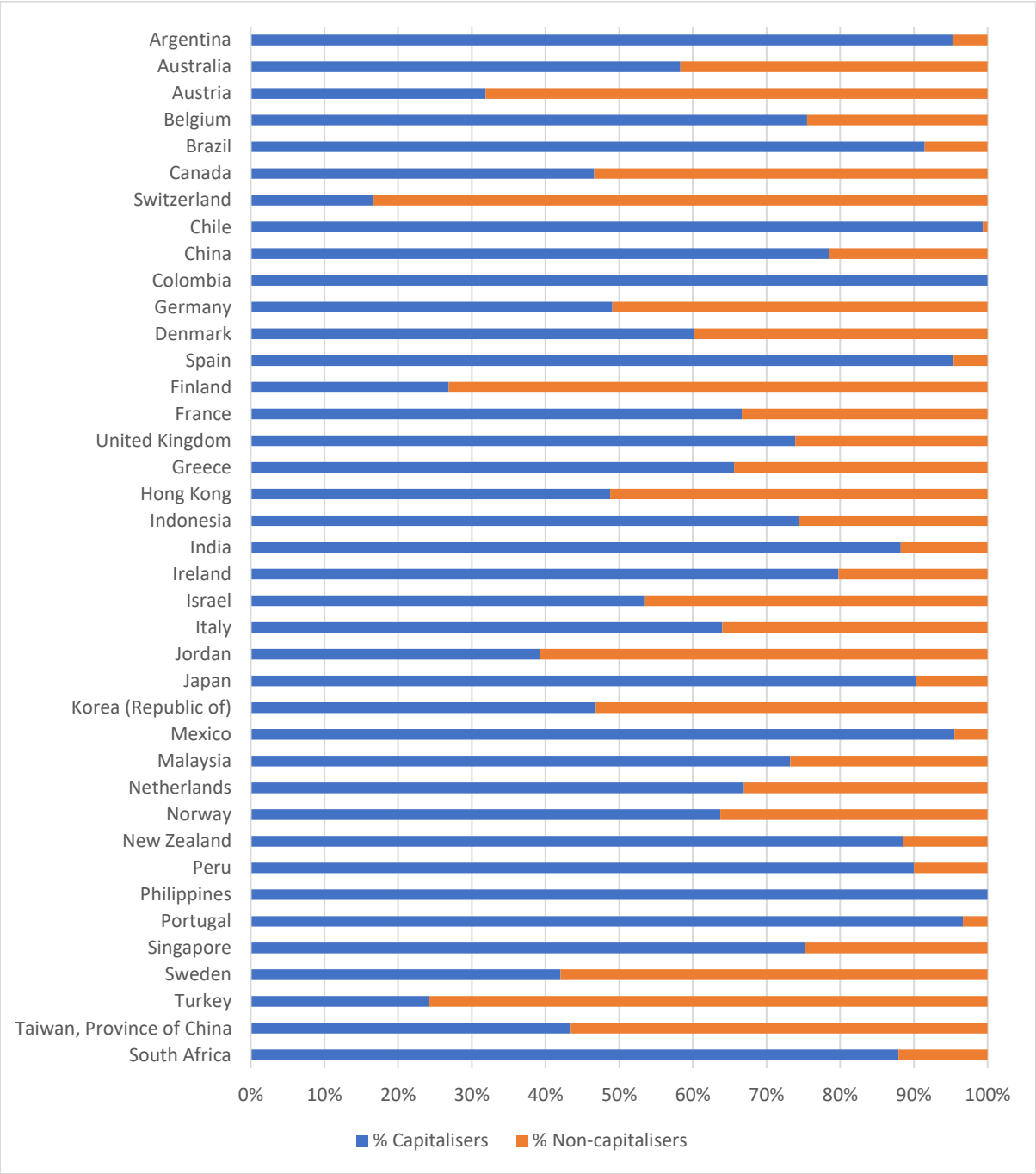


**Figure 4.2: Proportion of capitalisers and non-capitalisers across industries**

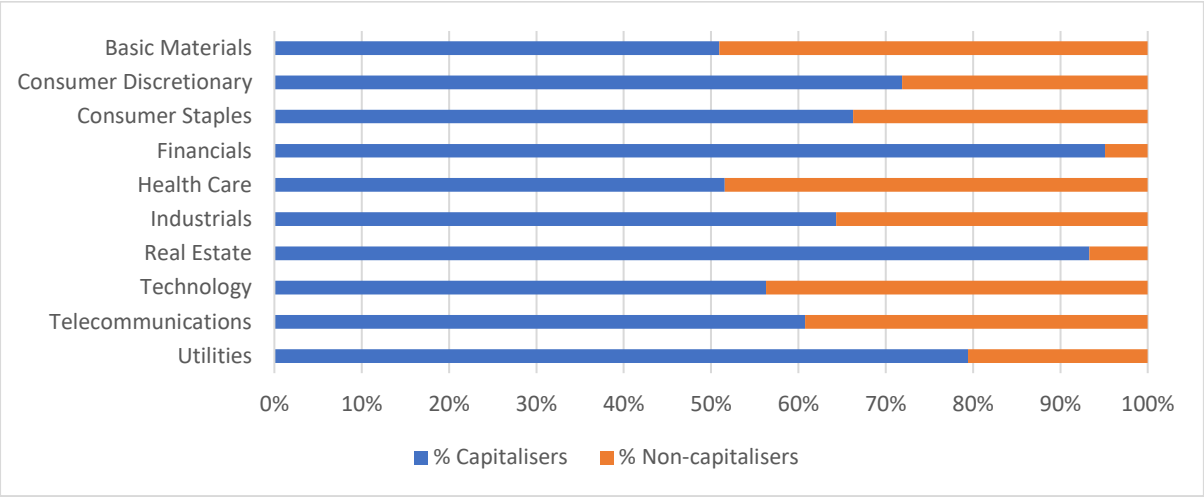
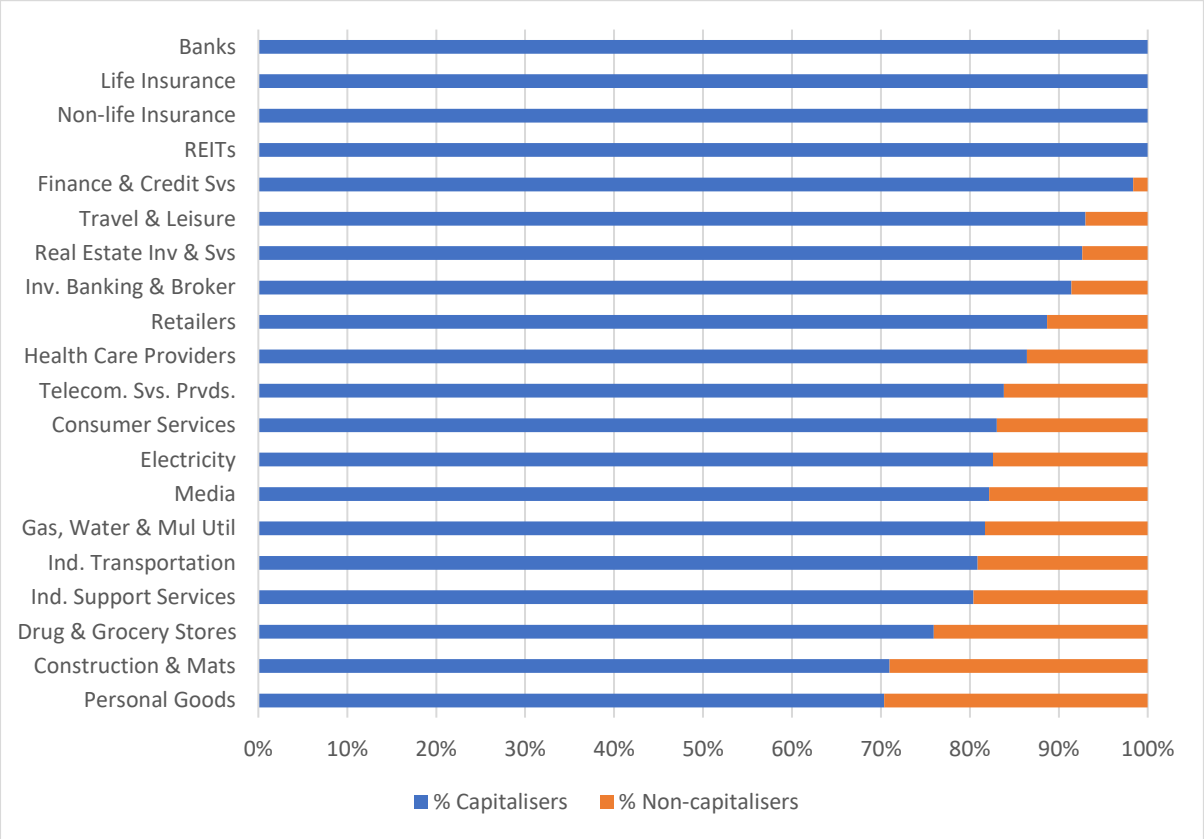



**Figure 4.3: Proportion of capitalisers and non-capitalisers for Sectors with a high proportion of capitalisers**




As part of IFRS 3 requirements, when companies complete a business combination they should recognise other intangible assets acquired (including SDCs) separately from goodwill. To

explore the influence of business combinations on companies' SDC intensity levels and frequency of annual capitalisation, we explore the 4,076 firm-year observations that conclude material business combinations during the year and present relevant information in Table 4.3.

Of these firm-year observations, a large proportion (3,115 firm-year observations – 76.4%) capitalise SDCs during the year (this represents 12.06% of the firms that capitalise SDCs during the year in the entire sample). Of these, 1,347 fully capitalise SDCs and do not expense any R&D (this represents 12.45% of such companies in the entire sample). Additionally, we note that 1,028 firm-year observations exhibit material business combinations and capitalise R&D in the year (this represents 13.80% of the firm-year observations that capitalise R&D in the year in the entire sample). Of these, 741 firm-year observations capitalise both R&D and SDCs (this represents 14.93% of the firms in the entire sample that recognise both types of intangibles during the year). Overall, these results indicate that the majority of companies that conclude material business combinations do recognise software and other development assets.

**Table 4.3: Firm-year observations of firms with material business combinations**

| | |
|---|---|
| Reporting material business combinations<br>(The consideration accounts for 5% of the previous year's book value of equity.) | 4,076 (100.00%) |
| 1. Reporting expensed R&D in the income statement and no SDC capitalised in the balance sheet in a given year (non-capitalisers) | 961<br>(6.66% of full sample non-capitalisers) |
| 2. Reporting SDC capitalised in the year (capitalisers) | 3,115<br>(12.06% of full sample capitalisers) |
| 2.1 Capitalising SDC in the balance sheet and recognising no R&D expense in the income statement in a given year | 1,347 (12.45%<br>of such companies in the full sample) |
| 3. Capitalising R&D in the year | 1,028 (13.80% of those capitalising R&D in the year) |
| 3.1 Capitalising R&D and SDC in the year | 741 (14.93% of those capitalising SDC and R&D in the year) |

### *4.2 SDC capitalisation intensity*

To give more insights into the importance of SDCs on companies' financial statements, this section reflects on the net SDCs on the balance sheet, scaled by total assets. First, we note that the mean (median) SDC asset intensity on the balance sheet is 0.6% (0.2%) of capitalisers' total assets (see *sdnetasset* in Table 4.4). Further, the mean (median) SDC asset capitalised in the year is 0.04% (0.10%) of capitalisers' market values (see *SDAsset in* Table 4.4). Delving

further in the data, from untabulated information, we see that for the 6,222 firm-year observations in the top quartile of SDC asset intensity, the mean (median) SDC intensity is 2.1% (1.3%) of total assets while the mean (median) SDC asset capitalised in the year is 1% (0.5%) of market values. Interestingly, 71% of the firms from Oceania that report a net SDC asset on the balance sheet are in this top quartile. Firm-year observations from Europe and Africa follow, with 58% and 56%, respectively. Only 13% of the firm-year observations from Asia that show a net SDC asset on the balance sheet are in the top quartile. This information suggests that the large proportion of firms from Asia distorts the picture of the amounts recognised across the overall sample. In fact, for non-Asian firms, the amounts of SDCs recognised on the balance sheet are far from negligible.

Among the subset of firm-year observations that conclude a material business combination (see also in Table 4.3), from untabulated information, we note the following. For the firms that capitalise SDCs during the year, the mean (median) SDC intensity is 1.1% (0.3%) of total assets, while the mean (median) SDC capitalised in the year is 0.5% (0.1%) of market values. Further, for the firms that fully capitalise SDCs and do not expense any R&D, the mean (median) SDC intensity is 1.4% (0.6%) of total assets, while the mean (median) SDC capitalised in the year is 0.8% (0.3%) of market values. For the firms that capitalise R&D in the year, the mean (median) SDC intensity is 0.8% (0.1%) of total assets, while the mean (median) SDC capitalised in the year is 0.4% (0.1%) of market values. Finally, for the firms that capitalise both R&D and SDCs, the mean (median) SDC intensity is 1.2% (0.4%) of total assets, while the mean (median) SDC capitalised in the year is 0.5% (0.1%) of market values. This suggests not only that companies that conclude material business combinations recognise software and other development assets but also that the amounts involved are not negligible and, in fact, these amounts appear to be higher than those from all capitalisers in the sample (see Table 4.4).

Figure 4.4 shows the yearly median value of net SDC intensity across each industry in our sample. Perhaps not surprisingly, given the nature of their operations, firms in Telecommunications exhibit the highest net SDC intensity (mean (median) 1.26% (0.37%) of total assets), followed by Technology and Consumer Discretionary (mean (median) is 1.06% (0.28%) and 0.80% (0.26%) respectively of total assets). Nonetheless, we note that the median value for firms in the Telecommunications industry has been decreasing over the last five years. Real Estate firms have the lowest median values of net SDC intensity (mean (median) 0.22%

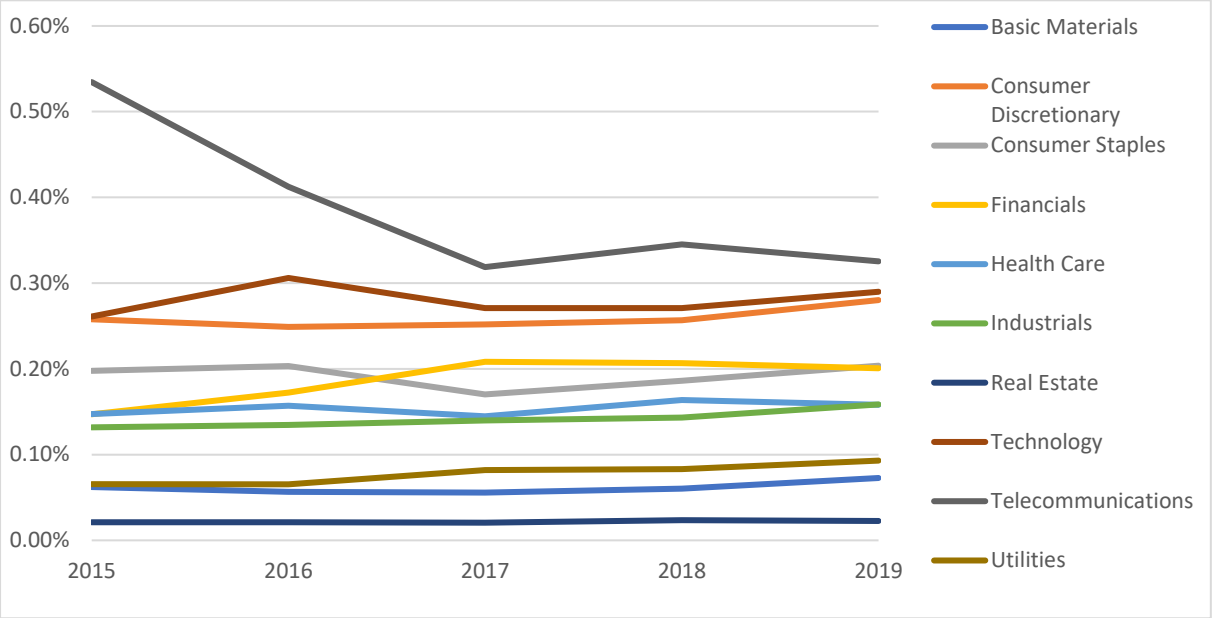
(0.02%) of total assets), although Real Estate firms include a relatively large proportion of capitalisers (see Figure 4.2). The remaining industries exhibit intermediate levels of net SDC intensity. Although firms in the Financials Sector have the highest proportion of capitalisers (see Figure 4.2), net SDCs intensity is intermediate when compared with other industries.

Figure 4.5 plots the yearly median values of net SDC intensity for each of the geographic areas/regions to which the countries included in our sample belong.[10] Firms from Oceania (ie firms from New Zealand and Australia) exhibit the highest intensity (mean (median) 2.22% (1.32%) of total assets). European and South African firms tend to present the second- and third-highest values of SDC assets in proportion to total assets (mean (median) for Europe: 1.51% (0.73%); mean (median) for Africa: 1.28% (0.66%) of total assets). Firms from Asia, exhibit the lowest net SDC intensity (mean (median) 0.32% (0.11%) of total assets). This, and the fact that firms from this region represent the largest proportion of our sample (63.89%, see Table 3.2), explains the relatively low SDC intensity levels across the full sample and brings to light an interesting feature of the firms in Asia. Although many of them report separately an SDC asset capitalised or an R&D expense, the amounts capitalised on the balance sheet are far smaller than corresponding amounts in other regions.

At a broader level, the information in these graphs demonstrates that, on average, companies appear to have a relatively stable investment in software as reflected on their balance sheets, with no increasing trend relative to total assets over the last five years.

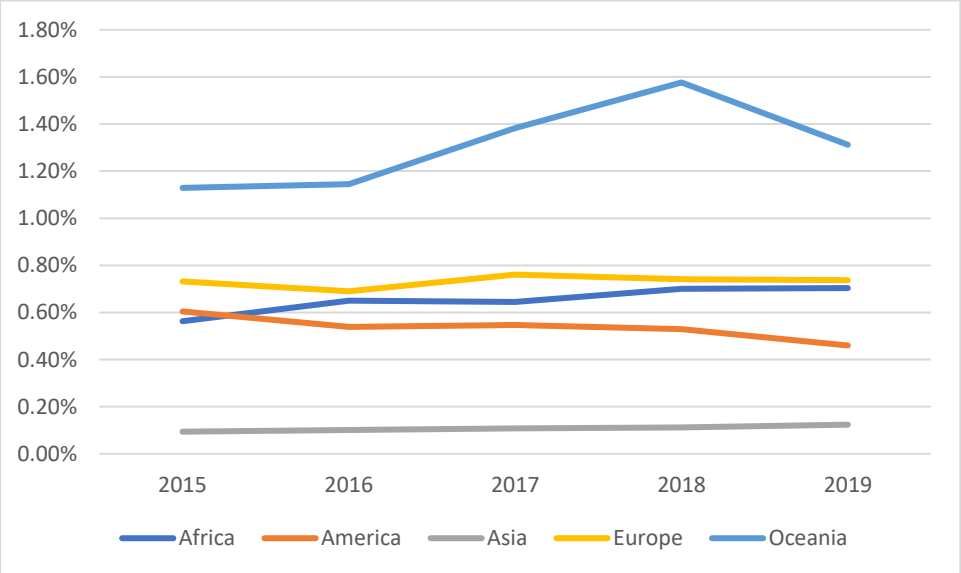
[10] Drawing on Table 3.2, Africa includes firms from South Africa while America includes firms from Argentina, Brazil, Canada, Chile, Colombia, Mexico and Peru. Asia includes firms from China, Hong Kong, India, Indonesia, Israel, Japan, Jordan, Korea, Malaysia, Philippines, Singapore, and Taiwan. Finally, Europe includes firms from Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

**Figure 4.4: Net software asset intensity across industries**




Yearly median net SDC asset on the balance sheet, scaled by total assets.

**Figure 4.5: Net software asset intensity across regions**




Yearly median net SDC asset on the balance sheet, scaled by total assets.

Further, to demonstrate the variation in the way companies describe the reasons behind their investment in SDCs, along with the relevant disclosures provided within their financial statements, we drew on the annual reports of 100 random firms from our sample that have high SDC asset intensity and come from different sectors and different countries and regions. Appendix C presents extracts from the financial statements of 15 such firms that we have

selected from this analysis and that could be considered examples of good disclosure practice, including mentions of SDC capitalisation as a key audit matter in auditors' reports.

### *4.3 Univariate analysis*

Table 4.4 shows the descriptive statistics of the variables included in equation 3.1, shown separately for capitalisers and non-capitalisers. We also compare the mean (median) values of each variable across the two groups through a T-test (Mann-Whitney test). Before we outline the key observations from these descriptive statistics, it is noted that these descriptive statistics are taken in isolation of one another. Hence, some findings may seem contradictory if viewed as interdependent.

The results indicate that, when compared with non-capitalisers, capitalisers tend to:

- ✓ document lower amounts of R&D expense in the income statement (mean *RDExp* = 0.014 for capitalisers vs. mean *RDEXp* = 0.037 for non-capitalisers; $p<0.01$)
- ✓ document lower amounts of R&D intensity (mean *RDInt* = 0.023 for capitalisers vs. mean *RDInt* = 0.043 for non-capitalisers; $p<0.01$)
- ✓ document lower amounts of capital expenditure (mean *CAPEX* = 0.055 for capitalisers vs. mean *CAPEX* = 0.061 for non-capitalisers; $p<0.01$)
- ✓ document lower incentives to capitalise software development costs for meeting earnings benchmarks (eg mean *BENCH_BEAT* = 0.190 for capitalisers vs. mean *BENCH_BEAT* = 0.224 for non-capitalisers; $p<0.01$)
- ✓ be marginally larger in size (mean *SIZE* = 18.576 for capitalisers vs. mean *SIZE* = 18.111 for non-capitalisers; $p<0.01$)
- ✓ be riskier (mean *BETA* = 1.003 for capitalisers vs. mean *BETA* = 0.924 for non-capitalisers; $p<0.01$)
- ✓ be more leveraged (mean *Leverage* = 0.827 for capitalisers vs. mean *Leverage* = 0.591 for non-capitalisers; $p<0.01$).
- ✓ have concluded almost twice as many material business combinations (mean *BC* = 0.121 for capitalisers vs. mean *BC* = 0.067 for non-capitalisers; $p<0.01$)
- ✓ report materially higher R&D value (mean *RDValue* = 420.781 for capitalisers vs. mean *RDValue* = 117.959 for non-capitalisers; $p<0.01$)
- ✓ be audited less frequently by Big Four audit firms (mean *BIG4* = 0.369 for capitalisers vs. mean *BIG4* = 0.461 for non-capitalisers; $p<0.01$)

- ✓ document lower amounts of R&D development asset on the balance sheet (mean *rdnetasset* = 0.001 for capitalisers vs. mean *rdnetasset* = 0.001 for non-capitalisers; p<0.01).

With respect to country-level characteristics, T-test and Mann-Whitney tests indicate that, compared with non-capitalisers, capitalisers tend to operate in countries with:

- ✓ higher levels of investor protection (mean *ANTISELF* = 0.650 for capitalisers vs. mean *ANTISELF* = 0.599 for non-capitalisers; p<0.01)
- ✓ higher levels of corruption (mean *CORR* = -65.333 for capitalisers vs. mean *CORR* = -74.226 for non-capitalisers; p<0.01)
- ✓ higher levels of GDP growth (mean *GDPGrowth* = 3.352 for capitalisers vs. mean *GDPGrowth* = 2.204 for non-capitalisers; p<0.01)
- ✓ marginally lower levels of skilled labour (mean *Skilledlabour* = 5.710 for capitalisers vs. mean *Skilledlabour* = 5.792 for non-capitalisers; p<0.01)
- ✓ marginally lower levels of scientific research legislation (mean *Scientificresearchlegislation* = 5.941 for capitalisers vs. mean *Scientificresearchlegislation* = 6.052 for non-capitalisers; p<0.01)
- ✓ lower levels of health infrastructure (mean *Healthinfrastructure* = 6.002 for capitalisers vs. mean *Healthinfrastructure* = 6.956 for non-capitalisers; p<0.01).

**Table 4.4: Descriptive statistics across capitalisers and non-capitalisers**

| | Capitalisers (25,819 firm-year observations) | | | | | Non-capitalisers (14,422 firm-year observations) | | | | | Comparison | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **Mean** | **St. Dev.** | **Min** | **Median** | **Max** | **Mean** | **St. Dev.** | **Min** | **Median** | **Max** | **T-test** | **Mann-Whitney test** |
| rdnetasset | 0.001 | 0.006 | 0.000 | 0.000 | 0.050 | 0.002 | 0.007 | 0.000 | 0.000 | 0.050 | -0.001*** | 0.000*** |
| sdnetasset | 0.006 | 0.013 | 0.000 | 0.002 | 0.082 | 0.000 | 0.001 | 0.000 | 0.000 | 0.069 | 0.006*** | 0.002*** |
| SDAsset | 0.004 | 0.008 | 0.000 | 0.001 | 0.057 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.004*** | 0.001*** |
| SDCAPD | 1.000 | 0.000 | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1 | 1 |
| RDExp | 0.014 | 0.032 | 0.000 | 0.002 | 0.280 | 0.037 | 0.053 | 0.000 | 0.017 | 0.280 | -0.023*** | -0.015*** |
| RDAsset | 0.001 | 0.006 | 0.000 | 0.000 | 0.058 | 0.002 | 0.008 | 0.000 | 0.000 | 0.058 | -0.001*** | 0.000*** |
| CAP | 0.192 | 0.394 | 0.000 | 0.000 | 1.000 | 0.172 | 0.378 | 0.000 | 0.000 | 1.000 | 0.020*** | 0.000*** |
| BM | 0.637 | 0.568 | 0.035 | 0.468 | 3.926 | 0.774 | 0.658 | 0.035 | 0.593 | 3.926 | -0.137*** | -0.125*** |
| SIZE | 18.576 | 4.186 | 8.699 | 18.072 | 30.873 | 18.111 | 4.901 | 8.699 | 17.584 | 30.873 | 0.465*** | 0.488*** |
| BETA | 1.003 | 0.693 | -1.435 | 0.980 | 6.764 | 0.924 | 0.665 | -1.435 | 0.906 | 6.764 | 0.079*** | 0.074*** |
| LEV | 0.827 | 1.281 | 0.000 | 0.412 | 8.107 | 0.591 | 0.956 | 0.000 | 0.298 | 8.107 | 0.236*** | 0.114*** |
| BIG4 | 0.369 | 0.482 | 0.000 | 0.000 | 1.000 | 0.461 | 0.498 | 0.000 | 0.000 | 1.000 | -0.092*** | 0.000*** |
| CAPEX | 0.055 | 0.088 | 0.000 | 0.024 | 0.606 | 0.061 | 0.096 | 0.000 | 0.025 | 0.606 | -0.006*** | -0.001** |
| INTSALES | 25.667 | 33.194 | 0.000 | 6.200 | 100.000 | 27.933 | 36.121 | 0.000 | 3.315 | 100.000 | -2.266*** | 2.885*** |
| RDValue | 420.781 | 2122.403 | -5900.000 | 26.080 | 27000.000 | 117.959 | 906.082 | -5900.000 | 7.224 | 27000.000 | 302.822*** | 18.856*** |
| RDInt | 0.023 | 0.044 | 0.000 | 0.008 | 0.395 | 0.043 | 0.073 | 0.000 | 0.017 | 0.395 | -0.020*** | -0.009*** |
| PAST_BEAT | 0.168 | 0.374 | 0.000 | 0.000 | 1.000 | 0.190 | 0.392 | 0.000 | 0.000 | 1.000 | -0.022*** | 0.000*** |
| ZERO_BEAT | 0.037 | 0.189 | 0.000 | 0.000 | 1.000 | 0.057 | 0.232 | 0.000 | 0.000 | 1.000 | -0.020*** | 0.000*** |
| BENCH_BEAT | 0.190 | 0.392 | 0.000 | 0.000 | 1.000 | 0.224 | 0.417 | 0.000 | 0.000 | 1.000 | -0.034*** | 0.000*** |
| AGE | 16.300 | 9.327 | 3.000 | 16.000 | 46.000 | 16.316 | 8.722 | 3.000 | 16.000 | 46.000 | -0.016 | 0 |
| BC | 0.121 | 0.326 | 0.000 | 0.000 | 1.000 | 0.067 | 0.249 | 0.000 | 0.000 | 1.000 | 0.054*** | 0.000*** |
| ANTISELF | 0.650 | 0.183 | 0.165 | 0.725 | 1.000 | 0.599 | 0.183 | 0.165 | 0.565 | 1.000 | 0.051*** | 0.160*** |
| CIV_COM | 0.708 | 0.455 | 0.000 | 1.000 | 1.000 | 0.777 | 0.417 | 0.000 | 1.000 | 1.000 | -0.069*** | 0.000*** |
| CORR | -65.323 | 20.214 | -99.519 | -57.692 | -36.058 | -74.226 | 17.727 | -99.519 | -79.327 | -36.058 | 8.903*** | 21.635*** |
| Healthinfrastructure | 6.002 | 1.618 | 1.510 | 5.940 | 8.746 | 6.956 | 1.297 | 1.510 | 7.388 | 8.746 | -0.954*** | -1.448*** |
| Skilledlabour | 5.710 | 0.601 | 3.077 | 5.702 | 7.532 | 5.792 | 0.543 | 3.077 | 5.685 | 7.532 | -0.082*** | 0.017*** |
| Scientificresearchlegislation | 5.941 | 0.977 | 3.028 | 5.895 | 8.064 | 6.052 | 0.876 | 3.028 | 5.904 | 8.064 | -0.111*** | -0.009*** |
| GDPGrowth | 3.352 | 6.273 | -36.279 | 4.171 | 15.154 | 2.204 | 5.976 | -36.279 | 2.861 | 15.154 | 1.148*** | 1.310*** |

Definitions and source of all the variables are reported in Appendix B.

### *4.4 Multivariate analysis*

#### *4.4.1. Full sample*

As the univariate analysis provided earlier does not necessarily identify influential factors associated with the decision to capitalise SDCs or the amounts of SDCs capitalised, Table 4.5 provides four models of multivariate analysis, presenting the empirical implementation of Equation 3.1 for the entire sample. The dependent variables are the decision to capitalise (Models 1 and 2) and the amount of SDCs capitalised in a given year (Models 3 and 4). The models differ only in the use of alternative measures to proxy for incentives to manipulate earnings by SDCs. Specifically, Models 1 and 3 employ *PAST_BEAT* and *ZERO_BEAT* while Models 2 and 4 use *BENCH_BEAT*. The latter effectively combines *PAST_BEAT and ZERO_BEAT* as it is also a binary variable and indicates if *PAST_BEAT* or *ZERO_BEAT* is one (1).

For firm-level determinants of the decision to capitalise SDCs, *SIZE*, *BETA*, *LEV*, *BIG4*, *INTSALES*, *PAST_BEAT*, *ZERO_BEAT*, *CAP* and *BC* report a positive and statistically significant coefficient. This suggests that companies more likely to decide to capitalise SDCs are larger, riskier, have higher leverage, employ one of the Big Four auditors, have more international sales, have incentives to capitalise SDCs to meet their earnings targets and capitalise other development costs, and have concluded material business combinations during the year. Conversely, firms with greater growth opportunities (high book-to-market ratio) and higher R&D intensity are less likely to capitalise SDCs (coefficients of *BM* and *RDInt* are negative and statistically significant).

Looking at the coefficients of the country-level variables, we infer that firms likely to decide to capitalise SDCs are headquartered in countries with more skilled labour and better scientific research legislation (*Skilledlabour* and *Scientificresearchlegislation* have positive and statistically significant coefficients). Instead, non-capitalisers are more likely to operate in countries with better health infrastructure (*Healthinfrastructure* has a negative and statistically significant coefficient).

The coefficients reported in Models 3 and 4 indicate that almost all factors associated with the decision to capitalise SDCs are also associated with the amounts of SDCs capitalised and in the same direction. The only exception/additional factor is being headquartered in countries with higher investor protection. This is positively associated with higher amounts of SDCs capitalised.

**Table 4.5: Multivariate analysis (decision and magnitude of SDCs capitalisation)**

| | Decision to capitalise SDCs | | | | Magnitude of SDCs capitalisation | | | |
|---|---|---|---|---|---|---|---|---|
| **VARIABLES** | **Model 1** | | **Model 2** | | **Model 3** | | **Model 4** | |
| BM | -0.192*** | (-8.59) | -0.191*** | (-8.55) | -0.109*** | (-9.23) | -0.108*** | (-9.17) |
| SIZE | 0.019*** | (5.12) | 0.019*** | (5.12) | 0.009*** | (4.89) | 0.009*** | (4.89) |
| BETA | 0.048*** | (3.08) | 0.048*** | (3.09) | 0.022*** | (2.93) | 0.022*** | (2.94) |
| LEV | 0.045*** | (3.86) | 0.045*** | (3.89) | 0.015*** | (3.41) | 0.015*** | (3.45) |
| BIG4 | 0.133*** | (4.56) | 0.133*** | (4.56) | 0.054*** | (3.61) | 0.054*** | (3.61) |
| CAPEX | -0.021 | (-0.15) | -0.019 | (-0.13) | 0.048 | (0.66) | 0.049 | (0.68) |
| INTSALES | 0.002*** | (6.19) | 0.002*** | (6.19) | 0.001*** | (7.09) | 0.001*** | (7.09) |
| RDValue | 0.000*** | (4.18) | 0.000*** | (4.19) | 0.000*** | (3.85) | 0.000*** | (3.87) |
| RDInt | -2.789*** | (-11.04) | -2.737*** | (-10.95) | -1.788*** | (-11.34) | -1.756*** | (-11.24) |
| PAST_BEAT | 0.100*** | (4.85) | | | 0.052*** | (4.91) | | |
| ZERO_BEAT | 0.095** | (2.31) | | | 0.054** | (2.34) | | |
| BENCH_BEAT | | | 0.101*** | (5.08) | | | 0.052*** | (5.12) |
| CAP | 0.192*** | (6.06) | 0.192*** | (6.06) | 0.118*** | (7.52) | 0.118*** | (7.52) |
| BC | 0.319*** | (10.05) | 0.319*** | (10.07) | 0.152*** | (11.60) | 0.153*** | (11.63) |
| AGE | -0.032 | (-1.56) | -0.032 | (-1.55) | -0.015 | (-1.47) | -0.014 | (-1.46) |
| ANTISELF | 0.105 | (0.96) | 0.105 | (0.97) | 0.141*** | (2.70) | 0.141*** | (2.70) |
| CIV_COM | -0.020 | (-0.45) | -0.020 | (-0.45) | 0.021 | (1.14) | 0.021 | (1.14) |
| CORR | 0.001 | (0.62) | 0.001 | (0.61) | 0.000 | (0.81) | 0.000 | (0.79) |
| Healthinfrastructure | -0.285*** | (-16.70) | -0.285*** | (-16.69) | -0.135*** | (-16.85) | -0.135*** | (-16.85) |
| Skilledlabour | 0.064** | (2.34) | 0.063** | (2.33) | 0.046*** | (3.77) | 0.046*** | (3.76) |
| Scientificresearchlegislation | 0.057** | (2.40) | 0.056** | (2.38) | 0.030** | (2.50) | 0.030** | (2.48) |
| GDPGrowth | -0.002 | (-0.93) | -0.002 | (-0.91) | -0.001 | (-1.08) | -0.001 | (-1.06) |
| Constant | 0.523** | (2.27) | 0.522** | (2.27) | 0.340*** | (3.42) | 0.340*** | (3.42) |
| Observations | 40,241 | | 40,241 | | 40,241 | | 40,241 | |
| r2_p | 0.155 | | 0.155 | | 0.0941 | | 0.0940 | |
| chi2/F | 2217*** | | 2215*** | | 83.63**8 | | 86.13*** | |
| MeanVIF | 6.04 | | 6.03 | | 6.04 | | 6.03 | |

Robust z-statistics (t-statistics for regressions on magnitude) in parentheses. We include industry and year fixed effects and standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1. Definitions and sources of all the variables are reported in Appendix B.

### *4.4.2 Expected and unexpected accounting treatment of SDCs' capitalisation*

Following the procedure described in section 3.2.2, from the 14,422 firm-year observations of non-capitalisers in our sample, we identified 6,484 firm-year observations as 'mandatory non-capitalisers'. Thus, arguably, the remaining non-capitalisers in our sample (7,938 firm-year observations) could potentially capitalise SDCs. From these, we find that the vast majority (6,058) follow the unexpected method (not capitalising) and thus could capitalise SDCs. Further, from the firm-year observations that actually capitalise SDCs, a small (large) proportion follow the unexpected (expected) method, ie 1,341 (24,485). Table 4.6 summarises this information.

**Table 4.6: Companies following the 'expected' and 'unexpected' accounting treatment**

| | **Non-capitalisers** | | **Capitalisers** |
|---|---|---|---|
| | **Mandatory non-capitalisers** | **Potential capitalisers** | |
| **Full sample [40,241 observations]** | 6,484 | 7,938 | 25,819 |
| **Expected method** | – | 1,880 (hence expected to be non-capitalisers) | 24,478 (hence expected to be capitalisers) |
| **Unexpected method** | – | 6,058 (ie they are expected to be capitalisers) | 1,341 (ie they are expected to be non-capitalisers) |

Figure 4.6 shows the percentage of firm-year observations following the unexpected method for each country in our sample. All firms from Argentina, Brazil, Greece, India, Indonesia, Ireland, Mexico, Peru, Portugal and South Africa that do not capitalise SDCs and are not classified as 'mandatory non-capitalisers' could have capitalised such expenditure at least partially. It is noted that, most of these are countries with low 'retention rates' in our sample (see Appendix A – Table A1). Hence, in combination, this suggests that these countries have a very small proportion of firms with an indication of some R&D expense in the income statement and even smaller proportion capitalising SDC assets in a given year. Other countries with high proportions of unexpected non-capitalisers include China, Jordan, Italy and Hong Kong. Firms from Germany, Belgium, Netherlands, France and Spain have the highest percentage of unexpected capitalisers. On the other side of the spectrum, firms from Argentina,

Brazil, Chile, Colombia, Greece, India, Indonesia, Ireland, Jordan, Mexico, Peru, Philippines, South Africa and Switzerland, do not have any unexpected capitalisers.

**Figure 4.6: Percentage of unexpected non-capitalisers and capitalisers by country**

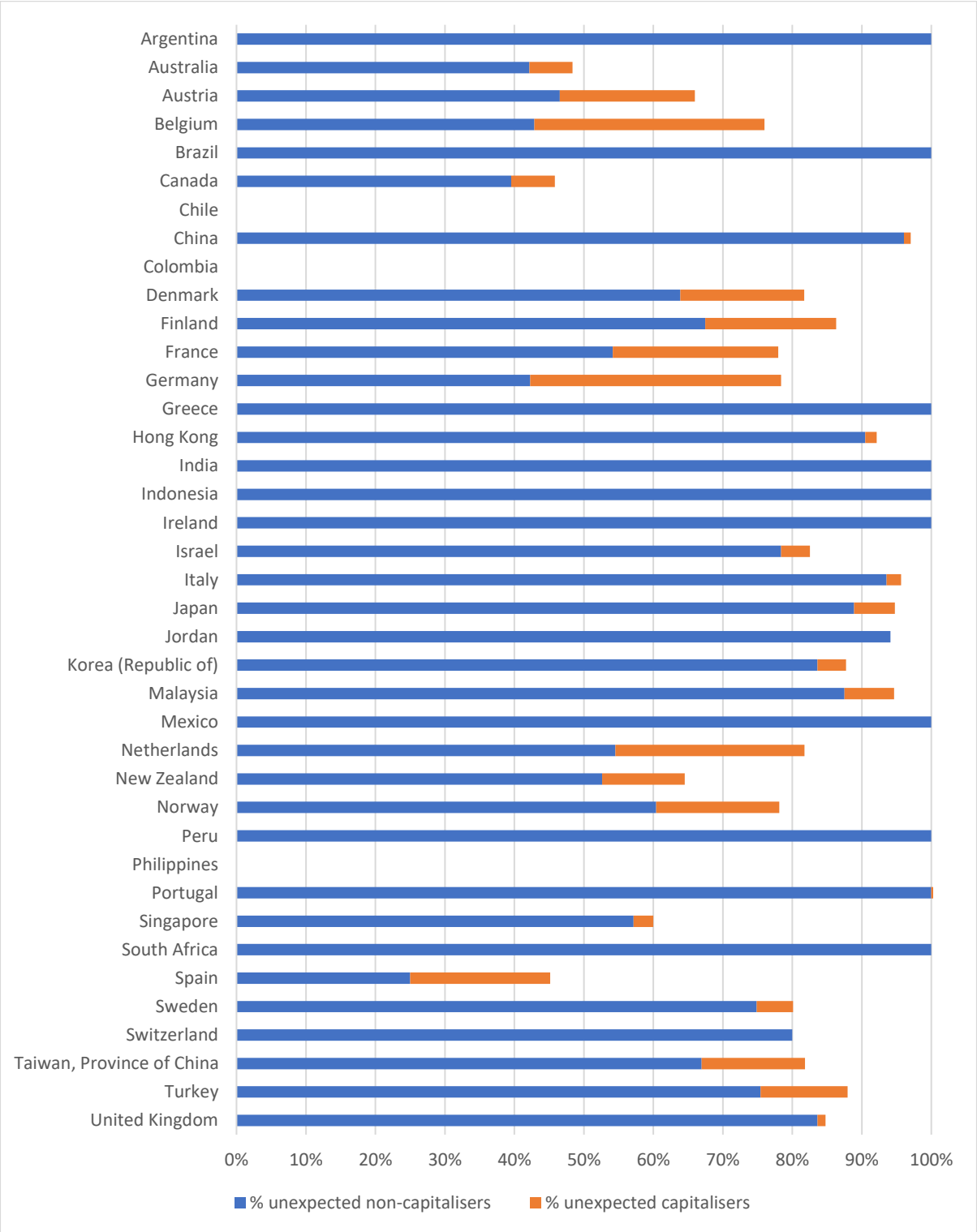
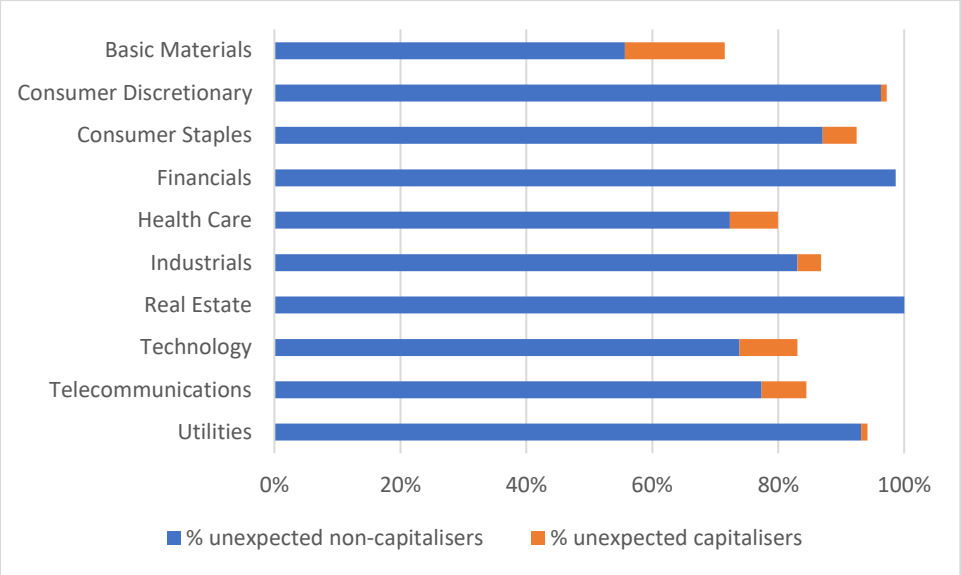


Figure 4.7 plots the percentage of firm-year observations following the unexpected method by industry. We note that all industries have a higher proportion of unexpected non-capitalisers (excluding 'mandatory non-capitalisers') than of unexpected capitalisers. Firms operating in Real Estate and Financials present the highest percentages of unexpected non-capitalisers. Further, firms in these industries have no unexpected capitalisers. Interestingly, firms in these industries also exhibit the highest (lower) percentage of capitalisers (non-capitalisers) (see Figure 4.2).

**Figure 4.7: Percentage of unexpected non-capitalisers and capitalisers by industry**




Overall, these results suggest that firms that capitalise SDCs are mostly those that would be expected to do so. Further, some non-capitalisers would be expected to capitalise some amounts of such expenditure, given their firm-level and country-level characteristics. Moreover, firms in specific industries, such as Real Estate and Financials, where we observe large proportions of capitalisers, appear to have even more companies that could have capitalised SDCs than other sectors.

### *4.4.3 SDC capitalisation and material business combinations*

As indicated in Table 4.4, firms that are capitalisers of SDCs have concluded significantly more material business combinations than non-capitalisers. We also see from the results in Table 4.5

that having concluded a material business combination in a given year is indeed positively associated with the likelihood of being a capitaliser and the amounts of SDCs capitalised in the year. Given these results and the expectation that firms with material business combinations in a given year are probably different from firms that do not conclude such a combination,[11] in this section the sample is split across these two sub-samples. We explore whether the two samples have different determinants for the decision to capitalise SDCs and the amounts they capitalise in a given year. Table 4.7 presents the results of our multivariate analysis in four models for each sub-sample. Similar to the main regression results, the first two models examine the decision to capitalise SDCs and the latter two examine the determinants of the magnitude of the amounts capitalised.

Some of the results on the decision to capitalise SDCs are similar to the main findings: ie, whether firms have concluded a material business combination or not, the likelihood of deciding to capitalise SDCs is higher when firms have higher betas and leverage and when companies have incentives to capitalise SDCs to meet earnings targets and have capitalised R&D costs. Further, firms headquartered in countries with more skilled labour and better scientific research legislation are more likely to capitalise SDCs. At the same time, firms with higher R&D intensity and those that operate in a country with lower health infrastructure are less likely to capitalise their software costs, irrespective of conducting material business combinations. Having greater growth opportunities (ie higher book to market), being larger in size, employing a Big Four auditor, and/or having more international sales are not significant for the sub-sample of firms that have material business combinations. Hence, these factors are significant determinants of SDC capitalisation for the sub-sample of firms that do not have material business combinations. Moreover, we find that firms headquartered in countries with common law and higher corruption levels are more likely to capitalise SDCs when they have concluded material business combinations in a given year, although these are not significant determinants for the full sample.

The coefficients reported in Models 3 and 4 indicate that, whether a company has a material business combination or not, factors associated with higher amounts of SDCs capitalised are: being riskier (ie having higher beta), being more leveraged, having lower R&D intensity, having incentives to capitalise larger amounts of SDCs for meeting earnings targets

[11] In untabulated descriptive statistics, indeed, we identify significant differences in most of the firm-level and country-level characteristics of firms with and without material business combinations.

or benchmarks, and being headquartered in countries with higher investor protection. Nonetheless, book to market, firm size, having a Big Four auditor, having more international sales, having more frequent R&D capitalisation and being headquartered in a civic-law country or a country with highly skilled labour and better health infrastructure are not significant determinants of the amounts of SDCs capitalised in the sub-sample of firms with material business combinations. Hence, these characteristics are related to the levels of SDCs capitalisation only for firms without material business combinations. In fact, health infrastructure environment has a statistically significant coefficient, albeit with the opposite sign across the two sub-samples. Overall, these findings suggest that firms with a material business combination in a given year have different determinants for the decision to capitalise software costs and the amounts they capitalise in a given year than those firms that do not do this.

**Table 4.7: Multivariate analysis across firms with and without material business combinations**

| | Decision to capitalise | | | | Magnitude of capitalisation | | | |
|---|---|---|---|---|---|---|---|---|
| **VARIABLES** | **Model 1** | | **Model 2** | | **Model 1** | | **Model 2** | |
| | **BC = 0** | **BC = 1** | **BC = 0** | **BC = 1** | **BC = 0** | **BC = 1** | **BC = 0** | **BC = 1** |
| BM | -0.194*** | -0.133* | -0.194*** | -0.117 | -0.111*** | -0.061* | -0.111*** | -0.054 |
| | (-8.53) | (-1.67) | (-8.52) | (-1.46) | (-9.09) | (-1.85) | (-9.08) | (-1.64) |
| SIZE | 0.024*** | -0.012 | 0.024*** | -0.013 | 0.012*** | -0.006 | 0.012*** | -0.006 |
| | (6.29) | (-0.94) | (6.29) | (-1.03) | (6.03) | (-1.20) | (6.03) | (-1.29) |
| BETA | 0.046*** | 0.093** | 0.047*** | 0.092** | 0.022*** | 0.027* | 0.022*** | 0.027* |
| | (2.90) | (2.02) | (2.90) | (1.99) | (2.79) | (1.75) | (2.80) | (1.72) |
| LEV | 0.041*** | 0.078** | 0.041*** | 0.084*** | 0.013*** | 0.023*** | 0.013*** | 0.025*** |
| | (3.39) | (2.52) | (3.39) | (2.70) | (2.91) | (2.73) | (2.91) | (3.02) |
| BIG4 | 0.143*** | 0.086 | 0.143*** | 0.084 | 0.061*** | 0.030 | 0.061*** | 0.027 |
| | (4.79) | (1.16) | (4.80) | (1.12) | (3.88) | (0.99) | (3.89) | (0.91) |
| CAPEX | -0.004 | -0.317 | -0.003 | -0.363 | 0.051 | -0.051 | 0.051 | -0.063 |
| | (-0.03) | (-0.65) | (-0.02) | (-0.75) | (0.68) | (-0.29) | (0.69) | (-0.35) |
| INTSALES | 0.003*** | -0.000 | 0.003*** | -0.000 | 0.002*** | -0.000 | 0.002*** | -0.000 |
| | (6.84) | (-0.27) | (6.85) | (-0.32) | (7.73) | (-0.21) | (7.73) | (-0.23) |
| RDValue | 0.000*** | 0.000 | 0.000*** | 0.000* | 0.000*** | 0.000** | 0.000*** | 0.000** |
| | (4.01) | (1.64) | (4.01) | (1.73) | (3.44) | (2.04) | (3.44) | (2.21) |
| RDInt | -2.722*** | -3.408*** | -2.701*** | -2.734*** | -1.780*** | -1.548*** | -1.766*** | -1.281*** |
| | (-10.31) | (-5.13) | (-10.31) | (-4.21) | (-10.58) | (-4.77) | (-10.57) | (-3.94) |
| PAST_BEAT | 0.080*** | 0.267*** | | | 0.044*** | 0.097*** | | |
| | (3.66) | (4.11) | | | (3.77) | (4.32) | | |
| ZERO_BEAT | 0.048 | 0.737*** | | | 0.028 | 0.258*** | | |
| | (1.11) | (4.83) | | | (1.10) | (6.14) | | |
| BENCH_BEAT | | | 0.076*** | 0.327*** | | | 0.042*** | 0.122*** |
| | | | (3.64) | (5.11) | | | (3.73) | (5.51) |
| CAP | 0.227*** | -0.048 | 0.227*** | -0.057 | 0.141*** | -0.017 | 0.141*** | -0.019 |
| | (6.97) | (-0.69) | (6.98) | (-0.82) | (8.44) | (-0.61) | (8.44) | (-0.70) |
| AGE | -0.029 | -0.016 | -0.029 | -0.019 | -0.013 | -0.005 | -0.013 | -0.007 |
| | (-1.36) | (-0.33) | (-1.35) | (-0.39) | (-1.27) | (-0.29) | (-1.26) | (-0.39) |
| ANTISELF | 0.084 | 0.239 | 0.085 | 0.243 | 0.134** | 0.203** | 0.135** | 0.207** |
| | (0.75) | (0.92) | (0.76) | (0.94) | (2.44) | (2.14) | (2.45) | (2.17) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CIV_COM | 0.028 | -0.213* | 0.028 | -0.218* | 0.044** | -0.064 | 0.045** | -0.067 |
| | (0.61) | (-1.74) | (0.62) | (-1.79) | (2.36) | (-1.57) | (2.37) | (-1.63) |
| CORR | -0.000 | 0.008** | -0.000 | 0.007** | -0.000 | 0.003** | -0.000 | 0.003** |
| | (-0.37) | (2.05) | (-0.36) | (2.02) | (-0.11) | (2.40) | (-0.11) | (2.31) |
| Healthinfrastructure | -0.316*** | -0.084* | -0.316*** | -0.086** | -0.153*** | -0.018 | -0.153*** | -0.019 |
| | (-18.05) | (-1.94) | (-18.04) | (-1.98) | (-18.05) | (-1.11) | (-18.05) | (-1.16) |
| Skilledlabour | 0.092*** | -0.107* | 0.092*** | -0.108* | 0.058*** | -0.030 | 0.058*** | -0.031 |
| | (3.29) | (-1.68) | (3.29) | (-1.70) | (4.53) | (-1.29) | (4.53) | (-1.31) |
| Scientificresearchlegislation | 0.079*** | -0.076 | 0.079*** | -0.074 | 0.042*** | -0.034* | 0.042*** | -0.034* |
| | (3.17) | (-1.49) | (3.17) | (-1.45) | (3.25) | (-1.66) | (3.24) | (-1.66) |
| GDPGrowth | -0.001 | -0.008 | -0.001 | -0.008 | -0.000 | -0.002 | -0.000 | -0.002 |
| | (-0.29) | (-1.56) | (-0.27) | (-1.52) | (-0.51) | (-1.18) | (-0.50) | (-1.10) |
| Constant | 0.208 | 2.467*** | 0.206 | 2.469*** | 0.188* | 1.219*** | 0.187* | 1.225*** |
| | (0.89) | (4.44) | (0.88) | (4.45) | (1.81) | (6.29) | (1.80) | (6.30) |
| Observations | 36,165 | 4,076 | 36,165 | 4,076 | 36,165 | 4,076 | 36,165 | 4,076 |
| r2_p | 0.161 | 0.0904 | 0.161 | 0.0852 | 0.0969 | 0.0570 | 0.0968 | 0.0536 |
| chi2/F | 2085*** | 255.8*** | 2084*** | 240.2*** | 83.68*** | 7.470*** | 86.29*** | 7.219*** |
| Mean VIF | 1.98 | 2.21 | 2.01 | 2.24 | 1.98 | 2.21 | 2.01 | 2.24 |

Robust z-statistics (t-statistics for regressions on magnitude) in parentheses. We include industry and year fixed effects and standard errors are clustered at the firm level.
*** p<0.01, ** p<0.05, * p<0.1 Definitions and sources of all the variables are reported in Appendix B.

### *4.4.4 Additional analysis: implementation of IFRS 3 (Revised) and capitalisation of SDCs*

The revised IFRS 3, which was effective for financial periods starting on or after 1 July 2009, and resultant changes in IAS 38 for recognition of intangible assets arising from business combinations, raised the expectation for 'an increase in the intangible assets recognised as a result of business combinations' (IASB 2014:13). To address this conjecture with particular regard to the recognition of SDCs, we focus on all countries that had adopted IFRS or had converged their accounting standards with IFRS by 2008. Subsequently, we followed the same sample selection approach discussed in Section 3.1. This time, however, we limited the sample period so that we considered the same number of years before and after the implementation of IFRS 3(R) (ie the earliest is 2006 and the latest is 2013) and we maintain only the firm-year observations for firms that made at least one business combination in the period before or after the implementation of IFRS 3(R). This yields a sample of c.6500 firm-year observations. We note that, in untabulated descriptive statistics, although the number of capitalisers increases slightly, the magnitude of capitalised SDCs and the net SDCs shown on the balance sheets is not different in the post IFRS 3R adoption period.

In order to examine the effect of IFRS 3(R) adoption, we extended Model (1), discussed in Section 3.2, and included an indicator variable (POST), which is equal to one (1) for reporting periods ending after 1 July 2010 and zero (0) otherwise. We present the results of the multivariate analysis in Table 4.8. Our results show that the coefficients of POST are negative but insignificant (coefficients: -0.079, -0.079, -0.042 and -0.043, respectively; p-values >10%). These results suggest that the adoption of IFRS 3(R) does not have an influence on a firm's decision to capitalise SDCs or the magnitude of SDC capitalisation.

We expanded this analysis and repeated the same test for the sub-sample of firm-year observations only for those firms that had conducted a material business combination in any given year before and after the implementation of IFRS 3(R). We present the results of this multivariate analysis in Table 4.9. Our results show that the coefficients of POST are again negative but insignificant (coefficients: -0.079, -0.077, -0.035 and -0.034, respectively; p-values>10%). These results suggest that the implementation of IFRS 3(R) does not influence a firm's decision to capitalise SDCs or the magnitude of SDC capitalisation, even if it has conducted a material business combination.

**Table 4.8: Multivariate analysis: the adoption of IFRS 3 (revised)**

| | Decision to capitalise SDCs | | Magnitude of SDC capitalisation | |
|---|---|---|---|---|
| **VARIABLES** | **Model 1** | **Model 2** | **Model 1** | **Model 2** |
| **POST** | -0.079 | -0.079 | -0.042 | -0.043 |
| | (-0.76) | (-0.76) | (-0.69) | (-0.69) |
| **BM** | -0.169*** | -0.166*** | -0.105*** | -0.103*** |
| | (-2.76) | (-2.73) | (-2.69) | (-2.66) |
| **SIZE** | -0.011 | -0.011 | -0.007 | -0.007 |
| | (-0.68) | (-0.68) | (-0.71) | (-0.72) |
| **BETA** | 0.166** | 0.165** | 0.109** | 0.109** |
| | (2.27) | (2.26) | (2.41) | (2.40) |
| **LEV** | 0.149*** | 0.149*** | 0.073*** | 0.073*** |
| | (3.55) | (3.56) | (3.91) | (3.93) |
| **BIG4** | 0.167** | 0.166** | 0.096* | 0.095* |
| | (2.14) | (2.13) | (1.88) | (1.87) |
| **CAPEX** | -0.066 | -0.065 | -0.026 | -0.025 |
| | (-0.20) | (-0.20) | (-0.14) | (-0.13) |
| **INTSALES** | -0.002 | -0.002 | -0.001 | -0.001 |
| | (-1.36) | (-1.35) | (-1.13) | (-1.12) |
| **RDValue** | -0.000 | -0.000 | -0.000 | -0.000 |
| | (-0.46) | (-0.44) | (-0.34) | (-0.33) |
| **RDInt** | -3.663*** | -3.583*** | -2.586*** | -2.529*** |
| | (-3.94) | (-3.88) | (-3.81) | (-3.75) |
| **PAST_BEAT** | 0.150*** | | 0.101*** | |
| | (2.77) | | (2.90) | |
| **ZERO_BEAT** | 0.149 | | 0.102 | |
| | (1.38) | | (1.44) | |
| **BENCH_BEAT** | | 0.163*** | | 0.108*** |
| | | (3.09) | | (3.22) |
| **CAP** | -0.277*** | -0.278*** | -0.179*** | -0.180*** |
| | (-3.07) | (-3.08) | (-2.85) | (-2.88) |
| **BC** | 0.170*** | 0.169*** | 0.104*** | 0.104*** |
| | (3.54) | (3.54) | (3.50) | (3.50) |
| **AGE** | 0.036 | 0.036 | 0.021 | 0.021 |
| | (0.52) | (0.51) | (0.50) | (0.50) |
| **ANTISELF** | -0.457 | -0.462 | -0.302 | -0.305 |
| | (-1.04) | (-1.05) | (-1.08) | (-1.09) |
| **CIV_COM** | -0.585** | -0.588** | -0.389** | -0.392** |
| | (-2.10) | (-2.11) | (-2.16) | (-2.17) |
| **CORR** | 0.001 | 0.001 | 0.001 | 0.001 |
| | (0.24) | (0.25) | (0.34) | (0.35) |
| **Healthinfrastructure** | -0.034 | -0.034 | -0.016 | -0.016 |
| | (-0.68) | (-0.67) | (-0.50) | (-0.48) |
| **Skilledlabour** | -0.032 | -0.032 | -0.018 | -0.018 |
| | (-0.69) | (-0.69) | (-0.66) | (-0.67) |
| **Scientificresearchlegislation** | -0.097* | -0.097* | -0.072** | -0.072** |
| | (-1.90) | (-1.90) | (-2.29) | (-2.29) |
| **GDPGrowth** | -0.010*** | -0.010*** | -0.005*** | -0.005*** |
| | (-3.08) | (-3.07) | (-2.80) | (-2.80) |
| **Constant** | 1.281** | 1.287** | 1.071** | 1.075*** |
| | (2.03) | (2.04) | (2.57) | (2.58) |
| **Observations** | 6,505 | 6,505 | 6,505 | 6,505 |
| **r2_p** | 0.103 | 0.103 | 0.0661 | 0.0660 |
| **chi2/F** | 202.6*** | 202.0*** | 6.168*** | 6.317*** |
| **Mean VIF** | 3.4 | 2.71 | 3.4 | 3.46 |

Robust z-statistics (t-statistics for regressions on magnitude) in parentheses. We include industry and year fixed effects, and standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1 Definitions and sources of all the variables are reported in Appendix B.

## Table 4.9: Multivariate analysis: the adoption of IFRS 3 (revised)

| | Decision to capitalise SDCs | | Magnitude of SDC capitalisation | |
|---|---|---|---|---|
| **VARIABLES** | **Model 1** | **Model 2** | **Model 1** | **Model 2** |
| **POST** | -0.079 | -0.077 | -0.035 | -0.034 |
| | (-0.47) | (-0.46) | (-0.39) | (-0.39) |
| **BM** | -0.059 | -0.055 | -0.040 | -0.037 |
| | (-0.54) | (-0.51) | (-0.65) | (-0.61) |
| **SIZE** | 0.037 | 0.037 | 0.017 | 0.017 |
| | (1.31) | (1.31) | (1.09) | (1.09) |
| **BETA** | -0.002 | -0.001 | 0.009 | 0.009 |
| | (-0.01) | (-0.01) | (0.14) | (0.14) |
| **LEV** | 0.260*** | 0.261*** | 0.103*** | 0.104*** |
| | (3.71) | (3.72) | (4.54) | (4.56) |
| **BIG4** | 0.256** | 0.252** | 0.126* | 0.124* |
| | (2.05) | (2.03) | (1.69) | (1.65) |
| **CAPEX** | -0.757 | -0.748 | -0.351 | -0.343 |
| | (-1.33) | (-1.31) | (-1.20) | (-1.18) |
| **INTSALES** | -0.002 | -0.002 | -0.001 | -0.001 |
| | (-1.16) | (-1.14) | (-0.91) | (-0.89) |
| **RDValue** | -0.000* | -0.000* | -0.000 | -0.000 |
| | (-1.78) | (-1.76) | (-1.64) | (-1.62) |
| **RDInt** | -4.451*** | -4.351*** | -2.760*** | -2.685*** |
| | (-3.34) | (-3.31) | (-3.13) | (-3.08) |
| **PAST_BEAT** | 0.160** | | 0.094** | |
| | (2.13) | | (2.20) | |
| **ZERO_BEAT** | 0.209 | | 0.137 | |
| | (1.18) | | (1.35) | |
| **BENCH_BEAT** | | 0.192** | | 0.113*** |
| | | (2.56) | | (2.67) |
| **CAP** | -0.327** | -0.330** | -0.199** | -0.201** |
| | (-2.47) | (-2.50) | (-2.35) | (-2.39) |
| **BC** | 0.177*** | 0.175*** | 0.109*** | 0.108*** |
| | (3.45) | (3.42) | (3.64) | (3.61) |
| **AGE** | -0.016 | -0.016 | -0.008 | -0.008 |
| | (-0.15) | (-0.15) | (-0.14) | (-0.14) |
| **ANTISELF** | -0.982 | -0.986 | -0.629 | -0.631 |
| | (-1.34) | (-1.35) | (-1.49) | (-1.50) |
| **CIV_COM** | -1.417*** | -1.419*** | -0.869*** | -0.870*** |
| | (-2.97) | (-2.97) | (-3.21) | (-3.22) |
| **CORR** | 0.005 | 0.005 | 0.004 | 0.004 |
| | (0.56) | (0.54) | (0.82) | (0.81) |
| **Healthinfrastructure** | 0.109 | 0.109 | 0.068 | 0.068 |
| | (1.33) | (1.33) | (1.47) | (1.47) |
| **Skilledlabour** | 0.052 | 0.051 | 0.031 | 0.030 |
| | (0.70) | (0.69) | (0.81) | (0.79) |
| **Scientificresearchlegislation** | -0.240*** | -0.241*** | -0.146*** | -0.147*** |
| | (-2.77) | (-2.80) | (-3.23) | (-3.24) |
| **GDPGrowth** | -0.003 | -0.003 | -0.001 | -0.001 |
| | (-0.58) | (-0.61) | (-0.32) | (-0.35) |
| **Constant** | 1.233 | 1.235 | 1.162* | 1.163* |
| | (1.20) | (1.20) | (1.85) | (1.85) |

| | | | | |
|---|---|---|---|---|
| **Observations** | 2,957 | 2,957 | 3,000 | 3,000 |
| **r2_p** | 0.142 | 0.142 | 0.0947 | 0.0946 |
| **chi2/F** | 123.5*** | 123.7*** | 5.741*** | 5.886*** |
| **Mean VIF** | 3.73 | 3.02 | 3.73 | 3.8 |

Robust z-statistics (t-statistics for regressions on magnitude) in parentheses. We include industry and year fixed effects, and standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1 Definitions and sources of all the variables are reported in Appendix B.

# 5. Conclusion

### *5.1 Conclusions and recommendations*

While the wider topic of intangible assets and their accounting treatment has been on the agenda of standard setters and regulators for some time, there is no evidence on the frequency with which SDCs are capitalised or of the amounts concerned on the balance sheets of IFRS-reporting firms. Further to the recent request in the IASB Agenda Consultation and various initiatives of other international, and standard-setting, bodies (FRC 2019; EFRAG 2019 and FASB 2021), in this study we address this lacuna. Specifically, by drawing on listed companies from 39 countries (40,241 firm-year observations) that have converged their national standards to IFRS or adopted IFRS, for the five-year period 2015 to 2019, we collected and summarised evidence on how many companies capitalise SDC during the year (capitalisers) and how many report R&D costs in the income statement but do not capitalise SDC during the year (non-capitalisers). This evidence is provided in aggregate and also at a country and industry level.

Key findings include the following. The data shows that almost two-thirds of the firm-year observations in the sample capitalise SDCs. This suggests that companies very frequently recognise and report SDCs separately. This contrasts with Mazzi et al.'s report (2019b) on general R&D costs, in which 62% of the sample are shown to expense such costs. The high frequency of SDC capitalisation we identify holds even though the amounts involved can be considered immaterial relative to the companies' total assets and/or market values. At a country/regional level, however, we find significant differences in the percentage of capitalising firms and the SDC asset intensity on companies' balance sheets. While firms from Asia show a greater tendency to recognise SDCs separately on the balance sheet than do firms in Oceania and Europe, the SDC asset intensity is far smaller than for firms in these other regions. At a sector level, firms in the Consumer Discretionary, Financials, Real Estate and Utilities Sectors exhibit the largest proportion of capitalisers (it is greater than 70%). Firms in the Telecommunications industry exhibit the highest net SDC asset intensity, followed by firms in Technology and Consumer Discretionary.

Of the firms that complete material business combinations in a given year, a large proportion capitalise both SDCs and R&D in the year. When compared with firms that do not capitalise SDCs, firms that do so are more likely to be larger, riskier, have higher leverage, employ one of the Big Four auditors, have more international sales, have incentives to capitalise SDCs to meet their earnings targets, capitalise other development costs and have

concluded material business combinations during the year. These same characteristics associate positively with the magnitude of amounts capitalised. Even so, firm size, employing a Big Four auditor, and making international sales are not significant factors affecting the decision to capitalise SDCs for the sub-sample of firms that have material business combinations. Further, book to market, firm size, having a Big Four auditor, international sales, frequency of R&D capitalisation and being headquartered in a civic-law country or a country with highly skilled labour and better health infrastructure are not significant determinants of the amounts of SDCs capitalised in the sub-sample with material business combinations. Hence, these characteristics are related to the levels of SDC capitalisation only for firms without material business combinations. The results from the separate sample focusing on the years before and after the implementation of IFRS 3 (R) in 2009 suggest that the implementation of the revised standard does not influence a firm's decision to capitalise SDCs or the magnitude of SDC capitalisation, even if it has conducted material business combinations.

The key recommendations from these findings are as follows. The high frequency of capitalisation of SDCs, in direct contrast to the prior evidence of relative lack of capitalisation of development costs of new products and processes (ie R&D-related costs) under IAS 38, reinforces the call for revision to the criteria of capitalisation of other development costs in IAS 38. The fact that having material business combinations is associated with a larger number of capitalisers and higher amounts of capitalised SDCs suggests that IFRS 3 does achieve its objectives for the separate recognition of SDCs. Nonetheless, the implementation of IFRS 3(R) does not seem to have had an effect (and hence has not improved financial reporting) in this respect, relative to the previous standard. No further revision of IFRS 3 appears pertinent, at least as far as the recognition of SDCs is concerned. The significant differences in the percentage of capitalising firms and SDC asset intensity on companies' balance sheets across countries/regions should alert users of financial statements, preparers, auditors and/or enforcers of financial information to the differential reporting incentives and contextual influential factors across different countries, which result in significant variations in reporting practices. Finally, although we observe relatively good disclosure practices on the issue of SDCs, IAS 38 and auditors and enforcing bodies could encourage more refined disclosures in assisting firms to distinguish how much of the capitalised amounts of SDC relate to externally acquired or internally developed software.

### *5.2 Limitations and directions for future research*

As in every research study, the results reported above are subject to a number of common limitations and caveats. First, the firm-level data we used is provided by commercial databases. These may contain errors and misclassifications. Second, certain firms may engage in R&D but may not separately report any R&D expense in the income statement or any SDC asset on the balance sheet. These companies are not included in the sample. In practice, their inclusion is unlikely to affect our results because these firms have low R&D intensity, and presumably low materiality. Third, certain firms may capitalise SDC costs but may not report these as a separate category of intangible assets; some companies may have (mis)classified such amounts as part of general development costs capitalised. Hence, we cannot classify them as capitalisers in our sample. Similarly, it is likely that some companies may develop software internally and part of this expenditure is treated as an expense in the income statement. The databases that we rely on for the data collection do not capture such amounts separately. It is likely that companies merge these expensed costs with other R&D-related expenses. The implications from these potential (mis)classifications would be negligible for the tests on and conclusions about the amounts capitalised, because it is presumed that the non-separate reporting of such amounts is due to their small, non-material, magnitude. Fourth, we rely on econometric techniques to identify the expected practice of SDC capitalisation. While we have made every effort to develop a model that accurately predicts the expected accounting treatment of SDCs, we recognise that this may misclassify some companies.

Future research could examine any consequences of the decision to capitalise SDCs and of the amounts capitalised on various equity and debt market outcomes. Further, insights about the decision to capitalise SDCs and about the amounts capitalised, while comparing IFRS and US GAAP reporters would be pertinent. Additionally, future research could consider the views of preparers on their respective accounting treatments of R&D costs compared with those costs associated with SDCs. This could shed useful light on the differences, in practice, between internally generated and externally purchased intangibles and their treatment under IAS 38.

## About the authors

***Dr Dionysia Dionysiou, University of Stirling***
Dionysia is a senior lecturer in Accounting and Finance at the University of Stirling. Before that, she was a researcher within the INTACCT network, where she was working on the implications of the mandatory implementation of IFRS in European countries. Dionysia's main areas of research interest are in corporate finance and corporate distress, as well as financial reporting and market-based accounting. She has published in internationally acclaimed journals in these areas and, for her practice-relevant research, she has received research grants from the Institute of Chartered Accountants of Scotland (ICAS) and ACCA.

***Dr Richard Slack, Durham University***
Richard is a professor in accounting at Durham University Business School. He joined Durham University in 2012, having previously been professor in accounting at Newcastle Business School, Northumbria University. Before his academic career, Richard, a graduate of St Andrews University, worked at Price Waterhouse and is a qualified chartered accountant. Richard's research encompasses areas of accounting information, and its use by, and usefulness to, capital market users. Further, Richard is interested in the way information is presented by companies and whether narrative disclosure is decision-useful to stakeholder groups.

***Dr Ioannis Tsalavoutas, University of Glasgow***
Ioannis is a professor of accounting at the University of Glasgow. His main area of expertise is financial accounting and reporting, in particular, investigating companies' reporting practices under IFRS across different jurisdictions, along with any economic consequences that may arise from divergence in practice. Ioannis' work experience includes positions as an accounting assistant (in Greece) and as a financial accounting and reporting analyst at Company Reporting Ltd in Edinburgh. Before joining the University of Glasgow in January 2015, Ioannis was a lecturer in accounting at the University of Stirling.

***Dr Fanis Tsoligkas, University of Bath***
Fanis is a lecturer in accounting at the University of Bath. His main research interests lie in the fields of financial reporting discretion and the adoption of International Financial Reporting Standards. They also include the capital market effects of accounting information and the effect of trading behaviour of corporate executives and directors. Before joining academia, Fanis practised accountancy in Greece.

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## Appendix A: Information for the firm-year observations excluded from our analysis

Table A1 shows the distribution, by country and year, for the firm-year observations that do not report R&D expense in the income statement and do not recognise an SDC asset on the balance sheet, which were hence excluded from our analysis. For comparative purposes, Table A1 also shows the number of firm-year observations included in our analysis, along with the resultant 'retention rate'. This latter column indicates that, on average, the percentage of firm-year observations that report an R&D expense in the income statement and/or recognise an SDC asset in the year is about 52%. Thus, overall, we include a large number of firms from a large number of IFRS reporting countries in our sample.

We note, however, that for 11 (5) countries the retention rate is below 30% (20%). On the one other hand, for China and Japan (Korea and Taiwan) the retention rate is above 90% (80%). This suggests that a significant majority of firms in these countries report an R&D expense in the income statement and/or recognise an SDC asset in the year. Further, this, and the fact that a very large number of firms are listed in each of China, Korea and Taiwan, explains why our sample heavily represents firms in the Asian region.

Like Table A1, Table A2 reports the distribution of firm-year observations excluded from and included in our analysis, across industries. Overall, with the exception of firms in the Real Estate industry, we included a very large number of firm-year observations from each industry in our analysis.

Looking at more details, the data in Table A2 indicates that, probably as expected because of their operations, our sample includes the majority of firms in the Health Care (76%), Technology (74%) and Telecommunications (69%) industries.

**Table A1: Distribution of firm-year observations excluded from and included in our analysis, by country**

| Country | 2015 | 2016 | 2017 | 2018 | 2019 | Total excluded | Total included | Retention rate |
|---|---|---|---|---|---|---|---|---|
| **Argentina** | 35 | 37 | 34 | 33 | 39 | 178 | 84 | **32.06%** |
| **Australia** | 690 | 603 | 620 | 631 | 631 | 3,175 | 1,326 | **29.46%** |
| **Austria** | 29 | 24 | 24 | 24 | 19 | 120 | 113 | **48.50%** |
| **Belgium** | 54 | 52 | 56 | 50 | 50 | 262 | 204 | **43.78%** |
| **Brazil** | 85 | 80 | 78 | 74 | 63 | 380 | 481 | **55.87%** |
| **Canada** | 633 | 520 | 502 | 495 | 481 | 2,631 | 1,030 | **28.13%** |
| **Chile** | 109 | 88 | 81 | 76 | 75 | 429 | 307 | **41.71%** |
| **China** | 257 | 216 | 188 | 174 | 180 | 1,015 | 11,058 | **91.59%** |
| **Colombia** | 0 | 14 | 13 | 11 | 11 | 49 | 18 | **26.87%** |
| **Denmark** | 71 | 57 | 55 | 59 | 56 | 298 | 168 | **36.05%** |
| **Finland** | 47 | 51 | 55 | 50 | 51 | 254 | 257 | **50.29%** |
| **France** | 234 | 234 | 225 | 207 | 171 | 1,071 | 902 | **45.72%** |
| **Germany** | 152 | 144 | 140 | 143 | 121 | 700 | 960 | **57.83%** |
| **Greece** | 87 | 76 | 69 | 65 | 21 | 318 | 247 | **43.72%** |
| **Hong Kong** | 760 | 814 | 864 | 946 | 860 | 4,244 | 1,491 | **26.00%** |
| **India** | 1,407 | 1,267 | 1,259 | 1,239 | 1,060 | 6,232 | 3,184 | **33.81%** |
| **Indonesia** | 343 | 337 | 338 | 352 | 254 | 1,624 | 383 | **19.08%** |
| **Ireland** | 14 | 14 | 14 | 13 | 12 | 67 | 79 | **54.11%** |
| **Israel** | 191 | 171 | 174 | 181 | 177 | 894 | 495 | **35.64%** |
| **Italy** | 161 | 150 | 154 | 158 | 146 | 769 | 300 | **28.06%** |
| **Japan** | 2 | 3 | 1 | 3 | 6 | 15 | 414 | **96.50%** |
| **Jordan** | 145 | 123 | 113 | 116 | 48 | 545 | 74 | **11.95%** |
| **Korea** | 210 | 162 | 165 | 140 | 161 | 838 | 4,986 | **85.61%** |
| **Malaysia** | 462 | 524 | 534 | 532 | 612 | 2,664 | 325 | **10.87%** |
| **Mexico** | 73 | 69 | 75 | 81 | 89 | 387 | 89 | **18.70%** |
| **Netherlands** | 37 | 33 | 35 | 32 | 24 | 161 | 236 | **59.45%** |
| **New Zealand** | 58 | 56 | 53 | 52 | 52 | 271 | 228 | **45.69%** |
| **Norway** | 83 | 88 | 93 | 91 | 91 | 446 | 204 | **31.38%** |
| **Peru** | 46 | 41 | 43 | 45 | 50 | 225 | 60 | **21.05%** |
| **Philippines** | 4 | 7 | 9 | 11 | 5 | 36 | 12 | **25.00%** |
| **Portugal** | 25 | 18 | 20 | 15 | 16 | 94 | 60 | **38.96%** |
| **Singapore** | 48 | 46 | 43 | 44 | 298 | 479 | 93 | **16.26%** |
| **South Africa** | 150 | 142 | 143 | 144 | 132 | 711 | 430 | **37.69%** |
| **Spain** | 54 | 56 | 53 | 53 | 42 | 258 | 281 | **52.13%** |
| **Sweden** | 191 | 199 | 212 | 234 | 241 | 1,077 | 547 | **33.68%** |
| **Switzerland** | 1 | 2 | 2 | 1 | 1 | 7 | 12 | **63.16%** |
| **Taiwan** | 296 | 292 | 303 | 283 | 313 | 1,487 | 6,481 | **81.34%** |
| **Turkey** | 188 | 172 | 165 | 169 | 145 | 839 | 528 | **38.62%** |
| **United Kingdom** | 505 | 467 | 444 | 423 | 339 | 2,178 | 2,094 | **49.02%** |
| **Venezuela** | 3 | 2 | 2 | 2 | 1 | 10 | 0 | **0.00%** |
| ***Total*** | 7,940 | 7,451 | 7,451 | 7,452 | 7,144 | 37,438 | ***40,241*** | **51.80%** |

**Table A2: Distribution of firm-year observations excluded from and included in our analysis, by industry**

| Industry | 2015 | 2016 | 2017 | 2018 | 2019 | Total excluded | Total included | Retention rate |
|---|---|---|---|---|---|---|---|---|
| **Basic Materials** | 1,455 | 1,274 | 1,253 | 1,232 | 1,174 | 6,388 | 5,101 | **44.40%** |
| **Consumer Discretionary** | 1,456 | 1,388 | 1,411 | 1,364 | 1,300 | 6,919 | 7,449 | **51.84%** |
| **Consumer Staples** | 551 | 533 | 536 | 534 | 517 | 2,671 | 2,710 | **50.36%** |
| **Financials** | 955 | 866 | 850 | 873 | 840 | 4,384 | 2,100 | **32.39%** |
| **Health Care** | 219 | 236 | 248 | 252 | 261 | 1,216 | 3,808 | **75.80%** |
| **Industrials** | 1,590 | 1,523 | 1,534 | 1,529 | 1,463 | 7,639 | 9,056 | **54.24%** |
| **Real Estate** | 845 | 811 | 823 | 846 | 809 | 4,134 | 915 | **18.12%** |
| **Technology** | 474 | 443 | 441 | 444 | 434 | 2,236 | 6,401 | **74.11%** |
| **Telecommunications** | 159 | 165 | 150 | 165 | 143 | 782 | 1,710 | **68.62%** |
| **Utilities** | 236 | 212 | 205 | 213 | 203 | 1,069 | 991 | **48.11%** |
| ***Total*** | 7,940 | 7,451 | 7,451 | 7,452 | 7,144 | 37,438 | ***40,241*** | **51.80%** |

Table A3 (Panel A) presents the descriptive statistics for key firm-level variables for the firm-year observations that are excluded from our analysis. Panel B of Table A3 contrasts this information with the corresponding characteristics of the firm-year observations we analyse in this report.

The data reveals that, on average, firms excluded from the analysis (ie firms that do not report R&D expense in the income statement and do not recognise an SDC asset on the balance sheet) are smaller in size and more leveraged, have significantly lower levels of international sales, and invest more in tangible fixed assets. and a lower percentage of them are audited by a Big Four auditor.

**Table A3: Descriptive statistics for firm-year observations excluded from our analysis**

| **Panel A: firm-year observations excluded from our analysis** | | | | | | |
|---|---|---|---|---|---|---|
| **VARIABLE** | **N** | **mean** | **sd** | **min** | **median** | **max** |
| **BM** | 37,438 | 1.174 | 1.124 | 0.031 | 0.849 | 7.259 |
| **SIZE** | 37,438 | 15.826 | 4.924 | 7.709 | 15.322 | 31.749 |
| **Beta** | 37,438 | 0.782 | 0.733 | –1.462 | 0.725 | 4.48 |
| **Lev** | 37,438 | 0.894 | 1.547 | 0 | 0.387 | 9.861 |
| **BIG4** | 37,438 | 0.333 | 0.471 | 0 | 0 | 1 |
| **CAPEX** | 37,438 | 0.082 | 0.143 | 0 | 0.027 | 1.004 |
| **INTSALES** | 37,438 | 13.229 | 28.383 | 0 | 0 | 100 |
| **AGE** | 37,438 | 17.261 | 8.985 | 3 | 17 | 46 |
| **Panel B: firm-year observations included in our analysis** | | | | | | |
| **VARIABLE** | **N** | **mean** | **sd** | **min** | **median** | **max** |
| **BM** | 40,241 | 0.686 | 0.605 | 0.035 | 0.508 | 3.926 |
| **SIZE** | 40,241 | 18.409 | 4.461 | 8.699 | 17.892 | 30.873 |
| **Beta** | 40,241 | 0.975 | 0.684 | –1.435 | 0.957 | 6.764 |
| **Lev** | 40,241 | 0.743 | 1.18 | 0 | 0.368 | 8.107 |
| **BIG4** | 40,241 | 0.402 | 0.49 | 0 | 0 | 1 |
| **CAPEX** | 40,241 | 0.057 | 0.091 | 0 | 0.024 | 0.606 |
| **INTSALES** | 40,241 | 26.479 | 34.289 | 0 | 5.3 | 100 |
| **AGE** | 40,241 | 16.306 | 9.115 | 3 | 16 | 46 |

# Appendix B: Variable definition

| Variable | Definition | Datastream code or other source |
|---|---|---|
| rdnetasset | is the net R&D asset on the balance sheet, scaled by total assets | Net development costs: WC02504<br>Total assets: WC02999 |
| sdnetasset | is the net SDC asset on the balance sheet, scaled by total assets | Net software development costs: WC18299<br>Total assets: WC02999 |
| SDAsset | is the capitalised amount of SDC in the year, measured as the change in net SDC asset (*sdnetasset*) plus amortisation of software, scaled by the market value of equity | Net software development costs: WC18299<br>Amortisation of software: WC01157<br>Market Capitalisation: WC08001 |
| SDCAPD | is an indicator variable equal to one (1) if a company capitalises SDC during the year (ie when *SDAsset* is greater than zero (0)) | |
| RDExp | is the research and development expense recognised in the income statement, scaled by the market value of equity | R&D expense: WC01201<br>Market Capitalisation: WC08001 |
| RDAsset | is the capitalised amount of R&D in the year, measured as the change in net R&D asset (*rdnetasset*) plus amortisation of R&D scaled, by the market value of equity | Net development costs: WC02504<br>Amortisation of R&D: WC01153<br>Market Capitalisation: WC08001 |
| CAP | is an indicator variable equal to one (1) if a company capitalises R&D during the year (ie when *RDAsset* is greater than zero (0)) | Net development costs: WC02504 |
| BM | is the book-to-market value of equity ratio | Common equity: WC03501<br>Market Capitalisation: WC08001 |
| SIZE | is the natural logarithm of market value of equity, measured at the fiscal year end | Market Capitalisation: WC08001 |
| BETA | is the firm beta estimated using 12 months of returns over each firm's local market index | Datastream regression formula |
| LEV | is the total debt-to-book value of equity | Total debt: WC03255<br>Common equity: WC03501 |
| BIG4 | is an indicator variable equal to one (1) if the company's financial statements are audited by one of the Big Four auditors and zero (0) otherwise | TR.BSAuditorCode |
| CAPEX | is the level of investment in tangible fixed assets for the year, scaled by the market value of equity | Capital Expenditure: WC04601<br>Market Capitalization: WC08001 |
| INTSALES | is international sales as a percentage of total sales | IntSalesPerc: WC07101 |
| RDValue | is R&D value, measured as the difference between the market value of equity and book value of equity, less the amount of R&D and SDC capitalised during the year divided by the sum of current and lagged annual R&D expenditure | Common equity: WC03501<br>Market Capitalisation: WC08001<br>R&D expenditure: RDExp+SDAsset+RDAsset |
| RDInt | is the R&D intensity measured as R&D expenditure (see above), divided by total assets less the amount of R&D or SDC capitalised during the year | R&D expenditure: RDExp+SDAsset+RDAsset<br>Total assets: WC02999 |
| PAST_BEAT | is equal to one (1) if prior year earnings are higher than current earnings, assuming full expensing of SDC capitalised in the year and | Net income before extra items/preferred dividends: WC01551 |

| | | |
|---|---|---|
| | prior year earnings are lower than current earnings, assuming full capitalisation of R&D expense and 0 otherwise (see also Dinh et al. 2016). Earnings refer to income before extra items/preferred dividends | |
| ZERO_BEAT | is equal to one (1) if earnings, assuming full expensing of SDC capitalised in the year, are negative, and earnings assuming full capitalisation of R&D expense are positive and zero (0) otherwise (see also Dinh et al. 2016). 'Earnings' refer to income before extra items/preferred dividends | Net income before extra items/preferred dividends: WC01551 |
| BENCH_BEAT | is equal to one (1) if *PAST_BEAT* and/or *ZERO_BEAT* are equal to one (1) and zero (0) otherwise | |
| AGE | Firm age in years. In multivariate analysis we use its natural logarithm | Base date |
| BC | is equal to one (1) if there is a material business combination and zero (0) otherwise. Material business combination is considered if the consideration accounts for 5% to previous year's book value of equity. | Compustat: Acquisition expense: ACQ Common equity: CEQ |
| ANTISELF | (anti self-dealing index) is a measure of legal protection of minority shareholders against expropriation by corporate insiders | La Porta et al. (2008) |
| CIV_COM | is an indicator variable that takes the value of zero (0) if the company is headquartered in a common law country and one (1) in a civil law country | La Porta et al. (1998) |
| CORR | Corruption is the percentile rank of control of corruption multiplied by –1. The higher the value, the higher is the corruption in a country | World Bank (2010). Worldwide Governance Indicators (WGI) Project |
| Healthinfrastructure | is the country-level health infrastructure | IMD World Competitiveness Yearbook 2021 |
| Skilledlabour | is the country-level skilled labour that is readily available | IMD World Competitiveness Yearbook 2021 |
| Scientificresearchlegislation | is the country-level scientific research legislation measuring whether laws relating to scientific research encourage innovation | IMD World Competitiveness Yearbook 2021 |
| GDPGrowth | is the annual growth rate of gross domestic product (GDP) | IMD World Competitiveness Yearbook 2021 |

## Appendix C: Examples of companies' disclosures

This Appendix provides extracts from the financial statements of 15 firms, as indicative examples of good disclosure practice, including mentions of SDC capitalisation as a key audit matter in auditors' reports. These firms have very high SDC asset intensity in the year 2019. Thus, for these firms, SDCs would be considered an important aspect and detailed and clear disclosures would be pertinent.