Innovation Disclosure and the Cost of Capital – UK-based Evidence

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Declaration

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Dedication

To the memory of loved late ones

To the love and cherishment of friends and dear ones

To the promise of freedom, a better future and what may come

Abstract

This study examines the economic effects of innovation disclosure in the annual reports of UK listed firms. Two overarching research questions are posed: first, to examine whether the levels of innovation disclosure are negatively associated with the cost of capital; and second, to examine the presence of proprietary costs (e.g. competition pressure proxied by the HH Index) for moderating effects on the association between innovation disclosure and the cost of capital. Two distinct types of innovation are recognized: exploration and exploitation. Both types of innovation disclosure are examined independently and combined. The dictionary tool of (Heyden et al. 2015: xvii) is adapted to identify exploration and exploitation disclosures through computer-aided textual analysis (CATA). The two components of the cost of capital are considered: the implied cost of equity capital and the after-tax cost of debt capital.

Using a longitudinal unbalanced panel dataset of FTSE 350 firms for the period 2011-2016, a number of findings are documented. First, evidence shows that firms with R&D expenditure, high analyst-followings, large market capitalization and new issues of financing tend to have more combined disclosure levels than do firms with non-R&D expenditure, low analyst-followings, small market capitalization, and no new financings, respectively. Second, firms on average disclose more exploration than exploitation innovation, although the bulk of benefits across the full sample (i.e. reductions in the cost of equity capital and the after-tax cost of debt capital) arise from exploitation rather than from exploration disclosure. Third, in a notable exception, R&D firms experience significant reductions in the cost of equity capital from exploration disclosure, but no significant reductions in the after-tax cost of debt capital from any of the disclosures. Interestingly, R&D firms show the highest synergic benefit in the cost of equity capital from the combined disclosure. Non-R&D firms, however, enjoy significant reductions in the cost of equity capital and the after-tax cost of debt capital from exploitation disclosure. Fourth, firms with high analyst-followings enjoy significant reductions in the cost of equity capital and the after-tax cost of debt capital from exploitation and combined disclosures. Firms with low analyst-followings, however, enjoy significant reductions only in the cost of equity capital from exploitation disclosure. Fifth, large-sized firms earn significant benefits in the cost of equity capital and the after-tax cost of debt capital from exploitation disclosure, while small firms earn significant reductions only in the cost of equity capital from exploitation disclosure. Sixth, firms with newly issued financings benefit only in the cost of equity capital from exploitation and combined disclosures, while firms with no new financings earn significant benefits only in the after-tax cost of debt capital from exploitation disclosure. The seventh finding, regarding the moderating effect of proprietary costs, reveals two contrasting stories depending on the type of cost of capital in question. Consistent with the hypothesis, the evidence from the implied cost of equity capital shows that the benefits of the combined disclosures are weaker in the presence of high proprietary costs. For the after-tax cost of debt capital, a moderating effect of proprietary costs is detected with exploitation rather than the combined disclosure. Unexpectedly, the evidence from the after-tax cost of debt capital shows that the benefits of exploitation disclosure are stronger in the presence of high proprietary costs.

Due to the inherently problematic nature of the implied cost of equity capital, a number of alternative measures were adopted, including the CAPM estimates of the cost of equity capital, stock returns volatility, liquidity metrics for the average of closing bid-ask spread percentages and the ratio of closing trading volume to the outstanding number of common shares and, finally, the accuracy of analyst forecasts. Findings from these alternative measures are qualitatively similar to those from the implied cost of equity capital, reaffirming the beneficial effects of innovation disclosure.

This work contributes to a number of fields as it integrates accounting research with a stream of organizational and management literatures. The first contribution is the introduction of a new typology of recognizing and measuring innovation disclosure; that is novel to accounting but well established in other organizational and management studies. Second, it contributes with evidence that the disclosure of exploration and exploitation innovation are of economic relevance and have significant effects in reducing information asymmetry. Finally, this study contributes vital evidence regarding the moderating effects of proprietary costs on the association of innovation disclosure and the cost of capital.

Keywords: Innovation disclosure, exploration, exploitation, computer-aided textual analysis, cost of capital, proprietary costs.

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List of Abbreviations

AEG	Abnormal Earnings Growth
CAPM	Capital Asset Pricing Model
CATA	Computer-Aided Textual Analysis
CSR	Corporate Social Responsibility
ESG	Environmental, Social and Governance
FASB	Financial Accounting Standards Board
FTSE	Financial Times Stock Exchange
HH	Herfindahl-Hirschman
IC	Intellectual Capital
ICB	Industry Classification Benchmark
IFRS	International Financial Reporting Standards
IIRC	International Integrated Reporting Council
IPO	Initial Public Offering
IR	Integrated Reporting
KWIC	Key-Word-In-Context
M&A	Merger and Acquisition
MPEG	Modified Price-Earnings Growth
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
PAT	Positive Accounting Theory
PEG	Price-Earnings Growth
R&D	Research and Development
SEO	Seasoned Equity Offering

Chapter 1 Introduction

1.1 Study Background

This study examines the economic effects of innovation disclosure on the cost of capital as well as the moderating effects of proprietary costs. Extant disclosure literature (Botosan 2006; Dhaliwal et al. 2011; Mangena, Li, and Tauringana 2016; Dhaliwal et al. 2014) gives valuable insights into various types of information disclosure and cost of capital associations, but no study so far, to the author's knowledge, has specifically examined either the economic effects of innovation disclosure on the cost of capital or the moderating effects of proprietary costs on such association.

The shifting of western and global economies from industrial to knowledge-based increases the relevance of innovation capital as well as the relevance of its disclosure to both individuals and organizations (Bellora and Guenther 2013). On a macro-economic level, innovation is a major driver for economic growth (Organisation of Economic Co-Operation and Development 2010a, 2010b; Bellora and Guenther 2013), while on a micro-economic level, it is key to economic sustainability, business survival, superior competitive advantage, value creation and improved organizational performance (O'Reilly and Tushman 2013; Bellora and Guenther 2013). Given such significance, the report of the International Integrated Reporting Council (IIRC (2013), posits that encouraging a culture of innovation is a key activity in the business model of the value creation process. Despite providing no clear definition of what is innovation, the IIRC framework adds that the managing and fair reporting of such activity is the responsibility of those charged with governance[1]. Similarly, Bellora and Guenther (2013) posit that "there is an increasing demand for information on the innovation activities among investors, other stakeholders and the public" (p. 255).

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[1] In a comprehensive and detailed critique of the IR framework, Flower (2015) argues that it lacks compulsion as it gives the firm's management wide discretion in what is to be reported. The same critique applies here to innovation disclosures since the IR framework does not set out a clear definition, never mind different types, of innovation. This will only give rise to concerns of potential impression management surrounding innovation disclosures. This thesis aims, in part, to recognise the two prominent strategies of innovation and puts forward a framework that identifies the distinct roles of both types in the value-creation process. The framework is presented and discussed in section 2.6.3 in the following chapter.

Innovation is considered as a core part of the intellectual capital that describes firms' ability to generate and implement new ideas and solutions that create value (Edvinsson and Malone 1997; Bellora and Guenther 2013). This normally involves both the creation and diffusion of new or significantly improved products, technological processes as well as organizational practices (Organisation of Economic Co-Operation and Development 2010b). The accounting literature, however, have examined innovation disclosure under the broad umbrella of IC disclosures (Beattie and Smith 2012; Mangena, Li, and Tauringana 2016) and does not recognize the unique effects of exploration and exploitation disclosures as two distinct strategies of innovation[2].

Innovation disclosure will, therefore, be examined here from the perspectives of organizational theory, organizational learning and behaviour as well as innovation management, where two, arguably conflicting, types of innovation prevail: explorative and exploitative innovation. The exploitative trend involves adding incremental improvements or enhancements to already existing innovations, while the explorative trend represents the creation of radically new innovations. The firms' ability to pursue both types of innovation simultaneously in a systematic process is known as organizational ambidexterity. This study examines disclosures relating to both types independently as well as together (i.e. combined). The examination of the combined disclosure is aimed at evaluating the overall disclosure policy of exploration and exploitation while the independent examination for evaluating the individual contribution of exploration and exploitation disclosures to the effectiveness of the overall policy. This operationalization of combined disclosure follows existing theoretical conceptualization of the combined approach as presented by several researchers (Cao, Gedajlovic, and Zhang 2009; He and Wong 2004; O'Reilly and Tushman 2013; Tushman and O'Reilly 1996)[3].

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[2] See section 5 of chapter 3 for in-depth discussion of relevant literature.

[3] As will be explained in the literature review, there is dispersion in the field over the operationalizing of the ambidexterity concept in terms of two dimensions: balanced and combined (O'Reilly and Tushman 2013).

In the era of globalization and remarkable technological breakthroughs, markets are becoming more competitive than ever, and a fundamental need is emerging to renew strategies and processes for more sustainable performance (Cao, Gedajlovic, and Zhang 2009; He and Wong 2004; O'Reilly and Tushman 2013; Tushman and O'Reilly 1996; Uotila et al. 2009). Pursuing innovation ambidextrously by balancing or combining both strategies is increasingly necessary for firms to survive and prosper, especially within dynamic environments and constantly changing conditions (O'Reilly and Tushman 2008; Uotila et al. 2009; O'Reilly and Tushman 2013). Previous research has accumulated solid evidence of positive links between the ambidextrous pursuit of innovation and organizational performance. O'Reilly and Tushman (2013), in an extensive review of the literature on theoretical and empirical studies of organizational ambidexterity, summarized the empirical evidence as a positive association of ambidexterity with growth, firm survival, market valuation, subjective performance ratings, and innovation performance. Hence, the disclosure of ambidexterity is an inevitable necessity given its importance to organizational performance in both the short and the long term. More interestingly, some of the organizational ambidexterity studies (Heyden, Sidhu, and Volberda 2015; Uotila et al. 2009; Ugur 2013) developed a list of keywords for exploration and exploitation and conducted a content analysis approach on annual reports to measure exploration and exploitation disclosures[4]. This preliminary empirical evidence indicates that both types of innovation are disclosed in annual corporate reports. However, it is noteworthy that this was not for the purpose of examining the economic effects of the corporate disclosure of innovation on the cost of capital, a gap which is addressed within the scope of this research.

Economic-based disclosure theory, one of the major streams in the corporate disclosure literature, revolves around the notion that disclosure is inherently an economically motivated behaviour (Verrecchia 2001). Consistent with this, it is posited that innovation disclosure could be explained as a cost/benefit trade-off (Bellora and Guenther 2013), where greater disclosure theoretically reduces information asymmetry and the accompanying adverse selection problems, leading to a reduction in perceived

[4] The long stream of literatures on exploration and exploitation used measurement tools such as survey data and interviews, R&D and patent data, as well as dictionary-based content analysis (Nazlihan Ugur, 2013).

risk, lower cost of capital, higher equity valuation, higher liquidity and ultimately more access to funding (Verrecchia 2001; Healy and Palepu 2001). This theoretical base is generally applied in empirical research to examine the disclosure and cost of capital associations in order to make inferences about the economic value-relevance of various disclosures.

However, Dhaliwal et al. (2011) argued that a straightforward generalization of the disclosure effect on the cost of capital from financial to non-financial disclosures (i.e. IC disclosure, CSR disclosure and voluntary disclosure) is not always straightforward. More disclosure does not necessarily mean more informative value. This point is particularly true when the narrative disclosures are 1) subject to less regulation; 2) less useful due to issues of non-comparability, and 3) subject to potential credibility issues due to the opportunistic behaviour of firms. Therefore, the link between various types of narrative disclosure and the cost of capital ultimately remains an empirical question depending on the nature of the information disclosed (Botosan 2006). Given this information type-dependency (Botosan 2006), there is a strong suggestion that the combined innovation disclosure of exploration and exploitation will have a unique pattern of impact on the cost of capital; this might also vary according to the individual type of disclosed innovation. Also, the significance of the innovation disclosure-cost of capital association might vary between different types of firm, such as R&D vs. non-R&D firms, high vs. low analyst-following firms, large-sized vs. small-sized firms, and firms that recently issued new financing vs. those that did not. This, henceforth, stands as an empirical question that needs to be examined as rigorously as possible. Finally, the moderating effects of proprietary costs (e.g. competition pressure) might mitigate potential benefits from such disclosure and act like a disincentive of disclosure for innovative firms; a vital empirical question addressed in the scope of the current thesis.

1.2 Research Question

As introduced earlier, the IR framework recognizes the significance of innovation as a key activity in the business model for value creation while clearly stating that the management and fair reporting of such activity is the responsibility of managers. The IR framework, however, does not set out a clear definition, never mind the recognition of different types, of innovation. This adds to the critiques of IR framework as put forward by (Flower 2015) since the framework leaves the decision open for managers discretion as to what innovation information to be disclosed. This will only give rise to concerns of potential impression management surrounding innovation disclosures.

Though the IASB standards do not refer to innovation per se, they set out strict standards to recognize intangible assets under IAS 38[5]. The IASB-based standards are very restricted in a way that many innovation outcomes generated internally by a firm have to go unrecognized. Such low recognition of intangibles value might lead to conservative bias in accounting numbers (Ciftci and Darrough 2015) and, therefore, innovative firms might tend to exert greater effort to reduce information asymmetry via more discretionary narrative disclosures (Jia 2017). The IASB states on its' website[6]: "IAS 38 sets out the criteria for recognising and measuring intangible assets and requires disclosures about them. An intangible asset is an identifiable non-monetary asset without physical substance. Such an asset is identifiable when it is separable, or when it arises from contractual or other legal rights. Separable assets can be sold, transferred, licensed, etc. Examples of intangible assets include computer software, licences, trademarks, patents, films, copyrights and import quotas. Goodwill acquired in a business combination is accounted for in accordance with IFRS 3 and is outside the scope of IAS 38. Internally generated goodwill is within the scope of IAS 38 but is not recognised as an asset because it is not an identifiable resource.

Expenditure for an intangible item is recognised as an expense, unless the item meets the definition of an intangible asset, and:

- it is probable that there will be future economic benefits from the asset; and
- the cost of the asset can be reliably measured.

The cost of generating an intangible asset internally is often difficult to distinguish from the cost of maintaining or enhancing the entity's operations or goodwill. For this reason, internally generated brands, mastheads, publishing titles, customer lists and similar items are not recognised as intangible assets. The costs of generating other internally generated intangible assets are classified into whether they arise in a research phase or a

[5]The IASB standards are mandatory for all firms listed on the FTSE index so R&D expenditure is reported in annual reports under IAS 38.

[6]See the link for full reference: https://www.ifrs.org/issued-standards/list-of-standards/ias-38-intangible-assets/

development phase. Research expenditure is recognised as an expense. Development expenditure that meets specified criteria is recognised as the cost of an intangible asset. Intangible assets are measured initially at cost. After initial recognition, an entity usually measures an intangible asset at cost less accumulated amortisation. It may choose to measure the asset at fair value in rare cases when fair value can be determined by reference to an active market. An intangible asset with a finite useful life is amortised and is subject to impairment testing. An intangible asset with an indefinite useful life is not amortised but is tested annually for impairment. When an intangible asset is disposed of, the gain or loss on disposal is included in profit or loss."

In clear contrast to the U.S. GAAP[7] which mandates the full expensing of R&D expenditures, the IAS 38 requires 1- the expensing of research costs as incurred and 2- the capitalization of development costs when certain criteria are met.[8] The criteria for capitalizing the development costs include "several conditions related to the successful completion and marketing of the developed product or service"(Chen, Gavious, and Lev 2017: 681). Though the standard does not require the disclosure of information on these *conditions* to investors, they include (Chen, Gavious, and Lev 2017: 681): "that the technical feasibility of the product under development has been established; the firm has the intention and financial resources to complete development; it expects to use or sell the product, such use or sale will generate future economic benefits; and the firm can reliably measure the expenditures attributable to product development, separately from the earlier research phase".

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[7] The U.S. GAAP is issued by the Financial Accounting Standards Board.

[8] Though the researcher recognizes that the research element of R&D expenditure relates to exploration strategy and the development element to the exploitation strategy, the recognition of R&D expenditure according to the IAS 38 makes it hard to collect the research costs and the development costs separately. Therefore and for the purposes of the current thesis, R&D expenditure is recognized totally within the exploration strategy which is consistent with the structural form of ambidexterity that entails separating explorative R&D units from other exploitative units (i.e. production and sales and marketing units) (Blindenbach-Driessen and Ende 2014: 1089). As set out in section 2.4 in the following chapter, structural ambidexterity requires a complete set of structures for different competencies, systems, incentives, processes and cultures, suited to separate and specialized sub-units of exploration and exploitation activities.

It is clear from the above discussion that the IASB is rather focused on asset valuation and fair presentation of financial position. The IAS 38 sets a limit so that any intangible asset generated internally is not recognized unless it meets the capitalization criteria as specified for development costs. So, uniquely recognizing and reporting the inputs and the outcomes of exploration and exploitation as two distinct innovation strategies is not a target for IASB. Furthermore, it is also noted that the capitalization of development costs when specific criteria are met entails a high degree of management discretion that might be incentivized by income manipulation and signalling. For instance, Landry and Callimaci (2003: 132-33) posit that "the decision to capitalize R&D spending involves a trade-off between the costs of displeasing some financial analysts and the benefits of seeking the most strategically advantageous accounting treatment. For instance, firms may overlook financial analysts' reservations in order to meet debt covenants and manage earnings." Such managerial discretion over the capitalization decision of R&D expenditure will inevitably entail a discretion over R&D narrative disclosures. In a study of French-based sample, Nekhili et al. (2016) find that R&D capitalization leads firms to disclose more R&D narrative information and that such R&D narratives exhibit a significant positive association with the firm's market value. This indicates that discretionary R&D narrative disclosures, which is a narrative content relevant for exploration disclosure, bear a credible informative value to capital market participants. This pattern might be observable in the UK context as well since UK-based firms comply with IAS 38 when disclosing R&D information. Unless impression management is used around R&D narratives, it is expected that R&D narratives bear an informative value to capital market participants in the UK and that such narratives will be negatively associated with the cost of capital.

However, according to the Financial Accounting Standards Board's (FASB's) (2001) definition of intellectual capital (IC), "intangibles include not only those resulting from research and development but also human resources, customer relationships, innovations and others" (p. vi). Despite no clear definition nor specific recognition of its' different types, this definition of intangibles regards innovation as one of the major building blocks of intangibles' value, and yet the research stream in the IC disclosure literature takes it as a simple item under the structural IC sub-category when addressing the broad topic of IC disclosure as a whole. Only a few papers have addressed a single category of IC disclosure, such as human capital (Abeysekera and Guthrie 2005;

Subbarao and Zéghal 1997; Olsson 2001) and innovation capital disclosure as part of the broad IC disclosure (Bellora and Guenther 2013). However, research on innovation disclosure as a phenomenon is still limited, never mind its effect on the cost of capital, despite the crucial role of innovation in the value creation process (Organisation of Economic Co-Operation and Development 2010a, 2010b; Lev 2000, 2003; Uotila et al. 2009; Bellora and Guenther 2013).

Being a significant part of the broad IC domain, it is posited that incentives for innovation disclosure decisions are comparable to those of IC disclosure (Beattie and Smith 2012). As with IC disclosure, it is expected that innovation disclosure decisions will be motivated more by incentives of avoiding competitive disadvantage and capital market considerations rather than incentives of legitimacy/reputation (Beattie and Smith 2012). In other words, economic-based incentives are the main motives for innovation disclosures. For this reason, the current study applies the economic-based disclosure theory to examine the economic consequences of innovation disclosure. In line with previous IC disclosure literature (Beattie and Smith 2012; Mangena, Li, and Tauringana 2016), the economic-based disclosure theory is an appropriate umbrella under which to explain the innovation disclosure phenomenon. In addition, theories such as positive accounting theory (PAT), and agency cost theory as part of PAT, provide reasonable explanations for such reporting incentives (Beattie and Smith 2012), as they overlap with the theoretical perspective of the economic-based disclosure theory.

Until now, innovation disclosure has been addressed vaguely under the broad label of IC disclosures without recognition of the two distinct types of innovation; exploration and exploitation. Methodologically, however, measurement of innovation disclosure, recognized as a generic category under the overall IC disclosure generally, has been implicated in operationalization limitations that are common in the IC disclosure literature (Beattie and Thomson 2007). These limitations include lack of transparency, specificity, uniformity and rigour, all of which could lead to confusing and generally non-comparable evidence (Beattie and Thomson 2007).

Given the notion of information type-dependency (Botosan 2006), it is important to distinguish the economic effects of innovation disclosures from the broad IC disclosures. This importance has been magnified since Wyatt (2008) found that many

IC disclosures are prone to a number of reliability and relevance issues which could limit their value-relevance to capital market considerations, such as the cost of capital. Moreover, Bellora and Guenther (2013) addressed innovation disclosure as part of overall IC disclosure, concluding that innovation disclosure is generally "qualitative, non-financial and historically orientated" (p. 255). These informational qualities might limit the reliability and relevance of disclosure, which in turn gives rise to questions on the economic relevance of innovation disclosure (Wyatt 2008; Dhaliwal et al. 2011).

Given the unique nature of innovation, its disclosure might be intentionally set to have limited informational content or quality so as to avoid competitive disadvantage (Beattie and Smith 2012). In line with this argument, Bellora and Guenther (2013) posit that "the fear of proprietary costs (e.g. competition pressure) may deter firms from making quantitative, verifiable innovation disclosure". Hence, the risk of proprietary costs might lead to less effective innovation disclosure in reducing the cost of capital. Firms will tend to protect themselves by diluting the credibility of innovation disclosure in the presence of fierce competitive pressure. Previous evidence shows that intensified competition pressure is associated with higher financing costs (Valta 2012; Gaspar, Massa, and Matos 2006). This suggests that the proprietary costs might moderate the effects of innovation disclosure on the cost of capital. However, it is noteworthy that none of the IC disclosure studies has, so far, examined the moderating effects of proprietary costs on the association between IC disclosure and the cost of capital.

Given the above discussion, there is an emergent need to address and distinguish the economic effects of innovation disclosure separately from the broad IC disclosures. Consistent with insights from organizational ambidexterity literature, the current study focuses on innovation disclosures of exploration and exploitation separately as well as combined. Examining the combined disclosure is aimed at evaluating the effectiveness of the overall disclosure policy of exploration and exploitation in reducing information asymmetry while the separate examination for evaluating the individual contribution of exploration and exploitation disclosures to the effectiveness of the overall disclosure policy. Consistent with the economic-based disclosure theory, the current thesis assesses the economic value-relevance of innovation disclosure by addressing two overarching research questions:

1- **Are the levels of innovation disclosures negatively associated with the cost of capital?**

2- **To what extent does the presence of proprietary costs moderate the association between innovation disclosure and the cost of capital?**

1.3 Research Aims and Objectives

This section presents the broad research aims of the current study and details the underlying research objectives.

1.1.1 Research Aims

Following the above discussion, the aims of this research are fivefold, to:

1- Assess the levels of exploration and exploitation disclosures, observe general trends over time and test for statistically significant differences between them,

2- Test the combined disclosure levels for statistically significant differences across various sub-groups of firms,

3- Longitudinally examine the economic consequences of innovation disclosure in annual reports by testing for significant associations with the cost of capital,

4- Identify any significant moderating effect of proprietary costs on the association of innovation disclosure and cost of capital, and

5- Compare the economic consequences of innovation disclosure on the cost of capital by re-examining various sub-groups of firms to identify any patterns based on unique firms' characteristics.

1.1.2 Research Objectives

These aims translate into the following research objectives, to:

1- Observe the general time-trends in the levels of disclosure on exploration and exploitation innovation,

2- Compare the general time-trends of innovation disclosure (i.e. the combined disclosure of exploration and exploitation) to those of (Environmental, Social and Governance (ESG) disclosure[9], cost of equity capital and after-tax cost of debt capital,

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[9] See section 2 of chapter 5 for details on measurement of ESG disclosures.

3- Test for statistically significant differences between exploration and exploitation disclosure levels,

4- Compare innovation disclosure (i.e. the combined disclosure of exploration and exploitation) across various sub-groups of firms (R&D vs. non-R&D, high vs. low analyst-following groups, large-sized vs. small-sized, and firms with newly issued financing vs. those without),

5- Examine for a negative association between innovation disclosures and the cost of equity capital,

6- Examine whether the presence of proprietary costs moderates (weakens) the association between innovation disclosure and cost of equity capital,

7- Investigate the presence of a negative association between innovation disclosures and the after-tax cost of debt capital,

8- Examine whether the presence of proprietary costs moderate (weakens) the association between innovation disclosure and the after-tax cost of debt capital,

9- Examine whether firms with R&D expenditure display a unique pattern from other companies, regarding innovation disclosure and cost of capital (i.e. cost of equity capital and after-tax cost of debt capital),

10- Examine whether high analyst-following firms display a different pattern from that of low analyst-following firms regarding innovation disclosure and cost of capital (i.e. cost of equity capital and after-tax cost of debt capital),

11- Examine whether large-sized firms display a different pattern from that of small-sized firms regarding innovation disclosure and cost of capital (i.e. cost of equity capital and after-tax cost of debt capital), and

12- Examine whether firms with newly issued financing display a different pattern from those without regarding innovation disclosure and cost of capital (i.e. cost of equity capital and after-tax cost of debt capital).

1.4 Research Scope and Methodology

The methodology is developed following an extensive review of the literature and theoretical frameworks. A positivist approach is applied using a quantitative methodology to answer the research questions identified above. A longitudinal unbalanced sample of FTSE 350 firms for the period 2011-2016 is used and data are collected from the Bloomberg database[10].

The choice of the UK as a context for this study is based on earlier evidence as presented by (Beattie and Smith, 2012). In a survey of UK finance directors about incentives to IC disclosure, Beattie and Smith (2012) found that the cost of capital incentive is of mid-ranking importance compared to that of avoiding competitive disadvantage. They argue that the inherent uncertainty surrounding the interpretation of many IC disclosures is the underlying reason that the cost of capital incentive is of relatively moderate rather than high importance. This highlights a unique empirical need in the UK to find out the specific effects of innovation disclosure on the cost of capital, rather than from broad IC disclosures.

The UK Department of Business, Innovation and Skills issued the Innovation and research strategy for growth in December 2011; this was followed by the government's Science and innovation strategy in 2014. This makes UK companies an interesting case for observing and examining the phenomenon of innovation disclosure for the period 2011-2016, since the publication of both strategies created a fertile environment for innovation at the UK-wide level (UKIS 2014, 2016). This is further evident by looking at the annual rankings of the UK on the Global Innovation Index as issued by the World Intellectual Property Organization[11]. In 2011, the UK ranked the 10th on the global scale while the U.S., for instance, ranked the 7th. In 2012 onwards, however, the UK reings as one of " the world's five most-innovative nations"(Wunsch-Vincent, Lanvin, and Dutta 2015: xvii). For the period of 2012-2016, the UK maintained a leading position even ahead of the U.S.A and demonstrated "a strong rise from 10th in 2011 to 2nd place in 2014 and 2015"(Wunsch-Vincent, Lanvin, and Dutta 2015: 22).

The choice of this period, however, presents an extra advantage as it minimizes the negative effects of the 2008 financial meltdown on the sample observation. UKIS

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[10] See section 4 of chapter 4 for in-depth discussion of why choosing 1- this unique time-frame, 2- the UK context, and 3 the FTSE 350 firms.

[11] See the link https://stats.areppim.com/stats/links_innovationxlists.htm for more details on the Global Innovation Index for the UK and other world countries.

(2012) reported a fall in the overall share of UK businesses engaging in innovation activities during the crisis period 2008-2010, while subsequent UKIS reports (2014, 2016) showed improved innovation performance since 2011 with a steady increase throughout the post-crisis period. These reasons together, therefore, justify the choice of UK-based panel data for the period 2011-2016. The choice of UK FTSE 350 firms is due to their highly capitalized nature that enables them to pursue relatively more innovation than do small-sized firms (Cao, Gedajlovic, and Zhang 2009, UKIS 2012, 2014, 2016).

The collection of data includes the Capital Asset Pricing Model (CAPM) estimates for the cost of equity capital, the after-tax cost of debt capital, share prices and analyst forecasts of future earnings, future dividends[12] as well as other firm characteristics that will be used as control variables. For alternative measures of implied cost of equity capital, data are also collected for returns volatility, analyst forecast accuracy, the average of the closing of bid-ask spreads, and the relative of closing trading volumes to the outstanding number of shares. After deleting observations with missing data, an unbalanced panel dataset is generated totalling 1,832 firm-year observations, out of which the panel regression nets 295 firms for the cost of equity capital and 232 for the after-tax cost of debt. The CAPM and a number of measures for the implied cost of equity capital (i.e. PEG and MPEG models developed by Easton (2004) as well as the AEG model developed by Gode and Mohanram (2003) and Ohlson and Juettner-Nauroth (2005)) will be examined against various risk factors to decide on which model is superior in capturing them. Examination of implied measures of cost of equity capital (PEG, MPEG and AEG models) resulted in the choice of estimates from the Price-Earnings Growth (PEG) model for modelling the association between disclosure and cost of equity capital. The PEG model shows greater capacity in capturing various risk factors than the Modified Price-Earnings Growth (MPEG) and Abnormal Earnings Growth (AEG) models.

A number of planned robustness checks will be applied using the CAPM, as well as alternative measures for the implied cost of equity capital (i.e. returns volatility, the

[12] Share prices, forecasts of future earnings and future dividends are used to estimate the implied measures of cost of equity capital.

average of the closing of bid-ask spreads, the relation of closing trading volumes to the outstanding number of shares and analyst forecast accuracy). For the measurement of innovation disclosure, the wordlists of exploration and exploitation were borrowed from Heyden et al. (2015) and further improved with a number of added words. The final lists consisted of 87 and 131 words for exploration and exploitation nodes, respectively[13]. The computer-aided textual analysis (CATA) approach is applied using the dictionary of keywords for exploration and exploitation. CATA builds on the premise that the presence or absence of specific keywords reveals the underlying themes of a general concept (i.e. a corporate strategy of innovation in this case), and that the co-occurrence of keywords reflects associations between the underlying concepts (Heyden et al., 2015). The medium of disclosure used for analysis in this study is the annual report[14]. Annual reports are collected from official company websites and NVIVO software is used to run a search query on each wordlist across the collected annual reports. The search-query generates the word frequencies and coverage percentages of total documents for measures of exploration and exploitation disclosure for each annual report. The combined disclosure is derived as the square root of the product of exploration and exploitation coverage percentages.

A mixture of analytical procedures is applied including regular descriptive statistics of all variables, time and industry trends, univariate and multivariate analysis. The time trend analysis is run to look for strategic patterns of dependent (cost of equity capital and after-tax cost of debt capital) and independent variables (exploration, exploitation, combined, and the ESG disclosures). The industry trends compare the averages of both dependent and independent variables across various industries. The univariate analysis includes Pearson correlation of all variables, paired T-test, and two-sample T-test. The paired T-test is run to test for statistically significant differences in the averages of

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[13] See section 5 of chapter 4 for in-depth details on the content validity checks that were conducted on the added words.

[14] Unlike some other mediums of disclosure, annual reports are mandatory, regularly produced and audited, and widely distributed. The annual report is not the only corporate medium of disclosure, but it is the main one and firms put a substantial editorial input into it (Campbell 2004; Guthrie, Petty, and Ricceri 2006). Moreover, earlier evidence indicates a positive association between annual report disclosure and the accuracy of analysts' earnings forecasts (Hope, 2003), and that analysts do revise their earnings forecasts after the release of annual reports (Li Eng and Kiat Teo, 1999).

exploration and exploitation disclosures. The two-sample T-test compares the levels of combined disclosures across the four sub-groups of firms: - R&D vs. non-R&D, high vs. low analyst-following, large vs. small, and firms with newly issued financings vs. those without.

The multivariate analysis includes fixed effects panel regression estimation for both baseline models as well as models of the moderating effects of proprietary costs. First, the baseline models are designed in two forms: 1) to test exploration and exploitation disclosures independently to see which is the real source of benefit that represents incremental information: and 2) to test the combined disclosures to identify any synergic benefits of combining them. Both forms of baseline models will be tested across the full sample and then retested across the four sub-groups already listed. Secondly, the moderating effects of proprietary costs will be tested by modelling the interaction of innovation disclosure with the Herfindahl-Hirschman (HH) Index. For the cost of equity capital, a moderating effect of the HH Index is observed with the combined disclosures, while for the after-tax cost of debt, a moderating effect of the HH Index is observed with the exploitation disclosure.

As for the regression estimation, a fixed effects panel regression is used to test hypotheses while controlling for firm fixed effects and year fixed effects. The panel design controls for unobserved heterogeneity and omitted variable bias. Robust standard errors by clustering at the firm level are used to control for heteroscedasticity and autocorrelation bias. All right-hand side variables are one-year lags to mitigate endogeneity bias caused by reverse-causality. The large unbalanced panel sample controls for survivorship bias by treating missing observations as exogenous according to the missing at random hypothesis. The normality assumption is not a requirement since the large sample size (well over 200 firms) is sufficient to ensure a roughly normal distribution of error terms according to the assumption of the central limit theorem.

1.5 Overview of Key Findings

A detailed discussion of findings is presented in chapters 6, 7 and 8. A summary of these findings is presented as follows:

1- The main findings of univariate analysis (see chapter 6) are those of the paired T-test and the two-sample T-test. The paired T-test of exploration and exploitation disclosures shows that, on average, firms disclose more exploration than exploitation. The two-sample T-test of the combined disclosure shows that firms with R&D expenditure, high analyst followings, large market capitalization, and new issues of financing tend to extend more combined disclosure levels than do their respective counterparts.

2- The results of the baseline models for the cost of equity capital (see chapter 7) and after-tax cost of debt capital (see chapter 8) show that the bulk of benefits arise from exploitation rather than exploration disclosure; this is intriguing, given the earlier finding that firms disclose more exploration than exploitation.

3- For the cost of equity capital, significant benefits (reduction in the cost of equity capital) arise from exploitation and combined disclosures across the full sample. For the after-tax cost of debt capital, significant benefits arise from exploitation disclosure only.

4- The following variables are applied as robustness checks for the implied cost of equity capital: 1) the average cost of equity capital estimates from CAPM and PEG models; 2) CAPM estimates; 3) average closing bid-ask spread percentages; 4) the ratio of closing trading volume to the outstanding number of shares; 5) the volatility of stock returns; and 6) analyst forecast error. The average cost of equity capital estimates from CAPM and PEG models shows significant benefits from exploitation and combined disclosures but no evidence for benefits of exploration disclosure. Robustness checks using CAPM estimates alone, however, show weak but supportive evidence for benefits of exploitation and combined disclosures but no evidence for benefits of exploration disclosure. Similarly, the liquidity measures (i.e. average closing bid-ask spread percentages and the ratio of closing trading volume to the outstanding number of shares) also show weak but supportive evidence for the benefits of exploitation disclosure but no evidence for benefits of exploration disclosure. However, both the liquidity measures show significant evidence of benefits associated with the combined disclosures. Evidence of modelling volatility of stock returns and analyst forecast error supports benefits from the combined disclosures rather than the individual exploration and exploitation disclosures, reinforcing the notion of synergic benefits from the combination.

5- As for the moderating effects of proprietary costs, the evidence from the implied cost of equity capital shows that the benefits of the combined disclosures are weaker in the presence of proprietary costs. Firms facing low (high) competitive pressure, earn more (less) reductions in the implied cost of equity capital from the combined disclosure. For the after-tax cost of debt, a moderating effect of proprietary costs is detected with exploitation rather than the combined disclosure. Evidence of the interaction term of exploitation disclosure and proprietary costs reveals that firms with low (high) competitive pressure earn less (more) reductions in the after-tax cost of debt capital from exploitation disclosure.

6- When baseline models are retested for R&D vs. non-R&D firms, evidence from the implied cost of equity capital shows that R&D firms enjoy significant benefits from exploration and combined disclosures while non-R&D firms enjoy significant benefits from exploitation disclosure only. Interestingly, R&D firms show the highest synergic benefit in the cost of equity capital from the combined disclosure. Evidence from the after-tax cost of debt capital shows that non-R&D firms enjoy significant benefits from exploitation disclosure whereas there is no significant evidence of benefits to R&D firms from any of the disclosures.

7- When baseline models are retested for high vs. low analyst-following groups, evidence from the implied cost of equity capital shows that firms with high analyst-following enjoy significant benefits from exploitation and combined disclosures. Firms of low analyst-following, however, enjoy benefits only from exploitation disclosure; these are double the full sample average benefits and triple the high analyst group of firms' benefits from exploitation disclosure. This is consistent with previous evidence from the literature that firms with low analyst-followings enjoy higher benefits for the same disclosure levels than do firms with high analyst-followings (Botosan 2000; Richardson and Welker 2001). Evidence from the after-tax cost of debt capital shows that firms with high analyst-following enjoy significant benefits from exploitation and combined disclosures, while their counterparts benefit from none of the disclosures.

8- When baseline models are retested for large vs. small-sized firms, evidence from the implied cost of equity capital shows that large firms enjoy significant benefits from exploitation and combined disclosures, and small firms from exploitation disclosure only. Evidence from the after-tax cost of debt capital, however, shows that large firms exhibit weak evidence of benefits only from exploitation disclosure, while small firms show no significant evidence of benefits from any of the disclosures. These results are robust if either of the size proxies is used (total assets or market capitalization).

9- When baseline models are retested for firms with new financing issuance vs. those with no new financing, evidence shows that the former benefit from exploitation and combined disclosures only, with the implied cost of equity capital; there is no evidence for benefits of disclosure with the after-tax cost of debt capital. The group of firms with no new financings, however, present no evidence for disclosure benefits with the cost of equity capital although they earn significant benefits on the after-tax cost of debt capital from exploitation disclosure only.

1.6 Key Contributions and Implications

This thesis assimilates accounting literature with a stream of other organizational and management literature including organizational theory, organizational learning and behaviour, organizational design and strategic management, innovation management and technology. Therefore, the contributions of the current research extend to all of this literature. Here is a detailed list of contributions:

1- As for the accounting literature, this research breaks away from the common recognition of innovation disclosure as part of the broader IC disclosures and introduces a typology of innovation that is novel to accounting, although well-established in other organizational and management literature. Building on insights from all this literature, this thesis introduces innovation disclosure as per two distinct types of innovation: exploration and exploitation. For the measurement, a well-established content analysis tool has been borrowed from Heyden et al. (2015) and further improved to measure both types of disclosure.

2- The main contribution is extended jointly to the accounting and other organizational and management literature. It is represented in the empirical examination of the economic effects of innovation disclosures on the cost of equity capital as well as the after-tax cost of debt capital. For the literature on organizational theory, organizational learning and behaviour, organizational design and strategic management, innovation management and technology, this is the first time that exploration and exploitation have been examined from a corporate disclosure perspective. Findings show that exploration and exploitation disclosure have economic relevance and significant effects in reducing information asymmetry, leading to improved firm valuation.

3- This thesis examines the moderating effects of proprietary costs on the association between innovation disclosure and the cost of capital. For instance, the association between combined disclosures and the cost of equity capital is moderated by the HH Index of competition; the findings show that firms with less competition (lower proprietary costs) earn higher benefits from the combined disclosures of exploration and exploitation, and vice versa. The association between exploitation disclosure and the after-tax cost of debt capital is moderated by the HH Index, and firms with less competition (lower proprietary costs) earn fewer benefits from exploitation disclosure and vice versa. These findings are vital to the accounting and other organizational and management literature as they offer a better understanding of how proprietary costs moderate the benefits of exploration and exploitation disclosures in competitive environments.

4- The empirical examination applied in this study uses a longitudinal unbalanced dataset, which is relatively rare in the disclosure literature (Campbell 2004). So, the current research helps to supplement the deficiency of longitudinal research in the disclosure literature.

5- The findings reported in this thesis contribute to the ongoing research around the informational type-dependency of the association between disclosure and cost of capital. As explained earlier, exploitation disclosure is found to have significant effects on reducing the cost of capital, both equity capital and debt capital, for a wide range of firms, while exploration disclosure has a significant effect in reducing the cost of equity capital only for R&D firms.

6- This study also contributes to the ongoing literature on ESG disclosure as the empirical evidence of the implied cost of equity capital unveils an interesting trail[15]. There are significant benefits from ESG disclosure only for firms of high analyst following; in fact, benefits from ESG disclosure for the full sample are not significant at any level.

7- Last but not least, this thesis contributes to the ongoing debate in accounting literature regarding the suitability of various measures of implied cost of equity

[15] See part 2 of section 4 in chapter 7 for in-depth discussion on the unique evidence of ESG disclosures.

capital by providing empirical evidence from a UK context. It presents an evaluation of three measures for implied cost of equity capital (PEG, MPEG and AEG models) and finds consistent evidence (Easton and Monahan 2005; Botosan, Plumlee, and Wen 2011) that the PEG model, as introduced by Easton (2004), is superior to the other measures in capturing various risk factors. In light of this evidence, PEG estimates could be used in future research for modelling the association between disclosure and cost of equity capital in a UK context.

Based on these contributions, a number of research implications are recognized. First, implications bear significant relevance to practitioners and preparers of annual reports. For instance, the preparers of the annual reports for non-R&D firms might need to reconsider the content of exploration disclosure since the results, so far, show no evidence of benefit from exploration disclosure in terms of reducing information asymmetry or the cost of equity capital. Assuming that exploration disclosure is not intended simply as an impression management tool, non-R&D firms need to reassess their policy so that to reflect improved information content and quality while taking into account other prevailing factors such as proprietary costs. The exploration disclosure policy of R&D firms, however, proves to be effective in reducing the cost of equity capital which indicates a reduced information asymmetry. This reinforces the significance of narratives around exploration disclosure for R&D firms, which is also consistent with previous US-based evidence by (Merkley, 2013).

As for exploitation disclosure policy, the evidence reported here reinforces its vitality in reducing information asymmetry and lowering the cost of equity capital for a wide range of firms: non-R&D, high and low analyst-followings, large- and small firms, and those with newly issued financings. Furthermore, exploitation disclosure policy is vital in reducing the after-tax cost of debt for non-R&D firms, high analyst-followings firms, large firms, and firms with no newly issued financings. Even the examination of the moderating effects of proprietary costs shows that firms operating in highly competitive environments benefit from higher reductions in the after-tax cost of debt capital as they extend more exploitation disclosures.

However, the integration policy of both exploration and exploitation disclosures (i.e. combined disclosure) proves effective as the evidence points to high synergic benefits in terms of reduced cost of equity capital for R&D firms as well as firms with high analyst followings. The combined disclosure also proves vital to reducing information asymmetry and estimation risk as it lowers analyst forecast error and returns volatility. Furthermore, combined disclosure improves liquidity by lowering the bid-ask spread percentages. However, the examination of the moderating effects of proprietary costs shows that firms operating in highly competitive environments suffer from lower reductions in the cost of equity capital as they extend more combined disclosures.

On a side-note, however, it is worth recalling that ESG disclosure has an effective impact in reducing information asymmetry by lowering the cost of equity capital for a unique class of firms, the group with high analyst followings. This reinforces both the importance of ESG disclosure policy and the role of analyst followings in improving the information environment and reducing the cost of equity capital.

Second, there are implications relevant for regulators, policy-makers and standard-setters such as the IIRC. The findings reported in this thesis provide a picture of the effectiveness of innovation disclosure in mitigating information asymmetry. Exploitation disclosure proves to have a significant effect here, although exploration disclosure, which is on average more disclosed than exploitation disclosure, reflects this only for R&D firms. This indicates that the narratives of exploration disclosure of non-R&D firms need to be closely monitored since they might be potentially used as an impression management tool. This offers important feedback to IIRC standard-setters, indicating the need for a reporting framework that is uniquely designed to the specification of innovation disclosures. A potential reporting framework should integrate the well-established types of innovation disclosure, in terms of exploration and exploitation, as previously defined (OECD 2010; OECD/Eurostat). It should also specify disclosure requirements for firms combining both strategies in the process of value creation. This should help control and mitigate the reporting biases of employing exploration disclosure narratives in impression management tactics.

1.7 Structure of the Thesis

The rest of this thesis proceeds as follows. The second chapter reviews the literature and empirical evidence on exploration and exploitation. The third chapter reviews theories and empirical evidence on the association of corporate disclosure and cost of capital; it concludes with development of the hypotheses. The fourth chapter outlines the research methodology, scope and variables measurement, and the fifth designs the empirical model for testing the association of disclosure and cost of capital. The sixth chapter presents the results of the descriptive statistics and univariate analysis; the seventh the results of the empirical modelling of the association between innovation disclosure and the implied cost of equity capital; and the eighth the results of the empirical modelling of the association between innovation disclosure and the after-tax cost of debt capital. The final chapter concludes with empirical findings, implications, contributions, limitations and future research avenues.

Chapter 2 Exploration and Exploitation: A Background on Organizational Literatures

2.1 Introduction

This chapter is dedicated to discussing the concepts of exploration, exploitation and organizational ambidexterity so as to give an adequately informative background to the main controversies in and the developments of the literature on ambidexterity. As with any other literature, the definitions, conceptualized frameworks and operationalization of the ambidexterity construct at various levels (i.e. organizational, business unit and individual) have long been the subject of academic debates (Simsek et al. 2009; Cao, Simsek, and Zhang 2010; Jansen, Simsek, and Cao 2012; Lubatkin et al. 2006; O'Reilly and Tushman 2013; He and Wong 2004; Birkinshaw and Gibson 2004). The next section presents a reflective discussion of the definitions of exploration and exploitation, while briefly presenting the controversial issues around defining organizational ambidexterity and concluding with the introduction of a new definition. The third section discusses the controversy surrounding the operationalizing constructs of ambidexterity as combined vs. balanced. The fourth section discusses the conceptualization controversy according to three dominant forms: structural, sequential and contextual ambidexterity. The fifth section presents some of the empirical evidence for the association between ambidexterity and performance. The sixth section reflects on the conceptualized frameworks of organizational ambidexterity available in the literature and concludes with a new framework. The seventh section offers a reflective evaluation of the ambidexterity literature and statement of the research problem.

2.2 Organizational Ambidexterity: Exploration vs. Exploitation

March (1991) recognized a fundamental adaptation challenge facing organizations, the ability to *exploit* existing resources and capabilities to create incremental improvements while exerting adequate *exploration* to create radical innovation. Organizational ambidexterity, however, involves a systematic dexterous combination of exploration and exploitation strategies which would protect the firm from becoming incompetent or outdated by changes in the markets as well as in technologies. *Exploitation* behaviour is about efficiency, control, certainty and variance reduction, all of which are vital for current viability. *Exploration* behaviour is linked to search, discovery, autonomy and radical innovations, all of which are vital for long-term viability (Tushman and O'Reilly

1996; O'Reilly and Tushman 2013; He and Wong 2004; Jansen, Van Den Bosch, and Volberda 2006; Uotila et al. 2009).

Previous research (March 1991; Tushman and O'Reilly 1996; O'Reilly and Tushman 2013; He and Wong 2004; Uotila et al. 2009; Cao, Gedajlovic, and Zhang 2009; Stettner and Lavie 2014) suggests that firms which are more focused on *explorative* innovation 1) introduce radically new products, services, knowledge or technologies; 2) engage in new markets, new investment opportunities and new technological fields; 3) make considerable expenditure on R&D; 4) conduct alliance partnerships, and 5) take over firms from a different business field. While those which concentrate on *exploitative* innovation 1) continually leverage existing knowledge to achieve incremental cost savings; 2) introduce refinements to further the flexibility of existing products, services or technologies; 3) expand existing markets and existing investment opportunities; and 4) take over other firms in order to build economies of scale and take advantage of merger synergies[16].

It should be noted that notions of exploitation, exploration and ambidexterity have a long history as research themes in innovation performance (Danneels 2002; Rothaermel and Deeds 2004; Lee, Lee, and Lee 2003), technology and innovation management (Benner 2010; Benner and Tushman 2002; Benner and Tushman 2003; McGrath 2001; Brown and Eisenhardt 1997; O'Reilly 3rd and Tushman 2004), organizational learning and strategy (Siggelkow and Levinthal 2003; Volberda, Baden-Fuller, and Van Den Bosch 2001; Sanchez, Heene, and Thomas 1996; Levinthal and March 1993; Vera and Crossan 2004; March 1991), entrepreneurship (Shane and Venkataraman 2000), leadership and strategic management (He and Wong 2004; Heyden et al. 2015; Oehmichen et al. 2016; Volberda, Baden-Fuller, and Van Den Bosch 2001), organization theory (Holmqvist 2004), managerial economics (Ghemawat and Ricart Costa 1993), organizational adaptation (Jansen, Volberda, and Van Den Bosch 2005; Brown and Eisenhardt 1997; Tushman and O'Reilly 1996; Smith and Tushman 2005) and organizational design (Adler, Goldoftas, and Levine 2000; Jansen, Volberda, and

[16] It should be noted that these definitions are the base for developing the dictionary for exploration and exploitation which is used as a tool to measure the content disclosures of both phenomena.

Van Den Bosch 2005; Jansen, Van Den Bosch, and Volberda 2005; Gibson and Birkinshaw 2004; Adler, Heckscher, and Grandy 2011).

Defining organizational ambidexterity, however, is still a controversial issue and there is a wide range of definitions throughout the literature (Lubatkin et al. 2006; O'Reilly and Tushman, 2008; Cao et al, 2009; Simsek, 2009; Tushman and O'Reilly, 2013). Different definitions reflect underlying differences in perceptions of conceptualized constructs (i.e. sequential, structural and contextual), operationalized constructs (e.g. combined vs. balanced), and the level of unit analysis (i.e. organization, business unit or individual). Tushman and O'Reilly (1996: 24) defined organizational ambidexterity as "the ability to simultaneously pursue both incremental and discontinuous innovation…from hosting multiple contradictory structures, processes, and cultures within the same firm". He and Wong (2004: 483) defined the ambidextrous organization as "capable of operating simultaneously to explore and exploit", while Lubatkin et al. (2006: 2) defined them as firms "capable of exploiting existing competencies as well as exploring new opportunities with equal dexterity".

For the purpose of this thesis, however, and consistent with previous definitions, organizational ambidexterity is recognized as a *systematic* ability to simultaneously exploit current resources and capabilities to achieve *incremental* innovations while continuing to explore for and create *new* radical innovations (March 1991; Simsek et al. 2009; Tushman and O'Reilly 1996; O'Reilly and Tushman 2013). This definition of organizational ambidexterity is also consistent with the generic definition of innovation as the implementation of *new* or *significantly improved* products, processes or organizational practices (OECD 2010).

2.3 Balanced vs. Combined Dimensions of Ambidexterity

Previous research has conceptualized and operationalized constructs of organizational ambidexterity in two distinct dimensions: balanced and combined (Cao, et al., 2009; He and Wong, 2004; Lubatkin, et al., 2006; and Gibson and Birkinshaw, 2004). The balanced dimension of ambidexterity corresponds to the absolute difference between exploitation and exploration levels where managers aim to bring such difference to zero. The combined dimension, however, equates ambidexterity to either the product (Cao, et al., 2009; He and Wong, 2004; Gibson and Birkinshaw, 2004) or the sum of both exploitation and exploration levels (Cao, et al., 2009; Lubatkin, et al., 2006).

According to the balanced dimension, exploration and exploitation are assumed to be in opposition to each other, as they imply different ways of competing for resources and pursuing organizational goals (March, 1991; Cao, et al., 2009; Andriopoulos and Lewis, 2010). A strong emphasis on a balanced approach to ambidexterity is argued to be vital to better control performance risks. Imbalances can subject the firm to risks of obsolescence when exploitation exceeds exploration. Similarly, when explorative orientation exceeds exploitation, firms fail to appropriate returns from costly investments in research and development activities. Both types of imbalances, therefore, threaten the long-term success, survival, and sustainability of the firm.

The conceptualization of the combined approach to ambidexterity, however, revolves around the proposition that exploitation and exploration are not inherently in opposition, but could rather be complementary (Cao, Gedajlovic, and Zhang 2009; Brown and Eisenhardt 1997; Gupta, Smith, and Shalley 2006). For instance, Gupta et al. (2006) point out that exploitation and exploration can exist in a complementary context and be supportive of one another in different domains, such as technology and markets. Cao et al. (2009) reason that excessive exploitative orientation can positively affect the exploration efforts through repetitive utilization of existing knowledge leading to better awareness of where the firm currently stands in terms of its capabilities and direction. This will enable the firm to leverage on existing knowledge to create novel breakthroughs which will enhance exploration effectiveness, positively impact performance and, most important, lead to prolonged sustainability. Similarly, opportunities from fruitful explorative efforts can be exploited and implemented in successful business projects which will boost profitability and the firm's market value. In short, organizations can often exploit to explore and explore to exploit knowledge and resources; therefore, the two orientations are viewed as integral to each other: one cannot exist without the other.

Cao et al. (2009) attempted to unpack the conceptualization construct of organizational ambidexterity into one with two distinct dimensions, balanced and combined. In the balanced dimension of ambidexterity, firms tend to balance between exploitation and exploration on a relative basis, while the combined dimension corresponds to their combined magnitude. These authors added that the ambidexterity-firm performance link is contingent on the firm's available resources, which are indicated by both the firm size (for internal resources) and the environment (for external resources). They also find that firms operating in a context of scarce resources benefit greatly from the balanced dimension of ambidexterity, and thus managers should focus on a trade-off between exploitation and exploration. On the other hand, firms with greater access to resources benefit more from the combined dimension of ambidexterity, so managers should develop exploitation and exploration efforts concurrently, wherever deemed possible and desirable. They also find that both dimensions contribute to firm performance but through very different processes. This is mainly because the processes are mutually supportive and are differentially impacted by resource conditions. Earlier evidence, however, points to the interdependence between exploration and exploitation processes and highlights the need to combine them for synergic benefits (Floyd and Lane, 2000).

In summary, some researchers (Smith and Tushman 2005; Sidhu, Volberda, and Commandeur 2004; Sidhu, Commandeur, and Volberda 2007; Auh and Menguc 2005) propose that exploitative and explorative activities are inherently conflicting; and managers need to trade-off between them and find the appropriate balance to achieve ambidexterity. Others (Cao, et al., 2009; Gupta, et al., 2006; Jansen, et al., 2006; Lubatkin, et al., 2006) argue that both exploitative and explorative activities are rather orthogonally independent and it is all down to the firm's capacity and desire to undertake both at high levels concurrently to achieve ambidexterity. The view of the current study is in line with the latter. Despite the recognition of potential conflict inherent in their activities, their combined strength is most important since both exploration and exploitation are indispensable for long-term survival.

2.4 Forms of Ambidexterity: Structural, Sequential, and Contextual

An evolving topic that is rapidly catching the attention of scholars in organizational behaviour studies is the question of organizational ambidexterity. With ever-growing research interest over the last 28 years, a considerable research output has been delivered on organizations' ambidextrous behaviour, as it is deemed necessary for firms’ long-term survival and organizational sustainability (Duncan and Duncan 1976; March 1991; Anderson and Tushman 1990; Benner and Tushman 2003; Jansen, Andriopoulous, and Tushman 2013; Lavie, Stettner, and Tushman 2010; O’Reilly and Tushman 2008; O'Reilly 3rd and Tushman 2004; O'Reilly, Harreld, and Tushman 2009; O'Reilly and Tushman 2013, 2011; Raisch et al. 2009; Tushman and O'Reilly 1997; Tushman 1997; Tushman and O'Reilly 1996; Tushman and Smith 2004; Stettner and Lavie 2014; Jansen et al. 2009; Jansen, Van Den Bosch, and Volberda 2005, 2006; Jansen, Vera, and Crossan 2009; Cao, Gedajlovic, and Zhang 2009; Jansen, Simsek, and Cao 2012; Uotila et al. 2009; Simsek 2009; Simsek et al. 2009). The literature, however, argues for three dominant forms of ambidexterity: structural (simultaneous/separation); sequential (temporal/periodical shifting); and contextual (behavioural) (Tushman and O’Reilly, 1996; O’Reilly and Tushman, 2004; and O’Reilly and Tushman, 2013).

The first form, structural ambidexterity, means having separate organizational R&D units as it is expected that separating innovation activities from other functions will lead to positive effects on ambidexterity (O’Reilly and Tushman, 2013)[17]. Benner and Tushman, (2003) posited that the organizational design aims to achieve ambidexterity, presumably at the organizational level; this entails employing a complete set of structures for different competencies, systems, incentives, processes and cultures, suited to separate and specialized sub-units of exploration and exploitation activities. For instance, production-related units are responsible for exploitation while marketing and sales units are responsible for exploration. These separate units are productively integrated into the organizational design by common strategic interest and shared values, a combination which will serve the simultaneous efforts of exploitation and exploration to achieve ambidexterity. The conventional paradigms of the innovation

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[17] Though the researcher recognizes that the research element of R&D expenditure relates to exploration strategy and the development element to the exploitation strategy, the recognition of R&D expenditure according to the IAS 38 makes it hard to collect the research costs and the development costs separately. Therefore, R&D expenditure is recognized totally within the exploration strategy which is consistent with the structural form of ambidexterity that entails separating explorative R&D units from other exploitative units (i.e. production and sales and marketing units) (Blindenbach-Driessen and Ende 2014: 1089). Structural ambidexterity requires a complete set of structures for different competencies, systems, incentives, processes and cultures, suited to separate and specialized sub-units of exploration and exploitation activities.

management discipline also argue for separate R&D units (Burns and Stalker 1961; Christenson 1997) as this would enable "R&D personnel to develop new knowledge and innovations for the longer term (exploration), not hindered by the processes, constraints, and practices from operational activities" (Blindenbach-Driessen and Ende 2014: 1089).

The authors quoted here attempted to answer one of the open questions in literature, as to whether the separation or integration of innovation units facilitates higher levels of ambidexterity; they thus explored the effects of having separate R&D units for exploration, exploitation and overall ambidexterity in the context of manufacturing as well as service firms. Furthermore, they made a distinction between ambidexterity and ambidextrous performance, where the former stands for employing the different activities of exploration and exploitation and the latter for the financial performance results of employing such activities. They assessed ambidextrous performance by calculating the relative percentages of turnover that result from exploitative versus explorative activities. Using data from the Dutch Community Innovation Survey (CIS) for the period 2004-2006[18], Blindenbach-Driessen and Van den Ende (2014) find empirical evidence that having separate units for innovation activities is positively associated with exploration, exploitation and ambidexterity in both manufacturing and service firms; however, the positive association is significantly weaker in service than in manufacturing firms. Their result is in line with Jansen et al. (2009) who found an indirect positive association between having separate innovation units and ambidexterity.

The second form of ambidexterity, sequential, was defined by Gupta et al. (2006) as the periodical shifting (cycling) between modes of exploration and exploitation. Proponents of sequential ambidexterity (also referred to as punctuated equilibrium) suggest that periodical shifting between exploration and exploitation activities is a better alternative to simultaneous pursuit of both. To accommodate the conflicting alignments required for innovation and efficiency, Duncan (1976) suggested that ambidexterity is achieved when the organization shifts from one structural design (exploration or exploitation) to

[18] Blindenbach-Driessen and Van den Ende (2014) defined the CIS survey as "an instrument of the European Union that assesses and compares the innovativeness of firms in the countries of the European Union".

the other over a period of time according to their respective stand on innovation, thus aligning structure with the firm's strategy. Similarly, from an analysis conducted with the Intel Corporation, Burgelman (1991) concluded that sequential ambidexterity is a viable alternative to simultaneous ambidexterity as exploration can be successfully pursued at a given point in time and exploitation at another point in time. However, in the face of rapid change, Tushman and O'Reilly (1996) argued that sequential ambidexterity might be ineffective where firms need to simultaneously maintain modes of exploitation and exploration by accommodating structurally separate but adequately integrated exploration and exploitation units. Simsek (2009) conceptualized ambidexterity as balancing high levels of exploitation and exploration, rather than periodically (spatially) switching between them, pointing out that an organization with low levels of exploitation and exploration may be balanced, but not necessarily ambidextrous.

Finally, Gibson and Birkinshaw (2004) argued that a firm could attain contextual ambidexterity by designing features of the organization to permit individuals to decide how to divide their time between exploratory and exploitative activities. According to contextual conceptualization, ambidexterity is realized at the individual rather than the organizational level by "building a set of processes or systems that enable and encourage individuals to make their own judgments about how to divide their time between conflicting demands for alignment and adaptability" (p. 201).

Gibson and Birkinshaw (2004) also conceptualized ambidexterity as a function of a high-performance context in which individuals are embedded; they based this on the proposition of (Ghoshal and Bartlett 1994) of the behaviour-framing attributes of discipline, stretch, support, and trust, concepts which were borrowed from the strategy process literature. The behaviour-framing attributes are grouped into two interdependent and complementary classes: 1) performance management, which combines discipline and stretch; and 2) social support, which combines support and trust. The performance management-related behaviour-framing attributes indicate how an organization encourages its personnel to voluntarily strive for more ambitious goals and outcomes. The social support-related behaviour-framing attributes ensure that individuals establish their own ambitious goals within a cooperative work environment, as well as motivating employees to assist colleagues and to rely on each other's commitments. The interaction of the performance management and social support classes of behaviour-framing attributes create a high-performance context, which in turn leads to organizational ambidexterity.

2.5 Organizational Ambidexterity and Performance Associations

A long history of research links organizational ambidexterity with the firm's performance, either operating or financial[19]. Various measures of financial performance have been considered, such as Tobin's Q, profitability, ROA, ROE, cash-flow from operations and market share prices. Operating measures of performance include sales growth, market share growth, operational efficiency, market reputation, innovation and firm survival.

For instance, Stettner and Lavie (2014) document a positive impact of exploration and exploitation on financial performance measured by the firm's market value. Representing the investors' ex-ante expectations about future performance, these authors argued that market values of firms are a reliable way to proxy for their innovative behaviour, assuming that stock market prices capture and reflect the outcomes of explorative and exploitive behaviour as perceived by investors. Uotila et al. (2009) also document evidence for the introduction of newly innovated products (exploration effect) effectively capturing the firm's market value.

Organizational ambidexterity has also been found to have a positive impact on a number of performance metrics, including sales growth (Auh and Menguc 2005; Caspin-Wagner, Ellis, and Tishler 2012; Geerts, Blindenbach-driessen, and Gmmel 2010; Han and Celly 2008; He and Wong 2004; Lee, Lee, and Lee 2003; Lin, Yang, and Demirkan 2007; Venkatraman, Lee, and Iyer 2007; Raisch 2008); subjective performance ratings (Bierly and Daly 2007; Burton, O'Reilly, and Bidwell 2012; Cao, Gedajlovic, and Zhang 2009; Gibson and Birkinshaw 2004; Lubatkin et al. 2006; Markides and Charitou 2004; Masini, Zollo, and van Wassenhove 2004; Schulze 2009); innovation performance (Burgers et al. 2009; Katila and Ahuja 2002; McGrath 2001; Phene,

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[19] See section '2.6.3 A New Framework of Organizational Ambidexterity' for in-depth details on how organizational ambidexterity affects firm performance and how it creates value to the firm.

Tallman, and Almeida 2012; Rothaermel and Alexandre 2009; Rothaermel and Deeds 2004; Sarkees and Hulland 2009; Yang and Atuahene-Gima 2007); market valuation as measured by Tobin's Q (Goosen, Bazzazian, and Phelps 2012; Wang and Li 2008; Uotila et al. 2009); and firm survival (Cottrell and Nault 2004; Laplume and Dass 2012; Kauppila 2010; Piao 2010; Tempelaar and Van De Vrande 2012; Yu and Khessina 2012).

It can be concluded from the above discussion that organizational ambidexterity seems to be profoundly associated with enhanced performance, which implies its significant role in value creation, survival, success and sustainable competitiveness. Leveraging on these conclusions, it is posited that the firm's disclosure of exploration and exploitation strategies will include significant information content that would alleviate information asymmetry and reduce the perceived risk to investors. If so, disclosures of exploration and exploitation would be negatively associated with the cost of capital.

2.6 The Conceptual Framework of the Ambidexterity System

A number of studies have attempted to conceptualize a framework for organizational ambidexterity (Gibson and Birkinshaw 2004; Jansen, Van Den Bosch, and Volberda 2006; Raisch and Birkinshaw 2008; Simsek 2009). This section reviews the frameworks proposed by (Simsek 2009) and (Raisch and Birkinshaw 2008) and then presents the researcher's own framework of organizational ambidexterity.

2.6.1 The Framework of Simsek (2009)

Simsek (2009) conceptualized a framework which displayed a systematic view of ambidexterity entailing components for input, process and outputs. Antecedents at three main levels are viewed as inputs to this systematic view: firm, inter-firm, and environmental levels. However, the ambidexterity process is composed of exploration and exploitation activities, where three prevalent forms of ambidexterity are recognized: a realized form which is defined as the level of exploration and exploitation achievements; a structural form obtained by simultaneously adopting separate and autonomous sub-units for exploration and exploitation (Tushman and O'Reilly, 1996); and thirdly, a contextual form obtained by designing a system motivating and enabling individuals to explore and exploit (Gibson and Birkinshaw, 2004). Finally, the output of the ambidexterity process includes various benefits such as better financial performance and improved operating performance.

2.6.2 The Framework of Raisch and Birkinshaw (2008)

Raisch and Birkinshaw (2008) reviewed 20 leading articles and displayed their theorization of ambidexterity as a system. They recognized that the heart of the organizational ambidexterity process "spans various, hitherto disconnected research fields and cuts across disciplines such as organizational learning, strategic management, leadership theory, and organizational design" (p. 403). However, they regard the structural, contextual and leadership factors of an organization as the main antecedents of the ambidexterity process, while the outputs are mainly reflected in improved accounting measures, enhanced market valuation and higher growth rates. Their theoretical ambidexterity framework recognizes the effects of a number of moderators, including environmental factors (e.g. competitiveness vs. dynamism) and other factors (availability of sufficient resources and the firm's scope of operation). These moderators directly affect the firm's organizational ambidexterity in addition to moderating the association between antecedent-ambidexterity on one side and moderating the association between ambidexterity-output on the other.

Considering the antecedents, Raisch and Birkinshaw argue for three main approaches to achieve ambidexterity: structural, contextual and leadership-oriented. The structural approach emphasizes the importance of creating structural mechanisms that efficiently handle the competing demands of alignment and adaptability (Gibson and Birkinshaw, 2004). This is achieved by employing either *structural mechanisms* that enable organizational units to shift between both requirements (Brown and Eisenhardt, 1997) or *complex structures* where it is possible to combine organic and mechanistic elements[20]. Examples of complex structure solutions to the ambidexterity quest are spatial separation (Duncan, 1976; Tushman and O'Reilly, 1996; Benner and Tushman;

[20] Burns and Stalker (1961) posit that organic structure employs a high level of decentralization and autonomy to support flexibility demands, whereas mechanistic structure employs high levels of centralization, hierarchy and standardization to support efficiency demands. Duncan and Duncan (1976) argue that organizations need both structures: organic to create innovations and mechanistic to efficiently implement them.

2003) and parallel structures (Adler, 1999). The former (spatial separation) suggests a complete separation between exploration and exploitation units to enable the pursuit of disruptive innovation. Such separation is intended to ensure that contrasting units are physically and culturally separated by different tasks, incentives and managerial teams, so that each unit is configured according to the specific requirements and peculiarities of the assigned tasks. Co-integration amongst contrasting units is strategically accomplished at the senior management level to achieve ambidexterity. The latter (parallel structures), however, suggests the use of parallel structures at the unit level, to facilitate shifting back and forth between two or more structures depending on the requirements of each task. This entails having a formal and informal structure at the unit level to achieve ambidexterity. The formal structure can be used for regular and repetitive tasks to maintain stability and efficiency while the secondary informal structure supports non-repetitive tasks and innovations (Goldstein, 1985), thus correcting for the limitations of the formal structure while ensuring efficiency and flexibility (Adler, 1999).

The contextual approach as pioneered by Gibson and Birkinshaw (2004), however, emphasizes the behavioural capacity to simultaneously exhibit alignment and adaptability across the entire business unit, where leaders are expected to create a supportive business-unit context. Finally, the leadership-based approach emphasizes the importance of the role of senior executives (top management team) as key leaders of the organization in fostering and facilitating ambidexterity, as they are responsible for reconciling the tensions between explorative and exploitative demands.

With regard to other organizational antecedents, factors such as firm size, firm age, number of employees, industrial background, hierarchal structure and informal social relations are argued to affect ambidexterity (Jansen et al. 2006; Tushman and O’Reilly, 2013). For instance, Jansen et al. (2006) examined the impact of two different organizational coordination mechanisms on exploration and exploitation by using an integrated model that focuses on organizational units. The two coordination mechanisms are 1) the formal hierarchical structure including elements such as centralization and formalization; and 2) informal social relations such as connectedness. They posit that the antecedent of organizational centralization is negatively associated with exploration and insignificantly related to exploitation, while the antecedent of formalization is positively associated with exploitation but negatively associated with exploration. Finally, they assert the positive impact of connectedness between organizational units on both exploration and exploitation.

As for the environmental moderators, the innovative behaviour of firms varies according to different environments (Levinthal and March, 1993; Jansen et al. 2006; Simsek, 2009; Raisch and Birkinshaw, 2008; Tushman and O'Reilly, 2013). For instance, two environmental factors, namely dynamism and competitiveness, are recognized as environmental antecedents of ambidexterity (Levinthal and March, 1993; Jansen, et al. 2006; Menguc, 2008; Raisch and Birkinshaw, 2008). Environmental dynamism is defined as the rate of change and the degree of instability of the environment (Jansen, et al. 2006). It is characterized by short product life-cycles, rapid changes and disruptive breakthroughs in technologies and processes, all of which make current products and services outdated and require the development of new competencies (Jansen, et al. 2006). Environmental competitiveness is recognized as the degree of competition and is denoted by the number of competitors and of areas in which there is competition (Jansen, et al. 2006). Both environmental dynamism and competitiveness are positively associated with higher levels of ambidexterity (Levinthal and March, 1993; Jansen, et al. 2006). Jansen et al. (2006) concluded that the impact of exploration and exploitation on the units' financial performance is moderated by environmental aspects such as dynamism and competitiveness; this is similar to the findings of Levinthal and March (1993). Jansen et al. (2006) further found that pursuing exploration is more effective in dynamic environments, whereas pursuing exploitation is more beneficial to a unit's financial performance in a more competitive environment. Furthermore, Uotila et al. (2009) showed that there is a trade-off between exploration and exploitation and that the optimal balance between them depends on environmental conditions.

2.6.3 A New Framework of Organizational Ambidexterity

Based on the review of the literature, the current thesis presents a conceptualized framework that integrates the frameworks of ambidexterity discussed above.

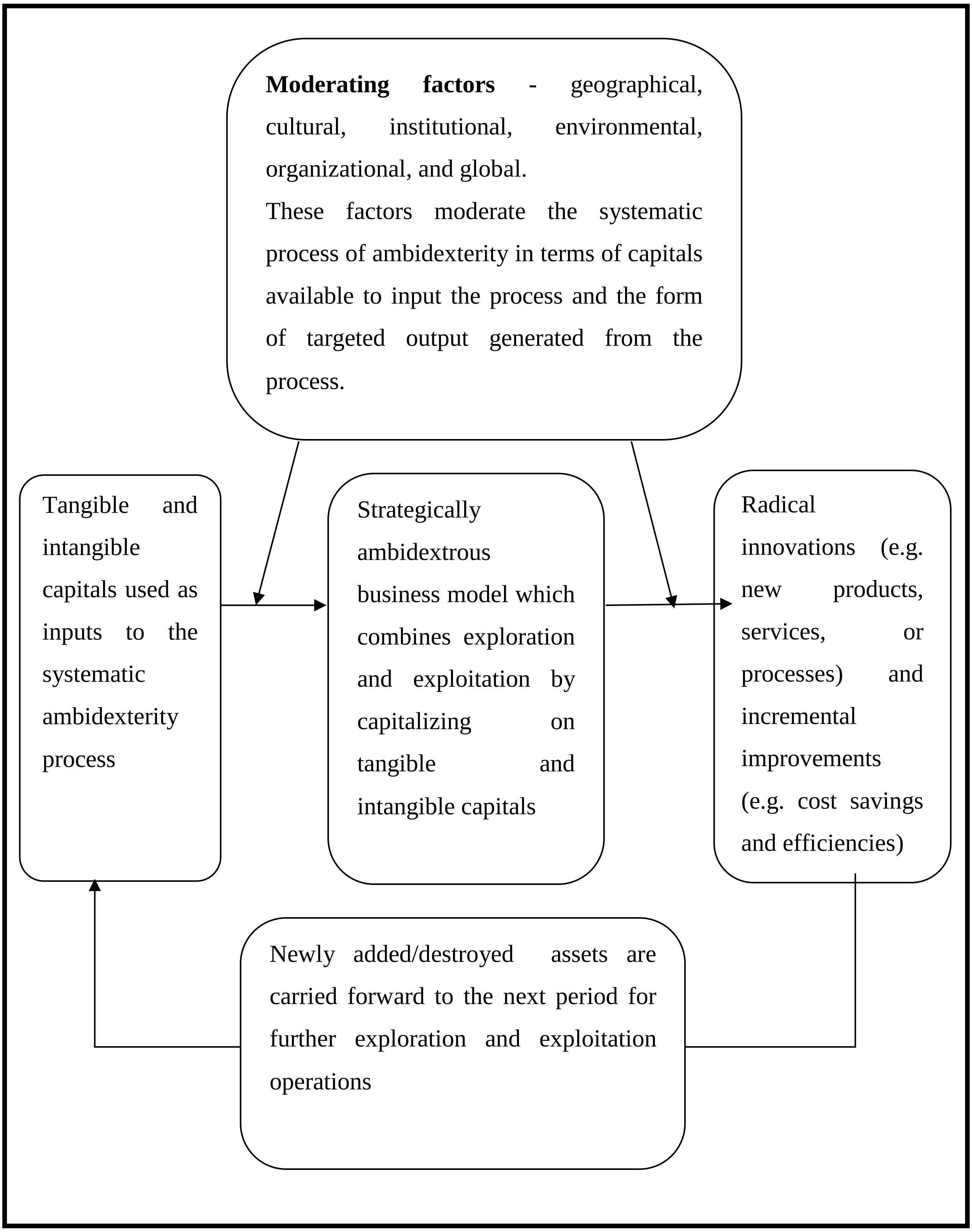

Figure 2.1 Framework of Organizational Ambidexterity. (Source: the authors' own)

Figure 2.1 displays an abstract framework of the ambidexterity system in generating radical and incremental innovations, and how it creates value and sustains competitive advantage. Similar to that of Simsek (2009), this study conceptualizes the ambidexterity framework as a system of inputs, process and outputs. Firms capitalize on their repositories of tangible and intangible capitals by ambidextrously combining exploration and exploitation strategies to generate incremental as well as radical innovations.

It is important to note that combining exploration and exploitation is of vital importance in generating synergic benefits, due to the interdependent nature of these two processes (Floyd and Lane, 2000). The ambidexterity process could be conducted through either one of the three prevalent forms: sequential ambidexterity by shifting the organizational structure over time (Duncan, 1976); structural ambidexterity by simultaneously adopting separate and autonomous sub-units for exploration and exploitation (Tushman and O'Reilly, 1996); or contextual ambidexterity by designing a system motivating and enabling individuals to explore and exploit (Gibson and Birkinshaw, 2004). Larger-sized firms presumably have access to greater resources to generate innovations and grow their capital repositories (Cao, Gedajlovic, and Zhang 2009). Individual firms, however, have different strategic perceptions of how to manage and grow both types of capital, for various reasons: geographical, cultural, institutional, environmental (i.e.

dynamic and competitive markets), organizational (i.e. scarcity of resources), and global factors. The same set of reasons are argued to moderate the levels of exploitation and exploration activities. Thus, firms tend to exhibit unique trends of innovative behaviour to adapt to change and sustain competitiveness. The explorative and exploitative strategies are strategically embedded in the business model for value creation as well as in the organizational structure. A completely new innovation in a given period is the outcome of explorative efforts, which are added to the existing capitals and taken forward as a base for future exploration and exploitation. Incremental innovations, however, are the outcome of exploitative efforts on the previous period's explorative and exploitative outcomes. The outcomes of exploitation are also added to the existing capitals and taken forward for future exploration and exploitation.

The outputs of the ambidexterity process could take either a tangible or intangible form, both of which would lead to improved financial performance, longer organizational survival, accelerated growth rates, and better competitive advantage. These outputs are added to the existing capitals and, regardless of physical form, are carried forward to the next period for further use in exploration and exploitation. The following cases are a simple list of potential forms of output from the ambidexterity process (Tushman and O'Reilly, 1996; He and Wong, 2004; Jansen, et al. 2006; Lavie and Rosenkopf, 2006; O'Reilly and Tushman, 2008; Stettner and Lavie, 2014):

1- Cost savings from exploiting synergies of mergers and acquisitions (M&As), improved learning curves, enhanced efficiencies from employing better internal controls, enhancements from restructuring processes and systems, and economies of scale in existing markets,
2- Increased profitability from introducing technologically refined versions of existing products, and
3- Higher stock market values and greater pay-offs from exploring new markets or new products as radical innovations.

Whichever the case that results in improved financial performance, it will enlarge the balances of either or both tangible and intangible capital. In a basic sense, current resources of tangible and intangible capital represent a repository that could be exploited for future innovation. Such a repository is partially built during the period and/or accumulated from previous periods. The innovation outcomes are directly related and traced back to their relevant activities of exploitation or exploration (Jansen, et al. 2006). This is why exploration and exploitation are commonly used synonymously with radical innovation and incremental innovation, respectively (Jansen, et al. 2006). However, the outcome and the process are not necessarily the same; the ambidexterity process and the ambidextrous performance are distinguished by (Junni et al. 2013; Blindenbach-Driessen and Ende 2014)[21].

2.7 Summary

Throughout this second chapter, definitions of exploration, exploitation and organizational ambidexterity have been reviewed. The combined and balanced dimensions of ambidexterity have been discussed and the various forms of the ambidexterity concept (sequential, structural and contextual) presented. The empirical evidence for the impact of organizational ambidexterity on financial and operating performance has been reviewed. Previous frameworks of organizational ambidexterity have been reviewed and a new framework has been conceptualized. So far, it is noted from reviewing the ambidexterity literature that the question of combining exploration and exploitation have never been addressed from a disclosure and cost of capital angle. Therefore, this thesis recognizes a research problem to be examined: the impact of disclosing exploration and exploitation information on alleviating informational asymmetry and reducing the cost of capital. This new angle of examining exploration and exploitation presents a valuable contribution to the ambidexterity as well as the disclosure literature. The reviews conducted in this chapter, however, will inform the development of the content analysis tool for measuring exploration and exploitation disclosures, as presented in the fourth chapter. The following chapter will review theories of corporate disclosure, empirical evidence for the association of disclosure and cost of capital, and evidence of innovation disclosure; it concludes with the development of the hypotheses.

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[21] While the outcome and the process are not necessarily the same, the outcome, indicates the level of the respective strategy conducted. Therefore, while developing the content analysis tool for measuring exploration and exploitation, as presented in the following chapter, words that are used could be relevant to either the process or the outcome.

Chapter 3 Corporate Disclosure and Cost of Capital: Hypotheses Development

3.1 Introduction

It is worthy of note that the disclosure literature is already very rich and diverse and continues to evolve over time through the contributions of many academic researchers who express a longstanding interest in it. Of the disclosure literature, Verrechia (2001: 98) posits that "there is no central paradigm, no single compelling notion that gives rise to all subsequent research, no well-integrated theory", further arguing that it could be best described as "an eclectic commingling of highly idiosyncratic (and highly stylized) economics-based models" as each model attempts to examine a small piece of the overall disclosure puzzle. The eclecticism in disclosure models is intensified as the disclosure literature inherently spans three kinds of literature: accounting, finance and economics; it will inevitably be characterized by an unlimited combination of their respective features (Verrechcia, 2001).

This chapter proceeds as follows. The following section reviews theories of disclosure. The third section reviews the direct and indirect links between disclosure and the cost of capital, the fourth the empirical evidence on IC disclosure and the fifth the evidence for innovation disclosure. The sixth section presents the hypothesis development, the seventh the subsampling approach, while the eighth section concludes with a chapter summary.

3.2 Theoretical Foundations of Disclosure

The disclosure literature provides various theoretical perspectives that help to explain policies of corporate disclosure (Merkl-Davies and Brennan 2007). These include, but are not limited to, positive accounting theory (Watts and Zimmerman 1986; Watts and Zimmerman 1990, 1978), agency theory (Jensen and Meckling 1976; Fama 1980), signalling theory (Spence 2002; Connelly et al. 2011; Spence 1978), proprietary cost theory (Verrecchia 1983, 2001), economic theory of disclosure (Verrecchia 2001; Healy and Palepu 2001), and other theories such as institutional theory, legitimacy theory, and stakeholder theory.

3.2.1 Positive Accounting Theory

Watts and Zimmerman presented the concept of Positive Accounting Theory (PAT) for the first time in (1978) to explain management discretion over accounting-related policies and choices (i.e. disclosure). The PAT literature looks at contractual and political factors to explain management discretion over accounting choices in the presence of agency conflicts and information asymmetry (Healy and Palepu 2001). Contractual factors are costs related to establishing and enforcing contracts of two types: 1) compensation contracts between the management and shareholders; and, 2) debt contracts between the firm and its creditors[22]. Political factors are management's concern about attracting public and political scrutiny resulting in explicit or implicit costs such as taxes or other forms of regulatory action (Watts and Zimmerman 1986)[23].

In line with agency theory, as presented later, PAT assumes that managers are self-interest maximizing units who have a potential conflict of interest with the owners of the firm (Watts and Zimmerman 1986; Watts and Zimmerman 1990, 1978). Hence, it is argued that management discretion over accounting policies is opportunistic in a way that maximizes their own self-interest. Compensation contracts are one of the mechanisms for dealing with information asymmetry (Healy and Palepu 2001), by designing compensation schemes that align management's interests with those of owners (i.e. share-based compensations and stock options). Empirical evidence supports the argument that share-based compensation plans minimize the managerial averseness to disclosure (Nagar, Nanda, and Wysocki 2003). In fact, it is argued (Watts and Zimmerman 1990; Merkl-Davies and Brennan 2007) that management has more

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[22] Regarding the debt contracts type of contractual factors, empirical studies in the PAT theory stream find evidence that managers of highly leveraged firms make accounting and disclosure choices that 1) manage earnings upward to loosen the debt constraint if the firm is approaching violation of debt covenants (DeFond and Jiambalvo 1994; Sweeney 1994) and 2) help to preserve cash if the firm is in financial distress (Healy and Palepu 1990; DeAngelo, DeAngelo, and Skinner 1996).

[23] Regarding the political factors, Watts and Zimmerman (1978) argue that large-size firms attract political attention and public scrutiny as they report large absolute amounts of profits; this is associated with potential monopoly power (Watts and Zimmerman 1978) and abuses of human as well as environmental resources (Milne 2002). Therefore, Watts and Zimmerman (1990) argue that political costs are a function of reported earnings and that management have the incentive to manage the earnings downwards so as to avoid scrutiny from the public and politicians.

incentives to make voluntary disclosures when a share-based compensation plan is put into effect. Management's opportunistic discretion over accounting and disclosure policies is, presumably, intended to improve the market valuation of stock prices, and therefore enhance the wealth of managers by increasing the value of their shareholdings and stock options as well as entitling them to other forms of compensation (e.g. cash bonuses for meeting market-based targets) (Healy and Palepu 2001; Merkl-Davies and Brennan 2007). Hence, management considers disclosing good (bad) news as signalling a positive (assertive) attitude to the market and, in turn, boosting market stock prices. Disclosure of good news is inherently positive and has a good impact on share prices. Disclosing bad news helps to avoid: 1) the negative market reaction to non-disclosure by asserting confidence that the situation is under control (Healy and Palepu 2001; Verrecchia 2001); and 2) prospective litigation risks and associated costs as a result of non-disclosure that would be damaging to the firm's value (Healy and Palepu 2001; Merkl-Davies and Brennan 2007).

Reflecting on the phenomenon of innovation disclosure, the release of such information is viewed as a positive signal to the market given its inherently unique nature as competitive-oriented information. Hence, management proximity to disclosing innovation-related information is incentivized by creating a positive market reaction through higher stock prices. This, in turn, will enable management to maximize their wealth through the enhanced value of their own shareholdings and stock options as well as through entitlement to cash-based bonuses. In short, managers have positivist-based incentives for disclosing innovation information as a way to maximize their own individual wealth.

3.2.2 Agency Theory

Agency theory revolves around issues arising from the separation of ownership from the management functions of a firm (Jensen and Meckling 1976; Fama 1980). Under the PAT conception, everyone is assumed to be a self-interest maximizing units, but the agency theory looks at the self-interest driven behaviour in the context of a principal-agent relationship. In an agent/principal form of relationship, managers (agents) are hired to act on behalf of shareholders (principals) in running the business, where both parties in the relationship are believed to be self-utility maximizing units (Fama 1980;

Merkl-Davies and Brennan 2007; Ballwieser et al. 2012; Eisenhardt 1989). This notion raises the possibility that managers are motivated by self-interest when managing shareholders' funds in a way that is not necessarily aligned with the owners' interest in maximizing firm value. This opportunistic behaviour by managers means that the business is not necessarily being run in the best interests of shareholders, but rather that of managers. In this case, shareholders and managers must incur monitoring and bonding-related costs to assure the running of the business in accordance with shareholders' best interests. These costs are referred to as agency costs. The monitoring-related costs are intended to align the interests of managers with those of shareholders by 1) establishing formal control systems and regular external reporting to monitor ongoing performance, and 2) establishing appropriate incentive schemes to reward managers for meeting performance targets and upholding budgetary restrictions. The bonding-related costs (e.g. contracting an external independent auditor) are paid by the managers, indirectly on behalf of shareholders, to reassure owners that their funds are properly managed. The higher the external equity financing, the bigger the agency problem is and the more resources shareholders need to expend as agency costs. High agency costs could have a negative effect on a firm's value as the shareholders consider it when evaluating the share price (Jensen and Meckling 1976).

One way to mitigate the negative effects of agency costs is to disclose more decision-useful incremental information (Botosan 1997; Sengupta 1998; Verrecchia 2001). Incremental information is decision-useful for owners if it encapsulates enhanced quantity and/or quality disclosures. Information asymmetry arises from the fact that managers who run the business are better informed about the business affairs than are its owners, hence, the need for corporate disclosure as a monitoring device over the agency relationship between managers and owners. Shareholders, therefore incur the agency monitoring costs to mitigate information asymmetry and to ensure that equity funds are being wisely managed. Hence, the disclosure of incremental information has the advantage of reducing information asymmetry and therefore reduces the need for incurring high agency costs. These reduced agency costs will translate into positive effects such as higher firm valuation and improved stock prices. An imperative part of disclosure which reduces information asymmetry is the incremental information disclosed relating to the firm's innovation strategy and performance.

Innovation is a key activity embedded in the value creation process of a business model, and its disclosure remains the responsibility of those charged with governance (IIRC 2013). Innovation disclosure could reduce information asymmetry when the informational content addresses: 1) how the firm is employing an innovation-driven value creation strategy; 2) investments with an innovative solution that put owners' finances to best use, and 3) the actual vs. potential generated economic benefits from innovation-driven investments and strategies. Voluntary disclosure on innovation with incremental information content could serve to bridge the information asymmetry gap by enabling investors to make better-informed decisions and have more accurate estimates of future earnings. To recap, the incentive of bridging information asymmetry and reducing agency cost is a major driver for incremental innovation disclosure.

3.2.3 Signalling Theory

Looking from a job market perspective, Spence (1978) illustrated the use of signalling techniques as a way of communicating superior performance to the market. In a job market setting, employers are uncertain of how well potential job candidates will perform their assigned tasks. This uncertainty makes it difficult to distinguish between good and bad candidates, forcing the employer to pay an average wage which, in turn, leaves better-performing candidates underpaid and disadvantaged. In this case, candidates with superior performance would distinguish themselves from those with a weaker performance by signalling superior quality and added value, such as higher education and years of experience. From this job market-based analysis, Spence (1978) developed the theoretical perspective of signalling superior performance, higher quality, and greater value as a means of bridging the information asymmetry and communicating incremental information useful for decision making when deciding between good and bad opportunities.

Signalling theory leverages the notion of information asymmetry (Spence 2002; Connelly et al. 2011; Spence 1978). An information gap between two parties in a given exchange relationship (information asymmetry) may result in adverse selection problems on the buyer side since the seller holds better information about the commodity being exchanged (Lev 1988; Connelly et al. 2011). This leaves the buyer with the uncertainty of whether the price paid truly reflects the underlying value of the commodity, or is overestimated. This uncertainty, resulting from the information gap, leads to misevaluation issues where good trading opportunities are undervalued and bad ones are overvalued (Lev 1988; Connelly et al. 2011; Healy and Palepu 2001). In the case of publicly traded companies, such misevaluation is reflected in market terms by higher cost of equity capital (i.e. the required rate of return by equity investors) and lower stock prices. This negative implication on firm valuation is thus a direct effect of information asymmetry (Healy and Palepu 2001). Firms with good potential may, therefore, resort to signalling techniques to uniquely differentiate themselves from others as a way of underlining their outstanding performance.

Disclosure is one of the means used to signal outstanding performance to the market (Gray, Meek, and Roberts 1995; Aerts 2005). Better performing firms tend to signal superior potential through extended disclosures to allow investors to better compare them with bad performing firms (Cooke 1989; Wallace and Naser 1995; Wallace, Naser, and Mora 1994). Therefore, better performers tend to articulate, through the means of disclosure, more information to reemphasize current success and highlight strong potential in such a way that enables investors to distinguish them from weak performers. Hence, firms that signal superior performance through expanded disclosures are arguably more capable of attracting capital at cheaper costs (i.e. lower cost of equity capital), which translates into a higher market valuation of stock prices. Such an advantage, however, is not attained by weak performers as they lack the incentive to articulate more disclosures on their frail performance.

Less disclosure, nevertheless, does not necessarily suggest a negative signal, despite the negative market reaction (Verrecchia 1983, 2001) by implying a higher required rate of returns on investments of equity capital. In some cases, it is the potential costs of disclosure that discourage firms from extending elaborative information on their performance. Disclosure costs generally comprise: 1) direct forms of costs such as gathering data, processing, preparation, and dissemination of information; and, 2) indirect forms such as proprietary information costs[24]. Thus, firms tend to trade-off

[24] Proprietary information is copyrighted information that, if disclosed, will give away company trade secrets to competitors and render them in a competitively disadvantaged position.

costs for potential benefits when deciding upon disclosure policies and offer elaborate disclosures when the perceived benefits outweigh the potential costs of disclosure (Verrecchia 1983, 1990, 2001; Beattie and Smith 2012; Healy and Palepu 2001; Bellora and Guenther 2013). The costs associated with disclosure indicate potential uncertainty for investors, making it unclear whether the withheld/non-disclosed information is of a negative nature or not (Verrecchia 1983, 2001).

Innovation disclosure is generally of a positive nature as it relates to information about how the firm's innovation-oriented strategy supports superior current performance and how it ensures outstanding future potential. Given the positive nature of innovation disclosure, it is posited that firms will provide elaborate innovation disclosure as a positive signal of superior performance. Provided that it does not involve proprietary information, innovation disclosure is expected to send a positive signal and attract a favourable market reaction in the form of higher expected future earnings by analysts, lower cost of equity capital and higher market valuation of stock prices.

3.2.4 Proprietary Cost Theory

The cost of proprietary information is one of the major incentives for non-disclosure (Verrecchia 1983, 2001), even though non-disclosure is perceived negatively in capital market terms. The danger of disclosing proprietary information is critical for a firm's sustainable performance as it could give away confidential business secrets for competitors, and thus render the firm competitively disadvantaged.

Non-disclosure, however, may aggravate proprietary costs as it might entice potential competitors to enter the market, and thus accelerate fierce industrial competition. Disclosure of negative information, however, has a counter-effect as it deters potential competitors from entering the market (Darrough and Stoughton 1990). Hence, when the industry is highly competitive or characterized with low entry costs, firms have an incentive to disclose negative information about corporate performance as a way of discouraging new entrants to the market (Dye 2001; Darrough and Stoughton 1990). Furthermore, Hayes and Lundholm (1996) posit that, when deciding on the appropriate level of aggregation in segmental disclosures, firms take into account competitors' reactions and associated proprietary costs.

Decisions on corporate disclosure policies include 1) the decision to disclose vs. not to disclose; 2) the nature of the information to be disclosed (i.e. positive vs. negative), and 3) disclosure levels (partial vs. full disclosure). These three types of disclosure decision rest upon how fierce the industrial competition is and how costly it is to disclose proprietary information. These considerations remain relevant to disclosure decisions for innovation-related information (Jansen 2010; Hughes and Pae 2015; Bhattacharya and Ritter 1983). Previous evidence in the disclosure literature (Blanco, Garcia Lara, and Tribo 2015; Botosan and Stanford 2005) points to a moderating effect of proprietary costs on the association between disclosure and cost of capital; in the presence of high proprietary costs, the disclosure benefits from reducing the cost of capital are smaller. How the presence of proprietary costs moderates the association between innovation disclosure and cost of capital is addressed in the current study.

3.2.5 Economic-based Theory of Disclosure

Through the lens of economic theory, corporate disclosure is viewed as inherently economically motivated (Verrecchia, 2001), based on the classical form of economic decision making: a cost vs. benefit trade-off (Bellora and Guenther 2013). Hence, the economic stream of disclosure literature assumes that enhanced disclosure quality (i.e. incremental information) will reduce the cost of capital by reducing information asymmetry (Verrechcia, 2001; Lambert et al., 2007) or reducing the perceived risk to investors (Hughes, Liu, & Liu, 2007; Lambert, Leuz, & Verrecchia, 2007). Therefore, the disclosure content of added information value is generally associated with lowering information asymmetry and reducing the perceived risk, which in turn reduces adverse selection problems and the cost of equity capital (Botosan 2006; Botosan and Plumlee 2000; Botosan 2000) as well as the cost of debt capital (Sengupta 1998). The lower cost of capital will increase equity valuation and the market liquidity of the shares, ultimately allowing access to more funding (Verrecchia 2001; Healy and Palepu 2001). Hence, firms that need to raise funding from capital markets have the incentive to give more voluntary disclosures as a way of reducing information asymmetry and attracting capital investments at cheaper rates of required returns (Lang and Lundholm 1993; Cooke 1989; Healy and Palepu 2001; Lambert, Leuz, and Verrecchia 2007; Gray, Meek, and Roberts 1995). Expanded disclosure contents with incremental information value would aid investors in undertaking informed decision making when evaluating various investment opportunities and allocating capital to the highest-rewarding options (Lambert, Leuz, and Verrecchia 2007; Verrecchia 2001). This is because enhanced disclosure can result in lower information asymmetry among investors or between managers and investors. When the level of disclosure is inadequate, some investors are better informed than others; informationally underprivileged investors price-protect themselves by becoming less willing to trade, leading to higher market illiquidity, higher bid-ask spreads, higher transaction costs, higher cost of capital, and ultimately lower share prices (Verrecchia 2001, Dhaliwal, Li et al. 2011).

Exploring the economic-related effects of information disclosure is of long-standing and considerable interest in the accounting and finance research stream, as it provides empirical evidence with vital implications for the policy-making and standard-setting processes (Christensen, Lee, & Walker, 2007; Leuz & Verrecchia, 2000; Verrecchia, 2001). The research implications of the economic-based disclosure literature are to develop the general understanding of the costs vs. benefits effects of various types of incrementally informative disclosures; this is a vital consideration in the standard-setting process (Botosan, 2006). The disclosure literature examines the link between disclosure and the cost of capital by focusing on different types of information disclosure: financial information, intellectual capital information, Corporate Social Responsibility (CSR) information, environmental information, mandatory vs. voluntary information, and integrated information (García-Sánchez and Noguera-Gámez 2017). The empirical findings, however, were in many cases mixed, as the disclosure of different types of information has different effects on the cost of capital (Healy and Palepu, 2001; Botosan, 2006). This has given rise to various calls for additional research to enhance the general understanding of the economic-related effects of disclosure for different types of information (Botosan, 2006; Mangena et al. 2016). In response to these calls, this study will examine the economic consequences of a very specific type of disclosure: innovation information. Furthermore, as innovation is conceptually classified into two types it is necessary to address two types of innovation disclosure: exploitative and explorative. With the recognition of these two distinct types of innovation disclosure, there arises the need to distinguish the respective economic effects of each on the cost of capital. Consistent with the ambidexterity construct (He and Wong, 2004; Cao et al. 2009; Uotila et al. 2009), the combined disclosure of the two types of innovation will also be examined for economic effects on the cost of capital.

3.2.6 Other Theories of Disclosure

Other theories, including institutional, legitimacy and stakeholder theories, try to explain incentives for various corporate disclosures and mostly used when identifying societal determinants of environmental and social disclosures. The institutional theory, for instance, focuses on the institutional pressures from the environment surrounding the firm and how they alter the firm's strategies including disclosure (Cormier, Magnan, and Van Velthoven 2005). It predicts that firms will conform to societal expectations by complying with institutional norms. While in terms of legitimacy theory, Bebbington, Larrinaga-González, and Moneva-Abadía (2008) posit that firms are regarded as legitimate if they hold values that are consistent with those of the wider society. The legitimacy theory predicts that firms would strive to be recognized as legitimate in the society where they operate so that they continue to access resources and maintain successful performance over the longer term (Wilmshurst and Frost 2000). The stakeholder theory, however, takes into account other societal parties that have an interest in the firm's operations and it is based on the view that there should be an explicit recognition of the welfare of wider stakeholders (Dhaliwal et al. 2014). These three theories overlap in the sense that they view the firm as a legal or artificial person functioning in wider society and embedded in a web of social relations which will influence the fundamental nature of corporate disclosure policies. The institutional theory assumes that firms react to institutional pressures in their corporate reports in a way that depicts compliance with institutional norms (Cormier, Magnan, and Van Velthoven 2005). A compliant picture of the firm will validate its legitimacy and, according to the legitimacy theory, justifies its' access to resources controlled by others (Bebbington, Larrinaga-González, and Moneva-Abadía 2008; Wilmshurst and Frost 2000). Firms disclose environmental and social information as a response to public pressures, scrutiny and increased media attention (Cormier, Magnan, and Van Velthoven 2005) as well as to meet the expectations and demands of various other stakeholders. Corporate disclosures on social and environmental practices are assumed to alter public perceptions about the legitimacy of the firm (Hooghiemstra 2000). This thesis poses a question on the economic consequences of innovation disclosures. So, studying the societal incentives to innovation disclosure is a valid research question for future research but remains outside the scope and the objective of the current study.

3.3 Corporate Disclosure and the Cost of Capital

This section presents reviews 1) previous evidence suggesting the direct as well as indirect links between disclosure and the cost of capital; 2) evidence of the association between various disclosure types and the cost of capital, and 3) a number of factors affecting the association between disclosure and the cost of capital.

3.3.1 The Direct Link through Stock Liquidity

Economic theory predicts that enhanced disclosure, by either quantity or quality, reduces information asymmetry (Beyer et al. 2010) which in turn enhances firms' valuation and increases stock liquidity (Easley and O'hara 2004). Stock liquidity refers to the immediate capability of selling or buying a given stock; in other words, a liquid market is available instantly to deal the stock (O'hara 1995). The more liquid a stock is, the easier it becomes to trade it while trading entails the lowest effect possible on the price (O'hara 1995). In the absence of an immediate buyer or seller, the demand and supply is said to be imbalanced, in which case a specialist steps in to keep the market liquid. The specialist charges a transaction cost for their service: the price of immediacy as paid by the trader. These transaction costs are known as the bid-ask spread (Easley et al. 1996). Copeland and Galai (1983) show that the presence and magnitude of information asymmetry are reflected in the size of the bid-ask spread. An enhanced disclosure will reflect a lower information asymmetry as shown by lower bid-ask spread, implying a lower cost of equity capital[25]. The lower the bid-ask spread, the more liquid the market is. Amihud and Mendelson (1986) find that firms which provide more disclosures reduce the adverse selection component of a bid-ask spread, which

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[25] Another measure of liquidity is the trading volume; which is also argued to capture information asymmetry (Easley et al. 1996; Dhaliwal et al. 2011). Enhanced disclsoure is argued to reflect less information asymmetry by observing significantly higher trading volumes and lower bid-ask spreads. The bid-ask spread decreases with the trading volume because, as Glosten and Milgrom (1985) show, the trading itself bears information content as it incorprates them into market prices.

indicates a potential reduction in the cost of equity capital. Similar empirical findings are reported by various authors (Welker 1995; Healy, Hutton, and Palepu 1999; Botosan and Harris 2000; Leuz and Verrecchia 2000), where enhanced levels and contents of disclosure reflect lower information asymmetries by evidently lower bid-ask spreads. Overall, empirical findings are in line with the argument that enhanced disclosure lowers information asymmetry as reflected by higher liquidity which implies a lower cost of equity capital.

3.3.2 The Indirect Link Through Pricing of Information Risk

Corporate disclosure is generally linked to the cost of capital through two main mechanisms: estimation risk and information asymmetry (Blanco, Garcia Lara, and Tribo 2015). Estimation risk denotes the uncertainty associated with estimating the asset's future returns or payoff distributions. Information asymmetry, as previously explained, denotes the potential risk of trading with better-informed investors. Both estimation risk and information asymmetry constitute what is generally referred to as information risk (De George, Li, and Shivakumar 2016). One way to reduce information risk is through enhanced disclosures by providing accounting information of either greater volume or higher quality with more precision (De George, Li, and Shivakumar 2016; Easley and O'hara 2004). Enhanced disclosure is argued to reduce information asymmetry (Easley and O'hara 2004; Verrecchia 1983, 2001) which, in turn, alleviates estimation risk for investors (Lambert, Leuz, and Verrecchia 2007). The information risk is argued to be priced by the market (Easley and O'hara 2004) and, if reduced, will be rewarded with a lower cost of capital and higher stock valuation. The argument that information risk is priced by the market (Easley and O'hara 2004) rests upon the notion that such risk is systematic and not diversifiable (Barry and Brown 1985; De George, Li, and Shivakumar 2016). Barry and Brown (1985) show that risk-averse investors prefer securities that have more information available because they indicate less estimation risk. Coles and Loewenstein (1988) show that uncertainty around estimation risk affects equilibrium prices, portfolio weights, asset expected returns and betas.

In a counter-argument, Hughes, Liu, and Liu (2007) posit that information risk "can be diversified away when the economy is large", emphasizing, "the role of under-diversification due to the restriction to a finite set of assets" (p. 707) rather than the pricing of information risk itself. The argument of diversifiability of information risk as put forward by these authors is largely true. Reinganum and Smith (1983) argue that in large economies with many securities, the information risk could be mostly diversifiable. Only when the economy is large enough to have a perfect market portfolio and all firms exhibit the same levels of disclosure would it be possible to diversify the information risk away (De George, Li, and Shivakumar 2016; Lambert, Leuz, and Verrecchia 2007). Furthermore, there is evidence that information risk might be both diversifiable and non-diversifiable, depending on the basis used for asset pricing (Clarkson and Thompson 1990; Clarkson, Guedes, and Thompson 1996). So, in the case of imperfect mimicking portfolios that partly consist of stocks with differential information factor, information risk is a systematic component that cannot be diversified away (Clarkson, Guedes, and Thompson 1996). The diversifiability of information risk, therefore, remains an open empirical question (Clarkson, Guedes, and Thompson 1996) as there is no conclusive evidence that such risk could be totally diversified away.

3.3.3 Review of Empirical Evidence

Building on the theoretical reasoning as explained above, a wealth of empirical studies have been conducted on the association between corporate disclosure and the cost of capital. Beyer et al. (2010) recognized two main forms of empirical studies on the disclosure and cost of capital association: corporate event-driven and cross-sectional analysis. Studies in the corporate event-driven category focus on disclosure around specific corporate events such as Initial Public Offerings (IPOs) and Seasoned Equity Offerings (SEOs) (Schrand and Verrecchia 2005; Lang and Lundholm 2000), adoption of new standards or rules (e.g. IFRS adoption) (Daske 2006; Daske et al. 2008), or events of cross-listing on different stock exchange markets (Hail and Leuz 2009; Bailey, Karolyi, and Salva 2006; Lang, Raedy, and Yetman 2003; Leuz 2003; Lang, Lins, and Miller 2003). For instance, extensive pre-IPO disclosures are found to be associated with lower underpricing (Schrand and Verrecchia 2005) while extensive pre-SEO disclosures are associated with reductions in the cost of equity capital and higher market prices (Lang and Lundholm 2000). Non-US firms that seek cross-listing on US stock exchange markets face increased disclosure requirements and this enhancement of the disclosure environment leads to significant increases in both market returns and volume of traded shares (Bailey, Karolyi, and Salva 2006). Also, empirical evidence points out that mandatory and voluntary adoption of International Financial Reporting Standards (IFRS) leads to post-adoption benefits of lower cost of capital and increased market valuations, although the benefits are more pronounced for voluntary adopters (Daske 2006; Daske et al. 2008). Studies in the cross-sectional category, however, examine the effects of various types of disclosure (i.e. financial, corporate social, environmental, voluntary vs mandatory) in a general sense without consideration of a specific corporate event setting.

Theoretically speaking, there is a relative consensus that enhanced disclosure will be associated with lower information asymmetry, lower estimation risk, and thus lower cost of capital. Empirical evidence, however, for the association of disclosure and the cost of capital is mixed and mostly dependent on the type of information disclosed (Botosan 2006). Although most research on the disclosure and cost of capital association has focused on financial disclosures (Healy and Palepu 2001; Dhaliwal et al. 2011) both the mechanisms and underlying assumptions apply equally to non-financial disclosures as long as the information in question is value-relevant (Dhaliwal et al. 2011). However, Dhaliwal et al. (2011) argued that a straightforward generalization of the cost of capital effect from financial disclosure to non-financial disclosures (i.e. IC, CSR and voluntary disclosure) is not always obvious. This is especially true if the non-financial disclosures are: 1) subject to fewer regulations, 2) less useful due to issues of non-comparability, and 3) suffer from potential credibility issues due to opportunistic behaviours of firms. Therefore, the link between various types of disclosure and the cost of capital remains to be tested empirically.

The body of the disclosure literature shows a number of value-relevant disclosure types that are already well identified in theoretical and empirical studies. For instance, empirical evidence of disclosure studies documents a negative association with the cost of capital specifically from: aggregate disclosures and financial information (Botosan and Plumlee 2002a; Botosan and Plumlee 2002b; Botosan 2006, 1997), intellectual capital information (Mangena, Li, and Tauringana 2016; Orens, Aerts, and Lybaert 2009; Bontis et al. 2007; Singh and Mitchell Van der Zahn 2007; Campbell and Rahman 2010; Beattie and Thomson 2007; Bozzolan, Favotto, and Ricceri 2003;

Brennan 2001; Guthrie and Petty 2000), environmental information (Plumlee et al. 2015; Plumlee, Brown, and Marshall 2008), mandatory vs. voluntary information (Plumlee et al. 2015; Plumlee, Brown, and Marshall 2008; Francis, Khurana, and Pereira 2005; Hail 2002; Graham, Harvey, and Rajgopal 2005; Dhaliwal et al. 2011; Francis, Nanda, and Olsson 2008; Blanco, Garcia Lara, and Tribo 2015), strategic disclosures (Gietzmann and Ireland 2005), and integrated information (García-Sánchez and Noguera-Gámez 2017). However, CSR information (Richardson and Welker 2001; Al-Tuwaijri, Christensen, and Hughes 2004; Dhaliwal et al. 2011) was found to have a positive association with the cost of equity capital. The collective evidence of this literature demonstrates the notion of information type-dependency in the association between disclosure and cost of capital, as explained by (Botosan 2006).

For instance, in relation to financial disclosure, Botosan and Plumlee (2002b) document a significant negative association between enhanced disclosures in the annual report and the costs of equity capital. In the same study, however, they find an increase in the cost of equity capital associated with more disclosure levels in the quarterly report. Consistently, Brown and Hillegeist (2007) find that information asymmetry is negatively associated with the quality of the annual report and positively associated with the quality of quarterly report disclosure.

Richardson and Welker (2001) examined the effects of two types of disclosure (CSR and financial) on the cost of equity capital. In a longitudinal three-year study for a sample of Canadian firms, they found a negative association between financial disclosure and cost of equity capital only for firms of low (rather than high) analyst-following. In contradiction of their stated hypothesis, however, they documented a significantly positive association between CSR disclosure and cost of equity capital. Furthermore, Dhaliwal et al. (2011) examined voluntary CSR disclosure using a US-based sample of 294 listed firms and found that those with a high cost of equity capital are more likely to initiate greater voluntary CSR disclosure; however, only those firms with greater CSR performance ratings enjoyed a subsequent reduction in the cost of equity capital. They added that firms initiating voluntary CSR disclosure are subsequently more likely to raise equity capital and more likely to raise significantly larger amounts than non-initiating firms.

Plumlee, Brown, and Marshall (2008) examined the impact of voluntary environmental disclosure on the components of firm value (cost of capital and expected cash flow). They document that the quality of voluntary environmental disclosure is negatively associated with the cost of capital and positively associated with cash flows. Al-Tuwaijri, Christensen, and Hughes (2004) also found a positive association between, on the one hand, good environmental performance and extensive environmental disclosure, and on the other firm value. Assuming a negative association between the cost of capital and firm value, their results indicate a lower cost of capital due to both good environmental performance and good quality environmental disclosure.

Hail (2002) examined a sample of 73 Swiss firms and found a highly significant negative association between voluntary disclosure and cost of equity capital. In a cross-border study, Francis, Khurana, and Pereira (2005) examined a sample of firms from 34 countries and found that those from industries with greater needs for external financing tend on average to provide greater voluntary disclosure, leading to lower cost of both equity and debt capital. Furthermore, Blanco, Garcia Lara, and Tribo (2015) documented a negative association between voluntary disclosure of segment information and cost of equity capital, although the decrease in the cost of equity capital was less pronounced in the presence of competitive pressure. Gietzmann and Ireland (2005) documented a significant negative association between timely strategic disclosure and the cost of equity capital only for firms adopting aggressive (not conservative) accounting policies. In a cross-border study[26], García-Sánchez and Noguera-Gámez (2017) found a negative association between the disclosure of integrated reports and the cost of equity capital, and that this association is especially relevant for firms that need to increase their basic funding. In contrast, however, Bertomeu, Beyer, and Dye (2011) design a model that examines the capital structure, voluntary disclosure and cost of capital. Though they expect a negative association between the cost of capital and the extent of information disclosed, they find that more expensive voluntary disclosure does not cause a reduction in the cost of capital.

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[26] The authors used a sample of 3,294 firm-year observations for 995 firms from 27 countries including the UK for the five-year period 2009-2013.

3.3.4 Factors Affecting the Disclosure and Cost of Capital Association

The disclosure literature documents a number of factors that affect the association between disclosure and the cost of capital. The following sub-sections will discuss some of these factors such as: 1) size, 2) leverage, 3) profitability, 4) analyst following, 5) proprietary costs, 6) industry, 7) growth prospects and 8) issuance of new financings.

3.3.4.1 Size

There is strong evidence of a positive and significant association between size as an explanatory variable and the level of disclosure (Lang and Lundholm 1993; Botosan and Plumlee 2002a; Botosan 2006; García-Sánchez and Noguera-Gámez 2017). It is considered an important factor in corporate transparency (García-Sánchez and Noguera-Gámez 2017) and is used as a vital control variable when modelling the association between disclosure and the cost of capital (Richardson and Welker 2001; Botosan and Plumlee 2002b; Dhaliwal et al. 2011; Blanco, Garcia Lara, and Tribo 2015). Consistent with Agency Theory predictions, large firms need external funding from outside investors which increases the rift between shareholders, creditors and the firm's board as a result of more conflicts of interest. Disclosure serves as a mechanism to restrict these conflicts and reduce information asymmetry (García-Sánchez and Noguera-Gámez 2017).

3.3.4.2 Leverage

Leverage, proxies for the level of indebtedness and, is expected to have a positive association with the level of disclosure (García-Sánchez and Noguera-Gámez 2017). It also drives the cost of capital upwards (Modigliani and Miller 1958; Fama and French 1992, 1993; Botosan and Plumlee 2002b; Blanco, Garcia Lara, and Tribo 2015) and has been used as a control variable when modelling the association between disclosure and cost of capital (Richardson and Welker 2001; Botosan and Plumlee 2002a; Dhaliwal et al. 2011; Blanco, Garcia Lara, and Tribo 2015). According to Agency Theory, agency costs are higher for firms that use outside funding, and creditors protect their interests by imposing debt covenant restrictions in lending contracts. Disclosure serves as a means of monitoring compliance with these restrictions and reducing agency costs (García-Sánchez and Noguera-Gámez 2017).

3.3.4.3 Profitability (ROA)

Profitability, a proxy for financial performance, is argued to affect the association between disclosure and cost of capital. According to Agency Theory predictions, managers of profitable firms can use extensive external disclosures for personal purposes. Signalling Theory suggests that managers of profitable firms are interested in disclosing more good news to distinguish themselves from less profitable firms and thereby obtain economic benefits by having a favourable effect on the market. Empirical evidence for the association between disclosure and profitability, however, is not conclusive (García-Sánchez and Noguera-Gámez 2017). Some studies have found a statistically non- significant association between them (Richardson and Welker 2001; Domínguez and Gámez 2014), and others a negative association (Gul and Leung 2004; Sánchez, Domínguez, and Alvarez 2011) or a significant positive association (García-Sánchez, Rodríguez-Ariza, and Frías-Aceituno 2013; Frías-Aceituno, Rodríguez-Ariza, and García-Sánchez 2013).

3.3.4.4 Analyst-following

The number of analyst-followings is generally used as a proxy for the quality of the information environment and is expected to have a negative association with the cost of capital (Gode and Mohanram 2001). It is argued that firms which have a better connection with information intermediaries (e.g. high analyst-following) have a lower cost of equity capital. This is because the ready availability of information lowers information asymmetry, which lowers the cost of capital. Healy, Hutton, and Palepu (1999) found that firms that increase levels of disclosure increase their stock performance, institutional ownership, analyst following and stock liquidity. Lang and Lundholm (1996) found that higher levels of disclosure are associated with higher analyst-following and more precise analyst forecasts of future earnings. Richardson and Welker (2001) argue that the quality of information available to investors is dependent on the number of analysts following the firm, who process the information disclosed in separate reports by the company. Botosan (2000) found that, for the same level of disclosure, firms with low analyst-following are rewarded with greater reductions in the cost of equity capital than those of high analyst-following. He reasoned that for firms with fewer analyst-followings, the company's own disclosure is an important means of reducing information asymmetry and improving the information environment. In contrast, firms with a high analyst-following already enjoy the benefit of a better information environment, and incremental disclosures have a very limited effect on their valuation because analysts are already processing the company's information and making it available to investors.

3.3.4.5 Proprietary Costs – (Competition Pressure)

Product market competition, a proxy for proprietary costs of corporate disclosure, is argued to be a significant factor moderating the association between disclosure and cost of capital association (Gaspar, Massa, and Matos 2006; Valta 2012; Blanco, Garcia Lara, and Tribo 2015). Greater disclosure levels could unintentionally favour competitors, leaving the disclosing company with more uncertainties about future earnings and a worse competitive position (Blanco, Garcia Lara, and Tribo 2015). Empirical evidence, however, is mixed (Beyer et al. 2010). In a study of changes in segment reporting, Berger and Hann (2007) examined the moderating effects of proprietary costs and found inconclusive evidence that it affects levels of segment reporting. In line with the proprietary costs hypothesis, Botosan and Stanford (2005) found evidence that firms use segment reporting in a way that hides profitable segments operating in less competitive industries, but there was no evidence for hiding poorly performing ones. Bamber and Cheon (1998) found evidence that firms are less motivated to issue earnings forecasts in less competitive industries. Blanco, Garcia Lara, and Tribo (2015), however, examined the moderating effect of proprietary costs and found that it weakens the negative association between segment reporting and cost of equity capital. This supports the argument that greater disclosure benefits competitors and worsens the cost of capital in the presence of competition.

3.3.4.6 Industry

The industry/business sector in which a company operates is a vital determinant of levels of financial and non-financial disclosure (García-Sánchez and Noguera-Gámez 2017). According to Signalling Theory, companies in a given industry generally adopt similar disclosure strategies, reasoning that if one adopts a different strategy of disclosure from its competitors, it could be perceived as a negative sign to the market. The results of previous research, however, are not conclusive (García-Sánchez and Noguera-Gámez 2017); some observe a significant positive influence of sector practices on the volume of information disclosed by a company (Richardson and Welker 2001), others a significant negative influence (Domínguez and Gámez 2014; Larrán Jorge and Giner 2002) or no significant impact (Blanco, Garcia Lara, and Tribo 2015; Saini and Herrmann 2013).

3.3.4.7 Growth Prospects

Growth prospects, generally captured by a low book-to-market ratio or high long-term growth rates, play an important role in the association between disclosure and cost of capital. Firms with high growth potential disclose more information to account for high risks and information asymmetries; by doing so, they reduce the cost of capital and enhance the efficiency of their investments (García-Sánchez and Noguera-Gámez 2017). Previous research hypothesized a negative (positive) association between disclosure and book-to-market ratio (market-to-book ratio) assuming that firms with higher growth potential disclose greater volumes of information as a way of reducing information asymmetry (Domínguez and Gámez 2014; García-Sánchez, Rodríguez-Ariza, and Frías-Aceituno 2013; Frías-Aceituno, Rodríguez-Ariza, and García-Sánchez 2013; García-Sánchez and Noguera-Gámez 2017). Some researchers observed a significant and positive effect of the market-to-book ratio when modelling the association between disclosure and cost of capital (Botosan, Plumlee, and Xie 2004; Blanco, Garcia Lara, and Tribo 2015; Botosan and Plumlee 2005).

With regards to long-term growth rates, Easton and Monahan (2005) documented an association between various estimates of the implied cost of equity capital and actual growth rates. They argued that this gives rise to concerns of spurious associations between disclosure and implied cost of capital which are driven by higher growth rates. Previous research circumvented such concerns by including growth rates or market-to-book ratio when modelling the association between disclosure and cost of capital (Blanco, Garcia Lara, and Tribo 2015; Botosan and Plumlee 2005) while (Botosan, Plumlee, and Wen 2011) included both.

3.3.4.8 Issuance of New Financing

The factor of issuing new financing, either equity or debt financing, plays a significant role in determining the levels of information disclosure. Agency Theory predicts higher agency costs for firms that raise outside funding as disclosure is viewed as a means of monitoring the firm's management and alleviating agency costs and information asymmetries. Empirically, however, the evidence is mixed. Issuance of new financing is found to be positively associated with higher disclosure levels (Lang and Lundholm 1993; Lang and Lundholm 2000), which is consistent with the argument that firms disclose more information prior to issuance in order to alleviate information asymmetries and enhance their value as a way of maximizing proceeds from new issues. Gul and Leung (2004), however, found no significant association between new equity issues and voluntary disclosure levels. Dhaliwal et al. (2011) examined the case of firms initiating CSR disclosure versus non-initiating firms and found that the former enjoy subsequent reductions in the cost of equity capital and are more likely to exploit such benefit by issuing new equity offerings after the initiation of CSR reports. They also observed that the initiating firms raise significantly larger amounts of equity funding than non-initiating firms.

3.4 IC Disclosure and the Cost of Capital

This section reviews the problematic nature around the definition as well as the broad scope of IC disclosure before reviewing empirical evidence for the association between IC disclosure and the cost of capital.

3.4.1 IC Disclosure

IC refers to the value-generating intangible assets of a company (Mouritsen, Larsen, and Bukh 2001). A number of components of intangible assets are mentioned in the literature. For instance, it is posited that the IC "is of substantial and growing importance in innovation and productivity growth, enterprise competitiveness and economic performance. Intellectual capital comprises a number of components, including R&D, technology and intellectual property rights; human resources; organizational and workplace structure; marketing, customer and supplier networks; and software" (OECD 1999: 3). FASB (2001: p. vi) states that the range of intangible assets "include not only those resulting from research and development but also human resources, customer relationships, innovations, and others". In both references, innovation is considered a core driver and major building block of IC.

The IC value, among other factors[27], reflects the difference between market and book values since the value of intangibles is insufficiently reflected in the conventional accounting framework (Beattie and Thomson 2007). Broad use of the term IC has given rise to arguments that the concept is poorly defined or not defined at all (Guthrie, Petty, and Johanson 2001), calling for the development of a generally agreed definition (Zambon 2005) and a comprehensive theoretical framework to define the scope of IC (Mouritsen 2006). Beattie and Thomson (2007) observed that, despite the lack of a definitive scope, many attempts have been made at developing IC reporting models (Edvinsson 1997; Edvinsson and Malone 1997; Lev 2000). It is also argued that a general consensus exists that IC comprises three major categories: human, structural and relational capital.

Beattie and Thomson (2007) went on to describe the advantages of IC disclosure, positing that IC disclosure gives a company the opportunity to enhance transparency to the capital market, which in turn strengthens its trustworthiness with stakeholders. IC disclosure is also considered as a valuable marketing tool. Given that disclosure affects external perceptions of reputation and that a vital factor in IC value creation arises through improved reputation, it is also argued that IC disclosure is "self-perpetuating in terms of maintaining and enhancing IC value" (p. 130). Therefore, in a basic sense, it is assumed that firms will take the opportunity to disclose IC information in every corporate reporting tool. Empirical evidence of IC disclosure has been documented from annual reports (Brennan 2001; Mangena, Li, and Tauringana 2016), IPO prospectuses (Nikolaj Bukh et al. 2005), presentations to analysts (García-Meca et al. 2005) and analysts' reports (Arvidsson 2003).

Other than the advantages described by (Beattie and Thomson 2007), a number of incentives to IC disclosure have been examined. In a survey of the views of finance directors from 93 UK companies, Beattie and Smith (2012) evaluated various incentives

[27] Other factors that could cause the difference between market and book values include undervaluation of tangible assets, intangible liabilities that are not reflected on balance sheets, as well as the inefficiency of market prices to precisely capture the intrinsic value of a company (García-Ayuso 2003; Beattie and Thomson 2007).

to IC disclosure and found the strongest was avoiding competitive disadvantage. Out of 28 possible incentives, interestingly they found that the cost of capital benefits was of mid-ranking importance, possibly because of the inherent uncertainty surrounding the interpretation of many IC disclosures, which impedes the cost of capital benefits. This highlights the need to examine various types of IC disclosure separately from each other, in order to distinguish their respective cost of capital benefits[28].

The fact that avoiding competitive disadvantage is the strongest incentive implies potential managerial discretion on the quality of the IC information disclosed. This managerial discretion is subject to concerns regarding potential proprietary costs from disclosing private information that may favour competitors in the market, an argument consistent with the Proprietary Costs Theory[29]. This suggests that managers employ subjective judgment when considering the type of IC information to be disclosed and that the quality of commercially sensitive IC information may be diluted. If true, this explains why many types of IC information are subject to concerns over reliability and relevance (Wyatt 2008) and why the economic value-relevance of various IC disclosures is not always clear-cut. This once more motivates the need for empirical examination of various IC disclosures separately, in order to identify the individual value-relevance of each type of IC information.

The association between IC disclosure and cost of capital, however, is an interesting empirical question. Increased IC disclosure is not necessarily associated with a lower cost of capital for a number of reasons. One argument is that firms exhibit disclosure patterns or habits that have no significant impact on their value (Beattie and Thomson 2007). This relates to the question of value-relevance of disclosure to various capital market considerations (i.e. cost of capital, betas, stock prices, etc.). Value-relevant disclosure is argued to have two main qualities: reliability and relevance (Wyatt 2008). Wyatt (2008) found that many IC disclosures are subject to concerns of reliability and relevance, which raises questions regarding the value-relevance of IC information to

[28] The very question applies to innovation disclosure as a sub-category of IC disclosure and a core building block of intangibles value.

[29] This also suggests that the association between IC disclosure and the cost of equity capital is potentially moderated by the presence of proprietary costs (Singh and Mitchell Van der Zahn 2007).

capital market considerations. This means that not all IC information is value-relevant, which is why the topic needs to be empirically examined for the economic effects on various capital market considerations. One way of doing this is to look at each type of IC information separately from the other broad categories (Bellora and Guenther 2013). This would ensure a better understanding of the distinct economic effects of the many IC disclosure types, and thus their respective value-relevance. The next section reviews empirical evidence from relevant studies on the association of IC disclosure and cost of capital.

3.4.2 IC Disclosure and the Cost of Capital: Empirical Evidence

A recent study by Mangena, Li, and Tauringana (2016) examined the association of IC disclosure and financial disclosure with the cost of equity capital on a cross-sectional sample of 125 UK-listed firms. Using the checklist of (Li, Pike, and Haniffa 2008) to measure IC disclosure, they found that it is negatively associated with the cost of equity capital. The association is further magnified in the presence of IC disclosure. However, the estimated coefficients in results reported by (Mangena, Li, and Tauringana 2016) are marginal despite their significance[30]. This could be due to the inherent uncertainty surrounding the interpretation of many IC disclosures (Beattie and Smith 2012). (Mangena, Li, and Tauringana 2016) applied an index that captures the broad scope of IC information types as a single abstract measure, so disclosure types with potentially large benefits are averaged out by those with limited or insignificant benefit.

Bontis et al. (2007) also modelled both IC disclosure and financial disclosure and examined their association with the cost of equity capital. Based on a sample of 95 firms from four European countries, they found that IC disclosure and financial disclosure are respectively negatively and positively associated with the cost of equity capital. However, their measure of the cost of equity capital is based on the model of (Gebhardt, Lee, and Swaminathan 2001) which is argued to be problematic (Botosan 2006; Botosan and Plumlee 2005; Mangena, Li, and Tauringana 2016) as it is criticized for failing to effectively relate to risk factors (Botosan 2006). Interestingly, they

[30] Mangena, Li, and Tauringana (2016) report a coefficient value of (-0.0001**) for the association between IC disclosure and the cost of equity capital using the PEG model.

measured IC disclosure using a weighted scale of 11 IC items, four of which were related to exploration innovation.

Singh and Mitchell Van der Zahn (2007) used under-pricing as an indirect measure of the cost of capital to examine the association between IC disclosure and cost of capital. Based on a sample of 334 Singapore IPO firms, they found evidence of a positive relationship between IC disclosure and the cost of equity capital. However, their measure of under-pricing is argued to be an inappropriate proxy for the cost of capital (Mangena, Li, and Tauringana 2016). Furthermore, given the nature of their high failure rates (Fama and French 2004), results based on a sample of IPO firms cannot be generalized to SEO firms (Mangena, Li, and Tauringana 2016). Finally, they measured IC disclosure using a binary index of 81 IC items which does not capture the emphasis or level of detail on repeated IC items[31].

Orens, Aerts, and Lybaert (2009) examined the web-based IC disclosure and cost of capital association using a cross-sectional sample of 267 firms from four European countries and found evidence of a negative relationship between IC disclosure and both the cost of debt and cost of equity. They measured IC disclosure using a weighted index of 42 IC items, few of which accounted for aspects of exploration and exploitation innovations scattered across the three IC sub-categories. Similar to the current study, they measured the cost of capital for equity using Easton’s model and for debt using the ratio of interest expense at the end of the year to the sum of long-term and short-term financial debt at the start of the financial year.

Several general drawbacks to previous work (Bontis et al. 2007; Singh and Mitchell Van der Zahn 2007; Orens, Aerts, and Lybaert 2009; Mangena, Li, and Tauringana 2016) can be observed. First, there is no clear distinction between innovation disclosure and other, and very broad, IC disclosures. Second, despite the fact that they applied indexes that in part accounted for various aspects of exploration and exploitation, they provided no clear recognition of or clear distinction between the two types of innovation independently. Hence, the economic effects of innovation disclosure are still

[31] A binary index means that the researchers applied an unweighted dichotomous scale to measure IC disclosure; an item takes the value of 1 if it is reported and 0 if not reported.

ambiguous, as they are not uniquely identified. Given the information type-dependency of disclosure and the cost of the capital link (Botosan 2006), innovation disclosure might have specific peculiarities which remain to be empirically examined. Furthermore, the economic effects of innovation disclosure might depend on the type of innovation disclosed: exploration, exploitation or a combination of both.

3.5 Innovation Disclosure Within IC Disclosure Research

This section discusses relevant evidence on innovation disclosure from two viewpoints. First, it reviews the measurement limitations of IC disclosure as discussed in the literature, and how this reflects on the measurement of innovation disclosure within the broad scope of IC disclosure. Second, it reviews evidence of innovation disclosure examined independently of other broad IC disclosures.

3.5.1 Methodological Implications

The empirical studies on IC disclosure applied a variety of content analysis-based tools intended as comprehensive measurement checklists of IC components. For instance, Beattie and Thomson (2004) identified 128 items across three main IC sub-categories using a detailed content analysis of IC literature, while Li, Pike, and Haniffa (2008) developed a checklist of 61 items for the same three main IC categories based on an extensive review of IC literature. Innovation disclosure, despite its nature-specific importance, was generally marginalized within the broad scope of IC disclosure, with innovation considered as a single lower-level category of structural intellectual capital. In addition, innovation disclosure was subject to all the methodological limitations surrounding the measurement of IC disclosure. Beattie and Thomson (2007) reported a number of measurement concerns on the content-based tools encountered by almost every researcher in IC disclosure. The concerns relate to the lack of transparency, specificity, uniformity, and rigour, leading to conflicting and generally non-comparable evidence. Regarding the fourth concern, they state that “the meaning to be attached to some lower level categories (e.g. innovation) cannot be established without knowledge of context” Beattie and Thomson (2007: 133).

In addressing these concerns, the current study relies on the established notions of exploration and exploitation for a context of innovation. Specific meanings are assigned to both notions and then retrieved through computer-aided textual analysis, thereby addressing concerns of specificity and uniformity. These exact meanings are assembled in a list of keywords adapted from (Heyden et al. 2015) to measure exploration and exploitation. The list was checked for content validity in capturing the underlying notions efficiently. It was then improved by the addition of a number of words which had also undergone a series of rigorous validity checks[32]. The final list of words is used to measure exploration and exploitation, therefore addressing concerns of transparency and rigour. This methodological approach will avoid previous coding reliability issues (Beattie and Thomson 2007).

3.5.2 Recent Evidence on Innovation Disclosure

This section reviews two recent major studies on innovation disclosure: those by Bellora and Guenther (2013) on innovation capital disclosure, Merkley (2013) on R&D disclosure, and by (Jia 2017, 2018, 2019) on disclosure of explorative information.

In a European-based sample, Bellora and Guenther (2013) studied innovation capital disclosure in 51 IC statements of Nordic-based firms. Their purpose was to recognize potential factors explaining the differences between firms regarding the quality and quantity of innovation disclosure. Innovation capital was defined as that part of IC that describes a firm's ability to generate and use innovative solutions and related outcomes (Edvinsson and Malone 1997; Bellora and Guenther 2013). They found that industry, firm size, region and disclosure guidelines drive the quantity of innovation disclosure. More interestingly, they did found no evidence for an association between firm size and the quality of innovation disclosure. Their coding technique, however, was constructed to coincide with the general coding of IC in terms of applying three broad categories: internal, external and human capital. Therefore, they categorized innovation disclosure content according to its relevance to each of the three IC sub-categories. Their categorization was designed to ensure comparability with the IC disclosure literature. Despite this first attempt at examining innovation disclosure separately from other IC disclosures, comparability with previous IC disclosure studies is not a core interest of the present study, which is methodologically and empirically different. Methodologically, it follows the categorization of innovation as applied in the

[32] See section 4.5.

organizational theory literature. Hence, it will utilize an alternative methodological tool adapted from (Heyden et al. 2015) with the addition of more words. The list of words will be used to measure word frequencies and coverage percentages of exploration and exploitation from annual reports. Corresponding coverage percentages will be used in the longitudinal examination of the economic effects of innovation disclosure on the cost of capital. Given its merit as indicated in the organizational theory literature, this tool is sufficiently rigorous to measure innovation disclosure where meanings are assigned and clearly explained with insights from relevant literature. Empirically, however, Bellora and Guenther (2013) examined determinants of innovation disclosure while the current study examines the economic effects of innovation disclosure on the cost of capital. This is done by longitudinally assessing innovation disclosure effects on the cost of capital alone, separately from other IC disclosure content, given the importance of innovation in the value creation process (Edvinsson and Malone 1997; Bellora and Guenther 2013).

Moving on to the second study, Merkley (2013) specifically looked at the narrative disclosures of R&D expenditure in a US-based context, as R&D is the major driver for innovation. R&D firms endure relatively higher levels of risk and information asymmetry. Therefore, examining the value-relevance of narratives around R&D expenditure is of unique importance since conventional accounting standards do not adequately communicate its value. Merkley (2013) applied a content-analysis tool for measuring narratives of R&D disclosure by the number of sentences. He found that firms reporting lower (higher) earnings performance provide a greater (less) volume of narrative R&D disclosures. The evidence suggests that firms modify the levels of R&D disclosures based on earnings performance, so as to provide more relevant information to investors rather than obfuscating earnings performance. They further reported a positive relationship between narrative R&D disclosure with analyst following and analyst forecast accuracy; and a negative relationship with analyst forecast dispersion and information asymmetry.

The current study differs from (Merkley 2013) in the sense that it considers not only R&D-related innovation disclosures but also disclosures relating to other forms of innovation. R&D innovation falls mainly under the exploration type, while this study considers both R&D and non-R&D forms of exploration-related innovation. This study makes a further contribution by considering both exploration and exploitation as distinct forms of innovation. It does, however, apply similar metrics to Merkley's regarding analyst forecast accuracy and information asymmetry as a way of testing the value relevance of innovation disclosures.

Finally, in a study of US firms from 1992-2012, Jia (2017) examine capital market consequences of corporate innovation strategies and find that firms with an exploration-oriented strategy (as opposed to an exploitation-oriented one) are associated with lower analyst followings, higher forecast error, and dispersion. Jia (2017) also finds evidence that disclosure of innovation information alleviates the negative effect of exploration strategy, as indicated earlier, in terms of lower analyst followings, higher forecast error, and dispersion. The innovation disclosure measurement utilized by (Jia 2017) undertakes a content analysis approach on news articles and considers mainly exploration rather than exploitation information; focusing mainly on R&D narratives. Following (Gu and Li 2003), Jia (2017: 838) operationalize the measurement of innovation disclosure into three categories; "(1) Information about progress of innovation (e.g., major R&D milestone; details of pipeline projects or new products under development; details of research teams; implementation, continuation, or termination of R&D projects; financing for R&D projects; and whether R&D projects are on schedule), (2) Information about completion/commercialization of innovation (e.g., new product launch; licensing and royalty; transfer or sale of technology), and (3) Other innovation-related information (e.g., goal, objective, or plan of innovation; relationship with current innovation, time frame; acquisition of other firms for new technology or other innovation capabilities)". Using the same dataset of (Jia 2017), Jia (2018) report that exploration-oriented firms (versus exploitation-oriented ones) are more (less) prone to stock crash risk. Jia (2018) further report that exploration-oriented firms incur a higher failure-to-success ratio and are less likely to disclose interim negative news about their innovation projects. Continuing on the same dataset of US firms from 1992-2012, Jia (2019) further report that exploration-oriented firms (versus exploitation-oriented ones) are "more (less) inclined to issue management earnings forecasts. These forecasts are generally less (more) optimistic, accurate and precise." Jia (2019) also report that exploration-oriented firms issue more earnings forecasts (and more conservative forecasts) in order to avoid disclosing proprietary information (and to avoid large stock price decline). The findings of (Jia 2019) generally confirm that exploration-oriented firms are subject to higher information asymmetry as evident by the higher analyst earnings forecast error and greater forecast dispersion. With such nature, exploration-oriented firms tend to incorporate the corporate innovation strategy in developing their disclosure policy (Jia 2019). Finally, Jia (2017) argues that exploration and exploitation are essentially different strategies, therefore, exhibiting different impact on the firm’s future earnings as well as the level of information asymmetry with outside stakeholders. It should be noted that exploration-oriented firms are generally more informationally opaque and subject to higher volatility of earnings, thus, their share prices would less precisely reflect their fundamental values (Jia 2017).

By focusing on the UK rather than US context, the current study differs from (Jia 2017, 2018, 2019) and brings to light a tool that operationalizes measurements for exploration and exploitation disclosures. Even though the current study takes into account economic factors considered by (Jia 2017, 2019) such as analyst following and analyst forecast error, it adds further contribution by focusing on other economic factors such as; the cost of equity capital, bid-ask spread, stock returns volatility and the after-tax cost of debt capital.

3.5.3 Identification of Research Gap

It is clear from the above discussion that innovation disclosure has largely been addressed within the broad scope of IC disclosure, with no distinction of its inherent economic effects (with the notable exception of (Merkley 2013; Bellora and Guenther 2013). Furthermore, innovation disclosure has not been clearly measured and is greatly marginalized within the stream of research on IC disclosure. It is also clear that previous research does not distinguish between the two main types of innovation that are frequently addressed in other streams of literature (e.g. organizational theory, organizational design, organizational learning, strategic management, and technology and innovation management).

This thesis differs from previous studies as it considers the disclosure of exploration and exploitation distinctly as well as in combination. This, in part, aims to integrate the disclosure literature with the domains listed above. This study, therefore, introduces the notions of exploration and exploitation for the first time in the accounting literature and provides empirical insights about the value relevance of both types of disclosure to capital market considerations (e.g. cost of equity capital, after-tax cost of debt capital, analyst forecast accuracy and information asymmetry measured by bid-ask spread and trading volume). Furthermore, the combined disclosure of both types is also considered in order to observe potential synergies (Floyd and Lane 2000) from the disclosure of both types of innovation. Finally, given the potential effects of proprietary costs on innovation disclosure, the current study examines the potential moderating effects of proprietary costs on the association between innovation disclosure and the cost of capital.

3.6 Hypothesis Development

This section is dedicated to developing the baseline hypothesis regarding the association between innovation disclosure and the cost of capital, as well as the hypothesis for the moderating effect of proprietary costs on the association between innovation disclosure and the cost of capital.

3.6.1 Main Hypothesis

Given the above discussions, it is necessary to segment the broad scope of IC information and look at the individual economic effects of each information type separately. This is because the strongest incentive to IC disclosure is argued to be avoiding competitive disadvantage (Beattie and Smith 2012), which entails potential subjective managerial discretion over the disclosure quality of various IC information types. This vindicates earlier findings that many IC disclosures are prone to concerns over reliability and relevance (Wyatt 2008) which could question their economic value-relevance to various metrics of the capital market. The unique nature of innovation information suggests that disclosure of innovation is mostly subject to managerial discretion due to concern over proprietary costs. The fear of proprietary costs may motivate firms to intentionally set the quality of innovation disclosure at a relatively low level, with limited information as protection against competitive disadvantage (Beattie and Smith 2012; Bellora and Guenther 2013). Bellora and Guenther (2013) found that innovation disclosure is generally "qualitative, non-financial and historically orientated"

(p. 255) and posit that "the fear of proprietary costs may deter firms from making quantitative, verifiable innovation disclosure" (p. 266). This makes the association between innovation disclosure and cost of capital an interesting question for empirical examination.

As introduced earlier, the phenomenon of innovation disclosure is recognized as of not one but two distinct types: exploration and exploitation. Bearing in mind the argument that there is an information-type dependency between disclosure and the cost of capital, this suggests that the association between innovation disclosure and the cost of capital might vary by the type of innovation disclosed (i.e. exploration, exploitation or combined). The potential concerns of reliability and relevance around innovation disclosure lead to the question of whether the various types of innovation disclosure are actually value-relevant in capital market terms. Due to potentially limited value-relevance (as a result of potentially limited information quality from fear of proprietary costs), this brings into question the economic effects of innovation disclosure on the cost of capital. Thus, the various types of innovation disclosure are to be examined separately in relation to the cost of capital.

On the other hand, credible exploration and exploitation disclosures will help current and potential investors to make informed capital allocation decisions. Firms face high business risks while pursuing these two distinct, and arguably contradictory, strategies of innovation (Smith and Tushman 2005; Sidhu, Volberda, and Commandeur 2004; Sidhu, Commandeur, and Volberda 2007; Auh and Menguc 2005). This directly affects the level of business risk (March 1991; Uotila et al. 2009), future growth prospects (Fagiolo and Dosi 2003) and the estimation of future cash flows (Levitas and McFadyen 2009) which would only lead to higher estimation risk. Furthermore, the estimation risk could be even higher when firms conduct either a balanced approach or a trade-off between the two strategies. Previous studies (Auh and Menguc 2005; Raisch et al. 2009) argued that balancing or trading-off strategies of exploration and exploitation affect the level of business risk at the organizational level, which in turn, affects estimated profitability and prospects for future growth (Jia 2017). For instance, an explorative strategy is found to be associated with higher probability of stock crash risk and higher failure-to-success ratio (Jia 2018), higher analyst forecast error and greater forecast dispersion (Jia 2017, 2019) and lower analyst following (Jia 2017); all of which indicate a relatively high estimation risk that underlines a huge informational gap with outside stakeholders.

Therefore, exploration-oriented firms are generally more informationally opaque and subject to higher volatility of earnings, thus, their share prices would less precisely reflect their fundamental values (Jia 2017). Disclosure around both strategies of exploration and exploitation, however, is intended to mitigate such estimation risk, given that the disclosure is of sufficient quality and precision to be informative for capital market participants. Consistently, Jia (2017) finds evidence that disclosure of innovation information alleviates the negative effects of heavily explorative strategy as it leads to higher analyst followings as well as lower analyst forecast error and dispersion; indicating a lower estimation risk and reduced information asymmetry as a result of enhanced disclosure.

Hence, the disclosure policy will serve to clarify uncertainties around the firms' unique innovation strategies as a way of value creation (Jia 2017, 2019). Disclosures at exploration, exploitation and combined levels, if credible, will enable better forecasting of future earnings and cash flows. Enhanced informational environment (e.g. lower forecast error) would lead to lower information asymmetry, lower cost of capital and higher liquidity (e.g. lower bid-ask spreads).

Furthermore, there is evidence that innovation-related information is viewed as informative by capital market participants because it is negatively associated with information asymmetry and positively correlated with the accuracy of analyst forecasts (Merkley 2013). The significant negative association of innovation disclosure with information asymmetry leads to the expectation that there is also a significant negative effect on agency costs. Potential reduction of agency costs in the light of credible innovation disclosure could suggest better monitoring over managerial decision making so as to limit the likelihood of managers undertaking ineffective investment decisions that would hurt the firm's value or future prospects.

Given the importance of both types of innovation as well as their overall level as core activities in the value creation process (O'Reilly and Tushman 2013), this lends credibility to the related disclosures around exploration and exploitation so that it would bear an informative value to market participants and thereby reduce information risk. Therefore, it is appropriate to posit that credible innovation disclosure will have negative associations with the cost of capital through the means of reduced estimation risk and reduced information asymmetry. Thus, the first hypothesis stated in the alternative forms as follows:

H1a: there is a negative association between exploration disclosures and the cost of capital.
H1b: there is a negative association between exploitation disclosures and the cost of capital.
H1c: there is a negative association between the combined disclosures and the cost of capital.

The two types of cost of capital are addressed; equity and debt. It is assumed that greater disclosure will lead to reduced information asymmetry which, in turn, will lower the cost for both equity and debt. Even though the underlying dynamics in response to reduced information asymmetry are similar between equity and debt financings, it should be recognized that both types of financing correspond to different magnitudes of risk, and therefore, information asymmetry. It is argued that the information asymmetry is generally greater between managers and equity (versus debt) investors (Ettredge, Richardson, and Scholz 2002). Modigliani and Miller (1958: 292) argue that "if the owners of a firm discovered a major investment opportunity which they felt would yield much more than [the cost of capital], they might well prefer not to finance it via common stock at the then ruling price, because this price may fail to capitalize the new venture". This essentially means that asymmetric information makes debt a better financing tool than new equity when the equity is underpriced (Modigliani and Miller 1958; Narayanan 1988; Klein, O'Brien, and Peters 2002). Ross (1977) posit that the manager of a firm whose wages depend on current and future values of the firm will use debt to signal the quality of the firm (known only to him) to the market. While Narayanan (1988) posits that, in a world of asymmetric information, high-quality profitable firms signal superior performance by using debt rather than equity financing. Consistent with (Ross 1977) argument, Klein, O'Brien, and Peters (2002: 321) explains that "firms with lower expected cash flows find it more costly to incur higher levels of debt (because bankruptcy is more likely) than do firms with higher expected cash flows". The bottom line of this discussion concludes that firms with superior profitability prospects endure relatively fewer risks compared to inferior ones, and therefore, they signal superior performance by resorting to a cheaper mode of financing; debt. The relatively lower risk of high-quality firms exhibit relatively less information asymmetry than those with lower quality.

This is also consistent with the pecking order theory by (Myers and Majluf 1984) which predicts that information asymmetry between managers and investors creates a preference ranking over financing sources. The ranking preference scales the way up from the cheapest source of financing to the most expensive; starting with internal funds (i.e. retained earnings), followed by debt, and then equity. Firms work their way up the pecking order to finance investment in an effort to minimize adverse selection costs (Leary and Roberts 2010).

In general, it should be noted that debt-holders exhibit a stronger risk-averse preference than equity-holders; since the debt-holders invest in higher quality (superior) firms with stronger profitability prospects at a cheaper rate of return for financing (cost of debt). That is in contrast to equity-holders who invest in riskier firms at a relatively higher rate of return (cost of equity). This difference in the risk-averse attitude between debt and equity investors might depict a unique difference in the result for the current study.

3.6.2 Proprietary Costs (Competition) as a Moderating Factor

Firms operating in relatively more competitive industries might endure higher proprietary costs from greater innovation disclosure. Hence, the risk of proprietary costs might lead to less effective innovation disclosure in reducing the cost of capital. This is due to the expectation that firms will tend to protect themselves by diluting the credibility of innovation disclosure in the presence of fierce competitive pressure. The previous evidence shows that intensified competition pressure is associated with higher financing costs (Valta 2012; Gaspar, Massa, and Matos 2006). This leads to the expectation that in the presence of strong competition, the effect of innovation disclosure on the cost of capital is less pronounced. Thus, the following hypothesis, considering only the combined form of innovation disclosure,[33] is stated:

H2: the association between the combined disclosure of innovation and the cost of capital is less pronounced for firms in highly competitive industries.

3.7 Additional Analysis – Sub-sampling Approach

This section will strategize the sub-sampling approach around four different sub-grouping criteria in order to reassess the baseline hypothesis as a way of checking unique peculiarities for different groups of firms. It is expected that the association between innovation disclosure types and cost of capital might vary by different sub-groups of firms (i.e. R&D expenditure, analyst-following, firm size and issuance of new financing). This study applies a sub-sampling approach so that to verify the robustness of the main results from the full sample to the sub-groups. The following sub-sections discuss relevant empirical evidence to motivate the sub-sampling approach according to each criterion.

3.7.1 R&D vs. Non-R&D Firms

R&D firms are characterized by high expenditure on innovation strategies. R&D activities, a major driver of innovation, are crucial in creating tangible and intangible forms of value (Gu and Lev 2001; Lev 2000). Unlike other firms, R&D firms provide quantitative and verifiable audited information on the scale and amount of R&D expenditure, suggesting that innovation disclosure is more value-relevant to them. Merkley (2013) argues that innovation disclosure around R&D activities is of vital importance as it is positively related to analyst-following and analyst forecast accuracy, and negatively related to analyst forecast dispersion and information asymmetry. This evidence shows that investors view innovation disclosure of R&D firms to be informative as it serves to alleviate uncertainties of R&D activities. This evidence suggests that R&D firms offer more value from relevant innovation disclosure than do other firms, as they provide reliable and relevant innovation information. This is the

[33] For robustness checks, the moderating effect of proprietary costs is also examined for the individual disclosures of exploration and exploitation.

motive for retesting the first hypothesis with two sub-samples of R&D and non-R&D firms, to see whether they display unique patterns for the association of innovation disclosure and the cost of capital.

3.7.2 High vs. Low Analyst-following Firms

The role of analyst-following is highlighted in previous studies (Botosan 2000, 1997; Botosan and Plumlee 2002b). Having applied a similar sub-sampling technique (groups of high analyst-following vs. low analyst following), Botosan (2000) found that, for the same level of disclosure, firms with low analyst-following are rewarded with greater reductions in the cost of equity capital than those of high analyst-following, probably because the latter have a better information environment. Similarly, there is a low-quality information environment in firms of low analyst-following due to the limited information from specialized analysts (Richardson and Welker 2001). In the absence of the benefits of a better information environment, investors rely on the disclosures of firms with low analyst-following as a key source of information. The overall evidence of these studies suggests that innovation disclosure for firms with low analyst-following provides more value-relevance for investors than that of high analyst-following firms. Therefore, the association between innovation disclosure and cost of capital might be weaker for the firms with high analyst-following. This is a reason, therefore, to retest the first hypothesis separately for two sub-samples of firms to compare the high and low analyst-following groups and see if one group enjoys more benefit from innovation disclosure than the other.

3.7.3 Large vs. Small Size Firms

Cao, Gedajlovic, and Zhang (2009) suggest that a firm’s size affects its ability to pursue OA innovation because of the scarcity of resources. Large firms are more capable of pursuing explorative innovation by allocating more resources to new investment opportunities and R&D projects; - of pursuing exploitative innovation through economies of scale and wide cost-saving improvements. This suggests that innovation disclosures from firms with relatively more resources have more credibility. The more credible the innovation disclosure is, the more value-relevance it is expected to have and the greater are the benefits from such disclosures. Therefore, large firms might have a relatively stronger association between innovation disclosure and cost of capital. The first hypothesis is therefore retested separately for two sub-samples of firms to compare whether large or small firms enjoy the more benefit from innovation disclosure.

3.7.4 Firms With New Financings vs. Those Without

As discussed in earlier sections, firms that raise new funding, either equity or debt financing, are motivated to disclose more information to alleviate uncertainties and reduce information asymmetry. Enhanced disclosure is intended to increase firm valuation as a means of maximizing the proceeds of the new issues (Dhaliwal et al. 2011). Innovation strategies bear high uncertainties and risk but also contribute to higher growth prospects for the firm (O'Reilly and Tushman 2013). This implies that innovation disclosure could have more value-relevance for innovative firms that seek outside funding to finance their business operations. Issuing firms would highlight the potential growth from innovation practices as a means of justifying the new issues and alleviating uncertainty around innovation practices. This motivates a closer look at issuing firms to see if they enjoy above-average benefits from innovation disclosure. Therefore, the first hypothesis will be retested for two sub-samples of firms: those that recently issued long-term financing and those that did not.

3.8 Summary

This chapter has reviewed theories of disclosure along with the empirical evidence for the association between disclosure and the cost of capital. It also presented a review of IC disclosure, which is the broader scope of innovation disclosure, as well as recent evidence unique to innovation disclosure. After the identification of the research gap, the hypotheses were developed, together with a strategy for a sub-sampling approach to retest the main hypothesis for different groups of firms.

The following chapter maps out the research methodology, methods, the sample and data collection, and the measurement of the study variables which will be used in the subsequent hypothesis testing.

Chapter 4 Methodology

4.1 Introduction

In the previous chapter, theories of disclosure and empirical evidence for the association between disclosure and the cost of capital were reviewed. The research gap was identified and hypotheses developed.

This chapter will evaluate different philosophical paradigms and research methods to determine those appropriate to the current study. It will also define the scope of the current study in terms of the sample characteristics and time horizon, and specify the relevant data sources. The measurement of study variables (innovation disclosure and cost of capital) will be defined and appropriate validity checks assigned for the measurement tools as well as checks for robustness of results. The content analysis-based measurement tool (wordlists) for innovation disclosure will be presented, validated and revised to measure notions of exploration and exploitation in annual reports. Regarding the cost of capital, measures for cost of equity capital and after-tax cost of debt capital will be presented, discussed and adopted. For the cost of equity capital, various measures (e.g. historical and future-based measures) will be presented and evaluated against various risk factors. The historical measure is CAPM while the future-based ones are PEG, MPEG and AEG models. Finally, a number of metrics that correlate with information asymmetry will be presented as alternatives to checking the robustness of the results from the cost of equity capital evidence. The alternative metrics include returns volatility, stock liquidity, and analyst forecast accuracy.

4.2 Research Philosophy

The first step to conducting a research inquiry is to decide on the appropriate methodology to be applied in approaching the research question. Kothari (2004: 8) defined research philosophy as “a way to systematically solve the research problem”. Such a systematic approach describes the researcher’s view of how knowledge is created or could be constructed (Saunders 2011). The researcher’s ontological and epistemological views usually determine the research philosophy and the underlying paradigm to be applied (Creswell 2009). There are a number of commonly applied paradigms (i.e. positivism, interpretivism, and pragmatism), each of which represents a different research strategy or unique philosophical stance (Creswell 2009; Saunders

2011). Each paradigm follows a unique ontology (one's view about the nature of reality) and epistemology (the way to approach a research phenomenon and obtain knowledge). Collis and Hussey (2014) define the research paradigm as a framework that guides how the research is conducted and how knowledge is obtained. The paradigm framework is generally designed based on the researcher's philosophy, attitudes, and perception about the reality of the world and the nature of knowledge (Collis and Hussey 2014).

4.2.1 Positivism

For instance, the ontological assumption of the positivist paradigm is based on the belief of an objectively existing reality that can be observed as a fact (Saunders 2011). The epistemology of the positivist paradigm is based on the scientific method, an approach similar to that applied in the natural and physical sciences. Therefore, in a positivist paradigm, the researcher is seen as a neutral, independent and objective observer of the subject in question so that the collected data are considered as natural as possible. Hence, the research output in a positivist paradigm can be generalized as a law, similar to the research outputs of natural and physical sciences which make generalizations based on natural laws (Collis and Hussey 2014). The positivist paradigm usually applies a deductive approach as it starts with logical theory-driven explanations and predictions of social phenomena; it, therefore, requires strong adherence to logical reasoning, precise measurements, and objectivity in observation and analysis (Saunders 2011). In terms of methods, the positivist paradigm follows highly structured quantitative assessments that employ the power of statistical techniques and confidence levels. Empirical testing is used to validate or refute hypotheses and the findings from such tests enable making population-wide generalizations.

4.2.2 Interpretivism

The ontology of the interpretivism paradigm, however, does not consider the existing reality to be factually objective but rather sees it as a social construct (Saunders 2011). Unlike the positivist paradigm, the epistemology of the interpretivist paradigm does not require the independence and objectivity of the researcher. It takes a qualitative approach to understand various social phenomena and subjectively explain differences in human actions. The researcher must be immersed in the individual's world to understand the subjectivity in their behaviour and be able to explain a social phenomenon. Interpretivism assumes that the researcher is a part of the reality structure being processed and that the researcher's own views and beliefs are important to understanding the numerous situationally subjective meanings of the phenomenon being studied (Creswell 2009; Saunders 2011). The purpose of interpretivist research is to explore the various views and conceptions about a phenomenon rather than testing or verifying theory-driven predictions and hypotheses. Hence, an inductive approach is generally applied because it does not use theory-guided analysis; rather, the findings of such research shape the theory that is supposed to explain the underlying perceptual subjectivity of the phenomenon in question. Therefore, the contextual subjectivity of the interpretivist research makes it highly unlikely to have law-like generalizability of research findings (Collis and Hussey 2014).

4.2.3 Pragmatism

As a new research paradigm, pragmatism replaces the conventional philosophy to knowledge approach as commonly applied in the social sciences in terms of ontology, epistemology, and methodology (Morgan 2014). The pragmatist paradigm is argued to serve social research in a unique way that accommodates the application of various methods: quantitative, qualitative or mixed (Morgan 2014; Yvonne Feilzer 2010). Therefore, pragmatism goes beyond the classical principle of adopting one philosophical stance over another (i.e. the fundamentally opposite worldviews of reality as in positivism vs. interpretivism). Instead, it attempts to integrate them in a way that focuses solely on what can best be done to achieve the research goals. Hence, pragmatic research utilizes all possible sources and a mix of different methods to achieve the research objectives, making it best suited for problem-solving analysis (Morgan 2014). Yvonne Feilzer (2010) argues that pragmatism supports problem-solving in the social world with an alternative, more flexible, and more reflexive research design that enables a continuous cycle of abductive reasoning while being guided primarily by the researcher's desire to produce socially useful knowledge. Abductive reasoning refers to the logical justification applied by researchers to theorize for surprising facts when data and theory mismatch (Teddlie and Tashakkori 2009). In abductive reasoning approach, pragmatic researchers move back and forth between induction and deduction (Morgan

2007). This is done by converting observations into theories and then assessing those theories through further tests. This process requires reflection on different approaches to theory and data whereby the researcher moves back and forth between qualitative and quantitative approaches (Yvonne Feilzer 2010).

4.2.4 The Paradigm for this Research

A positivist stance is adopted for a number of reasons. First, the study examines the economic effects of innovation disclosure on the cost of capital according to hypothetical predictions of the economic-based disclosure theory. It is clear that two main variables (innovation disclosure and cost of capital) are to be tested for associations; this requires a positivist approach. In contrast to other paradigms, interpretivism study human perceptions, actions and interactions which use completely different data types and methods of analysis. Whereas pragmatism relies on the use of mixed methods for problem-solving analysis rather than a theory-driven test of associations.

Second, the study applies a deductive approach whereby theory-driven hypotheses about predicted associations between variables of interest are stated at the start to guide the research design. It is posited that variations in innovation disclosure will drive variations in the cost of capital. The paradigm of interpretivism, however, follows more of an inductive approach whereby theory is the outcome rather than the guide for research design. Pragmatism, however, follows an abductive approach to theorize in the case of a data-theory mismatch. Inductive and abductive approaches, therefore, do not suit the current research design.

Last but not least, in order to examine the relationship between innovation disclosure and the cost of capital, the reality is assumed to be objectively measurable. Publicly available and observable data from capital markets (financial data obtained for measuring the cost of capital) and firms' annual reports (innovation disclosure measured as a percentage of total documents) are used to test hypotheses, requiring a positivist approach. The interpretive paradigm, however, considers reality as a social construct of human actions and interaction rather than an objectively measurable or observable fact. Pragmatism adopts a flexible approach to ontology as it moves beyond the definitive classification of reality into objectively observed versus socially constructed. Therefore, the interpretive and pragmatic paradigms are not suitable for the current research.

4.3 Research Methods

Research methods are generally classified according to two main criteria: the nature of the method (qualitative vs. quantitative) and the time span of the research (cross-sectional vs. longitudinal). This section discusses both criteria in some detail.

4.3.1 Qualitative versus Quantitative

The vital step of any research is to devise the methods appropriate to achieving the research objective. Three main types are recognized: qualitative (as in the interpretive paradigm), quantitative (as in the positivist paradigm), and mixed (as in the pragmatic paradigm). The appropriate method is usually decided according to the methodological approach adopted. In light of the current research objective, the study uses quantitative methods for the following reasons. First, it applies a positivist approach based on measurable observations and quantitative methods. Second, it is based on a theory-driven hypothesis which requires quantitative testing to empirically validate or refute the predicted association between the variables of interest (innovation disclosure and cost of capital). Lastly, it pursues generalization of empirical results to the wider population, that is all FTSE firms listed on the UK stock exchange.

The mainstream of accounting research, however, falls within the positivist approach whereby archival study is the most common application of the positivist philosophy (Libby, Bloomfield, and Nelson 2002). It relies heavily on quantitative methods of well designed econometric models and sizeable unbiased samples to empirically test for theoretically predicted associations of variables (Ryan, Scapens, and Theobald 2002). The fundamental premise of empirical testing in positivist accounting research is the verifiability and replicability of both methods and findings. Empirical findings give way to either validated or invalidated theories whereby the theory becomes generalizable knowledge about the phenomenon of interest (Ryan, Scapens, and Theobald 2002). The current study, however, falls within the mainstream of accounting research as it aims to test hypothetical predictions of innovation disclosure and cost of capital according to insights of economic-based disclosure theory. This is to discover whether or not the predictions of economic theory hold in the case of innovation disclosure.

4.3.2 Cross-sectional versus Longitudinal

Observational research within a timeframe is either cross-sectional or longitudinal (Saunders 2011). Quantitative methods following the cross-sectional approach are time efficient and cost effective but do suffer from common methods variance bias[34] and fail to capture time-trends of the phenomenon in question. This questions the validity of the findings from cross-sectional data but does not diminish the significance of cross-sectional studies (Rindfleisch et al. 2008).

In contrast, quantitative methods following the longitudinal approach are better suited to overcome common methods variance bias and are more powerful in capturing the time-trends of a phenomenon (Rindfleisch et al. 2008). Despite being the optimal setting for any research design, the limitation of longitudinal data is that it is very demanding in terms of time and resources. A longitudinal design is, nevertheless, crucial in understanding the strategic policy effects of a phenomenon (Baltagi 2008; Brüderl and Ludwig 2014) because it offers greater insight into the general time-trends, one of the strongest merits of longitudinal studies.

Longitudinal studies enable a more precise and accurate interpretation of a phenomenon due to the unique nature of panel data in comparison with cross-sectional and time-series data. Cross-sectional data is a group of observations collected in one period, while time-series data is one unit of observation collected over many periods of time. Panel data combines the merits of both types as it is composed of many observed units across multiple periods. In other words, panel data enjoys more degrees of freedom and greater sample variability than either cross-sectional data time-series data. These features of panel data design offer superior quality when it comes to mitigating omitted variable bias (Gujarati 2009; Wooldridge 2010). This clearly empowers the efficiency of econometric modelling and lends greater credibility to empirical findings. With these

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[34] Cross-sectional analysis is based on a single source of data at a single point in time, which presents a systematic method error generally known as common methods variance bias; as such it makes it hard to generalize causal inferences of results (Rindfleisch et al. 2008).

advantages of panel data, empirical results entail a higher level of precision and more accurate understanding of the time-trends (strategic pattern) of a phenomenon.

For the purposes of the current study, the longitudinal design is adopted for the following reasons. First, the current study aims to observe the time-trend of the association between innovation disclosure and the cost of capital. Unlike cross-sectional design, it enables the observation of strategic policy effects from innovation disclosure. Second, the panel design overcomes common methods variance bias and mitigates bias from unobserved heterogeneity and omitted variables, generating more accurate empirical results. Finally, longitudinal studies are less common than cross-sectional ones in empirical accounting research, partly because of the problems of data collection (Campbell 2004; Campbell and Rahman 2010). This study's adoption of a longitudinal design attempts to redress the deficit in longitudinal-based research in accounting.

4.4 Sample and Data Collection

To examine our hypotheses, data from UK FTSE 350 firms were collected for the period 2011 to 2016. Lists of FTSE 350 firms and the corresponding data types were retrieved from the Bloomberg database for 31st December of each of these years[35]. Annual reports were retrieved directly from company websites. The scope of the study is uniquely constructed, for a number of reasons. The following sections explain in detail the reasoning behind the choice of time-frame, UK context, and FTSE 350 firms.

4.4.1 Time-Frame

This period was primarily chosen to minimize the effects on the sample observation of the 2008 financial meltdown. UKIS (2012) reported a fall in product and process innovations as well as in the overall share of businesses engaging in innovation activities during the period 2008-2010, suggesting that the financial turmoil of 2008 negatively impacted innovation performance and innovation output in the UK[36].

[35] Easton (2004) recommends Bloomberg or I/B/E/S as data sources for analyst forecasts of future earnings. For the purpose of the current study, data of analyst forecast of EPS were collected from the Bloomberg database mainly due to logistics around the permission to access the databases.

[36] Although it would be interesting to observe and examine the economic effects of innovation disclosure before and after the financial crisis of 2008, the objective of the current study is to understand the link

However, UKIS (2014, 2016) reported improved innovation performance from 2011, with a steady improvement in the post-crisis environment of the UK, which explains the choice of panel data for the period 2011-2016.

4.4.2 UK Context

The choice of the UK as a context for this study was determined by the following factors. First, there is documented uncertainty around the interpretation of many IC disclosures and the cost of capital incentives in the UK context. For instance, in a survey of UK finance directors on the incentives for IC disclosure, Beattie and Smith (2012) found that the cost of capital incentive is of mid-ranking importance compared to that of avoiding competitive disadvantage. They argue that the inherent uncertainty surrounding the interpretation of many IC disclosures is the underlying reason that the cost of capital incentive is of relatively moderate rather than high importance. This highlights a unique empirical need in the UK to find out the specific effects of innovation disclosure on the cost of capital, rather than from broad IC disclosures. Focusing specifically on the effects of innovation disclosure would contribute to clearing the inherent uncertainties around innovation disclosure policies in the UK context.

Second, the UK Department of Business Innovation and Skills issued the Innovation and Research Strategy for Growth in December 2011; this was followed by the UK government's Science and Innovation Strategy in (2014). There is an expected correlation of greater innovation performance UK-wide with both of these governmental strategies (UKIS 2014, 2016), correlated with more innovation disclosure. This makes UK companies an interesting case for observing and examining the phenomenon of innovation disclosure for the period 2011-2016, since the publication of both strategies created a fertile environment for innovation at the UK-wide level (UKIS 2014, 2016). This is further evident by looking at the annual rankings

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between innovation disclosure and the cost of capital. Therefore, it is perhaps better to use a stable context to test the association and observe findings without the complicating effects of a financial crisis.

of the UK on the Global Innovation Index as issued by the World Intellectual Property Organization[37].

In 2011, the UK ranked the 10th on the global scale while the U.S., for instance, ranked the 7th. In 2012 onwards, however, the UK reings as one of " the world's five most-innovative nations"(Wunsch-Vincent, Lanvin, and Dutta 2015: xvii). For the period of 2012-2016, the UK maintained a leading position even ahead of the U.S.A and demonstrated "a strong rise from 10th in 2011 to 2nd in 2014 and 2015"(Wunsch-Vincent, Lanvin, and Dutta 2015: 22).

Third, the focus on UK firms adds a methodological advantage by holding country-specific factors constant in the panel regression analysis. In contrast, conducting a cross-border study would entail a high level of unobserved national heterogeneity. Country-related factors are both time-invariant (e.g. institutional, cultural or language) and time-variant (e.g. levels of economic development). Econometric modelling-based solutions could only control for time-invariant factors, although national levels of economic development, a time-varying factor, have a major influence on innovation performance (OECD 2010). This might give rise to omitted variable bias from country-related factors that would affect the corresponding levels of innovation disclosure, the variable of interest for the current study. The scope of the current study is, therefore, the UK context.

4.4.3 UK FTSE 350 Firms

The choice of UK FTSE 350 firms is due to their highly capitalized nature, as they have relatively larger resources to pursue various types of innovation than do smaller firms (Cao, Gedajlovic, and Zhang 2009). In line with this argument, UKIS (2012, 2014, 2016) consistently reported that the share of large firms engaging in innovation activities was higher than that of the small and medium-sized enterprises (SMEs) during the period 2008-2014[38]. The high engagement in innovation activities by large UK

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[37] See the link https://stats.areppim.com/stats/links_innovationxlists.htm for more details on the Global Innovation Index for the UK and other world countries.

[38] Even though SMEs are a fertile environment for innovation-related research and represent over 99% of all businesses (Audretsch et al. 2009), it is difficult to observe the economic consequences of their

firms is expected to reflect relative increases in the corresponding levels of innovation disclosure. To rule out survivorship bias (Elton, Gruber, and Blake 1996), we initially pooled all the ten ICB classes of industry (Industry Classification Benchmark) for the study period, totaling 2,120 year-firm observations as detailed in Table 4.1. After deleting observations with missing data for all three proxies of the cost capital (explained below), the sample was reduced to 1,832 year-firm observations. The most notable elimination occurred in the financial sector, with some 281 year-firm observations that are mostly investment trusts with no publicly available data. The remaining firm-year observations are an unbalanced panel sample.

Table 4.1 Industry and Year Decomposition of Sample

Industry Composition by Year								
Industry: ICB classes	Total FTSE 350	2011	2012	2013	2014	2015	2016	Available FTSE 350
Basic Materials (BM)	152	34 (0)	31 (0)	25 (0)	22 (0)	18 (0)	22 (0)	152 (0)
Consumer Goods (CG)	167	25 (0)	26 (0)	29 (0)	29 (0)	29 (0)	29 (0)	167 (0)
Consumer Services (CS)	389	58 (1)	58 (1)	61 (0)	70 (0)	71 (1)	68 (0)	386 (3)
Financials (F)	703	60 (53)	65 (51)	68 (48)	71 (41)	77 (44)	81 (44)	422 (281)
Healthcare (H)	74	8 (0)	10 (0)	12 (0)	14 (0)	14 (1)	15 (0)	73 (1)
Industrials (I)	384	62 (1)	63 (0)	66 (0)	65 (0)	63 (0)	64 (0)	383 (1)
Oil & Gas (OG)	94	22 (0)	19 (0)	17 (0)	15 (0)	11 (0)	10 (0)	94 (0)
Technology (T)	70	15 (0)	15 (0)	13 (0)	10 (0)	8 (2)	7 (0)	68 (2)
Telecommunications (TC)	43	9 (0)	8 (0)	8 (0)	7 (0)	6 (0)	5 (0)	43 (0)
Utilities (U)	44	8 (0)	7 (0)	7 (0)	8 (0)	7 (0)	7 (0)	44 (0)
Total	2,120	301	302	306	311	304	308	1,832
Reported in parentheses are the number of observations with missing values								

disclosure practices. Unlike large listed firms, SMEs do not experience capital market consequences (i.e. capital market benefits in terms of lower cost of capital) from disclosure practices. This makes it hard to study the effects of innovation disclosure on cost of capital in the SMEs context as compared to listed firms.

Unlike a balanced one, the unbalanced panel is more representative of the population of interest because it includes more observations and does not restrict the inclusion of observations to a predefined set of criteria (Raymond et al. 2010). Therefore, the unbalanced panel is less prone to survivorship bias, a form of selection bias which is commonly related to size (Agarwal and Audretsch 2001).

4.5 Measurement Methods

This section discusses methods of measuring innovation disclosure and cost of capital. The former uses a computer-aided textual analysis approach where a list of words borrowed from (Heyden et al. 2015) was amended as a device to capture concepts of exploration and exploitation disclosure in annual reports. For the cost of capital, a number of measures were devised to capture both the cost of equity capital and the after-tax cost of debt capital. The following sub-sections will demonstrate the measurement methods and validation processes for innovation disclosure and the cost of capital.

4.5.1 Measuring Innovation Disclosure

To measure innovation disclosure, we apply a content analysis approach to capture concepts of exploration and exploitation disclosure. Content analysis is defined as a technique to analyze, code and categorize texts into pre-established themes (Guthrie et al. 2004; Beattie and Thomson 2007). The coding process of content analysis is to identify and quantify patterns observed in the textual material and documents. Researchers usually follow theory-guided themes in the process of a systematic, consistent, reliable and transparent categorization of texts' contents to observe overall patterns and trends in the presentation of the information (Guthrie et al. 2004; Beattie and Thomson 2007). In the accounting literature, content analysis is widely used to measure corporate communications and disclosure[39]; for instance, researchers in corporate social reporting (Guthrie and Parker 1990; Cheng, Ioannou, and Serafeim 2014; Stellner, Klein, and Zwergel 2015; Cooper and Uzun 2015; Dhaliwal et al. 2014; Li et al. 2017; Campbell 2000); environmental disclosure (Campbell 2004; Gray, Kouhy, and Lavers 1995; Wilmshurst and Frost 2000; Qiu, Shaukat, and Tharyan 2016;

[39] See reviews (Beattie and Thomson 2007; Duriau, Reger, and Pfarrer 2007) on the use of content analysis in various streams of accounting literature.

Plumlee, Brown, and Marshall 2008; Al-Tuwaijri, Christensen, and Hughes 2004; Deegan and Gordon 1996; Plumlee et al. 2015); and intellectual capital disclosure (Beattie and Thomson 2004; Striukova, Unerman, and Guthrie 2008; Nikolaj Bukh et al. 2005; Mangena, Li, and Tauringana 2016; Meca et al. 2005; Bontis et al. 2007; Mazzoli and Cardi 2015; Pike and Li 2010; Orens, Aerts, and Lybaert 2009; Campbell and Rahman 2010) have commonly applied content analysis as a measurement of disclosure.

Manual or computer-aided techniques can be applied (Krippendorff 2004; Belderbos et al. 2017). The manual approach to content analysis relies on the human judgment of the coder to assess and recognize thematic categories of information content. It involves a great deal of subjectivity and therefore requires consistency between multiple coders. The time and effort consumed in manual coding make it hard, if not impossible, to generate sufficient data for longitudinal-based studies. In contrast, the computer-aided approach is recommended for large-scale samples and is more appropriate for longitudinal studies, as it is more time and effort efficient (Heyden et al. 2015). It also ensures consistent, systematic and reliable coding as it involves no human judgment in the coding process. The computer-aided content analysis relies on the application of high-quality dictionaries (lists of words) to capture the underlying thematic patterns in textual material. One of the major disadvantages of computer-aided textual analysis is that it does not capture the intuitive value of textual materials in the categorization process; for example, in the case of incomplete dictionaries, information relating to the underlying theme may require human judgment to recognize it. Therefore, it is the researcher's responsibility to assure a high-quality dictionary in the application of computer-aided textual analysis. This is achieved through multiple iterative steps of validity checks to ensure that the list of words captures the underlying themes in a consistent and reliable manner (Heyden et al. 2015). The iterative steps continue until a level of saturation is reached, where nothing more can be done to improve the dictionary tool (Krippendorff 2004; Belderbos et al. 2017).

Computer-aided textual analysis (CATA) was used here for the following reasons. First, it enables the analysis of the large mass of documents which supports a longitudinal study. Second, it is time and effort efficient and involves the least amount of subjective human judgment. Third, there are credible theory-established dictionaries to capture the themes of exploration and exploitation[40]. For instance, the dictionary of (Heyden et al. 2015), builds on that of (Uotila et al. 2009) with further improvements; is widely applied in organizational research (Belderbos et al. 2017). The current study amends it with further improvements in following their approach to measuring and capturing themes of exploration and exploitations. The following section will discuss the CATA approach in adequate detail.

4.5.1.1 CATA Approach

CATA requires searching archived texts for a comprehensive dictionary composed of a collection of meaningful keywords that exhibit the phenomenon of interest. Combining the merits of computer reliability and expert human judgment, the approach enables content analysis of large textual databases to construct indicators from keyword lists (Krippendorff 2004; Belderbos et al. 2017). It builds on the occurrence, absence and word frequencies of keywords depicting the underlying themes; co-occurrences reveal associations between them (Heyden et al. 2015; Frazier, Ingram, and Tennyson 1984; Duriau, Reger, and Pfarrer 2007). Belderbos et al. (2017) argue that the usage of words in narratives describing a firm’s activities in annual reports, press releases or any other means of corporate communication can provide valuable insights into its long-term strategies and perceptions. This quantitative-based content analysis, as a methodological tool, is popular in the accounting literature on corporate narrative disclosures (Clatworthy and Jones 2003; Abrahamson and Amir 1996; Smith and Taffler 2000) and in positive methodologies with large sample sizes entailing hypothesis testing and statistical associations (Merkl-Davies and Brennan 2007). Belderbos et al. (2017) indicate that two techniques are generally used in selecting keywords: deductive and inductive. The deductive method starts from theoretical definitions and uses critical keywords to reflect the concept in question, whereas the inductive method uses the body of text under analysis to derive keywords. The keywords of (Heyden et al. 2015; Uotila et al. 2009) arguably rely on the deductive

[40] Both (Heyden et al. 2015; Uotila et al. 2009) follow the theoretical definitions of exploration and exploration, as already defined (March 1991; Tushman and O'Reilly 1996; Tushman and O'Reilly 1997), to derive dictionary words capturing both themes.

method in full and the inductive method to some extent; hence, we extended their original keywords inductively, adding a total of 82 words.

Heyden et al. (2015)'s dictionary increased the number of Uotila's keywords to 66 and 75 for exploration and exploitation respectively, as shown in Appendix A1. These keywords were adopted, with a number of changes to improve on them: 23 words on exploration and 59 on exploitation were added and several removed (see Appendix A2). Terms removed do not consistently capture the theme of exploration; for example, 'risk' as used by (Uotila et al. 2009) mostly relates to financial risk reduction. After these modifications, 64 and 72 words remained for exploration and exploitation, respectively. Note that the asterisk (*) represents any missing characters (e.g. explor* will search for explore, explores, explored, exploring, exploration, etc.).

4.5.1.2 Content Validity Checks

To assure the quality and reliability of the dictionary tool in capturing the concepts of exploration and exploitation, a number of content validity checks for the added words were conducted; see Appendix A3[41]. The three checks, as used by (Heyden et al. 2015) and recommended by (Belderbos et al. 2017) are expert judgment of face validity[42]; validity of keywords' appropriateness by examining keywords-in-context (KWIC) (Krippendorff 2004; Belderbos et al. 2017); and validity of the overall dictionary in terms of accurately demonstrating the underlying phenomenon (Belderbos et al. 2017).

The added words were checked individually with KWIC analysis, to identify and remove keywords that generated inconsistencies or irrelevant feedback. A preliminary text-search query was run for each added word independently, and a minimum of ten instances of the results manually checked[43]. This phase of validation was conducted in

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[41] Validity checks for the original list of words had already been carried out by (Heyden et al. 2015).

[42] Dr Mariano Heyden, the leading co-author of (Heyden et al. 2015), kindly examined the added words for an expert judgment of face validity check. Also, discussions with Dr Yinshan Tang, as an expert academic, were conducted for a second a face-validity check.

[43] In the second validity check, words such as 'being_the-only'and 'coordinat*' were removed, and words such as 'reap*' were replaced with 'reap', 'reaped' and 'reaping to avoid outcomes such as 'reappoint*'. In general, the second validity check resulted in more words added than words removed, requiring a number of iterations of the KWIC checks.

multiple iterative stages to ascertain reliability; consistent with existing recommendations (Krippendorff 2004; Heyden et al. 2015; Uotila et al. 2009; Belderbos et al. 2017). Second, the overall complete dictionary for each theme was retrieved in a text-search query for a random sample of 36 annual reports (approximately 2% of the total annual reports under study). The retrieved outcome was closely examined to validate the accuracy of the overall dictionary in capturing the themes of exploration and exploitation. After a number of iterations, this phase resulted in no words being removed; indicating a level of saturation[44]. After concluding all alterations, additions and content validity checks, 87 and 131 keywords for exploration and exploitation nodes, respectively, were assembled and used in the subsequent NVIVO text-search query. Table 4.2 presents the final list of words and Table 4.3 a sample of text from annual reports, showing the words that have been extracted by the list of words.

[44] Despite the researcher's satisfaction with the level of saturation reached, this does not preclude further improvements and alterations to the current list of words in future research.

Table 4.2 Final Lists of Words

Exploration Wordlist with the Added Words
<u>Original List:</u> Explor*, Chang*, Search*, Creative*, Proactiv*, Decentral*, Innovat*, R&D_alliance, Invent*, Development_programme*, Research_development, Experiment*, Discontin*, Release*, Play_role, Distant*, Low_codification, Revolution*, Flexib*, distant_search, Low_formalization, Slow_learning, Discover*, Diversif*, Low_standardization, Dynamic*, Adventur*, Evolution*, Start*_Up, Anticipat*, Expand*, Transform*, Autonom*, Break*_away, Diffus*, Adapt*, Collaboration, Cooperation, Strength*_Pipeline, Expans*, Reposition*, Licensing, R&D_Outsource*, Variation*, Something_extra, New, Astound*, Fantasy*, Uncertain*, Far_beyond, Novel*, Forefront, Stakeholder_value, Stress, Open_mentality, Wide_background, Long_run, Long_time_horizon, Spirit_of_initiative, Freedom, Idea, Patent, Long_term, Tacit_knowledge **<u>Added List:</u>** Acquisition*, Agile*, Copyright, Entrepreneur, Intellectual_property, Trademark, Research_outsourc*, Research_development_outsource*, Research_development_alliance, Research_alliance, Research_portfolios, Reconfigur*, Market_portfolio, Breakthrough, Opportunities, Radical, Newer, Newest, Newly, Unique*, Evolv*, World_leading, UK_leading
Exploitation Wordlist with the Added Words
<u>Original List:</u> Exploit*, Fast*, React*, Refine*, Certification, Formalization, Choice*, Codification, Restyl*, Commercial_alliance, Select*, Continu*, Local_search, Routin*, Implement*, Control*, Modular_production, Rules, Directives, Execute, Correct*, Operational_strateg*, Serial_production, Accelerat*, Planning, Shorten*, Adjust*, Defend*, Applied_research, Differentiat*, Standard*, Automat*, Execution*, Updat*, Aversion_to_risk, Procedure, Bureaucr*, Programm*, Verification, Caution*, Prudence, Centraliz*, Rational*, Inertia, Speed*, Proxim*, Extens*, Optim*, Streamline*, Variant*, Certain*, Reduction_of_costs, Cost_reduction, Clarity, Reliab*, Improv*, Efficien*, Incremental_innovation*, Result_based_objective, Customer_loyalty, Perfect*, Short_term, Deep_background, Practicality, Precision, Predictability, Existing, Low_cost, Shareholder_value, Short_run, Short_time_horizon, Blockbuster_revenue. **<u>Added List:</u>** Accreditation*, Augment*, Advanced, Advancing, Boost*, Capitalize_on, Capitalise_on, Cost_control, Cultivat*, Discipline*, Enhanc*, Executed, Executing, Foster*, Lead_time, Modular, Maximi*, Minimi*, Iterat*, Nurtur*, Progress*, Reap, Reaped, Reaping, Reform*, Redeploy*, Reengineer*, Redesign*, Reinvent*, Restructur*, Reorgani*, Renovat*, Upgrad*, Better, Bigger, Cost_saving, Clearer, Easier, Efficien*, Economies_of_Scale, Economies_of_Scope, Grow*, Larger, Healthier, Proficien*, Rapid*, Ready*, Resilience*, Responsive*, Shorter, Synergy*, Stronger, Superior, Stabilize*, Stabilise*, Long-established, Well-established, Well_positioned, Quick*

Table 4.3 A Sample of Extracted Examples of Keywords in Annual Reports

Exploitation
"We are committed to working in a spirit of collaboration to achieve our goal of better health for patients."
"We are creating a much stronger focus on those who pay for our medicines to help us ensure that our medicines …"
"… in a dynamic environment that presents both opportunities and challenges. To make sure we are well positioned to manage these, our business strategy is driving significant changes across our organization. Previous sections …"
"… combination with its state-of-the-art center for training and education at its headquarters, advanced international education programmes and seminars are continuously being offered to existing and potential customers."
"Stronger than expected revenue performance provided the opportunity to drive future growth through accelerated marketing investment."
"The increases ensure that the Company is well positioned when seeking to recruit new Non-Executive Directors as part of routine refreshment of the …"
"… restructuring R&D organizations to create clearer accountabilities and smaller, more entrepreneurial units."
"… collaborative approach to TB drug development. It aims dramatically to speed up the development of shorter, safer and more effective multi-drug treatments which are urgently needed to control the global …"
"A strategic collaboration with the Sarah Cannon Research Institute (SCRI), an international leader in advancing therapies for cancer patients through clinical research, under which SCRI …"
Exploration
"Furthermore, faster-developing economies, such as China, India, and Brazil, offer new opportunities for the industry to help an expanding number of patients who can benefit from medicines …"
"Underpinning this model is the creation, protection and subsequent sharing of intellectual property. It is on this basis that we continue to invest in new medicines and work …"
"… design and testing of novel compounds, new opportunities also exist for the use of innovative small molecules as new medicines."
"We believe that there are ongoing opportunities to create value for those who invest in pharmaceutical innovation, and … ha the skills and capabilities to take advantage of these opportunities and turn them into long-term value through the research, development and …"
"Success of such current and future arrangements is largely dependent on the technology and other intellectual property we acquire and the resources, efforts, and skills of our partners."
Exploration and Exploitation
"To meet the high and growing need for new and better therapies for resistant bacterial infections we have built an anti-bacterials discovery capability which will …"
"… in R&D > Increased external collaboration > Our global orientation, reflecting the growth in Emerging Markets > Stronger customer orientation, particularly towards payers > Operational efficiency with a flexible cost base …"
"… economies, and intensifying regulatory and access challenges have led us to look at ways of better and more efficiently addressing the changing needs and preferences of payers, prescribers and patients."

4.5.1.3 Unit of Analysis: Word Count as a Percentage of Total Document

The accounting literature on voluntary disclosure debates two prominent issues of data measurement: unit of analysis and disclosure medium (Campbell 2004). The controversy over the unit of analysis in content analysis concerns the most effective way of extracting meaning from volumetric data by coding words or sentences (Milne and Adler 1999; Campbell 2004). Then, the coded content is counted as a quantity without considering the varying qualities of the disclosed contents (Campbell 2004). The most commonly applied units of analysis are: word count (Deegan and Rankin 1996; Deegan and Gordon 1996; Wilmshurst and Frost 2000); sentence count (Milne and Adler 1999; Deegan 2000); and page proportion count (Guthrie and Parker 1990; Gray, Kouhy, and Lavers 1995; Campbell 2000). Each measure has its own pros and cons. For the purposes of the current research, word count (as a percentage of the total document) was employed as the unit of analysis for the following reasons. First, while running validity checks on the list of words for exploration and exploitation, it was noticed that in some sentences, both themes are represented. So, counting the sentences is not deemed appropriate because it would be necessary to decompose them and categorize them into two different themes.

Second, the page proportion count is inappropriate since in this case, it would involve erroneous coding of other content that is potentially irrelevant to the concepts of exploration and exploitation. As with sentence count, many instances were found during the content validity checks of concepts of exploration and exploitation both present in the same paragraph, making it inappropriate to, label a given paragraph for either exploration or exploitation singly. Furthermore, the size of annual reports varies from small, with fewer than 100 pages, to large so the disclosed content of innovation might vary relatively to the size of the report, entailing a higher level of counting error (Campbell 2004).

For these reasons, the word count is the most robust measure (Deegan and Rankin 1996; Deegan and Gordon 1996; Wilmshurst and Frost 2000; Campbell 2004; Campbell and Rahman 2010). In order to take into account the different sizes of annual reports (assuming that the disclosure content correlates positively with document size), the word count is taken as a percentage of the total document and is taken as the unit of analysis for the current study.

4.5.1.4 Why Annual Reports?

The disclosure medium (e.g. annual reports analyst presentations, conference calls, standalone reports, official web pages, etc.) as the basis of data capture is equally debatable (Campbell 2004). However, only annual reports are mandatory, regularly produced and audited, and widely distributed, making them the main corporate means of disclosure[45] (Bozzolan, O'Regan, and Ricceri 2004; Campbell 2004; Guthrie, Petty, and Ricceri 2006); into which firms make a substantial editorial input (Deegan and Rankin 1996; Gray, Meek, and Roberts 1995; Campbell 2004).

In a relevant note to the economic relevance of annual reports, Hope (2003) found a positive association between annual report disclosure and the accuracy of analysts' earnings forecasts, while Li Eng and Kiat Teo (1999) found that analysts revise their earnings forecasts after the release of annual reports. This indicates the economic relevance of annual reports to capital market participants when estimating the firm value. Therefore, the analysis of annual reports has been gaining a consensus as a useful, unobtrusive source of documented textual data (Eggers and Kaplan 2009; Uotila et al. 2009; Heyden et al. 2015). For these reasons and for the purpose of the current study, the annual report is deemed an appropriate basis of analysis to measure disclosure scores for innovation exploration and exploitation.

A total of 1,756 annual reports were downloaded from company websites for the period 2011 to 2015. They were subjected to a text-search query with NVIVO software for wordlists of each node independently[46]. NVivo generated word frequencies and

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[45] It should be noted that the narrative sections of annual reports (which are the content under examination of the current study) are not audited but still this does not dismiss their importance to be used for empirical analysis on the disclosure and cost of capital association.

[46] The researcher conducted a comparison of various computerized applications for content analysis (e.g. NVivo, Corpus-linguistics, and linguistic analysis software). The first, however, was deemed effective for the purposes of the current study because it is the only one that provides a word count from each dictionary as a percentage of total document separately for each firm-year annual report.

coverage percentages for each available firm-year annual report. However, only the coverage percentages, as generated by the text-search, are used to proxy for disclosures of exploration and exploitation in the later longitudinal unbalanced fixed-effects panel regression[47]. The corresponding coverage percentages for the combined disclosure are obtained from the square-root of the product of the exploration and exploitation coverage percentages[48]. This operationalization is consistent with the combined dimension of the ambidexterity literature.

4.5.2 Measuring Cost of Equity Capital

For this study, two main types of the cost of capital were examined: the cost of equity capital and the after-tax cost of debt capital. Regarding the former, two approaches are prevalent in the literature: the historical approach employing actual (historical) stock returns, and the future-based approach employing forecasts of future earnings and current stock prices. The following sub-sections will discuss in detail the conceptualization and operational measurement of both historical and future-based types.

4.5.2.1 Historical vs. Future Based Measures: Overview

The cost of equity capital is defined as the minimum rate of return required by equity investors for providing capital to the firm (Botosan 2006). Since there is no direct precise observable measure, it is rather estimated and mostly referred to as the expected cost of equity capital (Botosan 2006). Given the difficulties surrounding the estimation of the cost of equity capital, academics continue to debate the best method to measure it.

One approach uses a predetermined set of priced risk factors, which yields explicit estimates of the cost of equity capital based on historical stock market values (Botosan 2006). For this method, CAPM (Sharpe 1964) and the CAPM-based extensions such as

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[47] For robustness checks in panel regression analysis, the natural logarithm of word frequencies was used instead of percentages of total document. The results are not just qualitatively similar, but exactly the same in every respect.

[48] Taking the square root is done to transform the functional form of the combined disclosure back to a percentage scale. It is intended to keep a consistent and comparable functional format amongst all the measures of disclosure and cost of capital.

the three-factors model (Fama and French 1993, 1992, 1996b) and the subsequent four-factors (Carhart 1997) and five-factors models (Fama and French 2016) are available. They are all based on the premise that a set of priced risk factors can explain stock returns by inferring the expected rate of return from the average realized returns.

Botosan (1997) indicated that CAPM estimates are based on the assumption that variations in market beta alone, which is the most widely used estimate of risk (Fama and French 1992), derive from variations in the cost of equity capital. This assumption imposes a limitation on the applicability of CAPM estimates to test the disclosure hypothesis because it does not directly support the notion that variations in disclosure induce variations in the cost of equity capital (Botosan 1997). Thus, CAPM estimates do not provide a powerful estimate of disclosure tests unless one assumes that variations in disclosure induce variations in beta, “a notion that has no theoretical support” (Botosan 1997: 337).

In a counter-argument, however, Lambert, Leuz, and Verrecchia (2007) use a model that is consistent with CAPM to examine whether and how public accounting reports and disclosures affect firms’ cost of equity capital. They empirically demonstrate that the quality of accounting information can influence the cost of equity capital both directly and indirectly. They explain that the quality of accounting information directly affects the assessed covariance of a firm’s cash flows with other firms’ cash flows, thereby indicating that information quality directly affects the cost of equity capital through the firm’s beta. They add that if the beta was measured with error, then a proxy for information risk would appear to be priced as long as it captures the measurement error in beta. This is consistent with previous findings (Barry and Brown 1985; Coles and Loewenstein 1988), that information quality affects stock returns and betas through variations in the estimation risk. Lambert, Leuz, and Verrecchia (2007) also argue that information quality would indirectly affect the cost of equity capital if it affects real economic decisions and the subsequent cash flows. Moreover, empirical evidence shows that market beta is strongly correlated with size (i.e. market capitalization) (Kothari and Wasley 1989; Jegadeesh 1992; Fama and French 1992, 1996a; Kothari, Shanken, and Sloan 1995), and size has evidently of a strong correlation with disclosure (Boesso and Kumar 2007; Beretta and Bozzolan 2004; Bozzolan, Favotto, and Ricceri

2003; Amran, Manaf Rosli Bin, and Che Haat Mohd Hassan 2008; Linsley and Shrives 2006; Bellora and Guenther 2013). There is a background of empirical evidence supporting the notion that large firms endure relatively higher market risks and tend to disclose more to account for that risk. This empirical evidence supports the belief that variations in disclosure could cause variations in market beta, therefore not precluding the applicability of CAPM in examining disclosure-cost of equity capital links.

In practice, however, the historical-based CAPM estimate is by far the most commonly used (Botosan 2006; Jacobs and Shivdasani 2012; Gregory, Hua, and Tharyan 2018). Partington (2013) predicts that the reign of CAPM is unlikely to be over in the near future. Furthermore, CAPM is the only estimation model for the cost of equity capital accepted by regulatory authorities in the UK (Grayburn, Hern, and Lay 2002; Gregory, Hua, and Tharyan 2018). The recent literature shows an increase in vigorous arguments defending CAPM (Levy 2010; Smith and Walsh 2013; Brown and Walter 2013). For instance, Smith and Walsh (2013) argue that it is the "only game in town" (p.77), even arguing that "CAPM is half-right and everything else is wrong" (p.73). Partington (2013: 69) stated that "even Fama and French (1993) resurrected the CAPM beta in their three-factor model, although their inclusion of other risk factors is in contradiction to the CAPM". Finally, Smith and Walsh (2013) cautioned that discarding CAPM for an unspecified alternative is like giving up something that is half-right for something that does not tell anything at all. All of these arguments in favour of CAPM estimates to give insights in practice are compelling. Therefore, in the current study, the validity of CAPM estimates will be evaluated to determine whether they are suitable for analysis of the association between innovation disclosure and the cost of equity capital.

The alternative approach uses analysts' forecasts of future earnings to estimate the internal rate of return that equates the market's expectation of future cash flows to the current stock price (Easton 2004; Botosan 2006). There are four common methods of estimating the implied cost of equity capital: 1) the residual income valuation model (RIV) developed by (Gebhardt, Lee, and Swaminathan 2001); 2) the abnormal earnings growth model (AEG) developed by (Gode and Mohanram 2003) and operationalized by (Ohlson and Juettner-Nauroth 2005); 3) the price-earnings-growth (PEG) model developed by (Easton 2004); and 4) the modified price-earnings growth (MPEG) model also developed by (Easton 2004). All of these models are variations of the classical dividend discount model that derives the stock price using expected future dividends (estimated by forecasts of future earnings) (Gebhardt, Lee, and Swaminathan 2001; Daske and Gebhardt 2006; Botosan 2006). They all use current stock prices and analyst consensus of future earnings forecasts as inputs but vary in terms of the complexity of the underlying assumptions about earnings forecasts, growth rates, and data requirements.

The future-based approaches are widely used in academic accounting research (Botosan 2006). This is mainly due to their superiority over the CAPM approach in terms of efficiently capturing whether a specific risk factor is priced or not; this makes them more suitable to address the disclosure-cost of equity capital questions (Botosan 2006, 2000; Mangena, Li, and Tauringana 2016). Unlike the CAPM approach, they are not based on the assumption that the cost of equity capital is "a function of a predetermined set of priced risk factors" (Botosan 2006: 33). The future-based approaches also produce estimates associated with several risk factors in a theoretically predictable and stable manner (Botosan 2006; Botosan and Plumlee 2005). Estimates of the three future-based cost of equity capital measures, namely AEG, PEG, and MPEG, are similar and positively correlated (Botosan and Plumlee 2005). For a broad spread, cost of equity capital will be derived using the CAPM historical approach and also three of the future-based approaches: the PEG, MPEG and AEG models[49].

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[49] The RIV model was not used in this study as it requires a relatively higher complexity in estimation of implied cost of equity capital. For instance, estimation must be made over a time horizon of 12 years and the terminal value beyond 12 years must also be estimated; this entails a high level of forecast error (Easton and Monahan 2005). It further poses the assumption of clean surplus accounting whereby it assumes that the change in a firm's book value of equity from one period to the next is eventually equal to earnings minus net dividends. The clean surplus assumption is the most problematic issue of RIV estimation as it does not hold on a per share basis in the real world. Furthermore, Chen, Jorgensen, and Yoo (2004) conclude that the RIV model is inferior to PEG and AEG in European countries (UK, Germany and France) as compared to US, Canada, Australia and Japan. This is mainly because the clean surplus assumption tends to hold more in the latter countries and is violated more in European countries. This makes the RIV model less relevant (as the current study has a UK context) and less reliable due to potentially high levels of forecast error.

Then, a validity check will be run to examine the association of these alternative measures to various documented and common risk factors (e.g. size, beta, B/M ratio, and leverage). The validity check will determine the best measures to use in the subsequent regression analysis of innovation disclosure-cost of equity capital association.

4.5.2.2 Historical-based Measure (CAPM)

According to CAPM (Sharpe 1964), advocated by (Lintner 1969), the cost of equity capital comprises the risk-free interest rate and a premium rate for the non-diversifiable risk of the firm (Botosan 2006), as shown in the following equation.

$$CAPM \; = \; RF \; + \; \beta * [RM - RF] \tag{1}$$

Ready CAPM-based estimates of the cost of equity capital were directly drawn from the Bloomberg database, in which beta is the raw historical beta of the firm and defined as the systematic risk of a firm relative to the systematic risk of the overall market; FR is the UK's 10-year rate of return for the risk-free sovereign debt, and [RM-RF] the market's expected return.

4.5.2.3 Future-based Measure of Implied Cost of Equity Capital (PEG)

The PEG model is a special case of the AEG) model, which imposes assumptions about the growth in abnormal earnings beyond the forecast horizon. The PEG model relaxes such assumption by assuming that the market expects zero growth in abnormal earnings beyond the forecast horizon. In addition, the PEG model depends on the growth of forecast short-term earnings for valuation purposes and it excludes the roles of one-year-ahead and two-years-ahead forecast earnings, and the beyond-two-years ahead forecast earnings. It is expressed as a special case of the price-earnings-growth ratio (calculated as the price/earnings ratio divided by the short-term growth rate of earnings), whereby the implied rate of return is taken as the square root of the inverse of price-earnings growth ratio and multiplied by a 100.

The formula for the implied cost of equity capital according to the PEG model is:

$$PEG = \sqrt{[(EPS2 - EPS1) \div P0]} \quad (2)$$

Where EPS2 is the analysts' consensus of the two-year forward EPS, EPS1 is their consensus of the one-year forward EPS, and P0 is the firm's share price at the end of the financial year. Data for calculating the COE of the PEG model was extracted from the Bloomberg database. In relation to other more complex models (e.g. RIV, AEG, and MPEG), the PEG model does not require the assumption of clean surplus nor data on book values per share, forecast return on equity ratios, forecast dividends per share or forecast growth in national GDPs. This makes it relatively easier to implement. On the downside, however, a mathematical limitation emerges from the fact that EPS2 must be greater than EPS1, which is not always the case for all firms.

4.5.2.4 Future-based Measure of Implied Cost of Equity Capital (MPEG)

Like the PEG model, the MPEG model is a special case of the AEG model, whereby the imposed assumption of growth in abnormal earnings beyond the forecast horizon is relaxed. While the PEG model assumes that the market expects no dividends in the one-year ahead forecasts, the MPEG model relaxes this assumption. The formula for the implied cost of equity capital according to the MPEG model is:

$$MPEG = A + \sqrt{\left[A^2 + \left((EPS2 - EPS1) \div P0\right)\right]};\ A = \left[\frac{DPS1}{2P0}\right] \quad (3)$$

Where DPS1 is the one-year-ahead forecast of dividends per share. Data of forecast dividends per share were taken from the Bloomberg database. In contrast to more complex models (e.g. RIV and AEG), the MPEG model does not require the assumption of clean surplus nor does it require data on book values per share, forecast return on equity ratios or forecast growth in national GDPs.

4.5.2.5 Future-based Measure of Implied Cost of Equity Capital (AEG)

The AEG model solves the dividend discount problem for expected returns by imposing assumptions on: 1) the one-year-ahead forecast earnings; 2) the one-year-ahead forecast dividends per share; 3) abnormal earnings: and 4) the growth rate in forecast short-term abnormal earnings. The formula for the implied cost of equity capital according to the AEG model is:

$$AEG = A + \sqrt{\left[A^2 + \left((EPS1 \div P0) \times \left((EPS2 - EPS1) \div EPS1\right)\right) - (\gamma - 1)\right]}\,; \quad A = \frac{1}{2} * \left[(\gamma - 1) + \frac{DPS1}{P0}\right] \tag{4}$$

Where (γ) is the perpetual growth rate of abnormal returns beyond the forecast horizon, represented by the economy-wide growth rate (in this case, forecast UK GDP rates for each year, following (Mangena, Li, and Tauringana 2016)). Data for the UK's forecast GDP rates was taken from national bulletins issued by the World Bank (WB), International Monetary Fund (IMF), United Nations (UN), European Commission (EC) an Organization for Economic Co-operation and Development (OECD). The GDP growth rate from the average of the five estimates is derived annually for 2011 to 2016, as shown in Table 4.4.

Table 4.4 Forecast GDP Growth Rates for the UK

Forecast GDP Growth Rate	**WB**	**IMF**	**UN**	**EC**	**OECD**	**Average GDP Growth Rate**
2011	0.0150	0.0151	0.0200	0.0151	0.0112	0.0153
2012	0.0130	0.0130	0.0120	0.0131	0.0028	0.0108
2013	0.0190	0.0191	0.0220	0.0191	0.0166	0.0192
2014	0.0310	0.0307	0.0310	0.0307	0.0320	0.0311
2015	0.0220	0.0225	0.0220	0.0219	0.0267	0.0230
2016	0.0200	0.0184	0.0160	0.0201	0.0261	0.0201

4.5.3 Validating the Measures of Cost of Equity Capital

As discussed above, the validity of CAPM estimates is contested by (Botosan 1997), as is the validity of future-based measures of implied cost of equity capital (Blanco, Garcia Lara, and Tribo 2015). There is mixed evidence about the reliability of implied measures of the cost of equity capital (Easton and Monahan 2005; Pástor, Sinha, and Swaminathan 2008; Botosan and Plumlee 2005).

One way to mitigate the concern over the reliability of estimation is to use the average of a combination of implied cost of equity measures (Hail and Leuz 2006; Botosan, Plumlee, and Wen 2011; Blanco, Garcia Lara, and Tribo 2015). For instance, Hail and Leuz (2006) used the average of four measures[50]: the RIV, MPEG and AEG models and the economy-wide growth model of (Claus and Thomas 2001).[51] However, using the average of a combination of measures does not necessarily assure the reliability of the implied cost of equity capital estimates even if it is highly correlated with other common measures. For instance, Botosan, Plumlee, and Wen (2011) compared 12 estimation models of the cost of equity capital, including the combination applied by (Hail and Leuz 2006), and concluded that the PEG model is relatively superior in capturing risk factors in a systematic and theoretically predictable manner. A similar conclusion was reached in other comparisons (Easton and Monahan 2005; Botosan and Plumlee 2005). This leads to considering other ways of mitigating the concern about estimation reliability.

One alternative is to comparatively evaluate the various measures of implied cost of equity capital against well-known risk factors in order to decide on the best models to capture the firm-specific risk in a systematic and theoretically predictable pattern (Botosan, Plumlee, and Wen 2011). For this purpose, the validity of the cost of equity capital measures is evaluated against a number of well known risk factors, including market beta, size (measured as the natural logarithm of market capitalization), book/market ratio and leverage (measured as total debt to total assets) (Botosan, Plumlee, and Wen 2011). Beta is calculated using two years of weekly data, one of the conventional estimation periods recognized in the literature (Gregory, Hua, and Tharyan 2018). Gregory, Hua, and Tharyan (2018) also argue that UK regulators have expressed a preference for higher frequency returns (i.e. weekly and daily rather than monthly) in estimating beta.

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[50] Botosan, Plumlee, and Wen (2011) report that the average of four implied measures of cost of equity capital as applied by (Hail and Leuz 2006) is strongly correlated with the PEG (0.66) MPEG (0.79) and AEG models (0.73).

[51] The economy-wide growth model by (Claus and Thomas 2001) was not applied in this study because several authors (Hail and Leuz 2006; Botosan, Plumlee, and Wen 2011) argue that it is highly correlated with the AEG model; in particular, Hail and Leuz (2006) report a positive correlation of 0.945.

The following fixed-effects panel regression model is estimated to comparatively test the validity of the CAPM, PEG, MPEG and AEG models.

$$
\begin{aligned}
COE_{i.t} = \ & \beta_0 + \beta_1 BETA_{i.t-1} + \beta_2 LogSize_{i.t-1} + \beta_3 B/M_{i.t-1} \\
& + \beta_4 Debt2Assets_{i.t-1} + \sum_n \beta_n \, \text{Year. Controls} + \varepsilon_{i.t}
\end{aligned} \tag{5}
$$

The model specified is a firm-fixed effect and year-fixed effects panel regressing with a large-scale longitudinal unbalanced panel dataset for the period 2011-2016. The use of fixed effects estimation is intended to mitigate any endogeneity issues arising from unobserved heterogeneity and omitted variable bias. The Hausman test is run for all models in order to decide between fixed effects and random effects estimations, and the decision is based on the significance of Hausman Chi2. The significance of Hausman Chi2 at 5% level indicates that the results of the fixed effects model are better estimates than those of the random effects model (Baltagi 2008; Wooldridge 2010). This is because the fixed effects estimation controls for firm-specific and year-specific effects which mitigates unobserved heterogeneity and omitted variable bias. The firm controls (firm dummies) fix for omitted variables that vary across firms and are constant over time, while year controls (year dummies) fix for omitted variables that vary across years but are constant over firms (Wooldridge 2010).

All of the right-hand side variables are one-year lagged to control for endogeneity issues arising from reverse causality bias. The use of unbalanced panel data, as research design, is aimed at controlling for survivorship bias by treating missing data as exogenous, according to the missing at random hypothesis. Finally, robust standard errors clustered at the firm level are used to control for heteroscedasticity and autocorrelation bias (Baltagi 2008; Petersen 2009; Wooldridge 2010). Results and discussion of the validity checks are presented in the following section.

4.5.4 Results of Validity Checks of the Implied Cost of Equity Capital Measures

In this section, the descriptive statistics, Pearson correlation matrix and output of the fixed effects panel regression are reported in Table 4.5,

Table 4.6 and Table 4.7, respectively. Each of the following sub-sections discusses the results presented in these tables.

4.5.4.1 Descriptive Statistics

Table 4.5 compares the descriptive statistical parameters for CAPM, PEG, MPEG and AEG estimations of the cost of equity capital. The mean (median, standard deviation) of the PEG model is 9.5% (8.4%, 5.2%). Botosan, Plumlee, and Wen (2011) report similar parameters (11.23%, 10.22%, 4.63%), as do Mangena, Li, and Tauringana (2016) in a similar UK-based study (9.95%, 9.02%, 6.29%). The mean parameters of CAPM and PEG are similar but slightly different in terms of standard deviation. The parameters of MPEG and AEG are very similar to each other but not as similar as those of CAPM and PEG. Botosan, Plumlee, and Wen (2011) report relatively similar parameters for the MPEG and AEG models[52]. For instance, they report (12.36%, 11.31%, and 4.61%) for the MPEG model on mean, median and standard deviation, respectively, and (13.2%, 12.11% and 4.99%) for AEG. Overall, the parameters of PEG, MPEG and AEG are similar to those reported in earlier studies.

Table 4.5 Descriptive Statistics of Cost of Equity Capital Measures

Stats	**Number of Observations**	**Mean**	**Median**	**St.dev**	**Range**	**Min**	**Max**
CAPM	1,832	0.106	0.102	0.028	0.261	0.016	0.278
PEG	1,693	0.095	0.084	0.052	0.671	0.004	0.675
MPEG	1,200	0.111	0.105	0.032	0.131	0.068	0.199
AEG	1,279	0.111	0.104	0.034	0.139	0.063	0.202

4.5.4.2 Univariate Analysis

Table 4.6 displays the Pearson correlations of CAPM, PEG, MPEG and AEG estimations of the cost of equity capital. In terms of the correlation sign and significance, all four estimates are positively and significantly correlated at 5% level or better. In terms of correlation magnitude, however, the MPEG and AEG models are strongly correlated at 98.97%. Botosan, Plumlee, and Wen (2011) report a similar correlation of 98% between MPEG and AEG models.

[52] The sample size in (Botosan, Plumlee, and Wen 2011) was 17,904 firm-year observations from the US stock market.

The PEG model shows a strong positive correlation with MPEG and AEG of 62% and 63% respectively. The latter correlations are not as strong as those reported by (Hail and Leuz 2006; Botosan, Plumlee, and Wen 2011). The latter, for instance, reports that the PEG model has a strong correlation of up to 91% with both MPEG and AEG, while Hail and Leuz (2006) report a correlation of 93.3% between PEG and AEG. The relatively weaker correlation of PEG with both MPEG and AEG is possibly due to the use of UK data only, as compared to Hail and Leuz (2006) and Botosan, Plumlee, and Wen (2011) who used international and US data, respectively.

Table 4.6 Pearson Correlation of Cost of Equity Capital Measures

	CAPM	**PEG**	**MPEG**	**AEG**
CAPM	1			
PEG	0.1964*	1		
MPEG	0.0981*	0.6207*	1	
AEG	0.1094*	0.6346*	0.9897*	1

* indicates significant correlation at 5% confidence level

4.5.4.3 Multivariate Analysis

Finally, moving on to Table 4.7 the panel regression results show that CAPM, (in column B), shows a significant association with the one-year lags of beta and size. However, the initial modelling of CAPM without beta (since beta is the major driver of CAPM estimation) shows a significant association with the one-year lag of size and book-to-market ratio, as shown in column A. This indicates the efficiency of CAPM in capturing various risk factors, potentially including information risk, especially as beta is directly affected by information risk due to measurement error, according to previous empirical findings (Barry and Brown 1985; Coles and Loewenstein 1988; Lambert, Leuz, and Verrecchia 2007).

The PEG estimate, as shown in column C, however, indicates significant associations with two risk factors: size and book-to-market ratio. The PEG model also shows a weak association with the beta at 10% confidence level. This evidence is consistent with previous findings (Botosan, Plumlee, and Wen 2011; Botosan and Plumlee 2005), that PEG is positively associated with various risk factors which results in a reasonably efficient estimate in capturing firm-specific risk factors. This is also in line with previous empirical findings, that the PEG model is superior to other future-based models for the implied cost of equity capital, including MPEG and AEG (Chen, Jorgensen, and Yoo 2004; Botosan and Plumlee 2005; Easton and Monahan 2005; Botosan, Plumlee, and Wen 2011). Furthermore, based on a review of the literature, Lee, Walker, and Christensen (2006) concluded that the PEG model is arguably superior in a European context (including the UK) to other future-based models.

However, the MPEG and AEG estimates (columns D and E) are not associated with any of the four risk factors. Therefore, there is a concern over the applicability of MPEG and AEG estimation models in the subsequent testing of the association between innovation disclosure and the cost of equity capital. This is in line with previous evidence by Easton and Monahan (2005) regarding the questionable reliability of various future-based measures of the implied cost of equity capital. This is especially the case as the MPEG and AEG models impose more assumptions than the PEG model, therefore demanding more forecast data requirements and relatively more complex estimation assumptions. The relatively higher forecast inputs of estimating MPEG and AEG models is ultimately subject to higher forecast error (Easton and Monahan 2005) which will, in turn, affect the reliability of their respective estimates in capturing the various firm-specific risk factors, as is observed in Table 4.7.

The overall finding from Table 4.7 is that CAPM and PEG are efficient in capturing firm-specific risk factors, which makes them suitable for the later longitudinal regression analysis of innovation disclosure and the cost of equity capital. Therefore, for this subsequent regression analysis, the PEG estimates will be used as the main proxy for the cost of equity capital, while CAPM estimates will be used to check the robustness of the PEG-based results. Finally, it is noteworthy that, unlike other noisy short-term measures (e.g. stock prices and stock returns) (Tumarkin and Whitelaw 2001; Jasic and Wood 2004; McMillan and Speight 2006), the use of implied cost of equity capital is superior since it captures the long-term effects for firm valuation.

Table 4.7 Evaluation of the Cost of Equity Capital Measures Against Risk Factors

	A	**B**	**C**	**D**	**E**
	CAPM	CAPM	PEG	MPEG	AEG
L.Beta	--	0.0337***	-0.013*	-0.001	0.000
	--	(0.004)	(0.008)	(0.006)	(0.007)
L.LogSize	-0.029***	-0.0372***	-0.0370**	-0.004	-0.005
	(0.009)	(0.009)	(0.016)	(0.012)	(0.012)
L.B2M	0.0109**	0.005	0.0169***	0.008	0.004
	(0.005)	(0.005)	(0.006)	(0.011)	(0.011)
L.Debt2Assets	0.0105	0.010	0.017	0.040	0.033
	(0.013)	(0.013)	(0.026)	(0.021)	(0.020)
Constant	0.363***	0.418***	0.436***	0.125	0.138
	(0.088)	(0.084)	(0.156)	(0.120)	(0.115)
Year Controls Included?	Yes	Yes	Yes	Yes	Yes
N Observations	1,246	1,246	1,161	826	887
N Groups	286	286	282	260	263
R-sq	0.243	0.328	0.076	0.081	0.079
Fstat	28***	713.7***	5.52***	5.82***	6.53***
DF	7	8	8	8	8
Mean VIF	2.83	5.54	4.39	4.58	4.66
Hausman Chi2	71***	160.7***	52.5***	28.8***	38***
Breusch-Pagan LM Chi2	563***	41.4***	337.6***	57.7***	66.8***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation. Please, refer to Appendix B1 for variable definitions.

4.5.5 Alternative Measures for Robustness Checks

There is an ongoing debate over the validity of future-based measures of the implied cost of equity capital (Blanco, Garcia Lara, and Tribo 2015). On the one hand, there is evidence that the future-based measures using analysts' forecasts properly capture variations in the implied cost of equity capital (Pástor, Sinha, and Swaminathan 2008). With consistent evidence, Botosan and Plumlee (2005) found that the PEG model, in particular, is positively related to various risk measures and concluded that it is an efficient estimate for the implied cost of equity capital. On the other hand, Easton and Monahan (2005), evaluating various future-based measures of the implied cost of equity capital, concluded that these measures are unreliable unless forecast errors of future earnings and forecast growth rates are very low. They also found an association between various estimates of the implied cost of equity capital and actual growth rates, which raises concern over spurious correlations between disclosure and the implied cost of equity capital driven by higher growth rates. This concern is applicable to the case of innovation disclosure and the cost of equity capital, whereby innovative firms experience relatively higher growth rates leading to the expectation that growing firms will extend relatively more disclosures. One way to mitigate the confounding effects of higher growth is to control for growth rates, as shown in the later empirical models. Another way is to evade any reliability problems arising from the use of future-based cost of equity capital measures by using alternative estimates of risk and firm valuation as dependent variables (Blanco, Garcia Lara, and Tribo 2015). For the purposes of the current study, three alternative dependent variables are applied,:the returns volatility (Blanco, Garcia Lara, and Tribo 2015; Gode and Mohanram 2001); stock liquidity measures (Daske et al. 2008; Christensen, Hail, and Leuz 2013); and analyst forecast accuracy (Merkley 2013; Blanco, Garcia Lara, and Tribo 2015).

Returns volatility is an important measure of risk as it encapsulates short- and long-term components of risks that make up for failures in the CAPM estimations. Adrian and Rosenberg (2008) decomposed returns volatility into short- and long-term risk components and found that the short-term risk component correlates highly with the risk premium for skewness of market returns and the long-term risk component correlates highly with the risk premium for industrial production growth. Returns volatility also encapsulates unsystematic risk which is correlated with future stock returns (Gode and Mohanram 2001). For the current study, returns volatility is measured as the standard deviation of daily returns for a time span of 360 days. Similar to the cost of equity capital, it is expected that innovation disclosure of greater quality is negatively associated with returns volatility.

Stock liquidity, however, correlates with enhanced disclosure through reduced information asymmetries (Welker 1995; Healy, Hutton, and Palepu 1999; Botosan and Harris 2000; Leuz and Verrecchia 2000). Disclosures enhanced by quantity or quality are associated with higher liquidity, which is captured by observing significantly higher trading volumes and lower bid-ask spreads. Also, the accuracy of analyst forecast correlates with information asymmetry. Improved disclosure quality reduces information asymmetry which is reflected by enhanced accuracy in analyst forecasts of future earnings (Healy and Palepu 2001). The accuracy of analysts' forecasts entails lower forecast error. Chapter five will present the equations to measure, along with the econometrical modelling for returns volatility, stock liquidity, and forecast errors.

4.5.6 After-Tax Cost of Debt Capital

A number of studies (Pittman and Fortin 2004; Francis, Khurana, and Pereira 2005; Kim et al. 2011; Orens, Aerts, and Lybaert 2009) measured cost of debt using the total annual interest expense scaled on the average short-term and long-term debt during the year, employed in analysis of various accounting and auditing phenomena. For instance, Orens, Aerts, and Lybaert (2009) examined the disclosure-cost of debt capital link and found that disclosure is negatively associated with the cost of debt, while Pittman and Fortin (2004) examined the effect of auditor choices on the cost of debt and found that contracting with big auditors enhances credibility of disclosures and reduces the cost of debt for young firms. Francis, Khurana, and Pereira (2005) examined disclosure incentives on the cost of debt capital and found that expanded voluntary disclosure leads to a lower cost of debt. In this study, the researcher follows the measurement approach for the cost of debt as applied by various authors (Pittman and Fortin 2004; Francis, Khurana, and Pereira 2005; Kim et al. 2011; Orens, Aerts, and Lybaert 2009), while taking into consideration the tax deductibility feature of the cost of debt. Therefore, the Bloomberg-based calculation for the after-tax cost of debt is used to examine innovation disclosure and the cost of debt association. The after-tax cost of debt is the effective interest rate a firm pays on its current outstanding debt after considering the tax-deductibility feature of interest expense. Data for the cost of debt after tax is readily available and was directly downloaded from Bloomberg. The use of Bloomberg's after-tax cost of debt is advantageous for two main reasons[53]. First, it is independently calculated and derived by a reliable third party; and second, it employs an adjustment factor that controls for various credit ratings.

4.6 Summary

In this chapter, different philosophical paradigms and research methods were reviewed and evaluated. The paradigm and research methods decided for the current study are positivism and a quantitative-based longitudinal study. The sample characteristics and data sources were discussed: UK FTSE 350 firms for 2011-2016 with data collected

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[53]See **Appendix B1** for Bloomberg definition and estimation of the after-tax cost of debt capital.

from the Bloomberg database and official company websites. Then, measurement of the study variables was discussed and assigned with the appropriate validity checks. For the independent variable, innovation disclosure, specialized wordlists for the concepts of innovation exploration and exploitation were adapted from (Heyden et al. 2015). The added words underwent a number of content validity checks: the expert judgment of face validity, KWIC and the validity of the overall dictionary. The final wordlists are used in the NVivo-based text-search query to retrieve the corresponding word frequencies and coverage percentages from annual reports. Coverage percentages are used as measures of innovation disclosure.

For the cost of capital (dependent variable), the cost of equity capital and the after-tax cost of debt capital are adopted. Variations for the cost of equity capital were proposed and evaluated through CAPM, PEG, MPEG, and AEG models. The four models were evaluated against a number of various risk factors: beta, size (market capitalization), book-to-market ratio and leverage (debt-to-assets ratio). The fixed-effects regression analysis presented evidence supporting the validity of CAPM and PEG estimates for the cost of equity capital. Therefore, PEG estimates will be used in the later panel regression analysis, and CAPM estimates for robustness checks to verify results from the PEG model. To further circumvent any inherent estimation problems around the cost of equity capital, a number of alternative measures for information asymmetry are employed to check the robustness of results from the PEG model. These alternative measures, adopted from the relevant literature, are returns volatility, stock liquidity, and analyst forecast accuracy. Finally, estimates for the after-tax cost of debt capital were downloaded from the Bloomberg database and will be used for the subsequent regression analysis on the association between innovation disclosure and the after-tax cost of debt capital.

Chapter 5 Empirical Modelling

5.1 Introduction

The previous chapter presented a positivist paradigm and a quantitative-based, longitudinal approach for the current study on a sample of UK FTSE 350 companies for the period 2011-2016. It also developed the measurement methods for the study variables, innovation disclosure and cost of capital. Specialized wordlists for concepts of exploration and exploitation have been adapted from (Heyden et al. 2015). The updated wordlists are used in an NVivo-based text-search query to retrieve coverage percentages from annual reports. Coverage percentages for exploration and exploitation are used to denote the disclosure for each type of innovation. The combined disclosure is obtained from the square root of the product of exploration and exploitation coverage percentages. For the cost of capital, the PEG model was selected as a proxy for the cost of equity capital and the Bloomberg-based after-tax cost of debt as a proxy for the cost of debt capital. CAPM estimates and the average estimates of CAPM and PEG will be used as alternatives to the PEG model to check for robustness. Returns volatility, stock liquidity, and analyst forecast accuracy are also used as alternative measures for the PEG model as a further check for robustness.

This chapter presents the empirical modelling for the dependent and independent variables. The following section will present the baseline models for the association between innovation disclosure and the cost of capital, which are used to test the three forms of hypothesis 1: H1a, H1b, and H1c. The modelling for the interaction term with proprietary costs is presented in section 5.3. This will be used to test for the second hypothesis regarding the moderating effects of proprietary costs on the association between innovation disclosure and cost of capital. Then, the modelling for additional analysis according to the sub-sampling approach is presented in section 4. The sub-sampling analysis is used to further test for the three forms of the first hypothesis, and considers four sub-groups: R&D vs non-R&D firms, high vs low analyst-following firms, large vs small-sized firms, and firms with issues of new financing versus those with none. Baseline models are used for modelling the CAPM and the average cost of equity capital, while further modelling is presented in section 5.5 for the alternative measures of the PEG model: returns volatility, stock liquidity, and analyst forecast accuracy. Section 5.6 reviews model-fitting decisions: OLS vs. panel regression (random effects); and fixed effects vs. random effects panel regression. A series of planned diagnostic tests for model fitting are presented in section 5.7, which includes checks for issues of non-normality, heteroscedasticity, autocorrelation, collinearity, and endogeneity. Finally, section 5.8 summarizes the chapter. By the end of the chapter, clear guidelines are established to map out the empirical analysis for both cost of equity capital and after-tax cost of debt capital.

5.2 Baseline Model

For the purposes of the current research, the following model was developed based on insights from previous literature while including firm-fixed effects and year-fixed effects:

$$\begin{aligned} COC_{i.t} = {} & \beta_0 + \beta_1 Explr.D_{i.t-1} + \beta_2 Explt.D_{i.t-1} + \beta_3 ESGScr_{i.t-1} \\ & + \beta_4 BETA_{i.t-1} + \beta_5 LogTotAss_{i.t-1} + \beta_6 B2M_{i.t-1} \\ & + \beta_7 Debt2Assets_{i.t-1} + \beta_8 ROA_{i.t-1} \\ & + \beta_9 Analyst.Dummy_{i.t-1} + \beta_{10} Growth_{i.t-1} \\ & + \beta_{11} R\&D.Dummy_{i.t-1} + \beta_{12} HH.Index_{i.t-1} \\ & + \beta_{13} NewFinancing.Dummy_{i.t-1} \\ & + \sum_n \beta_n \,\mathrm{Year.Controls} + \varepsilon_{i.t} \end{aligned} \tag{6}$$

Where COC is the cost of capital for company *i* at period *t*. The two types of cost of capital are modelled independently with the same baseline model shown in equation (6). The first type is the cost of equity capital as measured by the PEG model. Evidence from the PEG model will be validated by modelling two other measures of cost of equity capital: once by using the CAPM estimates as a dependent variable and the other by using the average measure of PEG and CAPM estimates for the cost of equity capital as a dependent variable. The second type is the Bloomberg-based measure of the after-tax cost of debt.

The variables of interest are *Explr.D* and *Explt.D* where the former denotes exploration disclosure and the latter exploitation disclosure of firm *i* in period *t-1*. A negative coefficient is expected for both variables to indicate that the decrease in the cost of capital is related to enhanced disclosure levels of exploration and exploitation. The baseline model in (6) thus tests for the existence of a negative association between exploration and exploitations disclosures and the cost of capital (hypotheses H1a and H1b). Exploration and exploitation disclosures are measured as the coverage percentages of the respective wordlists as retrieved by NVIVO textual analysis software from firm-year annual reports. The coverage percentage is measured as the ratio of total word frequencies of the wordlists to the total number of words in the annual report document.

ESGScr stands for the Bloomberg disclosure score of environmental, social and corporate governance practices. The Bloomberg database provides a percentage rank for each firm-year observation on these[54]. *ESGScr* is used here as a control variable for ESG disclosure, given the empirical evidence of its association with the cost of capital as demonstrated in previous studies (Richardson and Welker 2001; Dhaliwal et al. 2011; Plumlee et al. 2015; Plumlee, Brown, and Marshall 2009).

The baseline model also controls for other related variables such as market beta, the natural logarithm of total assets as a proxy for size[55], book-to-market ratio, financial leverage (total Debt-to-total Assets) (Botosan and Plumlee 2002b; Botosan, Plumlee, and Wen 2011; Botosan and Plumlee 2013; Blanco, Garcia Lara, and Tribo 2015), profitability as a measure of performance (ROA) (Gebhardt, Lee, and Swaminathan 2001), a binary control for high analyst coverage as a proxy for the quality of financial reporting environment (Gode and Mohanram 2001; Botosan and Plumlee 2005; Botosan, Plumlee, and Wen 2011), the forecast long-term growth rate of earnings (Gebhardt, Lee, and Swaminathan 2001; Easton and Monahan 2005; Easton 2009; Botosan, Plumlee, and Wen 2011; Botosan and Plumlee 2013), R&D binary control to proxy for the level of information asymmetry surrounding heavily innovation-oriented firms (Aboody and Lev 2000; Dhaliwal et al. 2011), the Herfindahl-Hirschman (HH) index as a proxy for proprietary costs, and a control for new financing which is a binary variable taking the value 1 if the firm issued new long-term debt or common stocks and 0 otherwise.

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[54] The ESG disclosure scores were directly drawn from the Bloomberg database. This score is a weighted percentage score of three percentage sub-scores, namely environmental disclosure score, social disclosure score, and governance disclosure score. Each sub-score is based on a detailed and comprehensive index, the data for which is collected and indexed by Bloomberg and made readily available for research and practice.

[55] Due to issues of high collinearity with all disclosure measures, the natural logarithm of total assets is used as a proxy for size instead of market capitalization.

Analyst coverage is represented by the number of total analyst forecasts of earnings per share obtained for a given firm from all of its following analysts. The analyst binary control is 1 for firms who have high analyst-following and 0 otherwise. The partitioning by high and low analyst-following is made by taking the median value of analyst coverage as a cut-off point. The forecast long-term growth rate is the estimated five-year ahead growth in earnings per share. The R&D binary control is 1 for firms who report R&D expenditure and 0 otherwise. The HH index proxies for proprietary costs by measuring industry competition; it is calculated as the sum of squared market shares as follows:

$$HH\ Index_{j,t} = \sum_{i=1}^{N_J} MS_{i,j,t}^2 \tag{7}$$

Where $MS_{i,j,t}^2$ is the market share of firm *i* in industry *j* in year *t*. The market share is calculated annually by dividing the firm's sales value by the sum of sales for all firms in the same industry for a given year. The index is estimated for each of the ten ICB industry classifications. High (low) values of the HH index indicate weaker (stronger) industry competition (Rhoades 1993).

The baseline model, as shown in equation (6), is designed to individually test exploration and exploitation disclosures for potential benefits on the cost of capital. Due to severe collinearity issues, the inclusion of an interaction term of exploration and exploration disclosure was not possible. The examination of an interaction term is important to observe for pronounced (synergetic) benefits from combining both disclosures. Previous evidence shows that exploration reinforces exploitation, and vice versa, with reference to the magnitude and potential organizational benefits (Cao, Gedajlovic, and Zhang 2009); this indicates potential synergetic benefit from combining exploration and exploitation disclosures (Floyd and Lane 2000). To check for such synergetic benefits, the baseline model was reconstructed, including firm-fixed and year-fixed effects, as follows:

$$\begin{aligned} COC_{i.t} = \ & \beta_0 + \beta_1 sqrootOA_{i.t-1} + \beta_2 ESGScr_{i.t-1} + \beta_3 BETA_{i.t-1} \\ & + \beta_4 LogTotAss_{i.t-1} + \beta_5 B2M_{i.t-1} + \beta_6 Debt2Assets_{i.t-1} \\ & + \beta_7 ROA_{i.t-1} + \beta_8 Analyst.Dummy_{i.t-1} \\ & + \beta_9 Growth_{i.t-1} + \beta_{10} R\&D.Dummy_{i.t-1} \\ & + \beta_{11} HH.Index_{i.t-1} + \beta_{12} NewFinancing.Dummy_{i.t-1} \\ & + \sum_n \beta_n \, \text{Year.Controls} + \varepsilon_{i.t} \end{aligned} \tag{8}$$

The coefficient of interest sqrootOA denotes the combined disclosure of exploration and exploitation of firm *i* in period *t-1*. It is derived by square–rooting the product of the respective percentages of exploration and exploitation disclosure for each firm-year annual report[56]. A negative coefficient is expected to indicate that the decrease in the cost of capital is related to enhancements in the combined disclosure levels of exploration and exploitation. If the coefficient of interest is higher in magnitude than the combined benefits of individual disclosures of exploration and exploitation as in model (6), it should indicate that the firm is enjoying synergetic benefits from combining the two disclosures. The reconstructed baseline model in (8) therefore tests for the existence of a negative association between the combined disclosures and the cost of capital according to hypothesis H1c.

5.3 Modelling for Interactions with Proprietary Costs

To follow on hypothesis H2, the original baseline model (8) is modified to include the interaction of *HH.Index* with the combined disclosure (*sqrootOA*) only[57]. The interaction term is intended to check for less pronounced benefits of the combined disclosures as industry competition intensifies. Therefore, the following model is constructed.

---

[56] The purpose of square-rooting the product is only intended as a functional transformation for the variable of interest from 10000 down to a percentile scale. However, robustness checks are also conducted to compare both functional forms of the variable to see whether there are sensitive changes in the reported results.

[57] Further checks, however, will be run using a similar model on the interaction term of exploration disclosure with HH index as well as the interaction term of exploitation disclosure and HH Index.

$$\begin{aligned}COC_{i.t} = {} & \beta_0 + \beta_1 sqrootOA_{i.t-1} + \beta_2 HH.Index_{i.t-1} + \beta_3 (sqrootOA \\ & * HH.Index)_{i.t-1} + \beta_4 ESGScr_{i.t-1} + \beta_5 BETA_{i.t-1} \\ & + \beta_6 LogTotAss_{i.t-1} + \beta_7 B2M_{i.t-1} + \beta_8 Debt2Assets_{i.t-1} \\ & + \beta_9 ROA_{i.t-1} + \beta_{10} Analyst.Dummy_{i.t-1} \\ & + \beta_{11} Growth_{i.t-1} + \beta_{12} R\&D.Dummy_{i.t-1} \\ & + \beta_{13} NewFinancing.Dummy_{i.t-1} \\ & + \sum_n \beta_n \text{Year.Controls} + \varepsilon_{i.t}\end{aligned} \tag{9}$$

The coefficient of interest in equation (9) is $\beta 3$ which denotes the interaction term of the combined disclosure with *HH.Index* of firm *i* in period *t-1*. The higher the HH index, the weaker the industry competition. Therefore, a significant negative coefficient of $\beta 3$ indicates that in the presence of lower competition (as the HH index increases), benefits from the combined innovation disclosures are more pronounced, and vice versa.

5.4 Modelling for Additional Analysis

This section presents the modelling required for the sub-sampling approach. Four sub-groups are presented: R&D vs. non-R&D firms, high vs. low analyst-following firms, large vs. small firms and firms with issues of new financing vs. those with no newly issued financing.

5.4.1 Modelling for R&D vs. Non-R&D Sub-sample

The original baseline models (6 and 8) are modified to test the first hypothesis, first for R&D firms only and secondly for non-R&D firms. For the R&D group, this is done by including the natural log of the relative R&D expenditure to sales value which would limit the testing to the group of firms that reported R&D expenditure[58]. For non-R&D firms, the baseline models are retested by excluding the R&D binary variable and making the conditional requirement (if *R&D.Dummy* = 0) when fitting the model. The purpose of this sub-sampling is to check for a unique pattern of benefits from both types of innovation disclosure on the cost of capital. To retest hypotheses H1a and H1b for R&D firms only, the following model is presented as a reconstructed version of the model (6).

[58] The baseline models (6 and 8) included R&D dummy variable which enables testing on the full sample.

$$
\begin{aligned}
COC_{i.t} = \ & \beta_0 + \beta_1 Explr.D_{i.t-1} + \beta_2 Explt.D_{i.t-1} + \beta_3 ESGScr_{i.t-1} \\
& + \beta_4 BETA_{i.t-1} + \beta_5 LogTotAss_{i.t-1} + \beta_6 B2M_{i.t-1} \\
& + \beta_7 Debt2Assets_{i.t-1} + \beta_8 ROA_{i.t-1} \\
& + \beta_9 Analyst.Dummy_{i.t-1} + \beta_{10} Growth_{i.t-1} \\
& + \beta_{11} Log.R\&D/Sales_{i.t-1} + \beta_{12} HH.Index_{i.t-1} \\
& + \beta_{13} NewFinancing.Dummy_{i.t-1} \\
& + \sum_n \beta_n \, \mathrm{Year.Controls} + \varepsilon_{i.t}
\end{aligned} \tag{10}
$$

The coefficients of interest in equation (10) are $\beta 1$ and$\beta 2$, both of which denote the association of exploration and exploitation disclosures with the cost of capital within the group of R&D firms only. Significant negative coefficients indicate the benefits of reduced cost of capital from both disclosures for R&D firms. To retest hypothesis H1c for R&D firms, the following model is reconstructed from the baseline model (8).

$$
\begin{aligned}
COC_{i.t} = \ & \beta_0 + \beta_1 sqrootOA_{i.t-1} + \beta_2 ESGScr_{i.t-1} + \beta_3 BETA_{i.t-1} \\
& + \beta_4 LogTotAss_{i.t-1} + \beta_5 B2M_{i.t-1} + \beta_6 Debt2Assets_{i.t-1} \\
& + \beta_7 ROA_{i.t-1} + \beta_8 Analyst.Dummy_{i.t-1} \\
& + \beta_9 Growth_{i.t-1} + \beta_{10} Log.R\&D/Sales_{i.t-1} \\
& + \beta_{11} HH.Index_{i.t-1} + \beta_{12} NewFinancing.Dummy_{i.t-1} \\
& + \sum_n \beta_n \, \mathrm{Year.Controls} + \varepsilon_{i.t}
\end{aligned} \tag{11}
$$

The coefficient of interest in equation (11) is $\beta 1$ which denotes the association of the combined disclosure with the cost of capital for R&D firms only. A significant negative coefficient indicates the benefits of reduced cost of capital from the combined disclosure for R&D firms. For non-R&D firms, the baseline models are retested if the firm reports zero R&D expenditure, which is the rest of the sample. Coefficients of exploration, exploitation and combined disclosures are compared between R&D and non-R&D groups as well as across the full sample.

5.4.2 Modelling for High vs. Low Analyst-Following Groups

The original baseline models (6 and 8) are modified to test the first hypothesis for firms of high versus low analyst followings. This is done by partitioning the full sample into high and low analyst-following groups based on the median observation of analyst following. Partitioning by the median observation requires removing the variable representing the number of analysts from the baseline models. The purpose of this sub-sampling is to check whether the role of analyst-following reflects uniquely on the benefits from innovation disclosure on the cost of capital. To retest hypotheses H1a and H1b, the baseline model (6) is redesigned as follows.

$$\begin{aligned} COC_{i.t} = \beta_0 &+ \beta_1 Explr.D_{i.t-1} + \beta_2 Explt.D_{i.t-1} + \beta_3 ESGScr_{i.t-1} \\ &+ \beta_4 BETA_{i.t-1} + \beta_5 LogTotAss_{i.t-1} + \beta_6 B2M_{i.t-1} \\ &+ \beta_7 Debt2Assets_{i.t-1} + \beta_8 ROA_{i.t-1} + \beta_9 Growth_{i.t-1} \\ &+ \beta_{10} R\&D.Dummy_{i.t-1} + \beta_{11} HH.Index_{i.t-1} \\ &+ \beta_{12} NewFinancing.Dummy_{i.t-1} \\ &+ \sum_n \beta_n \text{Year. Controls} + \varepsilon_{i.t} \end{aligned} \tag{12}$$

The model in equation (12) is tested for each group of analyst following. The coefficients of interest are $\beta 1$ and$\beta 2$, represent the relation of exploration and exploitation disclosures with the cost of capital. Significant negative coefficients indicate the benefits of reduced cost of capital from both disclosures with respect to each sub-group. These coefficients will be compared to each other across the two sub-groups and then compared across the full sample. To retest hypothesis H1c for high and low analyst-following groups, the following model is reconstructed from the baseline model (8).

$$\begin{aligned} COC_{i.t} = \ \beta_0 &+ \beta_1 sqrootOA_{i.t-1} + \beta_2 ESGScr_{i.t-1} + \beta_3 BETA_{i.t-1} \\ &+ \beta_4 LogTotAss_{i.t-1} + \beta_5 B2M_{i.t-1} + \beta_6 Debt2Assets_{i.t-1} \\ &+ \beta_7 ROA_{i.t-1} + \beta_8 Growth_{i.t-1} + \beta_9 R\&D.Dummy_{i.t-1} \\ &+ \beta_{10} HH.Index_{i.t-1} + \beta_{11} NewFinancing.Dummy_{i.t-1} \\ &+ \sum_n \beta_n \text{Year. Controls} + \varepsilon_{i.t} \end{aligned} \tag{13}$$

The model in equation (13) is also tested for each group of analyst-following. The coefficient of interest is $\beta 1$ which represents the relation of the combined disclosures with the cost of capital. A significant negative coefficient indicates the benefits of reduced cost of capital from the combined disclosures. This coefficient will be compared across the two sub-groups and then compared across the full sample.

5.4.3 Modelling for Large vs. Small Firms

Once more, the original baseline models (6 and 8) are modified to test the first hypothesis for large versus small firms. This is done by partitioning the full sample into two groups based on the median observation of total assets[59]. Partitioning by the median observation requires removing the variable representing the natural logarithm of total assets from the model. The purpose of this sub-sampling is to check whether the size factor reflects a distinct role on the benefits from innovation disclosure. To retest hypotheses H1a and H1b, the baseline model (6) is reshaped as follows:

$$\begin{aligned} COC_{i.t} = \; & \beta_0 + \beta_1 Explr.D_{i.t-1} + \beta_2 Explt.D_{i.t-1} + \beta_3 ESGScr_{i.t-1} \\ & + \beta_4 BETA_{i.t-1} + \beta_5 B2M_{i.t-1} + \beta_6 Debt2Assets_{i.t-1} \\ & + \beta_7 ROA_{i.t-1} + \beta_8 Analyst.Dummy_{i.t-1} \\ & + \beta_9 Growth_{i.t-1} + \beta_{10} R\&D.Dummy_{i.t-1} \\ & + \beta_{11} HH.Index_{i.t-1} + \beta_{12} NewFinancing.Dummy_{i.t-1} \\ & + \sum_n \beta_n \, \text{Year. Controls} + \varepsilon_{i.t} \end{aligned} \tag{14}$$

The model in equation (14) is tested first for large-sized firms and then for small-sized firms. The coefficients of interest are $\beta 1$ and$\beta 2$, both of which represent the relation of exploration and exploitation disclosures with the cost of capital. Significant negative coefficients indicate the benefits of reduced cost of capital from both disclosures depending on each sub-group. These coefficients will be compared to each other between the two sub-groups and then across the full sample.

To retest hypothesis H1c for large and small firms, the baseline model (8) is reconstructed in the following design.

---

[59] Also, the median observation for market capitalization is used for partitioning as additional analysis to check for robustness.

$$
\begin{aligned}
COC_{i.t} = \beta_0 &+ \beta_1 sqrootOA_{i.t-1} + \beta_2 ESGScr_{i.t-1} + \beta_3 BETA_{i.t-1} \\
&+ \beta_4 B2M_{i.t-1} + \beta_5 Debt2Assets_{i.t-1} + \beta_6 ROA_{i.t-1} \\
&+ \beta_7 Analyst.Dummy_{i.t-1} + \beta_8 Growth_{i.t-1} \\
&+ \beta_9 R\&D.Dummy_{i.t-1} + \beta_{10} HH.Index_{i.t-1} \\
&+ \beta_{11} NewFinancing.Dummy_{i.t-1} \\
&+ \sum_n \beta_n \text{Year.Controls} + \varepsilon_{i.t}
\end{aligned} \tag{15}
$$

The model in equation (15) is tested once for large-sized firms and then for small-sized firms. The coefficient of interest is $\beta 1$ which represents the relation of the combined disclosures with the cost of capital. A significant negative coefficient indicates the benefits of reduced cost of capital from the combined disclosures. This coefficient will be compared between the two sub-groups and then across the full sample.

5.4.4 Modelling for Firms with New Financing Issues vs. Without

The original baseline models (6 and 8) are modified to test the first hypothesis once for firms with new financing issues and a second time for firms with no newly issued financings. For the former, this is done by including the natural log of the new financing amounts (from both equity and long-term debt) which would limit the testing to the group of firms that have raised new long-term financing[60]. For firms with no new issues for financing, this is done by taking the binary variable for new financing out of the baseline models and making the conditional requirement (if *NewFinancing.Dummy* = 0) when fitting the model. The purpose of this sub-sampling is to check for a unique pattern of benefits from innovation disclosure for the group of firms that issue long-term financings. Therefore, the following model is presented to retest hypotheses H1a and H1b only for firms with newly issued financings:

[60] The baseline models includes new financing as a binary variable which enables testing for the full sample.

$$\begin{aligned} COC_{i.t} = {} & \beta_0 + \beta_1 Explr.D_{i.t-1} + \beta_2 Explt.D_{i.t-1} + \beta_3 ESGScr_{i.t-1} \\ & + \beta_4 BETA_{i.t-1} + \beta_5 LogTotAss_{i.t-1} + \beta_6 B2M_{i.t-1} \\ & + \beta_7 Debt2Assets_{i.t-1} + \beta_8 ROA_{i.t-1} \\ & + \beta_9 Analyst.Dummy_{i.t-1} + \beta_{10} Growth_{i.t-1} \\ & + \beta_{11} R\&D.Dummy_{i.t-1} + \beta_{12} HH.Index_{i.t-1} \\ & + \beta_{13} log.Financing_{i.t-1} + \sum_n \beta_n \,\mathrm{Year.Controls} + \varepsilon_{i.t} \end{aligned} \tag{16}$$

The coefficients of interest in equation (16) are $\beta 1$ and$\beta 2$, both of which denote the association of exploration and exploitation disclosures with the cost of capital only for the group of firms that raised new long-term financings. Significant negative coefficients indicate benefits of reduced cost of capital from both disclosures. These coefficients will be contrasted with the corresponding coefficients from the sub-sample of no newly issued financing and then compared to those of the full sample.

To retest hypothesis H1c, the following model is reconstructed from the baseline model (8) by nesting only those firms that raised new financings.

$$\begin{aligned} COC_{i.t} = {} & \beta_0 + \beta_1 \, sqrootOA_{i.t-1} + \beta_2 ESGScr_{i.t-1} + \beta_3 BETA_{i.t-1} \\ & + \beta_4 LogTotAss_{i.t-1} + \beta_5 B2M_{i.t-1} + \beta_6 Debt2Assets_{i.t-1} \\ & + \beta_7 ROA_{i.t-1} + \beta_8 Analyst.Dummy_{i.t-1} + \beta_9 Growth_{i.t-1} \\ & + \beta_{10} R\&D.Dummy_{i.t-1} + \beta_{11} HH.Index_{i.t-1} \\ & + \beta_{12} log.Financing_{i.t-1} + \sum_n \beta_n \,\mathrm{Year.Controls} + \varepsilon_{i.t} \end{aligned} \tag{17}$$

The coefficient of interest in equation (17) is $\beta 1$ which denotes the association of the combined disclosure with the cost of capital for firms with new financing issues only. A significant negative coefficient indicates benefits of reduced cost of capital from the combined disclosure. This coefficient will be contrasted for the two sub-groups and compared to that of the full sample.

5.5 Modelling for Alternative Measures of Implied Cost of Equity Capital

Due to inherent problems with the various measures of the implied cost of equity capital (Easton and Monahan 2005; Dhaliwal et al. 2011; Botosan, Plumlee, and Wen 2011;

Blanco, Garcia Lara, and Tribo 2015), the current study follows previous studies by taking a number of alternative measures that relate to information asymmetry as a way of circumventing these problems. Information asymmetry correlates with various measures such as liquidity, risk, and accuracy of analyst forecasts, all of which are therefore used as alternatives for the implied cost of equity capital. The following sub-sections present the reconstructed model accommodating these alternative measures.

5.5.1 Returns Volatility

Following previous authors (Blanco, Garcia Lara, and Tribo 2015; Gode and Mohanram 2001; Kothari, Li, and Short 2009), returns volatility is used as a risk proxy. Kothari, Li, and Short (2009) and Blanco, Garcia Lara, and Tribo (2015) content that the cost of capital, stock returns volatility, analyst forecast errors and analyst forecast dispersion are theoretically equivalent metrics for capturing the firm’s risk. Enhanced disclosures is associated with lower returns volatility. Returns volatility is measured as the standard deviation of daily returns for a time span of 360 days.

Returns volatility is an important measure of risk as it encapsulates short- and long-term components of risks that make up for failures in the CAPM estimations. Adrian and Rosenberg (2008) decomposed returns volatility into short- and long-term risk components and found that the short-term risk component correlates highly with the risk premium for skewness of market returns and the long-term risk component correlates highly with the risk premium for industrial production growth. Returns volatility also encapsulates unsystematic risk which is correlated with future stock returns (Gode and Mohanram 2001). Similar to the cost of equity capital, it is expected that innovation disclosure of greater quality is negatively associated with returns volatility.

The baseline models (6 and 8) are retested using the Bloomberg-calculated returns volatility measure, presented in the following models:

$$\begin{aligned} Volatility_{i.t} = {} & \beta_0 + \beta_1 Explr.D_{i.t-1} + \beta_2 Explt.D_{i.t-1} + \beta_3 ESGScr_{i.t-1} \\ & + \beta_4 BETA_{i.t-1} + \beta_5 LogTotAss_{i.t-1} + \beta_6 B2M_{i.t-1} \\ & + \beta_7 Debt2Assets_{i.t-1} + \beta_8 ROA_{i.t-1} \\ & + \beta_9 Analyst.Dummy_{i.t-1} + \beta_{10} Growth_{i.t-1} \\ & + \beta_{11} R\&D.Dummy_{i.t-1} + \beta_{12} HH.Index_{i.t-1} \\ & + \beta_{13} NewFinancing.Dummy_{i.t-1} \\ & + \sum_n \beta_n \,\mathrm{Year.Controls} + \varepsilon_{i.t} \end{aligned} \tag{18}$$

$$\begin{aligned} Volatility_{i.t} = {} & \beta_0 + \beta_1 sqrootOA_{i.t-1} + \beta_2 ESGScr_{i.t-1} + \beta_3 BETA_{i.t-1} \\ & + \beta_4 LogTotAss_{i.t-1} + \beta_5 B2M_{i.t-1} + \beta_6 Debt2Assets_{i.t-1} \\ & + \beta_7 ROA_{i.t-1} + \beta_8 Analyst.Dummy_{i.t-1} \\ & + \beta_9 Growth_{i.t-1} + \beta_{10} R\&D.Dummy_{i.t-1} \\ & + \beta_{11} HH.Index_{i.t-1} + \beta_{12} NewFinancing.Dummy_{i.t-1} \\ & + \sum_n \beta_n \,\mathrm{Year.Controls} + \varepsilon_{i.t} \end{aligned} \tag{19}$$

Where in both models (18 and 19), $Volatility_{i.t}$stands for the 360-days returns volatility for firm *i* in period *t*. The coefficients of interest in equation (18) are $\beta 1$ and $\beta 2$, both of which denote the association of exploration and exploitation disclosures with the returns volatility across the full sample. The coefficient of interest in equation (19) is $\beta 1$,which denotes the association of the combined disclosures with the returns volatility. If any of the coefficients for exploration, exploitation or combined disclosures shows a significant negative sign, it will indicate the benefits of reduced risk (returns volatility) from the respective disclosure. A significant negative coefficient indicates that the disclosure of innovation contributes to alleviating information asymmetry, which is consistent with the economic-based theory of disclosure.

5.5.2 Liquidity

Two alternative measures of liquidity are used here: closing bid-ask spread and trading volume. Stock liquidity, however, correlates with enhanced disclosure through reduced information asymmetries (Welker 1995; Healy, Hutton, and Palepu 1999; Botosan and Harris 2000; Leuz and Verrecchia 2000). Disclosures enhanced by quantity or quality are associated with higher liquidity, which is captured by observing significantly higher trading volumes and lower bid-ask spreads. Closing bid-ask spread as a proxy for information asymmetry has been used in a number of studies (Welker 1995; Leuz 2003; Lang, Lins, and Maffett 2012). The trading volume has also been used (Easley et al. 1996; Dhaliwal et al. 2011). Enhanced disclosure is argued to reflect lower information asymmetries by observing significantly lower bid-ask spreads and higher trading volumes.

The baseline models are retested using the Bloomberg-calculated average of closing bid-ask spread percentages of the last week of trading in the financial year. The equation for calculating the bid-ask spread percentage is given as follows:

$$Spread\% = \frac{|Ask\ Price - Bid\ Price|}{[(Ask\ Price + Bid\ Price)/2]} \tag{20}$$

Therefore, the baseline models (6 and 8) are retested using the average closing bid-ask spread percentages as a dependent variable.

$$\begin{aligned} Spread\%_{i.t} = {} & \beta_0 + \beta_1 Explr.D_{i.t-1} + \beta_2 Explt.D_{i.t-1} + \beta_3 ESGScr_{i.t-1} \\ & + \beta_4 BETA_{i.t-1} + \beta_5 LogTotAss_{i.t-1} + \beta_6 B2M_{i.t-1} \\ & + \beta_7 Debt2Assets_{i.t-1} + \beta_8 ROA_{i.t-1} \\ & + \beta_9 Analyst.Dummy_{i.t-1} + \beta_{10} Growth_{i.t-1} \\ & + \beta_{11} R\&D.Dummy_{i.t-1} + \beta_{12} HH.Index_{i.t-1} \\ & + \beta_{13} NewFinancing.Dummy_{i.t-1} \\ & + \sum_n \beta_n \,\text{Year. Controls} + \varepsilon_{i.t} \end{aligned} \tag{21}$$

$$\begin{aligned} Spread\%_{i.t} = {} & \beta_0 + \beta_1\ sqrootOA_{i.t-1} + \beta_2 ESGScr_{i.t-1} + \beta_3 BETA_{i.t-1} \\ & + \beta_4 LogTotAss_{i.t-1} + \beta_5 B2M_{i.t-1} + \beta_6 Debt2Assets_{i.t-1} \\ & + \beta_7 ROA_{i.t-1} + \beta_8 Analyst.Dummy_{i.t-1} \\ & + \beta_9 Growth_{i.t-1} + \beta_{10} R\&D.Dummy_{i.t-1} \\ & + \beta_{11} HH.Index_{i.t-1} + \beta_{12} NewFinancing.Dummy_{i.t-1} \\ & + \sum_n \beta_n \,\text{Year. Controls} + \varepsilon_{i.t} \end{aligned} \tag{22}$$

Where in both models (21 and 22), $Spread\%_{i.t}$ stands for the average closing 5-days bid-ask spread percentage for firm i, in period t. The coefficients of interest in equation (21) are $\beta 1$ and $\beta 2$, both of which denote the association of exploration and exploitation disclosures with the average of closing bid-ask spread percentages across the full sample. The coefficient of interest in equation (22) is $\beta 1$,which denotes the association of the combined disclosures with the average closing bid-ask spread percentages. Significant negative coefficients for exploration, exploitation or combined disclosures would indicate a beneficial effect if these disclosures do, in fact, alleviate information asymmetry and narrow down the bid-ask spreads.

Glosten and Milgrom (1985) showed that trading volume is associated with information asymmetry since the trading itself bears information content which is incorporated into share prices. So, the second measure of liquidity is devised by taking the ratio of trading volume of the last trading day in a financial year to the total number of shares outstanding at the year-end. Hence, the baseline models are also reconstructed, as follows, taking $Liquidity2$ as a dependent variable.

$$\begin{aligned} Liquidity2_{i.t} = {} & \beta_0 + \beta_1 Explr.D_{i.t-1} + \beta_2 Explt.D_{i.t-1} + \beta_3 ESGScr_{i.t-1} \\ & + \beta_4 BETA_{i.t-1} + \beta_5 LogTotAss_{i.t-1} + \beta_6 B2M_{i.t-1} \\ & + \beta_7 Debt2Assets_{i.t-1} + \beta_8 ROA_{i.t-1} \\ & + \beta_9 Analyst.Dummy_{i.t-1} + \beta_{10} Growth_{i.t-1} \\ & + \beta_{11} R\&D.Dummy_{i.t-1} + \beta_{12} HH.Index_{i.t-1} \\ & + \beta_{13} NewFinancing.Dummy_{i.t-1} \\ & + \sum_n \beta_n \, \text{Year.Controls} + \varepsilon_{i.t} \end{aligned} \tag{23}$$

$$\begin{aligned} Liquidity2_{i.t} = {} & \beta_0 + \beta_1 sqrootOA_{i.t-1} + \beta_2 ESGScr_{i.t-1} + \beta_3 BETA_{i.t-1} \\ & + \beta_4 LogTotAss_{i.t-1} + \beta_5 B2M_{i.t-1} + \beta_6 Debt2Assets_{i.t-1} \\ & + \beta_7 ROA_{i.t-1} + \beta_8 Analyst.Dummy_{i.t-1} \\ & + \beta_9 Growth_{i.t-1} + \beta_{10} R\&D.Dummy_{i.t-1} \\ & + \beta_{11} HH.Index_{i.t-1} + \beta_{12} NewFinancing.Dummy_{i.t-1} \\ & + \sum_n \beta_n \, \text{Year.Controls} + \varepsilon_{i.t} \end{aligned} \tag{24}$$

Where in both models (23 and 24), $Liquidity2$ stands for the ratio of closing trading volume to the total number of shares outstanding at the year-end. The $Liquidity2$ variable is considered as an alternative measure of liquidity (Dhaliwal et al. 2011). The coefficients of interest in equation (23) are $\beta 1$ and$\beta 2$, both of which denote the association of exploration and exploitation disclosures with the trading volume ratio. The coefficient of interest in equation (24) is $\beta 1$, which denotes the association of the combined disclosures with the trading volume ratio. Unlike the average bid-ask spread percentages, an expectation of significant *positive* coefficients for exploration, exploitation and combined disclosures is the case for the trading volume ratio. A significant positive coefficient would indicate a beneficial effect in terms of alleviating information asymmetry and boosting the trading volumes.

5.5.3 Analysts' Forecast Accuracy

Approximated by lower forecast error, analysts' forecast accuracy reflects lower information asymmetry (Merkley 2013; Blanco, Garcia Lara, and Tribo 2015). Improved disclosure quality reduces information asymmetry which is reflected by enhanced accuracy in analyst forecasts of future earnings (Healy and Palepu 2001). The accuracy of analysts' forecasts entails lower forecast error. Forecast error is measured as follows:

$$Error = \left| \frac{Forecasted\ EPS_{i.t-1} - Actual\ EPS_{i.t}}{Actual\ EPS_{i.t}} \right| \tag{25}$$

Where EPS is the earnings per share. Similar to the cost of equity capital, it is expected that innovation disclosure is negatively associated with errors in the forecast of future earnings. The baseline models (6 and 8) are retested using the forecast error as a dependent variable. Previous evidence points to the correlation of forecast errors with firm size, the number of analyst-followings (Lim 2001) and standard deviation of forecasts (Stickel 1990). The firm size and number of analyst-followings are already included in the baseline model as control variables. The standard deviation of forecasts, however, needs to be controlled for. Therefore, the baseline model is adjusted to include forecast dispersion, which is the standard deviation of EPS forecasts scaled by the mean forecast of earnings per share for each period (Merkley 2013). The following design is presented.

$$
\begin{aligned}
Error_{i.t} = \; & \beta_0 + \beta_1 Explr.D_{i.t-1} + \beta_2 Explt.D_{i.t-1} + \beta_3 ESGScr_{i.t-1} \\
& + \beta_4 BETA_{i.t-1} + \beta_5 LogTotAss_{i.t-1} + \beta_6 B2M_{i.t-1} \\
& + \beta_7 Debt2Assets_{i.t-1} + \beta_8 ROA_{i.t-1} + \beta_9 Analyst_{i.t-1} \\
& + \beta_{10} Growth_{i.t-1} + \beta_{11} R\&D.Dummy_{i.t-1} \\
& + \beta_{12} HH.Index_{i.t-1} + \beta_{13} NewFinancing.Dummy_{i.t-1} \\
& + \beta_{14} ForecastDispersion_{i.t-1} + \sum_n \beta_n \,\text{Year. Controls} \\
& + \varepsilon_{i.t}
\end{aligned}
\tag{26}
$$

$$
\begin{aligned}
Error_{i.t} = \; & \beta_0 + \beta_1 sqrootOA_{i.t-1} + \beta_2 ESGScr_{i.t-1} + \beta_3 BETA_{i.t-1} \\
& + \beta_4 LogTotAss_{i.t-1} + \beta_5 B2M_{i.t-1} + \beta_6 Debt2Assets_{i.t-1} \\
& + \beta_7 ROA_{i.t-1} + \beta_8 Analyst_{i.t-1} + \beta_9 Growth_{i.t-1} \\
& + \beta_{10} R\&D.Dummy_{i.t-1} + \beta_{11} HH.Index_{i.t-1} \\
& + \beta_{12} NewFinancing.Dummy_{i.t-1} \\
& + \beta_{13} ForecastDispersion_{i.t-1} + \sum_n \beta_n \,\text{Year. Controls} \\
& + \varepsilon_{i.t}
\end{aligned}
\tag{27}
$$

Where in both models (26 and 27), $Error_{i.t}$ represents the forecast error for firm *i*, in period *t* and $ForecastDispersion_{i.t-1}$ represts the forecast dispersion of firm *i* in period *t-1*. It is important to note the change to the analyst-following control variable. In the baseline model, the analyst-following variable was a binary variable to denote high versus low quality of information environment, whereas in models (26 and 27) it is modified to be a continuous variable representing the total number of analysts following the firm.

The coefficients of interest in equation (26) are $\beta 1$ and$\beta 2$, both of which denote the association of exploration and exploitation disclosures with the forecast error, while the coefficient of interest in equation (27) is $\beta 1$ which denotes the association of the combined disclosures with the forecast error. Significant negative coefficients of any of the disclosures would indicate a beneficial effect in terms of alleviating information asymmetry by reducing the forecast error.

5.6 Determining Model Fit

The following sub-sections discuss the statistical procedures for determining a good model fit. Statistical procedures are applied to contrast classical OLS regression and panel regression models and then contrast the fixed and random effects estimations of panel regressions.

5.6.1 Classical OLS vs. Random Effects Panel Design

As mentioned earlier, the study is designed to have a large-scale longitudinal dataset for the period 2011-2016. Hence, to ascertain the suitability of running a panel regression design over the classical ordinary least squares (OLS) regression design, the Breusch-Pagan Lagrange Multiplier (LM) test was run for all models. This tests for a null hypothesis that the variances across entities are zero (i.e. no significant differences across units means no panel effect)[61]. If the reported probability value of Chi2 in Breusch-Pagan (LM) is significant at 5% confidence level, this suggests that the random effects panel regression design is a better fit than the simple form of OLS regression. The value of Chi2 is reported for all models, with stars to indicate the respective level of significance.

5.6.2 Fixed Effects vs. Random Effects Panel Design

The Breusch-Pagan (LM) test aids in deciding whether a panel regression design is a better fit than OLS regression. This is done as a first step. Then, in a second step, a decision is made on what estimation method of panel regression to use. For the panel regression design, there are two alternatives: a random effects model, which is the conventional case of panel regression; and a fixed effects model which is a special case of the random effects panel regression. The latter is a special case because it fixes for entity effects (firm controls) and time effects (year controls). The fixed effects modelling, therefore, controls for unobserved heterogeneity and omitted variables bias. Technically, the firm controls fix for omitted variables that vary across firms and are constant over time, while year controls

[61] The Stata command for Breusch-Pagan (LM) tests is to run ‘xttext0’ right after running the command of random effects panel regression ‘quietly xtreg $ylist $xlist, re’.

fix for omitted variables that vary across years but are constant over firms (Wooldridge 2010). The firm-fixed effects setting entirely captures the time non-varying omitted variables, such as industry classification, sector type, cross-listing status, and regional and geographical location. The year-fixed effects entirely capture the firm constant omitted variables, such as an economy-wide financial crisis or natural disasters that happen once off. To decide which model is a better fit, the Hausman test was run for all models[62].

The Hausman command tests for the null hypothesis that the difference in coefficients of the fixed effects model and random effects model are not systematic (meaning that the coefficients of the two models are similar). If the reported probability value of Chi2 in the Hausman test is significant at 5% confidence level, this suggests that the fixed effects model is a better fit than the random effects model because there are consistent systematic differences between the coefficients of the two models that arise due to omitted variable bias. The fixed effects regression is therefore chosen for its superiority in controlling for such bias. The value of Chi2 in the Hausman test is reported for all models, with stars to indicate the respective level of significance. All of the panel regression models, as presented in this study, have been estimated with fixed effects panel regression even if the probability of Hausman Chi2 was not significant at 5% confidence level. This is mainly due to maintaining consistent and comparable estimation across all models.

On a relevant note, Nikolaev and Van Lent (2005) compared the use of OLS regression and fixed effects regression in examining the association of disclosure and cost of debt capital. They found evidence that disclosure is impacted by unobservable firm-specific factors that are also correlated with the cost of capital, thereby giving rise to endogeneity concerns. Their findings suggest that the use of instrumental variables to control for endogeneity is not really a valid option because any instrumental variable that correlates with disclosure is essentially correlated with the cost of capital[63]. They also showed that

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[62] The Stata command for the Hausman test is conducted in three consecutive steps: 1) run fixed effects model and save the reported estimates 'quietly xtreg $ylist $xlist, fe__estimate store fe', 2) run random effects model and save the reported estimates 'quietly xtreg $ylist $xlist, re_estimate store re' and, 3) run the Hausman test 'hausman fe re'.

[63] Even Wooldridge (2016) found evidence that using instrumental variables can cause more damage than value, resulting in greater inconsistency of empirical results.

using fixed effects modelling in a panel dataset, along with a theory-suggested set of relevant variables, reduces endogeneity bias and produces consistent results. They argued that the use of fixed effects estimation minimizes endogeneity concerns arising from unobservable firm-specific factors and from omitted variables bias. Hence, in the current study, fixed effects estimation is deemed as a better fit than random effects estimation, a decision supported by evidence from the Hausman test and suggestions from previous studies (Nikolaev and Van Lent 2005). The fixed effects estimation is also empowered with the use of a theory-suggested set of relevant control variables (i.e. ESG disclosure, beta, size, B/M ratio, leverage, profitability, number of analyst followings, long-term growth, R&D dummy variable, and new financing dummy variable). These control variables would minimize the non-constant omitted variable bias which is not controlled under a fixed effected estimation.

5.7 Diagnostic and Robustness Checks

A number of diagnostic checks and controls were performed for empirical modelling: including checks for normality, heteroscedasticity, autocorrelation, and collinearity. Also, a number of procedures and robustness checks were performed to ensure that endogeneity bias does not affect the empirical results. In the following sub-sections, a detailed discussion is presented to clarify the purposes and uses of both types of procedure.

5.7.1 Diagnostics of Normality

One of the basic assumptions of regression analysis is the normal distribution of error terms (Gujarati 2009). Residuals (error terms) are normally distributed when they depict a bell-shaped, symmetrical continuous curve. Complete violation of the normality assumption indicates that parametric tests (e.g. regression modelling) are not applicable (Pallant 2001). Skewness and kurtosis are usually used to check whether the distribution of error terms is normal or not.

Obtaining a perfectly normal distribution of error terms, however, is not necessary (Gelman and Hill 2006: 46) as it does not create bias or inefficiency in regression models (Solutions 2013). Furthermore, the normality assumption is necessary if the sample size is very small, but it is not needed when the sample size is sufficiently large (N>200). For a large sample, the central limit theorem will ensure that the error terms are approximately normally distributed (Solutions 2013). The sample size for the current study is well above 200 firms, ensuring that the normality assumption is maintained according to the central limit theorem.

In some cases, however, the error terms distribution is skewed by the presence of extreme values (outliers). The effects of outliers are commonly treated by winsorizing or trimming the highest and lowest 1% of observations of the dependent variable (Ruppert 2004). Treating for outliers by either approach will reduce the severity of skewness, which is an improvement even if it does not present exactly normal distribution. Therefore, to test for the sensitivity of results to the effects of outliers, three forms of each dependent variable are to be modelled and compared: 1) original form (untreated); 2) winsorized form for the highest and lowest 1%; and 3) trimmed form for the highest and lowest 1%. A comment on the results of the three forms is given in the notes on regression tables. However, it is noteworthy that the literature (Hail 2002; Francis, Khurana, and Pereira 2005; Gietzmann and Ireland 2005; Francis, Nanda, and Olsson 2008; Blanco, Garcia Lara, and Tribo 2015) left the cost of capital variable untreated when modelling it on the disclosure variable. This motivates leaving the dependent variables of the current study untreated.

5.7.2 Diagnostics of Heteroskedasticity, Autocorrelation, and Collinearity

Heteroscedasticity, the opposite of homoscedasticity, is one of the common issues around regression modelling. Homoscedasticity, however, is an optimal case where the variance of observations around the predicted line seems to be reasonably constant (error terms are identically distributed) as the independent variable changes. To test for heteroscedasticity, the modified Wald test for GroupWise heteroscedasticity in fixed effects regression was run for all models[64]. The null hypothesis in the modified Wald test is homoscedasticity (constant variance of observations). If the reported Chi2 probability of the modified Wald test is significant at 5%, the null hypothesis is rejected, indicating the presence of heteroscedasticity.

Autocorrelation, also known as serial correlation, is the lack of independence in error terms. It causes the standard errors of the coefficient to be smaller than they actually are

[64] The Stata command for the modified Wald test is to run 'xttext3' right after running the command of fixed effects panel regression 'quietly xtreg $ylist $xlist, fe'.

and generally leads to inflated R-squares. To check for serial correlation, the Lagram-multiplier test was run for all models[65]. The null hypothesis in this test is no serial correlation (independence of error terms). If the reported F-statistic probability of the test is significant at 5%, the null hypothesis is rejected, thereby indicating the presence of autocorrelation.

To correct for both heteroscedasticity and serial correlation issues, robust standard errors clustered at the firm level are used throughout all models (Baltagi 2008; Petersen 2009; Wooldridge 2010). This is done to ensure that error terms, across all models, are independently and identically distributed, which offers some reassurance of the exogeneity assumption of independent variables and mitigates the potential endogeneity bias in the relationship between disclosure and cost of capital.

Multi-collinearity, also known as collinearity, is present when there are two or more highly correlated independent variables in one model. Collinearity issues generally lead to results that contradict both theory and previous empirical evidence. However, Goldberger (1991) argues that high variance inflation factor (VIF) values can be ignored because essentially there is nothing that can be done about it. However, some control over collinearity is deemed appropriate. One way, for instance, is that Stata.15 software automatically omits variables from the fitted regression model if high collinearity is detected. A second way is to conduct a post-estimation check for collinearity. Both of these controls are applied throughout this study. To check for collinearity on a post-estimation basis, the mean of VIF was obtained for all models[66]. Across most models, the mean VIF value is below 10, a threshold deemed acceptable under which collinearity poses no serious concern to the empirical results (Gujarati 2009). Notably, the natural logarithm of total assets is used instead of market capitalization as a proxy for size in all models. This is mainly to maintain the mean VIF of the overall model below the threshold of 10.

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[65] The Stata command for the Lagram-multiplier test is to run the ‘xtserial $ylist $xlist, fe’ command.

[66] The Stata command for the variance inflation factor in panel regression is to run the ‘vif, uncentered’ right after running the command of fixed effects panel regression ‘quietly xtreg $ylist $xlist, fe’.

5.7.3 Endogeneity Bias

It has long been argued that endogeneity biases confound the results from modelling the association of disclosure and cost of capital (Healy and Palepu 2001; Nikolaev and Van Lent 2005). Endogeneity is a well-known source of bias which generally leads to inconsistent results of OLS regression (Wooldridge 2010). The body of disclosure literature reflects such potential bias because empirical evidence has not always been in line with theoretical predictions. In some cases, research has found no association between disclosure and cost of capital (Botosan and Plumlee 2002b), while others document theory-contradicting evidence of a positive association between disclosure and cost of capital (Heflin, W. Shaw, and J. Wild 2005). Four sources of endogeneity bias are recognized in the literature (Nikolaev and Van Lent 2005; Dhaliwal et al. 2011): 1) unobserved heterogeneity among firms (firm-specific factors bias) in a cross-sectional sample; 2) omitted variable bias (i.e failure to include observable determinants of cost of capital that are correlated with disclosure); 3) reverse causality bias (bi-directional association between disclosure and the cost of capital); and 4) self-selection bias, where some firms exercise a choice on whether to disclose or not disclose specific information. The following sub-sections will discuss the detail of these baises.

5.7.3.1 Unobserved Heterogeneity and Omitted Variable Bias

The first two sources of bias (unobserved heterogeneity and omitted variable bias) are variations of the correlated omitted variable bias and are theoretically equivalent (Nikolaev and Van Lent 2005). Empirically, however, they are very different because the former is unobservable and roughly constant over time, whereas the latter is observable and varies over time (Nikolaev and Van Lent 2005).

In a fixed effects estimation, the firm controls fix for omitted variables that vary across firms and are constant over time, while year controls fix for omitted variables that vary across years but are constant across firms (Wooldridge 2010). Unobserved heterogeneity bias in a disclosure and cost of capital association is, therefore, controlled by using firm-fixed effects estimation. In the current study, the fixed effects estimation is augmented by including year-controls for all models[67].

[67] Immediately after running each fixed effects model, the Stata command ‘test Y2 Y3 Y4 Y5 Y6’ was run to check for the joint significance of year controls. If the reported probability of F-statistic is significant at 5%

Omitted variable bias is minimized by including a theory-suggested set of relevant control variables (Nikolaev and Van Lent 2005). Therefore, the first two sources of endogeneity bias are controlled by using fixed effects estimation and theory-relevant control variables.

5.7.3.2 Reverse causality

The third source of endogeneity bias, reverse causality, is mitigated by using one-year lags of all right-hand-side variables for all models (Wooldridge 2010). This rests on the notion that the past causes variations in the future but not the other way round. The use of lag observations is to ensure that the disclosed information of the annual report is reflected in the stock valuation at the time of measuring the cost of capital (Hail and Leuz 2006), ensuring the exogeneity assumption between the dependent and independent variables[68]. A number of previous studies in accounting disclosure (Dhaliwal et al. 2011; Cheng, Ioannou, and Serafeim 2014; De Meyere, Vander Bauwhede, and Van Cauwenberge 2018) have used one-year lags of right-hand-side variables. For instance, De Meyere, Vander Bauwhede, and Van Cauwenberge (2018) used the lag approach in modelling financial reporting quality on debt maturity while Dhaliwal et al. (2011) used it in modelling ESG disclosure on the cost of equity capital.

5.7.3.3 Self-selection Bias

The fourth source of endogeneity, self-selection bias (also known as sample selection bias), "arises if the probability that a firm is included into the sample and the dependent variable are both affected by an omitted unobservable variable. As a result, the sample is no longer random" (Nikolaev and Van Lent 2005: 9). On the other hand, the omitted unobservable variable might affect the way an observation is categorized within a sample, even though the sample includes all observations. This is a common bias in samples where the disclosure variable is binary (e.g. adopters vs. non-adopters of IFRS (Karamanou and

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level, this indicates that joint effect of all year controls is significantly different from zero, so it is important to include year controls in the fixed effects estimation. For all models, the reported probability of F-statistic was found significant at 5% levels or even stronger.

[68] The exogeneity assumption is further asserted with the use of robust standard errors clustered at the firm level, which corrects for heteroscedasticity and serial correlation to ensure that the error terms are independently and identically distributed.

Nishiotis 2009) and disclosure vs. non-disclosure of CSR reports (Dhaliwal et al. 2011)). For instance, in the case of deciding to disclose CSR information, firms will gauge the expected benefits from making such disclosure with regard to the cost of capital. Therefore, the determinants of a specific disclosure decision (i.e. potential benefits in lower cost of capital) will most likely affect the dependent variable, that is the current cost of capital (Nikolaev and Van Lent 2005). Self-selection bias is usually monitored and checked for by the Heckman model (Heckman 1977), which is inapplicable in the current study. For a Heckman model to be applied, the dependent variable has to be binary (dichotomous); as the cost of capital is, rather, a continuous variable, the Heckman model is inappropriate. All firms have made disclosures relating to exploration and exploitation and data relating to both types can not be categorized as dichotomous (zero, one); therefore, the *Heckman model is not empirically applicable in this study*.

5.7.3.4 Endogeneity Check

Given the endogenous relationship between disclosure and cost of capital (Nikolaev and Van Lent, 2005), all models are designed to regress the cost of capital on the one-year lags of all disclosures and control variables. If the contemporaneous observations of the dependent and independent variables have bi-directional associations (reverse causality bias), then the use of period lags should alleviate the problem and mitigate endogeneity bias. This is because the past causes the future but not vice versa. To check whether or not the use of one-year lags in minimizing endogeneity bias is satisfactory, the baseline models are revised by switching over the dependent and independent variables.

The use of one-year lags will prove *insufficient* if the following conditions are satisfied: 1) the one-year lag of the cost of capital is found to be a significant predictor of disclosure, and 2) the one-year lag of disclosure variable is found to be a significant predictor of the cost of capital. The use of one-year lags, however, will be sufficient if the following conditions are met: 1) the one-year lag of the cost of capital is found to be an *insignificant* predictor of disclosure, and 2) the one-year lag of disclosure variable is found to be a significant predictor of the cost of capital. If the one-year lags are sufficient, this supports the argument that reverse causality is minimized and endogeneity bias mitigated. In other words, it confirms the assumption of strict exogeneity between the cost of capital (dependent variable) and the lagged disclosure variables (independent variables).

Therefore, historical disclosures cause current variations in the cost of capital but the historical cost of capital does not cause current variations in disclosure practices.

5.8 Summary

This chapter mapped out the guidelines for the later empirical analysis of the association between innovation disclosure and the cost of capital. It presented the baseline models and the modelling for the interaction term with proprietary costs which will be used for both the cost of equity capital (PEG) and the after-tax cost of debt capital. The baseline models are used to test the three forms of the first hypothesis, while modelling for the interaction term with proprietary costs is used to test the second hypothesis regarding the moderating effects of proprietary costs on the association between innovation disclosure and cost of capital. For further testing of the first hypothesis, the chapter also presented modelling for additional analysis based on four sub-group criteria: R&D vs. non-R&D firms, high vs. low analyst-following firms, large vs. small firms. and firms with issues of new financing vs. those without. The chapter also defined a series of robustness checks which involved retesting of the baseline models using alternative measures for the PEG estimates. These alternatives are: 1) the CAPM estimates; 2) the average cost of equity capital from CAPM and PEG estimates; 3) returns volatility; 4) stock liquidity; and 5) analyst forecast accuracy. It also presented a review of determining model fit based on the Breusch-Pagan Lagrange Multiplier (LM) and Hausman tests. Finally, it outlined a series of planned checks for non-normality, heteroscedasticity, autocorrelation, collinearity, and endogeneity. The following chapter will present descriptive statistics and the relevant univariate analysis for all the study variables.

Chapter 6 Descriptive and Univariate Analysis

6.1 Introduction

The previous chapter presented the empirical modelling for the study variables and laid out the guidelines for the subsequent empirical testing of the association between innovation disclosures and the cost of capital.

This chapter presents the descriptive statistics and relevant univariate analysis for all the study variables introduced in the previous chapter. A full explanatory list of all the study variables is presented in Appendix B1. Descriptive statistics are presented and discussed in section 6.2. Time-trend and industry-trend analyses are given in sections 6.3 and 6.4 respectively. Pearson correlation of all variables is presented in section 6.5. Paired T-test comparisons of exploration and exploitation disclosures are presented in section 6.6, and the two-sample T-test comparisons for the combined disclosures in section 6.7. Finally, section 6.8 summarizes the entire chapter. Notes to the tables are given on their first occurrence, but not in subsequent tables.

6.2 Descriptive Statistics

Descriptive statistics of every available firm-year observation for the dependent, independent and control variables are provided in Table 6.1. The disclosure measures for exploration, exploitation and combined (sqrootOA) appear to have much lower standard deviation than do those of the cost of equity capital and the after-tax cost of debt capital. Most of the descriptive statistics for exploration disclosure are higher than those for exploitation disclosure, with the wide range of the former standing out. This result points to the potentially significant difference between disclosures levels for exploration and exploitation innovation, justifying conducting a paired T-test analysis to for significant differences. Results of the paired T-test are reported in a later section. Obviously, all ESG disclosure scores are much higher than those for exploration, exploitation and combined disclosures, because they are derived with a different scale (a comprehensive index of ESG disclosure items as designed and collected by Bloomberg) from the wordlist index used here to measure innovation disclosure.

Table 6.1 Descriptive Statistics

Stats	N	Mean	Median	St.Dev	Range	Min	Max
Analysts	1832	13.525	13	6.727	39	0	39
B2M	1824	0.534	0.413	0.441	6.901	-1.138	5.764
Beta	1828	0.878	0.83	0.359	4.102	-1.743	2.359
CAPM	1832	0.106	0.102	0.028	0.261	0.016	0.278
CoDebt_AT	1832	0.018	0.017	0.015	0.132	-0.004	0.127
COE	1827	0.097	0.092	0.033	0.381	0.017	0.397
Debt2Assets	1832	0.213	0.195	0.182	1.656	0	1.656
ESGScr	1759	0.341	0.322	0.112	0.628	0.066	0.694
Explr	1710	0.024	0.023	0.009	0.315	0.005	0.32
Explt	1710	0.015	0.015	0.004	0.047	0.002	0.049
ForecastDispersion	1797	0.051	0.032	0.484	18.9	-11.9	7
ForecastError	1711	0.457	0.196	0.634	4.023	0	4.023
HH Index	1816	0.546	0.011	2.288	34.766	0	34.766
LGTM_GROWTH	1409	0.11	0.082	0.262	6.698	-3.673	3.025
Liquidity2	1822	0.561	0.51	0.307	3.105	0.004	3.109
MarketCap	1782	7797.075	1862.8	18963.2	187315.5	171.4147	187486.9
NewFinancing	1832	417.476	10.06	1365.354	24082.14	-50.3	24031.84
PEG	1688	0.095	0.084	0.052	0.671	0.004	0.675
RD.Expend/NetSales	1450	4.833	0	68.608	2075.526	0	2075.526
ROA	1824	0.071	0.057	0.137	2.89	-0.535	2.355
Spread%	1353	0.263	0.199	0.195	0.839	0.024	0.863
sqrootOA	1710	0.019	0.018	0.004	0.043	0.004	0.047
TotAssets	1832	32653.82	2142.91	155982.5	1923806	38.544	1923844
Volatility	1747	30.501	28.282	10.601	89.532	9.395	98.927

Refer to Appendix B1 for definitions of the variables in this and subsequent tables

The mean and medians of the cost of equity capital measures of both PEG and the CAPM are closely similar, although the PEG measure shows higher statistical variance (standard deviation) than the CAPM with an even larger range. The mean, median and standard deviation of the PEG model are 9.5%, 8.4%, and 5.2% respectively, similar to figures reported in previous studies. For instance, in a US-based study, Botosan, Plumlee, and Wen (2011) reported 11.23%, 10.22%, and 4.63%. In a UK-based study, Mangena, Li, and Tauringana (2016) reported 9.95%, 9.02% and 6.29%, close to the

PEG parameters reported in Table 6.1. CAMP estimates show 10.6%, 10.2%, and 2.8% respectively for the mean, median and standard deviation. The mean and median parameters of the CAPM estimates are similar to those for the PEG estimates reported in the current study as well as in previous ones. The only difference for the CAPM estimates is the standard deviation parameter (2.8%) which is relatively lower than the standard deviation of PEG estimates. In a French-based study, however, Boujelbene and Affes (2013) reported 9.36%, 9.23%, and 1.96% respectively for CAPM estimates; these figures are similar to those reported in Table 6.1 each differing by less than 1%.

The after-tax cost of debt, however, shows much lower parameters of mean, median, standard deviation, and range, indicating lower statistical variance than for the PEG and CAPM estimates. The after-tax cost of debt estimates show 1.8%, 1.7% and 1.5% for the mean, median, and standard deviation. These are in no way similar to results reported in previous studies, due to the tax-deductibility feature. This study uses the Bloomberg ready-made estimate of the cost of debt which takes into account the tax factor. Previous studies (Pittman and Fortin 2004; Francis, Khurana, and Pereira 2005; Orens, Aerts, and Lybaert 2009), however, measured the cost of debt capital using the total annual interest expense scaled on the average short- and long-term debt during the year, without considering the tax effects on interest expense. For instance, in a US-based study, Pittman and Fortin (2004) reported 9.3%, 9.6%, and 4% average interest rates for the mean, median, standard deviation, respectively. For the same parameters, Francis, Khurana, and Pereira (2005) reported 11.3%, 9.5% and 9.1% for average interest rates in a cross-border study. In a European sample, however, Orens, Aerts, and Lybaert (2009) reported 6.9% for the mean parameter of interest rates. Obviously, all of the parameters for the cost of debt capital using average interest rates reported by previous studies are significantly higher than those reported in Table 6.1, because they were not estimated after tax.

6.3 Time-Trend Statistics

The strategic mean trends of the dependent and independent variables over the study period are presented in Table 6.2. Exploration and exploitation disclosures show a relatively stable pattern with marginal increases over time. This also reflects a stable time pattern for their combined disclosure (sqrootOA).

Table 6.2 Time Trends of Dependent and Independent Variables

Variable	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Explr	0.023	0.024	0.025	0.024	0.025	0.025
Explt	0.014	0.014	0.015	0.015	0.015	0.015
sqrootOA	0.018	0.018	0.019	0.019	0.019	0.019
ESGScr	0.328	0.329	0.347	0.355	0.344	0.339
PEG	0.110	0.101	0.094	0.089	0.090	0.086
CAPM	0.126	0.114	0.107	0.101	0.095	0.092
COE	0.114	0.104	0.097	0.090	0.090	0.085
ForecastError	0.367	0.420	0.452	0.529	0.503	0.466
BidAskSpread%	0.213	0.293	0.286	0.283	0.256	0.202
Liquidity2	0.622	0.570	0.513	0.508	0.542	0.612
Volatility	32.857	34.670	28.305	26.131	27.061	33.745
CoDebt_AT	0.023	0.017	0.022	0.019	0.016	0.012

Interestingly, ESG disclosure shows a fluctuating pattern, with constant increases from 2011 to 2014 and then decreases in 2015-2016. The time trends of the three cost of equity capital measures show a consistent and gradual decrease over the period of the study, compared with the after-tax cost of debt variable's fluctuating trend from 2.3% to 1.2%. The alternative measures of the cost of equity capital (forecast error, bid-ask spread percentages, trading volume, and volatility) also reflect a degree of fluctuating time trends. The forecast error variable, a proxy for the accuracy of earnings forecasts, shows a steady increase through 2011-2014 and then decreases over the period 2015-2016. The bid-ask spread percentages show a sharp increase in 2012 and decrease steadily over the period 2013-2016. The trading volume (Liquidity2) shows a steady decrease throughout 2011-2014 but picks up again in 2015. Returns volatility, a proxy of risk, fluctuate heavily over the study period.

6.4 Industry-Trend Statistics

Table 6.3 details the means of disclosure and the cost of capital variables by industry. Considering the combined disclosure levels (sqrootOA), healthcare, technology, industrials, consumer goods, and telecommunication firms clearly have the highest averages of innovation disclosures, but not the highest ESG disclosures. However, their respective cost of equity capital averages appears to range from low to moderate levels, which could indicate that industries with a high level of innovation disclosure and relatively low ESG disclosures tend to have a lower cost of equity capital on average. This is most likely associated with the innovative nature and less environmental risk of such industries, which bear some of the lowest rates for the cost of equity. The same is true for the after-tax cost of debt capital; firms in the technology sector appear to enjoy the lowest rates of interest charges (1.1%). For the consumer goods sector, the forecast error is lowest and bid-ask spread percentage is the second lowest. Healthcare, industrials, consumer goods, and telecommunication sectors show relatively lower averages of returns volatility than other sectors.

The remaining five sectors (basic materials, consumer services, financials, oil and gas, and utilities) seem to have the lowest but fairly similar averages for innovation disclosure; their combined disclosure levels are all around 1.8%. The utilities sector is a unique case, with the second highest ESG disclosure level, the lowest cost of equity capital average, the lowest bid-ask spread percentages and returns volatility, and one of the highest trading volumes. A basic explanation is the relatively stable business operations and low competition in the utility sector (Dhaliwal et al. 2011), reflecting better prospects and better market valuation for firms in this sector[69].

Table 6.3 Means of Dependent and Independent Variables by Industry Type

Industry	**BM**	**CG**	**CS**	**F**	**H**	**I**	**OG**	**T**	**TC**	**U**
Explr	0.022	0.024	0.025	0.023	0.031	0.025	0.023	0.027	0.024	0.023
Explt	0.015	0.015	0.014	0.014	0.016	0.016	0.015	0.015	0.015	0.015
sqrootOA	0.018	0.019	0.018	0.018	0.022	0.020	0.018	0.020	0.019	0.018
ESGScr	0.432	0.358	0.319	0.326	0.338	0.328	0.408	0.276	0.304	0.413
PEG	0.129	0.097	0.092	0.091	0.087	0.087	0.138	0.084	0.088	0.071
CAPM	0.122	0.101	0.100	0.106	0.087	0.107	0.123	0.106	0.098	0.089
COE	0.117	0.099	0.093	0.093	0.081	0.095	0.122	0.094	0.090	0.073
ForecastError	0.560	0.220	0.446	0.494	0.540	0.421	0.672	0.382	0.510	0.565
BidAskSpread%	0.272	0.231	0.261	0.260	0.300	0.283	0.250	0.317	0.262	0.134
Liquidity2	0.661	0.551	0.582	0.495	0.453	0.565	0.666	0.596	0.475	0.650
Volatility	43.056	28.112	29.428	28.630	26.930	29.311	37.128	34.176	29.202	21.141
CoDebt_AT	0.028	0.015	0.018	0.018	0.019	0.017	0.016	0.011	0.020	0.024

The codes for ICB classes are taken from Table 4.1. Basic Materials (BM), Consumer Goods (CG), Consumer Services (CS), Financials (F), Health Care (H), Industrials (I), Oil&Gas (OG), Technology (T), Telecommunications (TC), Utilities (U).

[69] Table 4.1, shows only eight firms in the utilities sector, unchanged throughout the study period.

6.5 Univariate Pearson Correlations

Appendix B2 displays the Pearson correlations of all study variables starred at the 5% significance level. Innovation and ESG disclosures are clearly significantly and positively correlated. Innovation disclosures appear to have significant negative correlations with both cost of equity capital and after-tax cost of debt capital. However, ESG disclosure shows significant but positive correlations with the cost of equity capital and after-tax cost of debt capital, indicating that it might have an unfavourable effect on the cost of capital as compared to innovation disclosures, which have a favourable effect in reducing it. While not significant at the 5% level, the correlations between forecast error and all innovation disclosure measures are negative, pointing to a potentially favourable effect. For the liquidity measures, however, bid-ask spread percentage and trading volume (Liquidity2) show a significant negative correlation with exploration disclosure. Contrary to expectations, exploitation disclosure is positively correlated with bid-ask spread percentage and trading volume (Liquidity2), pointing to a potentially unfavourable effect on liquidity metrics. While the correlation with returns volatility is significant, it is negative for exploration disclosure and combined disclosure (sqrootOA) and, unexpectedly, positive for exploitation disclosure. These results, however, are not conclusive and will be further validated in the subsequent panel regression analysis. Furthermore, innovation disclosure measures show significant correlations with control variables: beta (a proxy for systematic risk), total assets (a proxy for size), book-to-market ratio (a proxy for growth prospects), total debt to total assets ratio (a proxy for leverage), R&D_Expenditure/net_sales ratio (a proxy for R&D-related information asymmetry), and issuance of new financings.

A final observation taken from the Pearson correlations is that all measures of the cost of equity capital and after-tax cost of debt capital are significantly positively correlated, indicating that they might give relatively similar results in the subsequent regression analysis.

6.6 Univariate Paired T-test

Table 6.4 presents the paired T-test comparisons of exploration and exploitation disclosure scores. The paired T-test is conducted to check for statistically significant differences between levels of exploration and exploitation disclosures. At a 1% significance level, the paired T-test shows that firms of the full sample, on average, disclose more exploration than exploitation. This is evident by looking at the significant mean differences and the large positive T-value in the last two columns of Table 6.4. This result is also robust at the 1% significance level even when exploration and exploitation disclosures are either trimmed or winsorized of the highest and lowest 1% of outliers. In fact, this finding suggests that firms are trying to communicate more exploration than exploitation trends.

Table 6.4 Paired T-test of Exploration-Exploitation Disclosure

Paired T-test	**N**	**Mean (Explr)**	**Mean (Explt)**	**Mean Diff (Explr – Explt)**	**T-value**
Full Sample	1710	0.0242833	0.0148769	0.0094064***	40.3768
R&D	524	0.0258413	0.0155253	0.010316***	34.1297
Non-R&D	1186	0.0235949	0.0145905	0.0090045***	29.277
High Analyst	902	0.0241868	0.0151096	0.0090772***	42.4048
Low Analyst	808	0.024391	0.0146171	0.0097739***	22.6741
Large Size	850	0.0244612	0.0148009	0.0096603***	23.3293
Small Size	860	0.0241074	0.014952	0.0091554***	42.2079
New Financing (Yes)	1308	0.0245498	0.0148599	0.00969***	33.6741
New Financing (No)	402	0.023416	0.0149324	0.0084836***	26.4371
Basic Materials	142	0.021714	0.0150889	0.006625***	12.0817
Consumer Goods	166	0.0242246	0.0151011	0.0091235***	19.7458
Consumer Services	378	0.0245313	0.0142536	0.0102777***	11.967
Financials	408	0.0233487	0.0143872	0.0089615***	32.4843
Healthcare	67	0.0307171	0.0158365	0.0148806***	14.3565
Industrials	368	0.0250746	0.0157023	0.0093723***	28.2376
Oil & Gas	70	0.0226059	0.0146974	0.0079085***	15.1841
Technology	44	0.02717	0.0151293	0.0120407***	13.8724
Telecommunications	32	0.0237479	0.0148887	0.0088591***	8.3833
Utilities	35	0.0227814	0.0149101	0.0078713***	7.0749

- N = number of observations.
- *** indicates significance at 1% level.
- Only firms that report R&D expenditure are classed as R&D firms.
- The median analyst-following observation is 13. Firms with 13 or more followers are classed in the high analyst-following group and those with fewer than 13 in the low group.
- The median observation of total assets of £2,142.91 million is used as a cut-off point. Firms with total assets of £2,142.91 million or more are classed as large and the rest as small.
- Only firms that issue new financing (either equity or long-term debt) are classed as firms with new financing issues.

The significant differences between exploration and exploitation disclosures are also robust when the paired T-test is repeated by grouping firms based on various factors. Firms are sub-sampled into groups of R&D vs. non-R&D, high vs. low analyst-following, large vs. small, and new financing vs. no new financing. For instance, R&D firms show higher T-values than non-R&D firms, indicating that the difference is more pronounced for R&D firms. Firms with high analyst-followings show higher T-values than their counterparts, as do those that make new issues for financing. Large firms show lower T-value than small ones; this result is robust even if market capitalization is used as a proxy for size instead of total assets. Therefore, the difference between exploration and exploitation disclosure is more pronounced for firms of high analyst-followings, small size, and new issues of financing. These results suggest that firms with R&D expenditure, high analyst-following, small size, and new issues of financing strongly emphasize exploration over exploitation in their disclosures.

Finally, when the sample is grouped by economic sector, it seems that all sectors have positive T-values, emphasizing exploration over exploitation trends in their disclosures. At a closer look, however, it is observed that firms in the financial, industrial and consumer goods sectors show the highest T-values across all economic sectors. This indicates that these firms put more emphasis on exploration than exploitation disclosures as compared to the remaining sectors.

6.7 Univariate Two-Sample T-test

Table 6.5 presents the two-sample T-test comparisons for the mean combined disclosure levels of different sub-samples. The test is conducted to check for statistically significant differences in combined disclosure levels across the four sub-sample groups.

Looking at the mean differences and T-values in the last two columns of Table 6.5, it is observed that R&D firms extend more combined disclosures of innovation than non-R&D firms do. This is evident given the high T-value (7.5117) and the significance of the differences at the 1% level. However, the differences between high and low groups of analyst-followings are significant at 5% level, indicating that the former also tend to offer more combined disclosure than their counterparts.

The differences between large and small firms, however, are not significant at any level if the total assets are used as a proxy for size. This indicates that there is no significant difference in terms of combined disclosure levels. This result, however, is not robust if a different proxy for size is used (market capitalization). When firm size is determined by the median observation of market capitalization, the mean differences in combined disclosure levels between the two groups becomes significant at 1% level. This indicates that firms with large market capitalization give more combined disclosure than do firms with small market capitalization. Finally, the mean differences between firms with new financings and firms with no new financings are significant at 5% level, indicating that the former make more combined disclosures than the latter.

The conclusion of these results is that firms with R&D expenditure, high analyst-followings, large market capitalization, and new financing issues tend to make more combined disclosure levels than do their counterparts.

Table 6.5 Two-sample T-test of Sub-samples

Two-sample T-test	**Yes (N#)**	**No (N#)**	**Mean Diff (Yes – No)**	**T-value**
R&D	0.0198 (524)	0.0183 (1186)	0.0015103 ***	7.5117
High Analyst	0.0189 (902)	0.0186 (808)	0.0003083**	1.6348
Large Size (total assets)	0.0187 (850)	0.0188 (860)	-0.0000308	-0.1635
Large Size (market cap)	0.0191 (838)	0.0184 (838)	0.000721***	3.7980
New Financing Issues	0.0188 (1308)	0.0185 (402)	0.0003666**	1.6514

- *, ** and *** indicate significance at 10%, 5%, and 1% levels respectively, in this and subsequent tables. Reported in parenthesis is the number of observations for each group.
- The full sample for combined disclosure (sqrootOA) is 1,710 firm-year observations.
- Criteria for group membership are as shown in Table 6.4.
- The median observation of market capitalization (£1,862.8 million) is used as a cut-off point. Firms with a market capitalization of £1,862.8 million or more are classed as large and those with less as small.

6.8 Summary

This chapter reported and discussed the descriptive statistics for all the study variables and compared them with corresponding parameters reported in previous studies. Estimates of the PEG model display statistical parameters that are close to those reported in previous studies. Time and industry trends for the dependent and independent variables were presented and compared across years and economic sectors. The time-trend analysis shows increasing innovation disclosure, while measures of the cost of capital show a downward time-trend. The industry trends show that the highest averages of innovation disclosures from firms in five sectors: healthcare, technology, industrials, consumer goods, and telecommunication.

A number of univariate analysis techniques were applied: Pearson correlation, paired T-test and two-sample T-test. According to Pearson correlation, innovation disclosures show significant negative correlations with both the cost of equity capital and the after-tax cost of debt capital. The paired T-test comparisons of exploration and exploitation disclosures show that firms disclose more exploration than exploitation innovation, and this result is robust and consistent across all industries and all four sub-groups. The two-sample T-test comparisons for the combined disclosures show that firms with R&D expenditure, high analyst-followings, large market capitalization, and new financings issues tend to make more combined disclosure levels than do their counterparts.

The following chapter presents empirical evidence for the cost of equity capital.

Chapter 7 Cost of Equity Capital: Empirical Evidence

7.1 Introduction

The previous chapter presented all relevant descriptive statistics and univariate analysis for all study variables. The results show that firms on average disclose more exploration than exploitation, and that those with R&D expenditure, high analyst-followings, large market capitalization, and new financings issues tend to give more combined disclosure levels than do their counterparts. This chapter embarks on the empirical analysis of the association between innovation disclosures (i.e. exploration, exploitation, and combined disclosures) and the implied cost of equity capital based on the PEG model estimation. The following section presents the baseline modelling results for the full sample including firms in the financial sector. Sensitivity analyses are run on a full sample, a sample without the financial sector and on the financial sector alone. Results are robust across the three cases and, therefore, a decision been made to retain the financial sector in the sample throughout all the empirical analysis. Section 7.3 presents the empirical results of modelling the interaction term of combined disclosure and HH Index to account for the moderating effects of proprietary costs on the association between innovation disclosure and the cost of equity capital. Section 7.4 presents the results to the sub-sampling approach by the four criteria: R&D expenditure, level of analyst-followings, size, and issuance of new financings. Section 7.5 presents the relevant robustness checks while section 7.6 concludes with a chapter summary.

7.2 Evidence of Baseline Models

Table 7.1 displays the firm-fixed and year-fixed effects regression models for the PEG estimates of the cost of equity capital. These results are robust and make it unnecessary to exclude the financial sector from the sample. Despite the insignificance of Hausman Chi2 for models 2-3 (see Table 7.1), the fixed effects estimation results are reported for the sake of consistency and comparison. The insignificance of Hausman Chi2 indicates that the results of the random effects model are better estimates than those of the fixed effects model (Wooldridge 2010). The researcher, however, recognizes that the insignificance of Hausman Chi2 is mainly due to the limited number of explanatory variables; two for model 2 and one for model 3.

Based on the PEG estimates for the full sample, exploitation and combined disclosure show consistent and significant benefits at 5% level or better. Exploitation disclosure is associated with significant reductions in the cost of equity capital in model 2 (1.22%***) and model 4 (1.194%***). This indicates that a 1% increase in exploitation disclosure is associated with an approximate 1.2% decrease in the cost of equity capital. Despite the negative sign of the association between exploration disclosure and cost of equity capital, there is no significant evidence at any level to support the hypothesized benefits of such disclosure (as per models 2 and 4).

The combined disclosure (sqrootOA), however, is associated with significant reductions in the cost of equity capital (1.057%**) as shown in model 3. The association is statistically even stronger in model 5 after adding in the control variables of model 1. Model 5 shows slightly higher benefits from the combined disclosure (1.11%***) than the ones detected in model 3. This suggests that a 1% increase in the combined disclosure is associated with 1.11% decrease in the cost of equity capital. Benefits of the combined disclosure appear to stem from exploitation disclosure across the full sample. However, the benefits from combined disclosure (1.11%***) are less than the individual benefits of exploitation disclosure (1.194%***)[70]. This indicates that there are no synergetic benefits from both disclosures at the full sample level and that, in fact, there might be a potential derogation of benefits from exploitation disclosure when combined with exploration disclosure.

The findings from these results support hypotheses H1b and H1c but fail to support hypothesis H1a. This means that across the full sample for the period 2011-2016, exploitation disclosure and combined disclosure are associated with the benefits of reduced cost of equity capital. In contrast with results from the previous chapter, it is intriguing to find that firms on average disclose more exploration than exploitation when, in fact, average market rewards are significant for exploitation rather than exploration.

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[70] In other words, the economic significance from one standard deviation increase in the combined (exploitation) disclosure is associated with 8.5% (9.2%) decrease in the implied cost of equity capital. The economic significance is calculated as: [(Coefficient of X * Standard Deviation of X) / Standard Deviation of Y]

Table 7.1 Baseline Models for the Implied Cost of Equity Capital: Full Sample

		Baseline Models				
		1	2	3	4	5
	Pred Sign	PEG	PEG	PEG	PEG	PEG
L.ESGScr	-	-0.0459			-0.0419	-0.0415
		(0.0392)			(0.0385)	(0.0384)
L.Beta	+	-0.0166*			-0.0188**	-0.019**
		(0.00875)			(0.00864)	(0.0086)
L.LogTotAssets	-	-0.0389*			-0.0429**	-0.0409*
		(0.0221)			(0.0215)	(0.0214)
L.B2M	+	0.0297***			0.0306***	0.03***
		(0.00798)			(0.00803)	(0.008)
L.Debt2Assets	+	0.0224			0.0321	0.0327
		(0.0248)			(0.0244)	(0.0246)
L.ROA	-	-0.0755**			-0.0802**	-0.077**
		(0.0383)			(0.0389)	(0.0386)
L.AnalystsDummyHigh	-	-0.00368			-0.00359	-0.00334
		(0.00240)			(0.00230)	(0.0023)
L.LGTM_GROWTH	?	0.00138			0.00169	0.00154
		(0.00979)			(0.00959)	(0.0096)
L.RDDUMMY	+	0.00306			0.00237	0.00365
		(0.00756)			(0.00652)	(0.0068)
L.NewFinancingdummy	?	-0.000342			-0.000767	-0.00087
		(0.00296)			(0.00288)	(0.0029)
L.HH Index	-	-0.0046**			-0.0041*	-0.004**
		(0.00231)			(0.00213)	(0.0020)
L.Explr	-		-0.0226		-0.0177	
			(0.0650)		(0.0559)	
L.Explt	-		-1.22***		-1.194***	
			(0.441)		(0.356)	
L.sqrootOA	-			-1.057**		-1.11***
				(0.428)		(0.409)
_cons	?	0.247***	0.104***	0.105***	0.280***	0.27***
		(0.0868)	(0.00664)	(0.00899)	(0.0854)	(0.0847)
Year Controls Included		Yes	Yes	Yes	Yes	Yes
N observations		1028	1295	1295	1017	1017
N groups		297	343	343	295	295
R-sq		0.119	0.028	0.026	0.136	0.134
Fstat		3.59***	3.42***	3.71***	3.64***	3.81***
DF		15	6	5	17	16
Mean VIF		5.92	3.31	2.23	6.6	6.88
Hausman Chi2		67***	7.9	5.6	83***	81***
Breusch-Pagan LM Chi2		193***	388***	389***	183***	178***

- *, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are

standard errors robust to heteroscedasticity and autocorrelation. To mitigate endogeneity bias, all right-hand-side variables are one-year lagged. An outlier sensitivity analysis was conducted by examining three separate cases: 1) keeping outliers in: 2) trimming the highest and lowest 1% of observations; and 3) winsorizing the highest and lowest 1% of observations. Results are robust across the three cases. Therefore, the results reported in this table are not treated for outliers, consistent with previous research (Hail 2002; Francis, Khurana, and Pereira 2005; Gietzmann and Ireland 2005; Francis, Nanda, and Olsson 2008; Blanco, Garcia Lara, and Tribo 2015).
- PEG stands for estimates of the implied cost of equity capital using the price-earnings-growth model. Explr (Explt) stand for the coverage percentages of exploration (exploitation) wordlists as disclosed in annual reports. SqrootOA is the combined disclosure obtained by square-rooting the product of exploration and exploitation coverage percentages. Due to severe multi-collinearity issues, exploration, exploitation and sqrootOA disclosures could not be combined in a single model. Therefore, the initial model is designed to have both exploration and exploitation as individual independent variables, and another model is designed to include only sqrootOA disclosure rather than the individual independent variables.
- Models 4-5 control for the related variables such as ESG disclosure score, market beta, the natural logarithm of total assets as a proxy for size, book-to-market ratio, financial leverage (total debt-to-total assets), profitability as a measure of performance (ROA), a binary control for high analyst coverage as a proxy for the quality of financial reporting environment, the forecast long-term growth rate of earnings, R&D binary control to proxy for the level of information asymmetry surrounding the heavily innovation-oriented firms, Herfindahl-Hirschman (HH) index as a proxy for proprietary costs, and a control for new financing which is a binary variable taking the value 1 if the firm issued new long-term debt or common stocks and 0 otherwise. The ESGScr disclosure score stands for the Bloomberg disclosure score of environmental, social, and corporate governance practices. Analyst coverage is represented by the number of total analyst forecasts of earnings per share obtained for a given firm from all of its following analysts. The AnalystDummyHigh is binary control that takes the value 1 for firms whose analyst following ≥ the median observation and 0 otherwise. The R&D binary control is 1 for firms who report R&D expenditure and 0 otherwise.

7.3 Evidence of Moderating Effects of Proprietary Costs

Table 7.2 displays the firm-fixed and year-fixed effects regression models for the PEG estimates of the cost of equity capital with respect to interactions between the combined disclosure and proprietary costs (HH Index)[71]. Following (Sharma, Durand, and Gur-Arie 1981), the three-step hierarchical regression is conducted to examine the moderating effects of proprietary costs on the association between the combined disclosure and the cost of equity capital. Three models of the independent variable (sqrootOA) along with the control variables, the moderating factor (HH Index) and their interaction term (sqrootOA*HH Index) are to be fitted on the dependent variable (PEG) one at a time. The first model (6 in Table 7.2) is fitted using the independent variable (sqrootOA) along with the control variables on the dependent variable (PEG). The second model (7) introduces the moderating factor (HH Index) into the picture while the third model (8) takes on board the interaction term (sqrootOA*HH Index).

[71] The interaction term of exploration disclosure and HH Index as well as the interaction term of exploitation disclosure and HH Index were checked for moderating effects on the cost of equity capital. Results (not reported here) did show no significant moderating effects of proprietary costs on the individual benefits of exploration or exploitation disclosures.

Table 7.2 The Moderating Effects of Proprietary Costs on the Asociation of Combined Disclosure and Cost of Equity Capital: Full Sample

		Disclosure-competition interaction		
		6	7	8
	Pred. Sign	PEG	PEG	PEG
L.ESGScr	-	-0.0424	-0.0415	-0.0404
		(0.0382)	(0.0384)	(0.0384)
L.Beta	+	-0.0184**	-0.0190**	-0.0195**
		(0.00875)	(0.00864)	(0.00865)
L.LogTotAssets	-	-0.0532**	-0.0409*	-0.0423*
		(0.0239)	(0.0214)	(0.0216)
L.B2M	+	0.0297***	0.0305***	0.0307***
		(0.00787)	(0.00801)	(0.00800)
L.Debt2Assets	+	0.0260	0.0327	0.0329
		(0.0254)	(0.0246)	(0.0245)
L.ROA	-	-0.0771*	-0.0772**	-0.0751*
		(0.0402)	(0.0386)	(0.0388)
L.AnalystsDummyHigh	-	-0.00308	-0.00334	-0.00355
		(0.00235)	(0.00230)	(0.00231)
L.LGTM_GROWTH	?	-0.00850	0.00154	0.00153
		(0.0135)	(0.00961)	(0.00962)
L.RDDUMMY	+	0.00479	0.00365	0.00354
		(0.00853)	(0.00683)	(0.00682)
L.NewFinancingdummy	?	-0.000574	-0.000872	-0.000798
		(0.00299)	(0.00290)	(0.00289)
L.sqrootOA	-	-1.185***	-1.111***	-1.001**
		(0.425)	(0.409)	(0.416)
L.HH Index	-		-0.00412**	0.00325
			(0.00201)	(0.00453)
L.sqrootOA*HH Index	-			-0.208**
				(0.0980)
_cons	?	0.321***	0.274***	0.275***
		(0.0945)	(0.0847)	(0.0851)
Year Controls Included		Yes	Yes	Yes
N observations		1022	1017	1017
N groups		296	295	295
R-sq		0.129	0.134	0.136
F-stat		3.49***	3.81***	4.13***
DF		15	16	17
Mean VIF		7.06	6.88	11.6
Hausman Chi2		86***	81***	80***
Breusch-Pagan LM Chi2		168***	179***	179***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation. Models 6-8 control for the related variables as described in Table 7.1.

For a moderating effect to be recognized, the three models should indicate gradual improvements in the value of (R-sq) and (F-stat). From the values of R-sq and F-stat across the models 6-8, this condition is seen to be satisfied and therefore a moderating effect exists. Sharma, Durand, and Gur-Arie (1981) distinguish two types of moderation: pure and quasi. Pure moderation is recognized if the coefficients of the independent variable (sqrootOA) and the interaction term (sqrootOA*HH Index) are significant at 5% level and the coefficient of the moderating factor (HH Index) is not significant. Quasi-moderation occurs when the three coefficients of the independent variable (sqrootOA), the moderating factor (HH Index) and the interaction term (sqrootOA*HH Index) are significant at 5% level. Looking at model 8, a case of pure moderation is detected. This suggests that proprietary costs moderate the association between disclosure and the cost of equity capital; however, disclosure does not moderate the association between proprietary costs and the cost of equity capital.

From models 6-8, the independent variable (combined disclosure of innovation) is seen to show consistent significant benefits of reduced cost of equity capital. These benefits range from a maximum of 1.185% in model 6 to a minimum of 1.001% in model 8. In model 8, however, the negative coefficient of the interaction term (-0.208**) indicates that the significant negative association between combined disclosure and the cost of equity capital is even more pronounced (that is more negative) when the HH Index is high. This result is robust even if firms in the financial sector are excluded from analysis. Referring back to concepts introduced earlier, the higher the HH Index, the less the competition and the less the proprietary costs are, and vice versa. In the light of the results shown in model 8, firms with a high HH Index, that are subject to less competition (and therefore lower proprietary costs), experience more pronounced benefits from the combined disclosure of innovation, and vice versa. In other words, firms with a low HH Index, which are facing strong competition and high proprietary costs, experience less pronounced benefits from the combined disclosures of innovation. These findings support hypothesis H2. This means that across the full sample for the period 2011-2016, the association between the combined disclosure of innovation and the cost of equity capital is more (less) pronounced for firms in poorly (highly) competitive industries. These findings are consistent with earlier evidence (Botosan and Stanford 2005; Blanco, Garcia Lara, and Tribo 2015), that the intensity of competition (proprietary costs) weakens the benefits of disclosure in terms of reducing the cost of equity capital.

7.4 Evidence from the Sub-sampling Approach

The following sub-sections discuss the results of the sub-sample modelling.

7.4.1 R&D vs. Non-R&D Firms

Table 7.3 displays the firm-fixed and year-fixed effects regression models for the PEG estimates of the cost of equity capital for the sub-groups R&D vs. non-R&D firms. Models 9-10 present the results of modelling for R&D firms only. Inferring from the results in model 9, R&D firms earn significant and considerably higher benefits from exploration rather than from exploitation disclosure. They experience a 1.459% decrease in the cost of equity capital with each 1% increase in exploration disclosure. Despite the fact that benefits of exploitation disclosure are not significant in model 9, evidence from model 10 shows that benefits of combined disclosure (2.572%***) for R&D firms are much higher than the significant benefits from exploration disclosure (1.459%***) separately. This evidence underlines the synergetic benefits from exploration and exploitation disclosure as reflected in the magnitude of significant benefits of combined disclosure for R&D firms. For each 1% increase in combined disclosure, R&D firms experience 2.572% decrease in the cost of equity capital.

In contrast to results from models 4-5 in Table 7.1, the magnitude of benefits from exploration disclosure (1.459%***) and combined disclosure (2.572 %***) for R&D firms outweighs the benefits from exploitation disclosure (1.194 %***) and combined disclosure (1.11 %***) of the full sample[72]. Clearly, R&D firms earn around double the benefits from innovation disclosure as compared to the rest of the sample. This is even clearer for models 11-12. Non-R&D firms see a reduction of 1.264%*** in the cost of equity capital with each 1% increase in exploitation disclosure[73]. This is consistent with

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[72] In other words, the economic significance from one standard deviation increase in the combined (exploration) disclosure of R&D firms is associated with 19.8% (25.2%) decrease in the implied cost of equity capital.

[73] The economic significance from one standard deviation increase in exploitation disclosure of non-R&D firms is associated with 9.72% decrease in the implied cost of equity capital.

evidence from model 4 in Table 7.1, where the significant benefits emerge mainly from exploitation disclosure, averaging around 1.194%***. However, the benefits of combined disclosures (0.723) for non-R&D firms, as shown in model 12, are not significant at any level. The results in models 11-12 remain robust even when firms in the financial sector are excluded from the sample. This points to potential credibility issues around exploration disclosures for non-R&D firms; that when exploration disclosure is combined with exploitation disclosure, there are no significant benefits at all to be observed, never mind the synergetic benefits. This might be a technical error, given the positive sign of the exploration disclosure coefficient in model 11, which perhaps cancels out the benefits from exploitation disclosure (with a negative sign). Therefore, in this special case, the combined disclosure perhaps does effectively represents neither of the individual disclosures nor their economic effects. The notable difference in magnitude of benefits from innovation disclosures between R&D and non-R&D firms explains the results from the two-sample T-test in the previous chapter, that R&D firms make more combined disclosures than do non-R&D firms.

The results of models 9-12 support hypotheses H1a, H1b, and H1c. The R&D sub-sample supports hypothesis H1a and H1c whereas the non-R&D sub-sample supports only H1b. This means that for the period 2011-2016, the R&D firms show evidence of significant benefits of reduced cost of equity capital from exploration as well as combined disclosures. The non-R&D sample exhibits evidence of significant benefits from exploitation disclosure. This is consistent with earlier US-based evidence by Merkley (2013), that innovation disclosure around R&D activities is of vital importance to capital market participants and that investors view R&D disclosures to be informative as they alleviate uncertainties of R&D activities. In a U.S.-based study, Merkley (2013) also found that R&D disclosures are negatively related to information asymmetry. Given that the exploration wordlist tool used to measure exploration disclosure in the current study entails a number of words relevant to R&D, this explains the magnitude of significant benefits from exploration disclosure, as well as the high synergistic benefits of combined disclosure, to R&D firms. Therefore, and consistent with other evidence (Merkley 2013), exploration disclosures, including R&D narratives, are negatively related to information asymmetry as reflected by the lower implied cost of equity capital.

Table 7.3 R&D vs. non-R&D Firms: Cost of Equity Capital

		R&D and non-R&D firms			
		9	10	11	12
	Pred Sign	PEG	PEG	PEG	PEG
		R&D	**R&D**	**Non-R&D**	**Non-R&D**
L.ESGScr	-	-0.0360	-0.0343	-0.0326	-0.0334
		(0.0609)	(0.0614)	(0.0433)	(0.0434)
L.Beta	+	-0.0350*	-0.0359*	-0.0173*	-0.0186*
		(0.0207)	(0.0201)	(0.00987)	(0.0100)
L.LogTotAssets	-	-0.0689	-0.0649	-0.0214	-0.0178
		(0.0477)	(0.0494)	(0.0222)	(0.0226)
L.B2M	+	0.0336	0.0339	0.0271***	0.0272***
		(0.0233)	(0.0233)	(0.00886)	(0.00882)
L.Debt2Assets	+	0.0417	0.0386	0.0224	0.0242
		(0.0310)	(0.0313)	(0.0314)	(0.0320)
L.ROA	-	-0.0352	-0.0389	-0.0904	-0.0867
		(0.0357)	(0.0356)	(0.0598)	(0.0596)
L.AnalystsDummyHigh	-	-0.00381	-0.00379	-0.00448	-0.00399
		(0.00365)	(0.00380)	(0.00286)	(0.00288)
L.LGTM_GROWTH	?	0.0231	0.0231	-0.00516	-0.00551
		(0.0143)	(0.0143)	(0.0118)	(0.0119)
L.NewFinancingdummy	?	-0.000523	-0.000842	-0.00196	-0.00215
		(0.00505)	(0.00501)	(0.00377)	(0.00379)
L.HH Index	-	0.0109	0.0109	-0.00554**	-0.00579***
		(0.00745)	(0.00718)	(0.00214)	(0.00213)
L.LogRD2Sales	+	0.0110	0.00993	Omitted	Omitted
		(0.0132)	(0.0129)		
L.Explr	-	-1.459***		0.0370	
		(0.504)		(0.0524)	
L.Explt	-	-1.021		-1.264***	
		(0.773)		(0.480)	
L.sqrootOA	-		-2.572***		-0.723
			(0.881)		(0.472)
_cons	?	0.416**	0.400**	0.200**	0.183**
		(0.183)	(0.188)	(0.0860)	(0.0876)
Year Controls Included		Yes	Yes	Yes	Yes
N observations		331	331	686	686
N groups		97	97	202	202
R-sq		0.180	0.174	0.166	0.160
Fstat		3.1***	3.06***	3.22***	3.16***
DF		17	16	16	17
Mean VIF		11.1	10.6	6.56	7***
Hausman Chi2		53.4***	51***	51***	49.6***

Breusch-Pagan LM Chi2	56***	57***	91***	89***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation. For models 9-10, the ratio of R&D expenditure to sales is included to limit the sample to R&D firms. This would control for the level of information asymmetry surrounding the heavily innovation-oriented firms. In 11-12, non-R&D firms are modelled with a conditional requirement of (if R&D.Dummy == 0) so as to limit the sample to non-R&D firms.

7.4.2 High vs. Low Analyst-Following Firms

Table 7.4 displays the firm-fixed and year-fixed effects regression models for the PEG estimates of the cost of equity capital for groups of high and low analyst-following firms. Models 13-14 present the results of the high analyst-following group, consistent with models 4-5 in Table 7.1. Firms with high analyst-followings enjoy significant benefits from exploitation disclosure (0.865%**) and combined disclosure (1.043%**). Benefits of exploration disclosure (0.106%) are not significant at any level. As with the R&D firms, the benefits of combined disclosure (1.043%**) outweigh the individual benefits from exploitation disclosure (0.865%**), indicating a synergetic benefit from the combination. However, firms with low analyst-following, as shown in models 15-16, enjoy significant benefits from exploitation disclosure (2.341%**) although benefits of exploration disclosure (0.0121%) and combined disclosure (1.35%) are not significant at any level. These results are robust even if financial firms are excluded from the sample. This indicates that narratives of exploration disclosure suffer from potential credibility issues and the benefits of such disclosure are not significant. This is consistent with previous evidence, that many narratives of IC disclosures are prone to a number of credibility issues which bring their economic effects into question (Wyatt 2008). These results also indicate that exploration disclosure dilutes the value of exploitation disclosure, as their combination is no longer significant despite the sizable benefits of exploitation disclosure (2.341%**). The notable difference in the magnitude of benefits from innovation disclosures between high and low analyst-following firms explains the results from the two-sample T-test in the previous chapter, that firms with high analyst-followings make more combined disclosures than do their counterparts. In contrast to the results from models 4-5 in Table 7.1, firms with low analyst-followings earn almost double the average benefits from exploitation disclosure compared to the rest of the sample. Firms with high analyst-followings earn below-average benefits from exploitation disclosure and qualitatively similar benefits from combined disclosure compared to the average of the full sample.

Table 7.4 High vs. Low Analyst-Following Firms: Cost of Equity Capital

		High vs low analyst-following firms			
		13	14	15	16
	Pred. Sign	PEG	PEG	PEG	PEG
		High Analyst Following		**Low Analyst Following**	
L.ESGScr	-	-0.0825**	-0.0807**	0.0294	0.0187
		(0.0407)	(0.0407)	(0.106)	(0.108)
L.Beta	+	-0.0141	-0.0142	-0.0469*	-0.0461*
		(0.00904)	(0.00902)	(0.0260)	(0.0262)
L.LogTotAssets	-	-0.0486**	-0.0479**	-0.0319	-0.0293
		(0.0235)	(0.0230)	(0.0455)	(0.0467)
L.B2M	+	0.0408***	0.0409***	0.00243	0.000186
		(0.00998)	(0.00997)	(0.00696)	(0.00808)
L.Debt2Assets	+	0.00814	0.00785	0.00603	0.0105
		(0.0257)	(0.0258)	(0.0507)	(0.0513)
L.ROA	-	-0.0702	-0.0684	-0.187***	-0.174***
		(0.0463)	(0.0460)	(0.0636)	(0.0630)
L.LGTM_GROWTH	?	0.00674	0.00669	-0.0200	-0.0224
		(0.00464)	(0.00465)	(0.0354)	(0.0356)
L.RDDUMMY	+	0.00385	0.00466	0.00928	0.0103*
		(0.00813)	(0.00837)	(0.00587)	(0.00617)
L.NewFinancingdummy	?	0.00239	0.00241	-0.0145*	-0.0141*
		(0.00330)	(0.00327)	(0.00800)	(0.00852)
L.HH Index	-	-0.00544**	-0.00530**	-0.00592	-0.00651
		(0.00214)	(0.00207)	(0.0128)	(0.0128)
L.Explr	-	-0.106		-0.0121	
		(0.390)		(0.0353)	
L.Explt	-	-0.865**		-2.341**	
		(0.427)		(0.970)	
L.sqrootOA	-		-1.043**		-1.350
			(0.480)		(1.054)
_cons	?	0.312***	0.312***	0.281	0.264
		(0.0961)	(0.0944)	(0.170)	(0.173)
Year Controls Included		Yes	Yes	Yes	Yes
N observations		673	673	344	344
N groups		200	200	177	177
R-sq		0.169	0.170	0.213	0.197
Fstat		3.8***	4.1***	----	----
DF		16	15	15	14
Mean VIF		8.2	7.7	5.8	6.3
Hausman Chi2		80***	80***	42***	46***
Breusch-Pagan LM Chi2		70***	68***	55***	44***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses

are standard errors robust to heteroscedasticity and autocorrelation. Models 13-14 are estimated with the condition that AnalystDummyHigh = 1 while models 15-16 are estimated with the condition that AnalystDummyHigh = 0. There is a problem with models 15-16 in that the F-stat value is reported missing by Stata.15. One potential explanation for this anomaly is that the comparatively small sample size of firms with low analyst-followings limits the availability of degrees of freedom, making it difficult to estimate the F-stat value. A close examination of step regression analysis, however, reports significant F-stat values when fewer control variables are used. Results of the step regression analysis report similar coefficients for the exploitation disclosure variable with significance at 5% level.

Furthermore, the magnitude of benefits from exploitation disclosure for low analyst-followings (2.341%**) is almost three times that of high analyst-following firms (0.865%**). This evidence is in line with previous findings (Botosan 2000; Richardson and Welker 2001), that firms with low analyst-followings enjoy higher benefits for the same disclosure levels than do firms with high analyst-followings, because the latter enjoy a higher-quality information environment. Therefore, when low analyst-following firms increase their disclosure levels, this contributes positively to the firm value by improving the information environment and alleviating uncertainties surrounding investments and business operations. Once more, the evidence supports hypotheses H1b and H1c for the high analyst-followings group, while evidence from the low analyst-followings group supports only hypothesis H1b.

Two more interesting findings can be inferred from models 13-16 regarding ESG disclosure. First, ESG disclosure shows significant benefits only for firms of high analyst-following: 0.0825%** and 0.0807%** as shown in models 13 and 14 respectively. However, according to models 4-5 in Table 7.1, the benefits of ESG disclosure show no significance at any level across the full sample. This evidence suggests that ESG disclosure is vital specifically for firms with high analyst-followings, given that analysts rely on ESG information for conducting their analyses and evaluations of the firm. Previous evidence shows that ESG disclosure is positively associated with share price (Crifo, Forget, and Teyssier 2015) and negatively associated with the cost of equity capital (Reverte 2012). In the current study, ESG disclosure is similarly found to be negatively associated with the cost of equity capital. In other words, ESG disclosure is effective in alleviating uncertainties and improving the quality of the information environment. The only difference with the previous literature is that

ESG disclosure presents significant benefits for firms of high rather than low analyst-followings, which underscores their significant role through market rewards to ESG disclosure.

Second, the size of benefits from ESG disclosure is very small compared to those from exploitation and combined disclosure. In model 13, benefits of ESG disclosure are 0.0825%**, while benefits of exploitation disclosure are 0.865%**. In model 14, benefits from ESG disclosure are 0.0807%** and benefits from combined disclosure 1.043%**. There are two potential explanations for such differences in the benefits between ESG and innovation disclosures. First, they might be due to the different scales of disclosure measurement; ESG is measured by Bloomberg using a comprehensive index, while exploitation and combined disclosures are measured using a wordlist as a percentage of the annual report document. Second, it could be that the content and substance of ESG and innovation disclosures are different in the way that they influence various aspects of value-creation, affecting the cost of equity capital. Regardless of whichever is the true explanation, this finding presents a new subject for debate and an interesting question for future research.

7.4.3 Large vs. Small Firms

Table 7.5 displays the firm-fixed and year-fixed effects regression models for the PEG estimates of the cost of equity capital for groups of large and small firms. These results are robust whichever proxy of size is used: total assets or market capitalization. Models 17-18 present results for large firms, which are relatively consistent with models 4-5 in Table 7.1. Model 17 shows weak evidence for benefits from exploitation disclosure 1.158%* for large firms. Model 18, however, shows significant benefits from the combined disclosure 1.197%** for large firms. For small firms (models 19-20), significant benefits stem from exploitation disclosure (0.776%**) although the benefits of combined disclosure (0.366%) are not significant at any level. Benefits of exploration disclosure for both groups are not significant at any level.

Despite the weak evidence, benefits of exploitation disclosure for large firms (1.158%*) outweigh those of small firms (0.776%**). Benefits from the combined disclosure for large firms (1.197%**) are supported by significant evidence, whereas those for small firms (0.366%) are not. Comparing the results with those of models 4-5 in Table 7.1, large-sized firms earn qualitatively similar benefits from exploitation and combined disclosures as the full sample. Small firms, however, earn below-average benefits from exploitation disclosure than the rest of the sample. This supports the previous argument that large firms are capable of pursuing more innovations given the scale of resources at their disposal (Cao, Gedajlovic, and Zhang 2009). Therefore, their exploitation disclosures are more credible. This explains why large firms enjoy greater benefits than do small firms, as shown from the evidence in models 17-20. The notable difference in the size of benefits from innovation disclosures between large and small firms explains the results from the two-sample T-test in the previous chapter, that large firms make more combined disclosures than do small firms.

Once again, supportive evidence is provided for hypotheses H1b and H1c for the group of large firms. Evidence from the small firms group supports hypotheses H1b. Analysis of evidence from sub-grouping by size factor is consistent and qualitatively similar to the evidence from sub-grouping by analyst followings. This is mainly because large-sized firms are the ones that tend to be more followed by market analysts (Botosan 2000; Richardson and Welker 2001).

Table 7.5 Large vs. Small Firms: Cost of Equity Capital

		Large vs small firms			
		17	18	19	20
	Pred. Sign	PEG	PEG	PEG	PEG
		Large	**Large**	**Small**	**Small**
L.ESGScr	-	-0.0540	-0.0532	-0.0194	-0.0187
		(0.0508)	(0.0505)	(0.0508)	(0.0511)
L.Beta	+	-0.0241**	-0.0247**	-0.0103	-0.0105
		(0.0118)	(0.0118)	(0.0142)	(0.0143)
L.B2M	+	0.0315***	0.0315***	0.0135	0.0151
		(0.00928)	(0.00925)	(0.0135)	(0.0137)
L.Debt2Assets	+	0.0505	0.0508	0.0165	0.0178
		(0.0486)	(0.0483)	(0.0270)	(0.0282)
L.ROA	-	-0.0759	-0.0728	-0.0714*	-0.0690*
		(0.0681)	(0.0677)	(0.0403)	(0.0397)
L.AnalystsDummyHigh	-	-0.00527*	-0.00513	-0.00146	-0.000932
		(0.00320)	(0.00320)	(0.00336)	(0.00325)
L.LGTM_GROWTH	?	-0.00759	-0.00777	0.0173***	0.0166***
		(0.0148)	(0.0149)	(0.00582)	(0.00559)
L.RDDUMMY	+	-0.0282**	-0.0276**	-0.000306	0.000749
		(0.0136)	(0.0135)	(0.00409)	(0.00401)
L.NewFinancingdummy	?	-0.00311	-0.00306	0.00126	0.00147
		(0.00411)	(0.00409)	(0.00455)	(0.00459)
L.HH Index	-	-0.00547***	-0.00542***	-0.00444	-0.0107
		(0.00209)	(0.00202)	(0.0325)	(0.0302)
L.Explr	-	-0.0618		0.539	
		(0.0669)		(0.373)	
L.Explt	-	-1.158*		-0.776**	
		(0.684)		(0.391)	
L.sqrootOA	-		-1.197**		-0.366
			(0.599)		(0.575)
_cons	?	0.145***	0.149***	0.0894***	0.0963***
		(0.0297)	(0.0299)	(0.0272)	(0.0281)
Year Controls Included		Yes	Yes	Yes	Yes
N observations		602	602	415	415
N groups		160	160		
R-sq		0.148	0.150	0.172	0.160
Fstat		----	----	10.94***	10.6***
DF		15	14	16	15
Mean VIF		4.8	4.77	4.96	4.5
Hausman Chi2		70***	71***	17.3	18.3
Breusch-Pagan LM Chi2		89***	88***	48***	45***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses

are standard errors robust to heteroscedasticity and autocorrelation. Models 17-18 are estimated with the condition that total assets ≥ the median observation, and models 19-20 with the condition that total assets < the median observation. The F-stat problem with models 17-18 was discussed in Table 7.4.

7.4.4 Firms with New vs. No New Financings

Table 7.6 demonstrates the firm-fixed and year-fixed effects regression models for the PEG estimates of the cost of equity capital for firms that issued new financing versus firms that did not. These results are robust even if the financial firms are excluded from the sample. Firms that issued new financings, as shown in models 21-22, exhibit consistent results with models 4-5 in Table 7.1. Firms that issue new financing enjoy significant benefits from exploitation disclosure (1.493%***) and combined disclosure (1.335%***). Benefits from exploration disclosure, however, are not significant at any level. In comparison with models 4-5 in Table 7.1, firms with new financing issues exhibit above-average benefits from exploitation and combined disclosures. The averages significant benefits of the full sample from exploitation and combined disclosures are 1.194%*** and 1.11%*** respectively.

Firms that did not issue new financings, as shown in models 23-24, exhibit significant costs from exploration disclosure (1.077%***) but no significant effects from exploitation or combined disclosures. In other words, a 1% increase in exploration disclosure leads to an increase in the cost of equity capital of 1.077%. This result is also robust using random effects estimation of the same models, given the insignificance of Hausman Chi2 in models 23-24. This finding contradicts not only the earlier stated hypotheses but also the very premise of the economic disclosure theory: greater disclosure reduces the cost of equity capital. This anomaly leaves an open question of why one group of firms (i.e. firms that did not raise new financing) is punished with a greater cost of equity capital for increases in exploration disclosure. An explanation might be inferred from the same model 23. This unique group of firms does not exhibit significant benefits from exploitation disclosure, which begs the question of whether they are properly managing and exploiting their resources for value creation. This is evident from the insignificant coefficients of variables such as size, B2M ratio, ROA and long-term growth ratio. This possible explanation remains an open question for future research.

Table 7.6 New Issues of Financings (Yes vs. No): Cost of Equity Capital

		Issuance of New Financing			
		21	22	23	24
	Pred. Sign	PEG	PEG	PEG	PEG
		Yes	**Yes**	**No**	**No**
L.ESGScr	-	-0.0349	-0.0337	-0.0346	-0.0398
		(0.0382)	(0.0381)	(0.184)	(0.185)
L.Beta	+	-0.0256**	-0.0258**	0.000260	0.000538
		(0.0110)	(0.0110)	(0.0258)	(0.0256)
L.LogTotAssets	-	-0.0944***	-0.0914***	0.0276	0.0202
		(0.0272)	(0.0267)	(0.0652)	(0.0676)
L.B2M	+	0.0271***	0.0270***	0.0126	0.0134
		(0.00834)	(0.00847)	(0.0132)	(0.0130)
L.Debt2Assets	+	0.0175	0.0161	0.0624	0.0825
		(0.0261)	(0.0262)	(0.0882)	(0.0900)
L.ROA	-	-0.111**	-0.107**	-0.0579	-0.0565
		(0.0478)	(0.0476)	(0.0699)	(0.0724)
L.AnalystsDummyHigh	-	0.000124	0.000244	-0.00391	-0.00260
		(0.00275)	(0.00274)	(0.00530)	(0.00560)
L.LGTM_GROWTH	?	0.0265***	0.0253***	-0.0243	-0.0237
		(0.00906)	(0.00901)	(0.0267)	(0.0268)
L.RDDUMMY	+	0.00291	0.00307	Omitted	Omitted
		(0.00501)	(0.00496)		
L.HH Index	-	-0.00318*	-0.00321*	-0.0431	-0.0422
		(0.00175)	(0.00171)	(0.0366)	(0.0363)
L.logfinancing	?	0.000757	0.000795		
		(0.000677)	(0.000675)		
L.Explr	-	-0.0592		1.077***	
		(0.0602)		(0.346)	
L.Explt	-	-1.493***		-0.361	
		(0.518)		(0.568)	
L.sqrootOA	-		-1.335***		0.831
			(0.476)		(0.992)
_cons	?	0.481***	0.471***	-0.0202	0.00597
		(0.110)	(0.108)	(0.196)	(0.198)
Year Controls Included		Yes	Yes	Yes	Yes
N observations		801	801	215	215
N groups		264	264	107	107
R-sq		0.162	0.162	0.219	0.196
Fstat		4.25***	4.75***	3.82***	2.04**
DF		17	16	15	14
Mean VIF		7	7.4	7	6.95
Hausman Chi2		71.19***	106***	17	17.3

Breusch-Pagan LM Chi2	136	135***	10.36***	9.3***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation. The binary control for new financing is removed from modelling and used as a conditional requirement when estimating models 23-24; it is set to have NewFinancingDummy = 0 so as to limit the sample to firms with no newly issued financings. For models 21-22, the natural logarithm of newly issued financings is added as a control variable to limit the sample to those with new financing issues. For consistency and comparability, fixed effects estimates are reported for models 23-24 despite the insignificance of Hausman Chi2. Random effects estimation, however, shows consistent results for the fixed effects estimation.

There is a notable difference in the magnitude of benefits from innovation disclosures between firms that issued new financing and those that did not. This difference explains the results from the two-sample T-test in the previous chapter, that firms with newly issued financings extend more combined disclosures than do firms with no newly issued financings.

The overall finding from models 21-24 is that firms with new issues for financing gain above average benefits from exploitation and combined disclosures than the rest of the sample, while firms with no issues for new financing entail significant costs from exploration disclosure. Therefore, the sub-sample of firms with new issues presents evidence in support of H1b and H1c whereas the other sub-sample presents no evidence to support any form of the first hypothesis.

7.5 Robustness checks for the implied cost of equity capital

The following sub-sections present empirical results for a number of robustness checks for the implied cost of equity capital. These result from re-estimating the baseline models using: 1) the CAPM estimates; 2) the average COE estimates of both CAPM and PEG models; 3) returns volatility; 4) the average of closing bid-ask spread percentages; 5) the ratio of the closing trading volume to the outstanding number of common stocks; and 6) analyst forecast error. Robustness checks also include remodelling the baseline models by reversing the dependent and independent variables so as to check for the sufficiency of one-year lags in mitigating endogeneity bias. A final round of robustness checks is discussed in section 7.5.6, to check for the sensitivity of results to omissions of any of the control variables as well as to check for different functional measurement forms of innovation disclosure.

7.5.1 Evidence of CAPM and Average COE: Robustness Check

Table 7.7 and Table 7.8 display the firm-fixed and year-fixed effects regression models for the CAPM estimates and the average estimates for the cost of equity capital (COE), respectively[74]. Models 28-29 in Table 7.7 and 33-34 in Table 7.8 show consistent results with models 4-5 in Table 7.1.

Based on the CAPM estimates for the full sample, models 28-29 show weak but consistent evidence with models 4-5. Exploitation disclosure and combined disclosure present significant benefits at 10% level or better. Exploitation disclosure is associated with reductions in the cost of equity capital of 0.434%* in model 28, while the combined disclosure is associated with benefits of 0.446%* in model 29. This indicates that 1% increases in exploitation disclosure and combined disclosure are associated with roughly 0.434% and 0.446% decreases in the CAPM cost of equity capital, respectively. Consistent with model 4 in Table 7.1, the benefits of exploration disclosure in model 28 are not significant at any level.

Based on the average COE estimates, models 33-34 also show consistent evidence with models 4 and 5. Exploitation and combined disclosure present significant benefits at 1% and 5% levels, respectively. Exploitation disclosure is associated with reductions in the average cost of equity capital of 0.709%*** in model 33, while the combined disclosure is associated with benefits of 0.603%** in model 34. This indicates that 1% increases in exploitation and combined disclosures are associated with roughly 0.709% and 0.603% decreases in the average cost of equity capital, respectively. Consistently, benefits of exploration disclosure, once again, are not significant at any level.

The findings from the evidence of CAPM and average COE estimates give support to hypotheses H1b and H1c but fail to support hypothesis H1a. This means that across the full sample for the period 2011-2016, exploitation and combined disclosure are associated with benefits of reduced cost of equity capital, reinforcing the findings from Table 7.1.

[74] The average cost of equity capital is the average from estimate of CAPM and PEG.

Table 7.7 Baseline Models: CAPM Evidence for the Full Sample

		25	26	27	28	29
	Pred. Sign	CAPM	CAPM	CAPM	CAPM	CAPM
L.ESGScr	-	-0.00707			-0.00597	-0.00600
		(0.0210)			(0.0212)	(0.0212)
L.Beta	+	0.0302***			0.0295***	0.0295***
		(0.00466)			(0.00476)	(0.00474)
L.LogTotAssets	-	-0.0222			-0.0238	-0.0231
		(0.0162)			(0.0164)	(0.0163)
L.B2M	+	0.0165***			0.0164***	0.0164***
		(0.00475)			(0.00480)	(0.00480)
L.Debt2Assets	+	0.0434**			0.0422**	0.0422**
		(0.0171)			(0.0172)	(0.0172)
L.ROA	-	-0.0212			-0.0214	-0.0206
		(0.0168)			(0.0170)	(0.0169)
L.AnalystsDummyHigh	-	-0.00324*			-0.00359*	-0.00352*
		(0.00192)			(0.00194)	(0.00194)
L.LGTM_GROWTH	?	-0.00361			-0.00353	-0.00361
		(0.00510)			(0.00497)	(0.00499)
L.RDDUMMY	+	0.00337			0.00383	0.00407
		(0.00408)			(0.00450)	(0.00459)
L.HH Index	-	-0.000378			-0.000217	-0.000227
		(0.00150)			(0.00151)	(0.00150)
L.NewFinancingdummy	?	0.00268			0.00277	0.00274
		(0.00224)			(0.00229)	(0.00228)
L.Explr	-		-0.0613*		-0.0413	
			(0.0327)		(0.0370)	
L.Explt	-		-0.312		-0.434*	
			(0.241)		(0.228)	
L.sqrootOA	-			-0.458		-0.446*
				(0.246)		(0.258)
_cons	?	0.140**	0.102***	0.104***	0.154***	0.152***
		(0.0554)	(0.00407)	(0.00510)	(0.0574)	(0.0573)
Year Controls Included		Yes	Yes	Yes	Yes	Yes
N observations		1091	1391	1391	1078	1078
N groups		299	347	347	296	296
R-sq		0.288	0.129	0.130	0.287	0.287
Fstat		21***	16.7***	19***	18.46***	18.64***
DF		15	6	5	17	16
Mean VIF		5.9	3.36	2.21	6.56	6.9
Hausman Chi2		72***	139***	109***	92***	91***
Breusch-Pagan LM Chi2		22***	616***	633***	20***	20***

, and * indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to teroscedasticity and autocorrelation.

Table 7.8 Baseline Models: Average Cost of Equity Capital for the Full Sample

		30	31	32	33	34
	Pred. Sign	COE	COE	COE	COE	COE
L.ESGScr	-	-0.0312			-0.0289	-0.0291
		(0.0206)			(0.0204)	(0.0205)
L.Beta	+	0.00904			0.00760	0.00751
		(0.00633)			(0.00632)	(0.0063)
L.LogTotAssets	-	-0.0157			-0.0170	-0.0158
		(0.0143)			(0.0141)	(0.0141)
L.B2M	+	0.0136*			0.0137*	0.0136*
		(0.00708)			(0.00714)	(0.0072)
L.Debt2Assets	+	0.0408**			0.0427**	0.043**
		(0.0168)			(0.0167)	(0.0167)
L.ROA	-	-0.0609**			-0.0651**	-0.063**
		(0.0255)			(0.0257)	(0.0255)
L.AnalystsDummyHigh	-	-0.0044***			-0.0046***	-0.0045***
		(0.00160)			(0.00162)	(0.0016)
L.LGTM_GROWTH	?	0.00704			0.00731	0.00716
		(0.00652)			(0.00659)	(0.0066)
L.RDDUMMY	+	0.00744			0.00945	0.00988
		(0.00775)			(0.00678)	(0.0065)
L.HH Index	-	-0.005***			-0.00466**	-0.0047**
		(0.00186)			(0.00192)	(0.0019)
L.NewFinancingdummy	?	-0.00125			-0.00143	-0.00151
		(0.00256)			(0.00260)	(0.0026)
L.Explr	-		-0.0355		-0.0163	
			(0.0407)		(0.0412)	
L.Explt	-		-0.724***		-0.709***	
			(0.251)		(0.220)	
L.sqrootOA	-			-0.685**		-0.603**
				(0.271)		(0.265)
_cons	?	0.140**	0.0977***	0.0990***	0.156***	0.151***
		(0.0544)	(0.00407)	(0.00569)	(0.0541)	(0.0541)
Year Controls Included		Yes	Yes	Yes	Yes	Yes
N observations		1091	1391	1391	1078	1078
N groups		299	347	347	296	296
R-sq		0.174	0.075	0.074	0.182	0.180
Fstat		9.74***	10.14***	11***	9.56***	9.4***
DF		15	6	5	17	16
Mean VIF		5.9	3.36	2.21	6.56	6.9
Hausman Chi2		84***	57***	20.1***	99***	97***
Breusch-Pagan LM Chi2		58***	453***	465***	53***	52.5***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation.

7.5.2 Evidence of Returns Volatility: Robustness Check

Table 7.9 displays the firm-fixed and year-fixed effects regression models for the 360-days returns volatility across the full sample. The returns volatility is a proxy of risk, which is expected to be inversely related to disclosure.

Similar to the evidence from forecast error (see Table 7.12), model 38 shows negative signs of exploration and exploitation coefficients, but they are not significant at any level. This evidence, however, is not consistent with evidence from model 4 in Table 7.1. Model 39, however, does show consistent results with model 5. In other words, 1% increase in the combined disclosure leads to a significant reduction in returns volatility of 240.9** points[75]. The fact that a benefit is presented by the combined rather than the individual disclosures reinforces the notion of synergic benefits from combining exploration and exploitation disclosures (Floyd and Lane 2000; Cao, Gedajlovic, and Zhang 2009). Evidence from returns volatility shows results similar to those from forecast error. It indicates that there is a beneficial effect of reduced return volatility from exploration and exploitation disclosure, but these beneficial effects are not individually significant. The combination of both disclosures, as shown in model 39, correlates with the significant beneficial effect of reduced returns volatility. Once more, the overall finding from the full sample gives support to the hypothesized significant benefits from the combined disclosures. This means that the full picture of exploration and exploitation, rather than their separate individual disclosures, has an effective impact on reducing returns volatility.

[75] In other words, the economic significance from one standard deviation increase in the combined disclosure is associated with 9.1 points decrease in the stock return volatility.

Table 7.9 Stock Returns Volatility: Full Sample

		35	36	37	38	39
	Pred. Sign	Volatility	Volatility	Volatility	Volatility	Volatility
L.ESGScr	-	-15.90**			-15.41**	-15.10**
		(6.920)			(6.868)	(6.714)
L.Beta	+	4.441***			4.089**	3.953**
		(1.644)			(1.637)	(1.589)
L.LogTotAssets	-	-2.242			-3.064	-2.869
		(5.326)			(5.391)	(5.274)
L.B2M	+	6.348***			6.327***	6.304***
		(1.770)			(1.779)	(1.767)
L.Debt2Assets	+	14.92**			14.73**	14.68**
		(6.679)			(6.807)	(6.768)
L.ROA	-	-0.229			0.242	0.568
		(6.479)			(6.558)	(6.440)
L.AnalystsDummyHigh	-	-0.457			-0.543	-0.515
		(0.686)			(0.702)	(0.699)
L.LGTM_GROWTH	?	-1.144			-1.162	-1.179
		(0.875)			(0.864)	(0.852)
L.RDDUMMY	+	1.225			1.190	1.245
		(3.557)			(3.583)	(3.656)
L.HH Index	-	0.947			0.978	1.016
		(0.939)			(0.929)	(0.900)
L.NewFinancingdummy	?	0.747			0.808	0.817
		(1.180)			(1.205)	(1.203)
L.Explr	-		-32.08		-14.44	
			(30.30)		(32.49)	
L.Explt	-		-62.36		-123.0	
			(87.80)		(93.99)	
L.sqrootOA	-			-242.3**		-240.9**
				(100.7)		(118.2)
_cons	?	36.08	35.10***	38.04***	41.48**	43.10**
		(18.48)	(1.555)	(2.027)	(19.04)	(18.91)
Year Controls Included		Yes	Yes	Yes	Yes	Yes
N observations		1084	1374	1374	1071	1071
N groups		296	340	340	293	293
R-sq		0.371	0.263	0.267	0.367	0.371
Fstat		28.5***	58***	68***	24***	25.3***
DF		15	6	5	17	16
Mean VIF		5.94	3.35	2.22	6.6	6.92
Hausman Chi2		62***	25.7***	22.11***	61***	66***
Breusch-Pagan LM Chi2		292***	695***	727***	278***	275***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation.

7.5.3 Evidence of Liquidity Measures: Robustness Check

Table 7.10 displays the firm-fixed and year-fixed effects regression models for the first liquidity measure: the averages of closing bid-ask spread percentages[76]. The lower the information asymmetry, the lower the bid-ask spread percentages and the higher the liquidity. According to evidence of the average of closing bid-ask spread percentages for the full sample, model 43 shows weak but consistent evidence with model 4 from Table 7.1. It indicates that a 1% increase in exploitation disclosure is weakly associated with 2.295%* reduction in the average of closing bid-ask spread percentage. Model 44, on the other hand, shows significant and consistent evidence with model 5. A 1% increase in the combined disclosure is significantly associated with 3.215%** reductions in the closing average of bid-ask spread percentages. In other words, evidence from models 43 and 44 shows that increases in exploitation and combined disclosures are correlated with less information asymmetry and higher liquidity based on the evidence of closing averages of bid-ask spread percentages.

Table 7.11 displays the firm-fixed and year-fixed effects regression models for the second liquidity measure: the ratio of closing trading volume to the outstanding number of common shares. Increases in the disclosure are expected to lead to higher trading volumes. In other words, the coefficients of disclosure variables should indicate positive signs with the trading volume. Contrary to expectation, however, models 48-49 show evidence of reduced closing trading volumes across the full sample from exploitation and combined disclosures. Model 48 indicates that a 1% increase in exploitation disclosure is weakly associated with decreases in closing trading volumes (-5.502%*). Model 49 shows that a 1% increase in combined disclosure is significantly associated with a reduction in the closing trading volume (8.806%***). In other words, models 48-49 show that increases in exploitation and combined disclosures are correlated with less liquidity as evidenced by the lower closing trading volumes, contradicting all the evidence from previous models. This contradictory evidence is perhaps due to the problematic nature of this specific measure of liquidity as argued by (Dhaliwal et al. 2011) who also reported a reversed sign of this specific variable.

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[76] See Appendix B1 for the definition of Average bid-ask spread percentages.

Table 7.10 Average of Closing Bid-Ask Spread Percentages (Liquidity 1): Full Sample

		40	41	42	43	44
	Pred. Sign	Spread%	Spread%	Spread%	Spread%	Spread%
L.ESGScr	-	-0.0330			-0.0196	-0.0194
		(0.0842)			(0.0840)	(0.0842)
L.Beta	+	0.0280			0.0170	0.0177
		(0.0249)			(0.0239)	(0.0238)
L.LogTotAssets	-	-0.109**			-0.110**	-0.108**
		(0.0515)			(0.0506)	(0.0502)
L.B2M	+	0.0461**			0.0458***	0.0457***
		(0.0178)			(0.0175)	(0.0175)
L.Debt2Assets	+	0.0541			0.0572	0.0555
		(0.0831)			(0.0844)	(0.0843)
L.ROA	-	-0.0738			-0.0544	-0.0541
		(0.0663)			(0.0644)	(0.0637)
L.AnalystsDummyHigh	-	-0.00416			-0.00450	-0.00438
		(0.0121)			(0.0124)	(0.0125)
L.LGTM_GROWTH	?	0.0297**			0.0299*	0.0298*
		(0.0148)			(0.0156)	(0.0155)
L.RDDUMMY	+	0.0493			0.0487	0.0489
		(0.0572)			(0.0603)	(0.0602)
L.HH Index	-	-0.00681			-0.00646	-0.00642
		(0.00480)			(0.00475)	(0.00472)
L.NewFinancingdummy	?	0.00439			0.00740	0.00733
		(0.0127)			(0.0129)	(0.0128)
L.Explr	-		-1.633**		-1.274	
			(0.824)		(0.928)	
L.Explt	-		-0.183		-2.264*	
			(1.431)		(1.345)	
L.sqrootOA	-			-2.015		-3.257**
				(1.370)		(1.356)
_cons	?	0.503**	0.225***	0.221***	0.574***	0.565***
		(0.194)	(0.0275)	(0.0275)	(0.195)	(0.193)
Year Controls Included		Yes	Yes	Yes	Yes	Yes
N observations		1034	1280	1280	1022	1022
N groups		283	330	330	281	281
R-sq		0.194	0.179	0.178	0.191	0.190
Fstat		12.38***	31.13***	37.5***	11.58***	12***
DF		15	6	5	17	16
Mean VIF		5.93	5.5	2.17	7.7	7
Hausman Chi2		26**	22.8***	22.7***	49***	46.7***
Breusch-Pagan LM Chi2		181***	712***	714***	174***	176***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation.

Table 7.11 Closing Trading Volume (Liquidity2): Full Sample

		45	46	47	48	49
	Pred. Sign	Liquidity2	Liquidity2	Liquidity2	Liquidity2	Liquidity2
L.ESGScr	+	-0.362			-0.342	-0.338
		(0.304)			(0.300)	(0.298)
L.Beta	-	0.0406			0.0270	0.0237
		(0.0529)			(0.0523)	(0.0521)
L.LogTotAssets	+	0.52***			0.484**	0.494**
		(0.156)			(0.156)	(0.156)
L.B2M	-	0.0453			0.0450	0.0443
		(0.0553)			(0.0557)	(0.0552)
L.Debt2Assets	-	0.260			0.265	0.261
		(0.183)			(0.187)	(0.186)
L.ROA	+	-0.354**			-0.348*	-0.335*
		(0.172)			(0.176)	(0.174)
L.AnalystsDummyHigh	+	0.0132			0.0142	0.0154
		(0.0231)			(0.0231)	(0.0231)
L.LGTM_GROWTH	?	-0.0276			-0.0264	-0.0270
		(0.0267)			(0.0283)	(0.0284)
L.RDDUMMY	-	0.0697**			0.0678**	0.0706**
		(0.0316)			(0.0317)	(0.0311)
L.HH Index	+	0.0175			0.0197	0.0206
		(0.0154)			(0.0154)	(0.0152)
L.NewFinancingdummy	?	0.0278			0.0317	0.0321
		(0.0234)			(0.0237)	(0.0235)
L.Explr	+		-0.477		-0.718	
			(0.568)		(0.753)	
L.Explt	+		-4.320		-5.502*	
			(2.833)		(2.933)	
L.sqrootOA	+			-6.630**		-8.8***
				(2.926)		(3.133)
_cons	?	-1.234**	0.712***	0.76***	-1.015	-0.984
		(0.588)	(0.0539)	(0.0660)	(0.581)	(0.580)
Year Controls Included		Yes	Yes	Yes	Yes	Yes
N observations		1091	1391	1391	1078	1078
N groups		299	347	347	296	296
R-sq		0.142	0.073	0.076	0.141	0.146
Fstat		5***	10.15***	12.3***	4.16***	4.46***
DF		15	6	5	17	16
Mean VIF		5.9	3.36	2.21	6.56	6.9
Hausman Chi2		71.4***	32***	26***	43***	66***
Breusch-Pagan LM Chi2		450***	880***	911***	448***	442***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation.

One potential explanation for this anomaly is that investors tend to withhold shares of firms with higher exploitation and combined disclosures due to expectations of higher growth and better future prospects. This informational content is reflected in evidence of association with lower trading volumes. This explanation might not be an accurate interpretation of the reversed sign, but it does open the door for future research to investigate anomalies related to this specific measure of liquidity.

7.5.4 Evidence of Analysts' Forecast Accuracy: Robustness Check

Table 7.12 displays the firm-fixed and year-fixed effects regression models for analyst forecast error while controlling for the forecast dispersion. The forecast error is an inverse proxy of forecast accuracy. Model 53 does not show consistent results with model 4 from Table 7.1. Despite the negative sign of exploration and exploitation coefficients, they are not significant at any level. Model 54, however, does show consistent results with model 5. Combined disclosure indicates significant beneficial effect at 5% level or better. In other words, a 1% increase in combined disclosure leads to a significant reduction in forecast error of 19** points[77]. This is consistent with evidence from returns volatility[78]. Evidence from the forecast error measure is unique. It indicates that both exploration and exploitation disclosures have the beneficial effect of reducing forecast error, given the negative signs of their coefficients in model 53, although these beneficial effects are not individually significant. Their combination, however, as shown by the negative coefficient of the combined disclosure in model 54, indicates a significant beneficial effect of reduced forecast error. This supports the notion of synergic benefits from combining exploration and exploitation disclosures, consistent with previous evidence (Floyd and Lane 2000; Cao, Gedajlovic, and Zhang 2009). The overall finding, at the level of the full sample, lends support to the hypothesized significant benefits from combined disclosures. This means that the full picture of exploration and exploitation, rather than their separate individual disclosures, is the effective policy for reducing forecast error.

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[77] In other words, the economic significance from one standard deviation increase in the combined disclosure is associated with 12 points decrease in the analyst forecast error.

[78] See Table 7.9.

Table 7.12 Accuracy of Analysts' Forecasts: Full Sample

		50	51	52	53	54
	Pred. Sign	Error	Error	Error	Error	Error
L.ESGScr	-	0.525			0.552	0.549
		-0.617			-0.612	-0.612
L.Beta	+	-0.197			-0.228	-0.234
		-0.146			-0.152	-0.153
L.LogTotAssets	-	1.186***			1.145**	1.165***
		-0.44			-0.456	-0.446
L.B2M	+	0.111			0.108	0.107
		-0.167			-0.168	-0.169
L.Debt2Assets	+	-0.138			-0.157	-0.169
		-0.515			-0.524	-0.523
L.ROA	-	-0.632			-0.617	-0.602
		-0.425			-0.429	-0.427
L.LGTM_GROWTH	?	-0.0438			-0.0398	-0.0401
		-0.102			-0.0978	-0.0974
L.RDDUMMY	+	0.201			0.196	0.21
		-0.422			-0.413	-0.417
L.HH Index	-	-0.176**			-0.174**	-0.173**
		-0.0752			-0.0758	-0.0762
L.NewFinancingdummy	?	0.0371			0.0448	0.0448
		-0.0761			-0.0772	-0.0767
L.ForecastDispersion	-	-0.152***			-0.155***	-0.154***
		-0.0393			-0.0381	-0.0385
L.Analysts	-	-0.00716			-0.00738	-0.00742
		-0.00798			-0.00797	-0.00795
L.Explr	-		-1.993		-1.992	
			-1.277		-1.373	
L.Explt	-		-6.163		-13.32	
			-7.761		-9.817	
L.sqrootOA	-			-13.93**		-19.00**
				-6.752		-8.333
_cons	?	-3.734*	0.620***	0.747***	-3.313	-3.272
		-1.635	-0.125	-0.138	-1.78	-1.734
Year Controls Included		Yes	Yes	Yes	Yes	Yes
N observations		1027	1310	1310	1015	1015
N groups		296	343	343	293	293
R-sq		0.052	0.01	0.011	0.056	0.058
Fstat		3.3***	1.37	1.7	3.53***	3.73***
DF		16	6	5	18	17
Mean VIF		6.18	3.35	2.24	6.85	7.18
Hausman Chi2		49***	8.13	10.3*	51***	55***
Breusch-Pagan LM Chi2		70.7***	173***	173***	71***	70***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation.

7.5.5 Endogeneity Control: Robustness Check

As described in previous studies (Nikolaev and Van Lent, 2005), the relationship between disclosure and the cost of capital is subject to endogeneity concerns. To check for the sufficiency of one-year lags in minimizing endogeneity bias, the baseline models are re-run by reversing the dependent and independent variables. Table 7.13 presents the firm-fixed and year-fixed effects regression models for exploration (models 55-56), exploitation (models 57-58) and combined disclosures (models 59-60). The six models show the three disclosures as dependent variables which are modelled on the one-year lags of control variables and the PEG estimates for the implied cost of equity capital. The base argument assumes that one-year lags of disclosure variables explain variations in the cost of equity capital, but the one-year lag of the cost of equity capital does not explain variations in the disclosure variables.

It is clear from Table 7.13 that the one-year lag of the cost of equity capital (using PEG estimates) does not explain variations in disclosure variables. Obviously, the one-year lag of the PEG variable is not significantly correlated with exploration disclosure (model 56), exploitation disclosure (model 58) or combined disclosures (model 60). The one-year lags of exploration disclosure (model 9 in Table 7.3), exploitation disclosure (model 4 in Table 7.1) and combined disclosure (model 5 in Table 7.1) are all significantly correlated with the PEG estimates for the cost of equity capital. This further asserts the assumption of strict exogeneity between the dependent and independent variables resulting from the use of one-year lags in modelling the association between disclosure and the cost of equity capital.

Further analysis (not reported here) was run using second-year lags for modelling the association between disclosure and the cost of equity capital. Results from the second-year lags stand robust and qualitatively similar to results from modelling with one-year lags.

Table 7.13 Endogeneity Control: Implied Cost of Equity Capital for the Full Sample

		55	56	57	58	59	60
	Pred. Sign	Explr	Explr	Explt	Explt	sqrootOA	sqrootOA
L.ESGScr	+	0.00489	0.00464	0.0022	0.00233	0.00343	0.00335
		(0.00365)	(0.00372)	(0.0026)	(0.00272)	(0.00258)	(0.00263)
L.Beta	+	-0.00181*	-0.00176*	-0.0008	-0.00092*	-0.00122**	-0.00122**
		(0.00098)	(0.00101)	(0.0005)	(0.00057)	(0.00058)	(0.00058)
L.LogTotAssets	+	-0.00145	-0.00141	-0.0013	-0.00156	-0.00113	-0.00124
		(0.00236)	(0.00229)	(0.0015)	(0.00164)	(0.00138)	(0.00139)
L.B2M	-	-0.00064	-0.00065	0.00013	0.00001	-0.00016	-0.00024
		(0.00046)	(0.00053)	(0.0003)	(0.0004)	(0.00034)	(0.00039)
L.Debt2Assets	+	0.00169	0.00246	0.00053	0.00033	0.000771	0.000889
		(0.00262)	(0.00281)	(0.0016)	(0.00195)	(0.0017)	(0.00195)
L.ROA	+	0.00511**	0.00560**	0.00156	0.00171	0.00313*	0.00339*
		(0.00245)	(0.00265)	(0.0018)	(0.00196)	(0.00179)	(0.00198)
L.AnalystsDummyHigh	+	0.000148	0.000256	0.00011	0.000152	0.000585	0.000408
		(0.00036)	(0.00037)	(0.0003)	(0.00034)	(0.00024)	(0.00025)
L.LGTM_GROWTH	+	0.00032	0.000223	-0.0001	-0.00092	0.000126	0.00097
		(0.00048)	(0.00052)	(0.0002)	(0.00025)	(0.00026)	(0.00029)
L.RDDUMMY	+	-0.00132	-0.00132	-0.0033	-0.00327	-0.00321	-0.00322
		(0.00161)	(0.00163)	(0.003)	(0.00307)	(0.00305)	(0.00306)
L.HH Index	+	0.000638**	0.000896**	0.00042*	0.00058*	0.000519**	0.000730**
		(0.000290	(0.00039)	(0.00022)	(0.00031)	(0.00022)	(0.00033)
L.NewFinancingdummy	+	-0.00022	-0.00037	0.000142	0.00001	-0.00024	-0.00013
		(0.00037)	(0.00037)	(0.00025)	(0.00026)	(0.00026)	(0.00026)
L.PEG	+		-0.00318		0.000906		-0.00069
			(0.00529)		(0.0038)		(0.00406)
_cons	?	0.0293***	0.0295***	0.0205***	0.0216***	0.0237***	0.0243***
		(0.00844)	(0.00837)	(0.00556)	(0.00616)	(0.00516)	(0.00528)

Year Controls Included	Yes	Yes	Yes	Yes	Yes	Yes
N observations	1030	977	1030	977	1030	977
N groups	295	289	295	289	295	289
R-sq	0.041	0.047	0.071	0.078	0.08	0.089
Fstat	2.13***	2.21***	2.7***	2.6***	2.65***	2.81***
DF	15	16	15	16	15	16
Mean VIF	6	6.15	6	6.15	6	6.15
Hausman Chi2	26.25**	33***	36.8***	46.6***	34.5***	37.5***
Breusch-Pagan LM Chi2	674***	571***	827***	823***	688***	636***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation.

7.5.6 Additional Robustness Checks

Two more types of robustness check were conducted. The first was to check for the sensitivity of results for omissions of any of the control variables; step hierarchical regressions were run by adding one control variable at a time. Results from the hierarchical regressions (not reported here) show robust and qualitatively consistent evidence with that reported in the main models (1-5) in Table 7.1. Second, a series of analyses was run to check for the robustness of results using different functional forms as measures of innovation disclosure. For instance, the natural log of word frequencies for exploration and exploitation instead of coverage percentages was used to measure their respective disclosures. Results (not reported here) are not only qualitatively similar but exactly the same statistically as those in the baseline models (1-5) in Table 7.1.

While regarding the functional form of combined disclosures, the simple product of coverage percentages of exploration disclosure and exploitation disclosure is used without square-rooting as a measure of combined disclosure. Results (not reported here) show exact significant levels with the dependent variable but with much-exaggerated coefficients. The simple product functional form as a measure of combined disclosures is not compatible with the functional forms of any of the cost of capital measures. This is why the magnitude of coefficients is very much exaggerated when the simple product is used as a functional form.

A final check was run to find whether there is an interaction effect between exploration and exploitation disclosures. To avoid the hike in collinearity estimates, an interaction term is generated using demeaned exploration and exploitation percentages. The baseline models were re-estimated while adding the demeaned interaction term along with the exploration and exploitation percentages and the results (not reported here) reveal no interaction effect of any form.

7.6 Summary

This chapter presented evidence for the association between innovation disclosure and the cost of equity capital. The PEG-based baseline models for the full sample suggest that the bulk of benefits emerge from exploitation rather than exploration disclosure, although the descriptive statistics of the previous chapter show that, on average, exploration is more often disclosed than exploitation. Evidence of the baseline models supports hypotheses H1b and H1c but fails to support H1a.

Further robustness checks resulted in evidence consistent with the baseline models of the PEG estimates. Robustness checks using the average cost of equity capital estimates from CAPM and PEG models show significant benefits from exploitation and combined disclosures but no evidence for benefits of exploration disclosure. Robustness checks using CAPM estimates alone, however, show weak but supportive evidence for benefits of exploitation and combined disclosures but no evidence for benefits of exploration disclosure. Similarly, the liquidity measures (i.e. average closing bid-ask spread percentages and the ratio of closing trading volume to outstanding number of shares) also show weak but supportive evidence for benefits of exploitation disclosure but no evidence for benefits of exploration disclosure. However, both of these liquidity measures show significant evidence in support of benefits from the combined disclosures.

Moreover, evidence of modelling volatility of stock returns and analyst forecast error supports benefits from the combined disclosures rather than the individual exploration and exploitation disclosures, reinforcing the notion of synergic benefits from combining exploration and exploitation disclosures. Endogeneity checks support the adequacy of one-year lags in mitigating endogeneity bias, confirming the assumption of an exogenous association between innovation disclosures and the cost of equity capital using the PEG estimates.

Evidence of modelling the interaction term of the combined disclosure and HH Index supports the second hypothesis that the benefits of combined disclosures are weakened in the presence of proprietary costs. Evidence from sub-sampling by R&D expenditure shows that R&D firms enjoy significant benefits from exploration and combined disclosures while non-R&D firms enjoy significant benefits from exploitation disclosure. Therefore, the R&D firms support hypotheses H1a and H1c whereas the non-R&D sub-sample supports only H1b. Interestingly, R&D firms enjoy over double the full-sample average benefits from combined disclosure, which indicates that they receive the highest synergic benefit from combining exploration and exploitation disclosures.

Sub-sampling by analyst followings, however, shows that firms with high analyst following enjoy significant benefits from exploitation and combined disclosures. For the high analyst-following group, the benefits of combined disclosure outweigh those of exploitation disclosure, which also indicates a synergic benefit of combining both exploration and exploitation disclosures. Firms with low analyst following enjoy only benefits from exploitation disclosure, which are double the full-sample average benefits and triple the high analyst group of firms' benefits from exploitation disclosure. This is consistent with previous evidence from the literature that firms with low analyst followings enjoy higher benefits for the same disclosure levels than do firms with high analyst followings (Botosan 2000; Richardson and Welker 2001). The summary of sub-grouping by analyst following shows that firms with high analyst followings offer supportive evidence in favour of hypotheses H1b and H1c, while the group of low analyst followings supports only hypothesis H1b.

Sub-sampling by size, however, shows evidence comparable to that of sub-sampling by analyst followings, since the large firms tend to be widely followed by market analysts (Botosan 2000; Richardson and Welker 2001). The group of large firms lends supportive evidence to hypotheses H1b and H1c group of small firms only to hypothesis H1b. The sub-grouping by size shows that large firms earn benefits from innovation disclosures that outweigh those of small firms. This is consistent with previous arguments that large firms are capable of pursuing relatively larger levels of innovation, given the scale of their resources (Cao, Gedajlovic, and Zhang 2009). This explains the sizable benefits from innovation disclosures for large-sized firms in comparison with small-sized firms.

Finally, the sub-sampling by the issuance of new financings shows that firms with newly raised financings earn benefits from exploitation and combined disclosures, supporting H1b and H1c. The sub-sample of firms with no new financings, however, presents no evidence to support any form of the first hypothesis.

The group of high analyst followings reveals interesting evidence regarding the ESG disclosure score. There are significant benefits from ESG disclosure only for high analyst-following firms, while the full-sample average benefits from ESG disclosure are not significant at any level. This finding contributes to the ongoing literature on ESG disclosure by underscoring the vital role of analyst followings with regards to capital market benefits from such disclosure. A second observation is also recorded on ESG disclosure: the amount of benefits from ESG disclosure is very small compared to the benefits from exploitation and combined disclosure. This could be due either to the different scales of measurement or to the different nature and substance of ESG and innovation disclosures.

The following chapter discusses empirical evidence from the after-tax cost of debt capital.

Chapter 8 After-Tax Cost of Debt Capital: Empirical Evidence

8.1 Introduction

The previous chapter discussed empirical evidence for the association of innovation disclosure and the cost of equity capital. Evidence for the full sample suggests that firms, on average, disclose more exploration than exploitation, although the bulk of benefits emerge from exploitation rather than exploration disclosure, with the notable exception of R&D firms that show significant benefits from exploration disclosure. This chapter presents the empirical results for the association between innovation disclosures (i.e. exploration, exploitation, and combined disclosures) and the after-tax cost of debt capital.

The following section discusses the baseline models of the after-tax cost of debt capital for a sample that excludes financial sector firms. A sensitivity analysis has been run on the full sample, a sample without the financial sector and a third time on a sample of the financial sector alone. Results show sensitive outcomes from including the financial sector firms and, therefore, a decision has been made to remove the financial sector from the sample throughout all the empirical analysis of this chapter. Section 8.3 presents the empirical results of modelling the interaction term of innovation disclosures and HH Index to account for the moderating effects of proprietary costs on the association between innovation disclosure and the after-tax cost of debt capital. Section 8.4 presents the results of the sub-sampling approach using the four sub-groups. Section 8.5 presents the results of the relevant robustness checks, while section 8.6 summarizes the chapter.

8.2 Evidence of Baseline Models

Table 8.1 displays the firm-fixed and year-fixed effects regression models for the after-tax cost of debt capital. Unlike the sample for the cost of equity capital analysis in the previous chapter, the sample for the cost of debt analysis is limited to non-financial sectors. The financial sector plays a significant role in determining the interest rates (cost of debt) for firms of other sectors and is therefore excluded.

Based on the after-tax cost of debt capital for the non-financial sample, model 64 shows that exploitation disclosure is associated with significant benefits at 5% level or better, whereas the effects of exploration disclosure are not significant at any level. Interestingly, the coefficient of exploration disclosure has a positive sign. Given that exploration orientation entails a higher degree of risk-taking, lenders might compensate for such risks by demanding a higher cost of debt capital. This explains the positive sign for the coefficient of exploration disclosure, but there is not enough statistical evidence to support such an argument at any level.

Exploitation disclosure is associated with reductions in the after-tax cost of debt capital at 5% significance level for 0.274%**, as shown in model 64. This indicates that a 1% increase in exploitation disclosure is associated with a roughly 0.274% decrease in the after-tax cost of debt capital[79]. One notable difference is observed regarding the benefits of exploitation disclosure: the amount of significant reduction in the after-tax cost of debt capital is marginal when compared to the benefits of reduced cost of equity capital[80]. However, despite the negative sign of the association between the combined disclosures (sqrootOA) and the after-tax cost of debt capital, model 65 shows that the benefits of the combined disclosure are not significant at any level. This, once again, highlights the potential erosion of benefits from exploitation disclosure when combined with exploration disclosure, never mind the potential of synergic benefits from both disclosures. The findings from these results support hypothesis H1b but fail to support hypotheses H1a and H1c. This means that for the sample of non-financial sectors during the period 2011-2016, only exploitation disclosure is associated with benefits of reduced after-tax cost of debt capital. It should also be noted that firms on average disclose more exploration than exploitation information[81], although significant benefits arise from exploitation rather than exploration disclosure. A final note on results of the baseline models is the reversed signs for variables of beta, size, leverage, binary control of analyst following and the R&D binary control. This anomaly is also observed in many of the later modelling results throughout the current chapter.

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[79] In other words, the economic significance from one standard deviation increase in exploitation disclosure is associated with 7.3% decrease in the after-tax cost of debt capital.

[80] See model 4 in Table 7.1

[81] See Table 6.4.

Table 8.1 Baseline Models for After-Tax Cost of Debt Capital: Adjusted Sample

		Baseline Models				
		61	62	63	64	65
	Pred Sign	CoDebt_AT	CoDebt_AT	CoDebt_AT	CoDebt_AT	CoDebt_AT
L.ESGScr	-	-0.00475			-0.00438	-0.00445
		(0.00855)			(0.00856)	(0.00860)
L.Beta	+	-0.00285			-0.00293	-0.00286
		(0.00233)			(0.00244)	(0.00241)
L.LogTotAssets	-	0.0149**			0.0162***	0.0162***
		(0.00573)			(0.00582)	(0.00578)
L.B2M	+	0.000808			0.000774	0.000718
		(0.00122)			(0.00120)	(0.00121)
L.Debt2Assets	+	-0.0000957			-0.00116	-0.000800
		(0.00946)			(0.00953)	(0.00958)
L.ROA	-	-0.0106			-0.0125*	-0.0120*
		(0.00730)			(0.00730)	(0.00724)
L.AnalystsDummyHigh	-	0.000405			0.000371	0.000445
		(0.00101)			(0.00102)	(0.00102)
L.LGTM_GROWTH	?	-0.0000268			0.0000884	0.0000329
		(0.000825)			(0.000831)	(0.000841)
L.RDDUMMY	+	-0.00156			-0.00114	-0.000972
		(0.00131)			(0.00129)	(0.00128)
L.HH Index	-	-0.00153**			-0.00136*	-0.00141*
		(0.000718)			(0.000740)	(0.000751)
L.NewFinancingdummy	?	-0.000394			-0.000335	-0.000399
		(0.00104)			(0.00106)	(0.00106)
L.Explr	-		-0.0246		0.00905	
			(0.0159)		(0.0212)	
L.Explt	-		-0.145		-0.274**	
			(0.107)		(0.121)	
L.sqrootOA	-			-0.125		-0.131
				(0.108)		(0.122)
_cons	?	-0.0342	0.0148***	0.0144***	-0.0346	-0.0365
		(0.0210)	(0.00170)	(0.00206)	(0.0213)	(0.0210)
Year Controls Included		Yes	Yes	Yes	Yes	Yes
N observations		838	1066	1066	826	826
N groups		235	267	267	232	232
R-sq		0.222	0.186	0.185	0.228	0.224
Fstat		18.6***	33.9***	40.76***	16.25***	17.63***
DF		15	6	5	17	16
Mean VIF		7.44	3.14	2.26	8.16	8.82
Hausman Chi2		83***	20**	6.34	62***	51***
Breusch-Pagan LM Chi2		520***	778***	783***	516***	519***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation. CoDebt_AT stands for the Bloomberg-based after-tax cost of debt capital.

For instance, models 61, 64 and 65 show that size has a significant association but a reversed sign coefficient, meaning that large firms tend to bear a higher after-tax cost of debt capital. This result does not make sense because large firms have a greater scale of resources and well-diversified business operations that make them relatively less risky. This is also inconsistent with reported findings of previous research (Pittman and Fortin 2004; Francis, Khurana, and Pereira 2005; Kim et al. 2011; Orens, Aerts, and Lybaert 2009) and points to a potential limitation in the Bloomberg-based estimates of the after-tax cost of debt capital. However, it is worth noting once again that previous studies (Pittman and Fortin 2004; Francis, Khurana, and Pereira 2005; Kim et al. 2011; Orens, Aerts, and Lybaert 2009) used the before-tax interest rates as a proxy for the cost of debt capital which is not essentially comparable with the after-tax cost of debt capital as estimated by Bloomberg.

8.3 Evidence of Moderating Effects of Proprietary Costs

Table 8.2 displays the firm-fixed and year-fixed effects regression models for the after-tax cost of debt capital with respect to interactions between combined disclosure and proprietary costs (HH Index). The three-step hierarchical regression, following (Sharma, Durand, and Gur-Arie 1981), is applied to study the moderating effects of proprietary costs on the association between the combined disclosure and after-tax cost of debt capital. Three models are to be fitted on the dependent variable (CoDebt_AT), one at a time. The first (model 66) includes the independent variable (sqrootOA) along with the control variables. The second model (68) introduces the moderating factor (HH Index) and the third model (67) adds in the interaction term (sqrootOA*HH Index). For a moderation effect to be recognized, the three models should indicate gradual improvements in the value of (R-sq) and (F-stat). There is an observed gradual improvement in their values from models 66 to 67 but not from models 67 to 68. So, the conditions for a moderating effect are not satisfied; moderating effect of proprietary costs on the association between combined disclosure and the after-tax cost of debt capital is therefore not recognized.

Table 8.2 Moderating Effects of Proprietary Costs on the Association between Combined Disclosures and the After-Tax Cost of Debt Capital: Adjusted Sample

		Disclosure-competition interaction		
		66	67	68
	Pred Sign	CoDebt_AT	CoDebt_AT	CoDebt_AT
L.ESGScr	-	-0.00469	-0.00445	-0.00475
		(0.00862)	(0.00860)	(0.00858)
L.Beta	+	-0.00261	-0.00286	-0.00276
		(0.00239)	(0.00241)	(0.00243)
L.LogTotAssets	-	0.0149***	0.0162***	0.0166***
		(0.00545)	(0.00578)	(0.00581)
L.B2M	+	0.000659	0.000718	0.000704
		(0.00117)	(0.00121)	(0.00121)
L.Debt2Assets	+	0.0000457	-0.000800	-0.000902
		(0.00943)	(0.00958)	(0.00959)
L.ROA	-	-0.0103*	-0.0120*	-0.0122*
		(0.00588)	(0.00724)	(0.00725)
L.AnalystsDummyHigh	-	0.000355	0.000445	0.000461
		(0.00100)	(0.00102)	(0.00102)
L.LGTM_GROWTH	?	0.000158	0.0000329	0.0000261
		(0.000737)	(0.000841)	(0.000843)
L.RDDUMMY	+	-0.000901	-0.000972	-0.000962
		(0.00130)	(0.00128)	(0.00128)
L.NewFinancingdummy	?	-0.000379	-0.000399	-0.000413
		(0.00107)	(0.00106)	(0.00106)
L.sqrootOA	-	-0.144	-0.131	-0.147
		(0.121)	(0.122)	(0.125)
L.HH Index	-		-0.00141*	-0.00241*
			(0.000751)	(0.00126)
L.sqrootOA*HH Index	-			0.0257
				(0.0203)
_cons	?	-0.0331	-0.0365	-0.0369
		(0.0195)	(0.0210)	(0.0210)
Year Controls Included		Yes	Yes	Yes
N observations		832	826	826
N groups		233	232	232
R-sq		0.220	0.224	0.224
Fstat		17.14***	17.63***	17.18***
DF		15	16	17
Mean VIF		8.73	8.82	13.52
Hausman Chi2		55***	51***	77***
Breusch-Pagan LM Chi2		536***	519***	483***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation.

Furthermore, the coefficients of the independent variable (sqrootOA) and the interaction term (sqrootOA*HH Index) are not significant at any level, while the coefficient of the moderating factor (HH Index) is weakly significant at 10% level. This indicates that proprietary costs do not moderate the association between combined disclosures and the after-tax cost of debt capital.

However, a further check was conducted on the individual disclosures of exploration and exploitation and a moderating effect of HH Index detected for exploitation disclosure. The results of the interaction term between exploitation disclosure and HH Index are reported in Table 8.3.

As shown in Table 8.3, model 69 includes the independent variable (Explt) along with the control variables. Model 70 introduces the moderating factor (HH Index) and finally, model 71 adds in the interaction term (Explt*HH Index). The three models (69-71) indicate gradual improvements in the value of R-sq while the F-stat value improves from 69 to 70 but decreases from 70 to 71. Nevertheless, the F-stat value in model 71 is higher than in model 69, which is an acceptable improvement overall. Hence, the first condition for recognizing a moderating effect is satisfied.

The second condition is also satisfied since model 71 shows significant coefficients for the independent variable (Explt), the moderating factor (HH Index) and the interaction term (Explt*HH Index) indicating a case of quasi-moderation. This unique case indicates, first, that the association between exploitation disclosure and the cost of debt capital is moderated by the level of competition (e.g. HH Index); and second that the association between the competition level and the cost of debt capital is moderated by exploitation disclosure. In models 69-71, the independent variable (exploitation disclosure) shows consistent significant reductions in the after-tax cost of debt capital. These benefits range from a minimum of 0.28%** in model 69 to a maximum of 0.29%** in model 71.

In model 71, however, the positive coefficient of the interaction term (0.0357**) indicates that the significant negative association (0.29%**) between exploitation disclosure and the after-tax cost of debt capital is less pronounced (as in less negative or weaker) when the

HH Index is high. In other words, the weaker the competitions (i.e. when HH Index is high), the lower the benefits from exploitation disclosure. That is, firms that are facing low (high) competition pressure, earn a less (more) reduction in the after-tax cost of debt capital from exploitation disclosure. This finding does not support hypothesis H2 and is not consistent with reported findings of previous research (Botosan and Stanford 2005; Blanco, Garcia Lara, and Tribo 2015). One potential explanation is the problematic nature of the Bloomberg-based after-tax cost of debt capital. As mentioned in the previous section, many critical control variables show a reversed sign, including the size factor. Even in Table 8.3, the same problem exists.

Another explanation, however, could be the unique effect of competition that makes it hard for firms to generate value from explorative activities and forces them towards more concentrated efforts to create credible exploitation outcomes (e.g. incremental improvements and cost savings). Therefore, the exploitative efforts of firms facing higher competition tend to have more value for creditors who appreciate risk reductions and generating valuable incremental improvements and cost savings. This perhaps explains why firms facing higher competition enjoy greater reductions in the after-tax cost of debt capital. Jansen et al. (2006) reported consistent evidence as they found that pursuing exploitative innovation is more beneficial to a unit’s financial performance when operating in a competitive environment, while pursuing exploratory innovation is more effective when operating in a dynamic environment. Whatever the true explanation is, this finding is interesting for future research to re-investigate the matter with more reliable measures of the cost of debt capital (e.g. bond yield rates).

Table 8.3 Moderating Effects of Proprietary Costs on the Association of Exploitation Disclosure and the After-Tax Cost of Debt Capital: Adjusted Sample

		Disclosure-competition interaction		
	Pred Sign	69	70	71
		CoDebt_AT	CoDebt_AT	CoDebt_AT
L.ESGScr	-	-0.00459	-0.00435	-0.00443
		(0.00857)	(0.00855)	(0.00854)
L.Beta	+	-0.00271	-0.00297	-0.00293
		(0.00244)	(0.00246)	(0.00246)
L.LogTotAssets	-	0.0150***	0.0162***	0.0165***
		(0.00549)	(0.00581)	(0.00582)
L.B2M	+	0.000704	0.000754	0.000737
		(0.00116)	(0.00120)	(0.00120)
L.Debt2Assets	+	-0.000269	-0.00113	-0.00115
		(0.00937)	(0.00952)	(0.00952)
L.ROA	-	-0.0107*	-0.0124*	-0.0125*
		(0.00591)	(0.00726)	(0.00727)
L.AnalystsDummyHigh	-	0.000283	0.000380	0.000380
		(0.00100)	(0.00103)	(0.00103)
L.LGTM_GROWTH	?	0.000197	0.0000885	0.0000931
		(0.000727)	(0.000830)	(0.000831)
L.RDDUMMY	+	-0.00108	-0.00114	-0.00114
		(0.00131)	(0.00129)	(0.00129)
L.NewFinancingdummy	?	-0.000317	-0.000339	-0.000354
		(0.00107)	(0.00107)	(0.00106)
L.Explt	-	-0.280**	-0.271**	-0.290**
		(0.120)	(0.121)	(0.123)
L.HH Index	-		-0.00136*	-0.0024***
			(0.000743)	(0.000901)
L.Explt*HH Index	-			0.0357**
				(0.0164)
_cons	?	-0.0316	-0.0345	-0.0350
		(0.0197)	(0.0213)	(0.0213)
Year Controls Included		Yes	Yes	Yes
N observations		832	826	826
N groups		233	232	232
R-sq		0.224	0.227	0.228
Fstat		16.76***	17.2***	16.9***
DF		15	16	17
Mean VIF		8.1	8.08	11.7
Hausman Chi2		59.4***	57***	67.3***
Breusch-Pagan LM Chi2		538***	521***	496***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation.

8.4 Evidence from the Sub-sampling Approach

The following sub-sections discuss the results for the sub-sampling approach using the four sub-grouping criteria.

8.4.1 R&D vs. non-R&D Firms

Table 8.4 displays the firm-fixed and year-fixed effects regression models for the after-tax cost of debt capital for sub-groups R&Dand non-R&D firms. Models 72-73 present the results of modelling R&D firms only and models 74-75 the non-R&D firms. It is worth noting that the financial sector is excluded from the sample.

The benefits of exploration disclosure (0.0195%), exploitation disclosure (0.0705%) and combined disclosures (0.0673%) of R&D firms appear not to be significant at any level. However, models 74-75 for the non-R&D sub-sample present results consistent with models 64-65 in Table 8.1. The coefficient of exploration disclosure shows a positive sign but is not significant at any level. The coefficient of exploitation disclosure shows significant benefits of 0.445%**, whereas the benefits of the combined disclosure (0.19%) are not significant at any level. This indicates that non-R&D firms gain 0.445%** of reduced after-tax cost of debt capital with each 1% increase in exploitation disclosure. In comparison with results from model 64 (Table 8.1), the amount of benefits from exploitation disclosure for non-R&D firms (0.445%**) is higher than that of the rest of the sample (0.274%**). The insignificance of benefits from the combined disclosure, however, again underscores potential credibility issues surrounding exploration disclosures for non-R&D firms. This explains why the combination of exploration and exploitation disclosures does not show any significant benefits, never mind the synergetic benefits.

The results of models 72-75 lend support only to hypotheses H1b based on evidence from the sub-sample of non-R&D firms. This means that for the period 2011-2016, only the non-R&D group of firms show evidence of significant reductions in the after-tax cost of debt capital from exploitation disclosure. The R&D sub-sample exhibits no evidence of significant benefits from any of the disclosures.

Table 8.4 R&D vs. non-R&D Firms: After-Tax Cost of Debt Capital

		R&D and non-R&D Firms			
		72	73	74	75
	Pred Sign	CoDebt_AT	CoDebt_AT	CoDebt_AT	CoDebt_AT
		R&D	R&D	non-R&D	non-R&D
L.ESGScr	-	-0.00964	-0.00964	0.00656	0.00545
		(0.00962)	(0.00963)	(0.0152)	(0.0154)
L.Beta	+	0.00124	0.00137	-0.00516*	-0.00566*
		(0.00353)	(0.00345)	(0.00314)	(0.00320)
L.LogTotAssets	-	0.0314***	0.0314***	0.00232	0.00252
		(0.00761)	(0.00766)	(0.00740)	(0.00769)
L.B2M	+	0.000356	0.000359	0.00106	0.00108
		(0.00299)	(0.00294)	(0.00142)	(0.00144)
L.Debt2Assets	+	0.0180**	0.0180**	-0.0132	-0.0121
		(0.00798)	(0.00798)	(0.0145)	(0.0147)
L.ROA	-	-0.00244	-0.00246	-0.0205*	-0.0193
		(0.00700)	(0.00694)	(0.0126)	(0.0124)
L.AnalystsDummyHigh	-	-0.000159	-0.000164	0.000406	0.000655
		(0.00142)	(0.00142)	(0.00146)	(0.00148)
L.LGTM_GROWTH	?	0.000334	0.000339	0.000345	0.000195
		(0.00151)	(0.00150)	(0.000901)	(0.000941)
L.HH Index	-	-0.00355	-0.00358	-0.000615	-0.000723*
		(0.00266)	(0.00265)	(0.000423)	(0.000422)
L.NewFinancingdummy	?	0.000517	0.000518	-0.000469	-0.000583
		(0.00155)	(0.00155)	(0.00138)	(0.00138)
L.Explr	-	-0.0195		0.00739	
		(0.135)		(0.0202)	
L.Explt	-	-0.0705		-0.445**	
		(0.141)		(0.211)	
L.sqrootOA	-		-0.0673		-0.190
			(0.203)		(0.161)
L.LogRD2Sales	+	-0.00272	-0.00277		
		(0.00306)	(0.00302)		
_cons	?	-0.100***	-0.100***	0.0166	0.0133
		(0.0281)	(0.0279)	(0.0259)	(0.0267)
Year Controls Included		Yes	Yes	Yes	Yes
N observations		346	346	480	480
N groups		98	98	139	139
R-sq		0.306	0.306	0.234	0.226
Fstat		15.25***	15.69***	9.04***	9.28***
DF		17	16	16	15
Mean VIF		11	10.6	9.11	10
Hausman Chi2		38***	44.5***	36***	29**

Breusch-Pagan LM Chi2	340***	339***	75***	80***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation. For models 72-73, the ratio of R&D expenditure to sales is included to limit the sample to R&D firms. For non-R&D firms, models (74-75) are estimated with a conditional requirement of R&D.Dummy = which limits the sample to non-R&D firms.

8.4.2 High vs. Low Analyst-Following Firms

Table 8.5 displays the firm-fixed and year-fixed effects regression models for the after-tax cost of debt capital for groups of high and low analyst-following firms. Once again, the sub-sampling approaching conducted in this analysis excludes the financial sector from consideration. Models 76-77 present the results of firms in the high analyst-following group and models 78-79 the results for low analyst following firms.

Firms with high analyst followings (models 76-77) enjoy significant benefits from exploitation disclosure (0.485%***) and combined disclosure (0.315%**). The amount of benefit from exploitation disclosure (0.485 %***) clearly exceeds the average of the larger sample (0.274%**) as shown in model 76. Exploration disclosure, however, shows a positive signed but insignificant coefficient (0.0904 %). The positive sign is potentially related to the core contents of exploration disclosure which are inherently of high-risk nature. While the insignificance indicates that narratives of exploration disclosure suffer from potential credibility issues, the effects of such disclosure are not significant at any level. This is even more evident when observing the benefits of the combined disclosure, which are lower than the individual benefits of exploitation disclosure; indicating an erosion of benefits when combining exploration with exploitation disclosure. Firms in the low analyst-following group, as shown in models 78-79, exhibit no effects of any of the disclosure measures at any level of significance. These results bring into question not only the credibility of exploration and exploitation disclosures of these firms but also the role of analysts following the firm in providing a more transparent and higher quality information environment. By contrasting the high and low analyst-following groups, evidence shows that only the former enjoy significant reductions in the after-tax cost of debt capital from exploitation disclosure and combined disclosures. This contradicts earlier findings based on the cost of equity capital, as in the previous chapter. It is also inconsistent with previous findings (Botosan 2000; Richardson and Welker 2001) that firms with low analyst followings enjoy higher benefits for the same disclosure levels than do firms with high analyst followings.

Table 8.5 High vs. Low Analyst-Following Firms: After-Tax Cost of Debt Capital

	High vs low analyst-following firms				
		76	77	78	79
	Pred Sign	CoDebt_AT	CoDebt_AT	CoDebt_AT	CoDebt_AT
		High Analyst Followings		Low Analyst Followings	
L.ESGScr	-	-0.00898	-0.00770	-0.0243	-0.0216
		(0.00861)	(0.00843)	(0.0255)	(0.0245)
L.Beta	+	-0.00111	-0.00125	-0.00107	-0.00120
		(0.00261)	(0.00263)	(0.00520)	(0.00525)
L.LogTotAssets	-	0.0103	0.0102	0.0245**	0.0238*
		(0.00820)	(0.00804)	(0.0121)	(0.0121)
L.B2M	+	0.00116	0.00101	-0.00181	-0.00142
		(0.00129)	(0.00129)	(0.00392)	(0.00358)
L.Debt2Assets	+	-0.00686	-0.00645	0.000577	-0.000193
		(0.0132)	(0.0133)	(0.0169)	(0.0168)
L.ROA	-	-0.0102*	-0.00897	-0.0106	-0.0147
		(0.00588)	(0.00583)	(0.0246)	(0.0241)
L.LGTM_GROWTH	?	-0.000848	-0.000858	-0.00151	-0.00132
		(0.000742)	(0.000763)	(0.00108)	(0.000988)
L.RDDUMMY	+	-0.00150*	-0.000963	-0.000595	-0.000306
		(0.000876)	(0.000948)	(0.00449)	(0.00420)
L.HH Index	-	-0.00127*	-0.00125	0.00215	0.00254
		(0.000777)	(0.000845)	(0.00543)	(0.00564)
L.NewFinancingdummy	?	0.00137	0.00128	-0.000343	-0.000522
		(0.00117)	(0.00120)	(0.00209)	(0.00205)
L.Explr	-	0.0904		-0.00101	
		(0.0704)		(0.0128)	
L.Explt	-	-0.485***		0.416	
		(0.148)		(0.337)	
L.sqrootOA	-		-0.315**		0.264
			(0.136)		(0.306)
_cons	?	-0.0138	-0.0135	-0.0609	-0.0583
		(0.0327)	(0.0320)	(0.0369)	(0.0365)
Year Controls Included		Yes	Yes	Yes	Yes
N observations		574	574	252	252
N groups		159	159	133	133
R-sq		0.251	0.242	0.239	0.235
Fstat		34.84***	16.12***	7.38***	7.3***
DF		16	15	16	15
Mean VIF		9.84	9.65	7.42	8.6
Hausman Chi2		29.5**	24.6*	39***	38***
Breusch-Pagan LM Chi2		61.3***	64***	91***	90***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation. Models 76-77 are estimated with the condition that AnalystDummyHigh = 1 and

models 78-79 with AnalystDummyHigh = 0.

The after-tax cost of debt capital evidence underscores the role of analyst followings in alleviating information asymmetries for lenders and creating a highly transparent information environment. Firms with high analyst followings enjoy a higher-quality information environment, reflecting the relatively fewer risks for creditors and lower interest rates. Once again, evidence from the after-tax cost of debt capital lends support for hypotheses H1b and H1c by firms in the high analyst-followings group. Evidence from firms in the low analyst-followings group does not support any form of H1.

8.4.3 Large vs. Small Firms

Table 8.6 displays the firm-fixed and year-fixed effects regression models for the after-tax cost of debt capital for groups of large and small firms. These results are robust if either proxy of size is used: total assets or market capitalization. Sub-sampling analysis by the size factor excludes firms in the financial sector. Models 80-81 present the results of large firms and models 82-83 present those of small firms. The effects of exploration disclosure and combined disclosure are significant at no level for either group. The only relevant result, as shown in model 80, is weak evidence of benefits from exploitation disclosure (0.422%*) for large-sized firms. These benefits are relatively similar to those from exploitation disclosure (0.485%***) of firms in the high analyst-following group (model 76 in Table 8.5). This makes sense as most of the highly followed firms are also large (Botosan 2000; Richardson and Welker 2001). The effects of exploitation disclosure for small firms are not significant at any level. Consistent with earlier evidence from the cost of equity capital (see the previous chapter), that large firms enjoy greater benefits from exploitation disclosure, is the argument that large firms have greater credibility in their exploitation disclosure since they are capable of pursuing more innovations, given the scale of the resources at their disposal (Cao, Gedajlovic, and Zhang 2009).

Overall, the results from sub-sampling by size factor present weak evidence in support of hypothesis H1b, and mainly for the large firms. Once again, the results are consistent with and qualitatively similar to the evidence from sub-grouping by analyst followings.

Table 8.6 Large vs. Small Firms: After-Tax Cost of Debt Capital

		Large vs small firms			
		80	81	82	83
	Pred Sign	CoDebt_AT	CoDebt_AT	CoDebt_AT	CoDebt_AT
		Large-sized Firms		Small-sized Firms	
L.ESGScr	-	-0.00205	-0.00206	-0.00213	-0.000766
		(0.0116)	(0.0115)	(0.0164)	(0.0164)
L.Beta	+	-0.00202	-0.00222	-0.00112	-0.00108
		(0.00303)	(0.00308)	(0.00403)	(0.00399)
L.B2M	+	0.00165	0.00159	-0.00269	-0.00239
		(0.00140)	(0.00140)	(0.00321)	(0.00312)
L.Debt2Assets	+	-0.00941	-0.00964	0.00630	0.00651
		(0.0194)	(0.0197)	(0.00902)	(0.00907)
L.ROA	-	-0.0111	-0.0108	-0.00981	-0.00939
		(0.00905)	(0.00903)	(0.0113)	(0.0113)
L.AnalystsDummyHigh	-	-0.000760	-0.000775	0.00154	0.00163
		(0.00158)	(0.00157)	(0.00126)	(0.00121)
L.LGTM_GROWTH	?	0.000867	0.000817	-0.00246**	-0.00258**
		(0.00115)	(0.00118)	(0.00121)	(0.00122)
L.RDDUMMY	+	0.00167	0.00164	0.00247	0.00253
		(0.00146)	(0.00147)	(0.00263)	(0.00277)
L.HH Index	-	-0.000798	-0.000947	0.00881	0.00838
		(0.000680)	(0.000682)	(0.00599)	(0.00600)
L.NewFinancingdummy	?	0.000480	0.000499	-0.00141	-0.00144
		(0.00186)	(0.00185)	(0.00114)	(0.00113)
L.Explr	-	0.00715		0.0342	
		(0.0185)		(0.112)	
L.Explt	-	-0.422*		-0.137	
		(0.232)		(0.151)	
L.sqrootOA	-		-0.128		-0.0975
			(0.158)		(0.188)
_cons	?	0.0266**	0.0232**	0.0100	0.00991
		(0.0112)	(0.0106)	(0.00874)	(0.00871)
Year Controls Included		Yes	Yes	Yes	Yes
N observations		463	463	363	363
N groups		115	115	134	134
R-sq		0.205	0.198	0.267	0.266
Fstat		---	---	6.83***	7.39***
DF		15	14	16	15
Mean VIF		4.82	4.81	4.92	4.56
Hausman Chi2		25.8*	27.6**	31**	30**
Breusch-Pagan LM Chi2		337***	345***	32***	32***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation. Models 80-81 are estimated with the condition that total assets ≥ the

median observation, and models 82-83 that total assets < the median observation. The F-stat problem with models 80-81 ws discussed under Table 7.4.

8.4.4 Firms with New vs. No New Financings.

Table 8.7 demonstrates the firm-fixed and year-fixed effects regression models for the after-tax cost of debt capital for firms that issued new financing versus firms that did not. The sub-sampling analysis excludes firms in the financial sector. Models 84-85 present results for firms that issued new long-term financings and models 86-87 those for firms that did not.

Starting with firms that issued new financings, the effects of exploration, exploitation and combined disclosures are not significant at any level. Firms that did not issue new financings enjoy a significant benefit only from exploitation disclosure (0.53%***). This indicates that for every 1% increase in exploitation disclosure, they enjoy a reduced after-tax cost of capital of 0.53%. These benefits are the largest across all the groups in the sub-sampling analysis.

This result lends support only to hypothesis H1b for the subgroup of firms with no newly issued financings. In summary, these firms enjoy above-average benefits from exploitation disclosure whereas there is no evidence of any benefits from any of the disclosures for firms with new issues of financings. This is inconsistent with earlier evidence from the cost of equity capital, as shown in the previous chapter. The evidence from the cost of equity capital shows that firms with new issues for financing receive above-average benefits from exploitation and combined disclosures, while firms with no issues for new financing bear significant costs from exploration disclosure.

Table 8.7 New Issues of Financings (Yes vs. No): After-Tax Cost of Debt Capital

		Issuance of New Financing			
		84	85	86	87
	Pred Sign	CoDebt_AT	CoDebt_AT	CoDebt_AT	CoDebt_AT
		Yes	Yes	No	No
L.ESGScr	-	-0.00295	-0.00291	-0.0326	-0.0364
		(0.00868)	(0.00871)	(0.0333)	(0.0363)
L.Beta	+	-0.00205	-0.00202	-0.00357	-0.00342
		(0.00261)	(0.00260)	(0.00562)	(0.00558)
L.LogTotAssets	-	0.00496	0.00530	0.0405**	0.0382**
		(0.00643)	(0.00642)	(0.0181)	(0.0177)
L.B2M	+	0.000372	0.000252	0.000117	0.000238
		(0.00150)	(0.00145)	(0.00220)	(0.00229)
L.Debt2Assets	+	-0.00258	-0.00263	0.00423	0.0101
		(0.0137)	(0.0138)	(0.0147)	(0.0154)
L.ROA	-	-0.0124	-0.0117	-0.0206	-0.0203
		(0.00887)	(0.00873)	(0.0157)	(0.0163)
L.AnalystsDummyHigh	-	0.000441	0.000456	0.00113	0.00168
		(0.00109)	(0.00108)	(0.00267)	(0.00294)
L.LGTM_GROWTH	?	-0.00136	-0.00158	0.000409	0.000800
		(0.00123)	(0.00125)	(0.00213)	(0.00223)
L.RDDUMMY	+	-0.0000721	-0.000166		
		(0.00197)	(0.00201)		
L.HH Index	-	-0.000724	-0.000771	0.0110*	0.0104*
		(0.000651)	(0.000657)	(0.00659)	(0.00622)
L.Explr	-	-0.00344		0.181	
		(0.0108)		(0.128)	
L.Explt	-	-0.293		-0.530***	
		(0.228)		(0.164)	
L.sqrootOA	-		-0.167		-0.269
			(0.168)		(0.277)
L.logfinancing	?	0.0000879	0.0000822	Omitted	Omitted
		(0.000325)	(0.000325)		
_cons	?	0.00353	0.000970	-0.105	-0.0970
		(0.0240)	(0.0237)	(0.0564)	(0.0544)
Year Controls Included		Yes	Yes	Yes	Yes
N observations		647	647	179	179
N groups		208	208	87	87
R-sq		0.223	0.221	0.331	0.294
Fstat		13.36***	14.28***	3.01***	3.67***
DF		17	16	15	14
Mean VIF		8.86	9.6	9.33	9.62
Hausman Chi2		37***	34.5***	42***	23.8**

Breusch-Pagan LM Chi2	469***	478***	26.9***	26.6***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation. The binary control for new financing was removed from modelling and used as a conditional requirement when estimating models 86-87; a conditional requirement was set to have NewFinancingDummy = 0 so as to limit the sample to firms with no newly issued financings. For models 84-85, the natural logarithm of newly issued financings was added as a control variable to limit the sample to those with new financing issues.

8.5 Robustness Checks for the After-Tax Cost of Debt Capital

The following sub-sections present empirical results of the relevant robustness checks for the after-tax cost of debt capital. These include results from re-estimating the baseline models by reversing the dependent and independent variables so as to check for the sufficiency of one-year lags in mitigating endogeneity bias. The second round is discussed in section 8.5.2, checking for the sensitivity of results to omissions of any of the control variables and for different functional measurement forms of innovation disclosure.

8.5.1 Endogeneity Control: Robustness Check.

To address endogeneity bias (Nikolaev and Van Lent, 2005), one-year lags were used in modelling the association between innovation disclosure and the after-tax cost of debt capital. The baseline models are re-run, reversing the dependent and independent variables so as to check for the sufficiency of one-year lags in mitigating endogeneity bias. Therefore, the three disclosures are modelled on the one-year lag of control variables and the after-tax cost of debt capital. Table 8.8 presents the firm-fixed and year-fixed effects regression models for exploration (models 88-89), exploitation (models 90-91) and combined disclosures (models 92-93).

These models indicate that the one-year lag of the after-tax cost of debt capital is not significantly correlated with any of the disclosures. Therefore, the one-year lag of the after-tax cost of debt capital does not explain variations in any of the disclosure variables: exploration (89), exploitation (91) or combined (93). Recalling evidence from models 64 (Table 8.10), 74 (Table 8.4), 76 (Table 8.5) and 86 (Table 8.7), exploitation disclosure is a significant predictor for the after-tax cost of debt capital. Model 77 (Table 8.5) shows that combined disclosure is a significant predictor of the after-tax cost of debt capital. This overall picture of evidence supports the base notion that the one-year lag of disclosure variables explains variations in the after-tax cost of debt capital, but not vice versa.

Consequently, the assumption of strict exogeneity between the dependent and independent variables is confirmed. The use of one-year lags in modelling the association between disclosure and after-tax cost of debt capital proves to be a sufficient procedure to mitigate endogeneity bias.

Additional analysis using second-year lags was also conducted. Once again, the results (not reported here) are qualitatively similar to those from modelling with one-year lags, showing the results to be strongly robust.

8.5.2 Additional Robustness Checks

Similar to modelling for the cost of equity capital, two additional types of robustness check were performed: first, a series of step hierarchical regressions to check for the sensitivity of results for omissions of any of the control variables; and second further checks for the robustness of results using different functional forms of innovation disclosure. The results (not reported here) of these two additional checks for the after-tax cost of debt capital are in line with those from the same checks for the cost of equity capital. For instance, results of the hierarchical regressions are qualitatively similar to those reported in the baseline models 61-65 (Table 8.1). Using the natural log of word frequencies for exploration and exploitation instead of coverage percentages gives exactly the same results as those in the baseline models (61-65).

Furthermore, using the simple product of coverage percentages of exploration disclosure and exploitation disclosure (i.e. without square-rooting) as a measure of combined disclosure shows qualitatively similar and robust results. While to check whether there is an interaction effect between exploration and exploitation disclosures, an interaction term is generated using demeaned exploration and exploitation percentages. The baseline models were re-estimated adding the demeaned interaction term along with the exploration and exploitation percentages and the results (not reported here) reveal no interaction effect of any form.

Table 8.8 Endogeneity Control for After-Tax Cost of Debt Capital

		88	89	90	91	92	93
	Pred Sign	Explr	Explr	Explt	Explt	sqrootOA	sqrootOA
L.ESGScr	+	0.00489	0.00490	0.00220	0.00222	0.00343	0.00344
		(0.00365)	(0.00366)	(0.00262)	(0.00263)	(0.00258)	(0.00259)
L.Beta	+	-0.00181*	-0.00182*	-0.000859	-0.000874	-0.00122**	-0.00124**
		(0.000984)	(0.000987)	(0.000563)	(0.000561)	(0.000577)	(0.000577)
L.LogTotAssets	+	-0.00145	-0.00147	-0.00127	-0.00130	-0.00113	-0.00115
		(0.00236)	(0.00235)	(0.00148)	(0.00148)	(0.00138)	(0.00137)
L.B2M	-	-0.000641	-0.000638	0.000131	0.000134	-0.000163	-0.000160
		(0.000461)	(0.000462)	(0.000357)	(0.000356)	(0.000344)	(0.000343)
L.Debt2Assets	+	0.00169	0.00177	0.000534	0.000625	0.000771	0.000851
		(0.00262)	(0.00261)	(0.00165)	(0.00163)	(0.00170)	(0.00168)
L.ROA	+	0.00511**	0.00501**	0.00156	0.00143	0.00313*	0.00301*
		(0.00245)	(0.00251)	(0.00181)	(0.00183)	(0.00179)	(0.00182)
L.AnalystsDummyHigh	+	0.000148	0.000144	0.000109	0.000104	0.0000585	0.0000544
		(0.000355)	(0.000356)	(0.000322)	(0.000323)	(0.000236)	(0.000237)
L.LGTM_GROWTH	+	0.000320	0.000309	-0.000104	-0.000118	0.000126	0.000114
		(0.000480)	(0.000484)	(0.000225)	(0.000228)	(0.000256)	(0.000260)
L.RDDUMMY	+	-0.00132	-0.00132	-0.00327	-0.00327	-0.00321	-0.00321
		(0.00161)	(0.00159)	(0.00306)	(0.00304)	(0.00305)	(0.00303)
L.HH Index	+	0.000638**	0.000641**	0.000420*	0.000423**	0.000519**	0.000522**
		(0.000285)	(0.000284)	(0.000218)	(0.000217)	(0.000222)	(0.000221)
L.NewFinancingdummy	+	-0.000218	-0.000213	0.000142	0.000149	-0.0000243	-0.0000182
		(0.000370)	(0.000372)	(0.000248)	(0.000249)	(0.000257)	(0.000258)
L.CoDebt_AT	+		-0.00596		-0.00762		-0.00674

			(0.0138)		(0.00744)		(0.00761)
_cons	?	0.0293***	0.0295***	0.0205***	0.0207***	0.0237***	0.0239***
		(0.00844)	(0.00835)	(0.00556)	(0.00551)	(0.00516)	(0.00509)
Year Controls Included		Yes	Yes	Yes	Yes	Yes	Yes
N observations		1030	1030	1030	1030	1030	1030
N groups		295	295	295	295	295	295
R-sq		0.041	0.041	0.071	0.072	0.080	0.081
Fstat		2.13***	2**	2.7***	2.56***	2.65***	2.6***
DF		15	16	15	16	15	16
Mean VIF		6	5.84	6	5.84	6	5.84
Hausman Chi2		26.25**	35***	36.8***	37.75***	34.5***	35***
Breusch-Pagan LM Chi2		674***	660***	827***	827***	688***	683***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation.

One final check relates to the reason for excluding the financial sector from the sample of analysis for the after-tax cost of debt capital. Table 8.9 displays the firm-fixed and year-fixed effects regression models for the after-tax cost of debt capital only for the financial sector firms. Models 94-98 show that financial firms are punished with a greater after-tax cost of debt capital for increases in innovation disclosure. With each 1% increase in exploitation disclosure, financial firms bear an extra (0.725%**) of after-tax cost of debt capital. The 1% increase in combined disclosures is associated with a 0.921%** increase in the after-tax cost of debt capital. These results from the financial sector present contradictory evidence to the first hypotheses H1b and H1c.

Also, keeping the financial sector in the full sample of the baseline models (as in Table 8.1) would have led to a mechanical error and could have presented misleading results. For instance, the coefficient of exploitation disclosure would have been lower in magnitude and the significance of evidence would have been weaker.

To avoid this problem, the modelling results of the financial sector are reported separately from the rest of the sample in Table 8.9. All the models from 61-86 are estimated for samples excluding the financial sector so that the reported results are as accurate as possible.

Table 8.9 Baseline Models for After-tax Cost of Debt Capital: Financial Sector Only

		94	**95**	**96**	**97**	**98**
	Pred. Sign	CoDebt_AT	CoDebt_AT	CoDebt_AT	CoDebt_AT	CoDebt_AT
L.ESGScr	-	-0.00206			-0.00398	-0.00306
		(0.0174)			(0.0159)	(0.0166)
L.Beta	+	0.00187			0.00117	0.000947
		(0.00422)			(0.00425)	(0.00429)
L.LogTotAssets	-	-0.00750			-0.00438	-0.00552
		(0.00962)			(0.00867)	(0.00880)
L.B2M	+	-0.00191			-0.00279	-0.00318
		(0.00272)			(0.00276)	(0.00277)
L.Debt2Assets	+	0.00462			0.00242	0.00177
		(0.0188)			(0.0189)	(0.0193)
L.ROA	-	-0.0123			-0.00964	-0.0102
		(0.0258)			(0.0267)	(0.0268)
L.AnalystsDummyHigh	-	-0.00322**			-0.00324**	-0.00323**
		(0.00124)			(0.00132)	(0.00132)
L.LGTM_GROWTH	?	-0.00194			-0.00155	-0.00134
		(0.00293)			(0.00291)	(0.00305)
L.RDDUMMY	+	Omitted			Omitted	Omitted
L.Competiton	-	0.00166**			0.00236***	0.00244***
		(0.000653)			(0.000843)	(0.000807)
L.NewFinancingdummy	?	0.00137			0.000498	0.000392
		(0.00175)			(0.00158)	(0.00156)
L.Explr	-		0.215		0.244	
			(0.223)		(0.235)	
L.Explt	-		0.701**		0.725**	
			(0.309)		(0.366)	
L.sqrootOA	-			0.838***		0.921**
				(0.316)		(0.353)
_cons	?	0.0432	-0.00409	-0.00436	0.0167	0.0210
		(0.0387)	(0.00585)	(0.00589)	(0.0366)	(0.0366)
Year Controls Included		Yes	Yes	Yes	Yes	Yes
N observations		253	325	325	252	252
N groups		64	80	80	64	64
R-sq		0.180	0.209	0.206	0.210	0.208
Fstat		8.3***	13.16***	15.6***	6.02***	6.55***
DF		14	6	5	16	15
Mean VIF		6.77	6.18	2.07	9.9	8.8
Hausman Chi2		11.9	5.8	7.77	9.3	18
Breusch-Pagan LM Chi2		159***	255***	251***	163***	159***

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are standard errors robust to heteroscedasticity and autocorrelation. The R&D binary control was omitted by Stata.15 because none of the financial sector firms report R&D expenditure.

8.6 Summary

This chapter discussed evidence on the association of innovation disclosure and the after-tax cost of debt capital. The results from the non-financial sectors suggest that exploitation disclosure is associated with significant average reductions of 0.274% in the after-tax cost of debt capital. This supports hypothesis H1b but fails to support H1a and H1c. Further support for H1b is provided by sub-groups of non-R&D firms, high analyst-following firms, large-sized firms, as well as firms with no newly issued financings. However, hypothesized benefits of the combined disclosure (H1c) are only supported by evidence from the high analyst-following firms. Consistent with evidence of the cost of equity capital, the significant reductions in the after-tax cost of debt capital arise from exploitation rather than exploration disclosure, when in fact, firms on average disclose more exploration than exploitation information.

In contrast, the benefits of exploitation disclosure in the after-tax cost of debt capital are marginal when compared to the reductions in the cost of equity capital. It is also noted that only firms in the financial sector present a significant positive association between exploitation and combined disclosures and the after-tax cost of debt capital. This does not support hypothesis H1b, and therefore the financial sector was excluded from the sample when modelling the association between innovation disclosures and the after-tax cost of debt capital[82]. Consistent with the cost of equity capital, endogeneity checks showed that the use of one-year lags is adequate in mitigating endogeneity bias.

Evidence of modelling the interaction term of the combined disclosure and HH Index does not support the second hypothesis, that reductions in the after-tax cost of debt capital are weakened in the presence of proprietary costs. The interaction term of exploration disclosure and HH Index, as well as the interaction term of exploitation disclosure and HH Index, were checked for moderating effects on the after-tax cost of debt capital. Only the interaction term of exploitation disclosure and HH Index shows significant moderating effects on the after-tax cost of debt capital. Contrary to the second hypothesis, the interaction term of exploitation disclosure and HH Index reveals

[82] The results of the financial sector are reported separately in Table 8.9

that firms which are facing low (high) competitive pressure earn less (more) reductions in the after-tax cost of debt capital from exploitation disclosure. This result is not consistent with the reported findings of previous research (Botosan and Stanford 2005; Blanco, Garcia Lara, and Tribo 2015). One potential explanation for this anomaly is the limitation of the Bloomberg-based after-tax cost of debt capital, which exhibits a reversed sign for a number of critical control variables including the size factor.

Another and potentially more reliable explanation is the moderating effect of competition (proprietary costs) which forces firms to move away from the risky explorative activities towards the risk-curbing exploitative activities as a way of value-generation. Creditors who appreciate risk reduction, generation of incremental improvements and creation of cost savings would perhaps give greater rewards to exploitative efforts in the presence of higher competition, explaining why firms facing higher competition enjoy greater reductions in the after-tax cost of debt capital from exploitation disclosure. This is consistent with Jansen et al. (2006) who found that pursuing exploitative rather than explorative innovation is especially beneficial to a unit's financial performance for firms operating in a competitive environment. The following chapter summarizes the main findings, conclusions, contributions, limitations and avenues for future research.

Chapter 9 Conclusions and Future Research

9.1 Introduction

The current chapter summarizes the research questions, methodology, and measurement methods in the next section. In the third section, it presents an overall summary of the research findings from 1) results of univariate analysis; 2) results of modelling the cost of equity capital and after-tax cost of debt capital; and 3) results of modelling the moderating factor of proprietary costs on the association between innovation disclosure and cost of capital. The fourth section summarizes the research implications and the fifth the main contributions of the study. The sixth section concludes the thesis with a discussion on limitations and future research avenues.

9.2 Research Questions, Methodology and Methods

Chapter 2 reviewed the literature on exploration, exploitation and their combined approach (organizational ambidexterity). The accounting literature, however, has never concentrated on these pivotal organizational strategies for value creation; the current study recognizes this gap and attempts, for the first time, to address the economic consequences of corporate disclosures of exploration, exploitation as well as their combination. It is hoped that this will broaden the academic discourse in accounting literature to integrate with and serve other domains of literature in organizational studies. Chapter 3 reviews the substantial body of literature linking disclosure and the cost of capital, and the study examines the value relevance of innovation disclosures (exploration, exploitation and combined) on the cost of equity capital as well as the after-tax cost of debt capital. The detection of significant evidence for economic effects would underscore the potential of the incremental information content of such disclosures, relevant for equity investors and creditors. At the same time, innovation disclosure might be intentionally set to have limited information content so as to avoid competitive disadvantage; the fear of proprietary costs is thus assumed to moderate the association between innovation disclosures and the cost of capital. The current thesis, therefore, addresses two main questions:

1- Are innovation disclosures negatively associated with the cost of capital?
2- To what extent does the presence of proprietary costs moderate the association of innovation disclosure and the cost of capital?

These main questions are then broken down into a number of sub-questions as follows:

1- Are there generally observed time-trends in the levels of disclosure on exploration and exploitation information?
2- How do the generally observed time-trends of innovation disclosure (i.e. the combined disclosure of exploration and exploitation) compare to those of ESG disclosure, cost of equity capital and after-tax cost of debt capital?
3- Are there any statistically significant differences between exploration and exploitation disclosure levels?
4- How does combined innovation disclosure differ between various sub-groups of firms (R&D vs. non-R&D, high vs. low analyst following, large vs. small, and firms with newly issued financings vs. those without?
5- Are the levels of innovation disclosure negatively associated with the cost of equity capital?
6- Does the presence of proprietary costs moderate (weaken) the association between innovation disclosure and cost of equity capital?
7- Are the levels of innovation disclosure negatively associated with the after-tax cost of debt capital?
8- Does the presence of proprietary costs moderate (weaken) the association between innovation disclosure and the after-tax cost of debt capital?
9- Do firms with R&D expenditure display a unique pattern compared with other companies regarding innovation disclosure and cost of capital?
10- Do high analyst-following firms display a different pattern from low analyst-following firms regarding innovation disclosure and cost of capital?
11- Do large firms display a different pattern from that of small firms regarding innovation disclosure and cost of capital?
12- Do firms with newly issued financings display a different pattern from that of firms with no newly issued financings?

A positivist approach was applied with a quantitative methodology to answer these research questions. A sample of FTSE 350 firms for the period 2011-2016 was used and data collected from Bloomberg database. The data included the CAPM estimates for cost of equity capital, the after-tax cost of debt capital, share prices and analyst forecasts of future earnings[83], returns volatility, the average of closing of bid-ask spreads, the ratio of closing trading volumes to outstanding number of shares, as well as other company characteristics that were used as control variables. After deleting observations of missing data, an unbalanced panel dataset was generated totalling 1,832 firm-year observations.

The CAPM and a number of measures for the implied cost of equity capital (i.e. PEG, MPEG, and AEG models) were examined for capturing various risk factors. The PEG model, as well as the CAPM, proved to be superior. It was therefore decided to use the PEG model as the official measure of the implied cost of equity capital and CAPM for robustness checks. For further verification, a number of alternative measures (i.e. returns volatility, the average of the closing of bid-ask spreads, the ratio of closing trading volumes to an outstanding number of shares and analyst forecast accuracy) were adopted as robustness checks.

For the measurement of innovation disclosure, the wordlists for exploration and exploitation compiled by Heyden et al. (2015) were borrowed and amended. The final wordlists contained 87 and 131 words respectively for exploration and exploitation. Computer-aided textual analysis (CATA) was applied using the dictionary of keywords for exploration and exploitation. Both dictionaries were retrieved by NVIVO software on a text-search query for each annual report. Annual reports were collected from the official company websites and used to generate the word frequencies and coverage percentages of total documents as measures of exploration and exploitation disclosures. The combined disclosure was derived by square –rooting the product of exploration and exploitation coverage percentages.

Various analytical procedures were applied including regular descriptive statistics, time and industry trends for the dependent and independent variables, univariate and multivariate analysis. The univariate analysis involved Pearson correlations of all

[83] Share prices and forecasts of future earnings were used to estimate the implied measures of cost of equity capital.

variables, paired T-test, and two-sample T-test. The paired T-test was run to test for statistically significant differences in the averages of exploration and exploitation disclosure. The two-sample T-test compared the levels of combined disclosures across the four sub-groups of firms: R&D vs. non-R&D, high vs. low analyst following, large vs. small, and firms with newly issued financings vs. those without.

For the multivariate analysis, the baseline models were designed in two forms: 1) to test exploration and exploitation disclosures independently to see which is the real source of benefit that represents an incremental information, and 2) to test the combined disclosures to observe for synergic benefits arising from the policy of combining exploration and exploitation disclosures. Both forms of the baseline models were tested across the full sample and then retested across the four sub-groups. The moderating effects of proprietary costs were tested using the interaction of innovation disclosure with the HH Index. For the cost of equity capital, a moderating effect of the HH Index was observed with the combined disclosures. For the after-tax cost of debt, a moderating effect of the HH Index was observed with exploitation disclosure.

A fixed-effects panel regression was used to test hypotheses while controlling for firm-fixed and year-fixed effects. The panel design controls for unobserved heterogeneity and omitted variable bias. Robust standard errors clustered at the firm level were used to control for heteroscedasticity and autocorrelation biases. All right-hand-side variables were one-year lags to mitigate endogeneity bias caused by reverse-causality. The large unbalanced panel sample controlled for survivorship bias by treating missing observations as exogenous according to the missing at random hypothesis. The normality assumption was not a requirement since the large sample size (well above 200 firms) was sufficient to ensure an approximately normal distribution of error terms according to the assumption of the central limit theorem.

9.3 Main Research Findings

This section summarizes the findings from the univariate and empirical modelling analysis. The first sub-section summarizes the results of the univariate analysis and the second the evidence from baseline models of the implied cost of equity capital and after-tax cost of debt capital. The third sub-section summarizes the modelling results of the interaction term with HH Index for proprietary costs. Finally, the fourth sub-section summarizes the evidence from the empirical models under the sub-sampling approach.

9.3.1 Findings from Univariate Analyses

A number of univariate analyses were performed: 1) time-trends and industry-trends for estimates of innovation disclosures (exploration, exploitation and combined), cost of equity capital and after-tax cost of debt capital; 2) Pearson correlation; 3) paired T-test, and 4) two-sample T-test.

First, the time-trend analysis showed increasing trends for innovation disclosure, while both measures of the cost of capital showed a downward time-trend. The industry-trends, however, showed that the highest averages of innovation disclosures were found in firms from five sectors: healthcare, technology, industrials, consumer goods and telecommunications. Second, the Pearson correlations showed that innovation disclosures are negatively correlated with both the cost of equity capital and the after-tax cost of debt capital. Third, the paired T-test comparisons of exploration and exploitation disclosures showed that, on average, firms disclose more exploration than exploitation and that this result is robust and consistent across all industries and four different sub-samples. Finally, the two-sample T-test comparisons for the combined disclosures showed that firms with R&D expenditure, high analyst followings, large market capitalization, and new financings issues tend to make more combined disclosure levels than do their counterparts, respectively.

9.3.2 Findings from Modelling on the Cost of Capital

This section summarizes the evidence from the baseline models for the implied cost of equity capital as well as the after-tax cost of debt capital. It also summarizes the evidence from the robustness checks using alternative measures for the implied cost of equity capital of the PEG model.

9.3.2.1 Main Evidence

Table 9.1 summarizes the evidence from the baseline models for the association between innovation disclosures and the implied the cost of equity capital and the after-tax cost of debt capital. Evidence using PEG estimates showed significant benefits from exploitation and combined disclosures, supporting hypotheses H1b and H1c but failing to support H1a. Similarly, evidence based on a sample of the non-financial sectors suggested that exploitation disclosure is associated with significant reductions in the after-tax cost of debt capital[84]. This supports hypothesis H1b but fails to support H1a and H1c. The collective evidence from the implied cost of equity capital and the after-tax cost of debt capital suggests that the bulk of benefits emerge from exploitation rather than exploration disclosure, even though the results of the univariate analysis showed that, on average, exploration is more disclosed than exploitation. However, the magnitude of benefits of exploitation disclosure in the after-tax cost of debt capital is marginal when compared to the reductions in the cost of equity capital.

Table 9.1 Summary of Evidence from the Baseline Models for the Cost of Capital

	Implied cost of equity capital	**After-tax cost of debt capital**
Exploration disclosure	(-)	(+)
Exploitation disclosure	(-)***	(-)**
Combined disclosure	(-)***	(-)

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively.

9.3.2.2 Findings from Modelling Alternative Measures and Robustness Checks

Further robustness checks for the implied cost of equity capital show evidence consistent with the baseline models of PEG estimates. Table 9.2 presents a summary of the associations between innovation disclosures and alternative measures for the implied the cost of equity capital, which includes CAPM estimates, average estimates of the CAPM and PEG models, analyst forecast error, an average of closing bid-ask spread percentages, the ratio of closing trading volume to the outstanding number of shares, and returns volatility.

Robustness checks using the average cost of equity capital estimates from CAPM and PEG model show significant benefits from exploitation and combined disclosures but no evidence of benefits from exploration disclosure. Robustness checks using CAPM

[84] Only firms in the financial sector present a significant positive association between exploitation and combined disclosures and the after-tax cost of debt capital. As this does not support hypothesis H1b, the financial sector was excluded from the sample when modelling the association between innovation disclosures and the after-tax cost of debt capital.

estimates alone, however, show weak but supportive evidence for benefits of exploitation and combined disclosures but no evidence for benefits of exploration disclosure. Similarly, the liquidity measures (i.e. average closing bid-ask spread percentages and the ratio of closing trading volume to outstanding number of shares) also show weak but supportive evidence for benefits of exploitation disclosure but no evidence for benefits of exploration disclosure. However, both of these liquidity measures show significant evidence in support of benefits from the combined disclosures. Moreover, evidence from modelling the volatility of stock returns and analyst forecast error supports benefits from the combined disclosures rather than the individual exploration and exploitation disclosures, reinforcing the notion of synergic benefits from combining both disclosures.

Table 9.2 Summary of Evidence from the Alternative Measures of the Implied Cost of Equity Capital

	CAPM estimates	**COE**	**Volatility**	**Spread %**	**Liquidity 2**	**Error**
Exploration disclosure	(-)	(-)	(-)	(-)	(-)	(-)
Exploitation disclosure	(-)*	(-)***	(-)	(-)*	(-)*	(-)
Combined disclosure	(-)*	(-)**	(-)**	(-)**	(-)***	(-)**

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. CAPM stands for the estimation of the historical cost of equity capital using the capital asset pricing model. COE is the average of CAMP estimates and PEG estimates of the cost of equity capital. Error stands for the analyst forecast error in estimating EPS. Spread% is the average of closing bid-ask percentages on the last week of trading in the financial year. The Liquidity2 is a ratio of the closing trading volume to the outstanding number of common shares. Volatility stands for the returns volatility (standard deviation) of 360-days stock returns. Exploration (exploitation) is the coverage percentage of the respective wordlist as disclosed in annual reports.

9.3.3 Findings from Modelling the Moderating Effects of Proprietary Costs

Both the implied cost of equity capital using the PEG model and the after-tax cost of debt capital were estimated to test the interactions between combined disclosure and proprietary costs (HH Index). Evidence of modelling the PEG estimates on the interaction term of the combined disclosure and HH Index supports the second hypothesis, that the benefits of combined disclosures are weakened in the presence of proprietary costs.

For the after-tax cost of debt, evidence of modelling the interaction term of the combined disclosure and HH Index does not reflect a moderating effect of proprietary costs on the association between the combined disclosure and the after-tax cost of debt. However, the interaction term of exploration disclosure and HH Index, as well as the interaction term of exploitation disclosure and HH Index, were checked for moderating effects on the after-tax cost of debt capital. Only the latter showed evidence of moderating effects. Contrary to the second hypothesis, this revealed that firms facing low (high) competitive pressure earn less (more) reductions in the after-tax cost of debt capital from exploitation disclosure. This result is inconsistent with the reported findings of previous research (Botosan and Stanford 2005; Blanco, Garcia Lara, and Tribo 2015). One potential explanation for this anomaly is the limitations of the Bloomberg-based after-tax cost of debt capital, which exhibits a reversed sign for a number of critical control variables including size.

Another, and potentially more reliable, explanation is the moderating effect of competition (proprietary costs) which forces firms to move away from risky exploration strategies towards the risk-curbing exploitation strategies as a means of value-generation. Creditors who appreciate risk reductions, generation of incremental improvements and creation of cost savings would perhaps give greater rewards to exploitative efforts in the presence of higher competition, explaining why firms facing higher competition enjoy greater reductions in the after-tax cost of debt capital from exploitation disclosure. This is consistent with the findings of Jansen et al. (2006), that pursuing exploitative rather than explorative innovation is especially beneficial to a unit's financial performance for firms operating in a competitive environment.

9.3.4 Findings from the Sub-sampling Approach

The following sub-sections summarize the results from modelling the implied cost of equity capital using PEG estimates and the after-tax cost of debt capital for the four sub-samples.

9.3.4.1 R&D vs. non-R&D Firms

Table 9.3 presents a summary of the associations of innovation disclosures with the cost of equity capital using PEG estimates, as well as the after-tax cost of debt capital, for R&D and non-R&D firms. Evidence from modelling with the PEG estimates shows that R&D firms enjoy significant benefits from exploration and combined disclosures, while non-R&D firms enjoy significant benefits from exploitation disclosure. Therefore, the R&D firms support hypotheses H1a and H1c and non-R&D firm only H1b. Interestingly, however, R&D firms enjoy over double the full sample average benefits from combined disclosure, indicating that they gain the highest synergic benefit from combining exploration and exploitation disclosures.

Evidence from modelling the after-tax cost of debt capital shows that non-R&D firms enjoy significant benefits from exploitation disclosure, while R&D firms show no significant evidence of benefits from any of the disclosures. Therefore, supportive evidence for H1b is lent by non-R&D firms in the case of the after-tax cost of debt capital.

Table 9.3 Summary of Evidence from R&D vs. non-R&D Firms

	Implied cost of equity capital		**After-tax cost of debt capital**	
	R&D	Non-R&D	R&D	Non-R&D
Exploration disclosure	(-)***	(+)	(-)	(+)
Exploitation disclosure	(-)	(-)***	(-)	(-)**
Combined disclosure	(-)***	(-)	(-)	(-)

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively.

9.3.4.2 High vs. Low Analyst Following Firms

Table 9.4 presents a summary of the associations between innovation disclosures on the cost of equity capital using PEG estimates and on the after-tax cost of debt capital for firms of high versus low analyst followings. Evidence from modelling the implied cost of equity capital shows that firms with high analyst following enjoy significant benefits from exploitation and combined disclosures, the benefits from combined disclosure outweighing those of exploitation disclosure; this also indicates the synergic benefit of combining exploration and exploitation disclosure[85].

[85] The group of high analyst followings revealed interesting evidence regarding the ESG disclosure score. There are significant benefits from ESG disclosure only for high analyst-following firms, although the full-sample average benefits from ESG disclosure are not significant at any level. This finding contributes

Firms with low analyst following enjoy benefits only from exploitation disclosure, but these are double the full-sample average benefits and triple the benefits of high analyst firms from exploitation disclosure. This is consistent with evidence from the literature, that firms with low analyst followings enjoy higher benefits for the same disclosure levels than do firms with high analyst followings (Botosan 2000; Richardson and Welker 2001). The summary of sub-grouping by analyst following shows that firms with high analyst followings offer supportive evidence in favour of hypotheses H1b and H1c while the group of low analyst followings supports only hypothesis H1b.

Evidence from modelling the after-tax cost of debt capital shows that firms with high analyst following enjoy significant benefits from exploitation and combined disclosures, supporting H1b and H1c but not H1a. Firms with low analyst following, however, exhibit no supportive evidence for any form of the first hypothesis.

Table 9.4 Summary of Evidence from High vs. Low Analyst Following Groups

	Implied cost of equity capital		**The after-tax cost of debt capital**	
	High analyst following	Low analyst following	High analyst following	Low analyst following
Exploration disclosure	(-)	(-)	(+)	(-)
Exploitation disclosure	(-)**	(-)**	(-)***	(+)
Combined disclosure	(-)**	(-)	(-)**	(+)

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively.

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to the ongoing literature on ESG disclosure by underscoring the vital role of analyst followings with regards to capital market benefits for such disclosure. A second observation is also recorded on ESG disclosure: the magnitude of benefits from ESG disclosure are very small compared to the benefits from exploitation and combined disclosure. This could be due either to the different scales of measurement or to the different nature and substance of ESG and innovation disclosures.

9.3.4.3 Large vs. Small Firms

Table 9.5 summarizes the associations between innovation disclosures and the cost of equity capital using PEG estimates, and the after-tax cost of debt capital for large and small firms. Evidence from modelling the implied cost of equity capital shows that large firms enjoy significant benefits from exploitation and combined disclosures, whereas small firms enjoy significant benefits from exploitation disclosure only. The group of large firms, therefore, provides supportive evidence for hypotheses H1b and H1c, while small firms support only hypothesis H1b. Furthermore, large firms earn benefits from exploitation disclosure that outweigh those of small firms.

This is consistent with previous arguments that large firms are capable of pursuing relatively larger levels of innovation given the scale of their resources (Cao, Gedajlovic, and Zhang 2009). It explains the sizable benefits from exploitation disclosure for large firms in comparison with small firms.

When modelling the after-tax cost of debt capital, however, large firms exhibit weak evidence of benefits, and only from exploitation disclosure; small- firms show no significant evidence of benefits from any of the disclosures. Therefore, weak supportive evidence is lent by large firms for H1b but none for H1a or H1c.

Two notable observations emerge from the evidence of sub-sampling by size. First, the results from the cost of equity capital and the after-tax cost of debt capital are both robust if either proxy of size is used: total assets or market capitalization. Second, results from sub-sampling by size is comparable to those from sub-sampling by analyst following, since the large firms tend to be highly followed by market analysts (Botosan 2000; Richardson and Welker 2001).

Table 9.5 Summary of Evidence from Large vs. Small Firms

	Implied cost of equity capital		**The after-tax cost of debt capital**	
	Large	Small	Large	Small
Exploration disclosure	(-)	(+)	(+)	(+)
Exploitation disclosure	(-)*	(-)**	(-)*	(-)
Combined disclosure	(-)**	(-)	(-)	(-)
*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively.				

9.3.4.4 Firms with New vs. No New Financings

Table 9.6 presents a summary of the associations of innovation disclosures with the cost of equity capital using PEG estimates and with the after-tax cost of debt capital for firms with newly issued financings and those without.

Evidence from modelling the implied cost of equity capital shows that firms with newly issued financings earn benefits from exploitation and combined disclosures, supporting H1b and H1c. Those with no new financings, however, present no evidence to support any form of the first hypothesis[86]. When modelling the after-tax cost of debt capital, however, only firms with no newly issued financings earn significant benefits from exploitation disclosure, supporting only H1b.

Table 9.6 Summary of Evidence from Firms with New vs. Firms with No New Financing

	Implied cost of equity capital		**The after-tax cost of debt capital**	
	Yes	No	Yes	No
Exploration disclosure	(-)	(+)***	(-)	(+)
Exploitation disclosure	(-)***	(-)	(-)	(-)***
Combined disclosure	(-)***	(+)	(-)	(-)
*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively.				

[86] Strangely, however, firms that did not issue new financings exhibit significant costs from exploration disclosure (1.077 %***) but no significant effects from exploitation or combined disclosures.

9.4 Summary of Research Implications

The findings reported in this thesis have a number of significant implications for practitioners and standard-setters such as the International Integrated Reporting Council (IIRC). First, several details are relevant to practitioners and those preparing corporate annual reports. For the annual reports of non-R&D firms, there is a need to reconsider the content of exploration disclosure since the results, so far, show no evidence of benefit from exploration disclosure in terms of reducing information asymmetry or the cost of equity capital. Assuming that exploration disclosure is not intended simply as an impression management tool, non-R&D firms need to reconsider their policy to reflect improved information content and quality while taking into account other prevailing factors such as proprietary costs. The exploration disclosure policy of R&D firms, however, proves to be effective in reducing both information asymmetry and the cost of equity capital. This reinforces the significance of narratives around exploration disclosure for R&D firms, which is also consistent with previous US-based evidence by (Merkley, 2013).

As for exploitation disclosure policy, the evidence reported here reinforces its vitality in reducing information asymmetry and lowering the cost of equity capital for a wide range of firms: non-R&D, high and low analyst-followings, large- and small firms, and those with newly issued financings. Furthermore, exploitation disclosure policy is vital in reducing the after-tax cost of debt for non-R&D firms, high analyst-followings firms, large firms, and firms with no newly issued financings. The integration policy of both exploration and exploitation disclosures (i.e. combined disclosure) creates high synergic benefits in terms of reduced cost of equity capital for R&D firms as well as firms with high analyst followings. The combined disclosure also proves vital to reducing information asymmetry and risk as it lowers analyst forecast error and returns volatility. Finally, combined disclosure improves liquidity by lowering the bid-ask spread percentages.

On a side-note, it is worth recalling that ESG disclosure has an effective impact in reducing information asymmetry by lowering the cost of equity capital for a unique class of firms, the group with high analyst followings. This reinforces both the importance of ESG disclosure policy and the role of analyst followings in improving the information environment and reducing the cost of equity capital.

Second, there are implications relevant for regulators, policymakers and standard-setters such as the IIRC. The findings reported in this thesis provide a picture of the effectiveness of innovation disclosure in mitigating information asymmetry. Exploitation disclosure seems to have a significant effect here, although exploration disclosure, which is on average more disclosed than exploitation disclosure, reflects this only for R&D firms. This indicates that the narratives of exploration disclosure of non-R&D firms need to be closely monitored since they might be potentially used as an impression management tool. This offers important feedback to IIRC standard-setters, indicating the need for a reporting framework that is uniquely designed to the specification of innovation disclosures. A potential reporting framework should integrate the well-established types of innovation disclosure, in terms of exploration and exploitation, as previously defined (OECD 2010; OECD/Eurostat). It should also specify disclosure requirements for firms combining both strategies in the process of value creation. This should help control and mitigate the reporting biases of employing exploration disclosure narratives in impression management tactics.

9.5 Main Contributions

The current thesis integrates accounting literature with a stream of other organizational and management literature including organizational theory, organizational learning and behaviour, organizational design and strategic management, innovation management and technology. Therefore, the contributions of the current research extend to all of these domains.

As for the accounting literature, this research breaks away from the common recognition of innovation disclosure as part of the broader IC disclosure, and introduces a new typology of innovation that is novel to accounting but well established in other organizational and management literature. Building on insights from all these subject areas, this thesis introduces innovation disclosure as two distinct types of innovation: exploration and exploitation. A well established content analysis tool was adopted from Heyden et al. (2015) and amended to measure both types of disclosure.

On a side-note, this thesis present an evaluation of three measures of implied cost of equity capital (PEG, MPEG and AEG models) and finds consistent evidence with (Easton and Monahan 2005; Botosan, Plumlee, and Wen 2011) that the PEG model, introduced by (Easton 2004), is superior to the other measures in capturing various risk factors. This contributes to the ongoing debate on the suitability of various measures of implied cost of equity capital by providing empirical evidence uniquely from a UK context. It also justifies the use of PEG estimates in modelling the association between disclosure and cost of equity capital, especially in the UK context. It is noteworthy that, unlike other noisy short-term measures (e.g. stock prices) (Tumarkin and Whitelaw 2001; Jasic and Wood 2004; McMillan and Speight 2006), the use of implied cost of equity capital is beneficial since it captures the long-term effects for firm valuation.

The main contribution, however, which is presented jointly to accounting and other organizational and management literature, is the empirical examination of the economic effects of innovation disclosures on the cost of equity capital as well as the after-tax cost of debt capital. For the non-accounting literature, this is the first time that exploration and exploitation have been examined from a corporate disclosure perspective. This study concludes that exploration and exploitation disclosures have economic relevance and have significant effects in reducing information asymmetry, leading to improved firm valuation. It also provides evidence for the moderating effects of proprietary costs on the association between innovation disclosure and the cost of capital. For instance, the association between combined disclosures and the cost of equity capital is moderated by the HH Index of competition; the findings show that firms with less competition (lower proprietary costs) earn higher benefits from the combined disclosures of exploration and exploitation, and vice versa. The association between exploitation disclosure and the after-tax cost of debt capital is moderated by the HH Index and the findings show that firms with less competition (lower proprietary costs) gain less benefit from exploitation disclosure and vice versa. Furthermore, the empirical examination applied here uses a longitudinal unbalanced dataset, which is relatively rare in the accounting literature.

Last but not least, the findings contribute to ongoing research into the information type-dependency of the association between disclosure and cost of capital. As explained earlier, exploitation disclosure was found to have significant effects on reducing the cost of capital, both equity capital and debt capital, for a wide range of firms, while exploration disclosure was found to have a significant effect in reducing the cost of equity capital only for R&D firms.

9.6 Limitations and Future Research Avenues

This study is subject to a number of limitations and future research is encouraged to overcome them partially or completely. These limitations, however, do not erode the importance nor the value of the current findings. In terms of methodological limitations, the use of different tools to measure either innovation disclosure or the cost of debt capital might yield different results. For instance, a different set of keywords for exploration and exploitation or a different categorization of innovation disclosure (e.g. similar to that of (Bellora and Guenther)) could lead to a different scenario of findings. More specifically, if future research develops a sector-oriented wordlist (e.g. a list of words for the financial sector, another for the industrial and so on…), that perhaps might lead to a different set of results and findings.

In addition, different measures of the cost of debt capital, such as the yield spread[87] could lead to different results. Context limitations, conversely, could also generate different findings if various contexts of innovation disclosure were examined such as in initial public offerings (IPOs) versus seasoned equity offerings (SEOs), mergers and acquisitions, or even in a completely different stock market such as the US. Finally, the use of a different medium of disclosure (e.g. earnings announcements, presentations and reports to analysts, official web pages and social media disclosures) might yield a different result. It would be interesting to build evidence from different measurement tools, contexts and mediums of disclosure so as to better understand corporate policies on innovation disclosure and compare with them to find the extent to which the current study findings are corroborated.

[87] The yield spread is differences in the yield to maturity of the firms' outstanding debt and sovereign treasury debt of corresponding duration.

Furthermore, a qualitative approach to studying the disclosure practices of exploration and exploitation is also encouraged. It is recommended for future research to look into the views of practitioners and preparers of annual reports around the disclosure strategies of exploration and exploitation so that to better understand industry-leading practices of innovation disclosure. Another recommended angle to study innovation disclosure is to look deeper into the use of discourses and rhetoric devices regarding innovation disclosures in annual reports. This would help better understand the representation of innovation in annual reports by looking at collocations and concordances of innovation information in the broad text.

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Appendix A

A1 Heyden's Lists of Words

Exploration wordlist (Heyden et al. 2015)
Adapt*, Adventur*, Anticipat*, Astound*, Autonom*, Being_the_first, Break*_away, Chang*, Collaboration, Cooperation, Creative, Decentral*, Development_programme*, Diffus*, Discontin*, Discover*, Distant*, Distant_search, Diversif*, Dynamic*, Evolution*, Expand*, Expans*, Experiment*, Explor*, Fantasy, Far_beyond, Flexib*, Forefront, Freedom, Idea, Innovat*, Invent*, Licensing, Long_run, Long_term, Long_time_horizon, Low_codification, Low_formalization, Low_standardization, New, Novel*, Open_mentality, Patent, Play, Proactiv*, R&D_alliance, R&D_Outsourc*, Release, Reposition*, Research_development, Revolution*, Search*, Slow_learning, Something_extra, Spirit_of_initiative, Stakeholder_value, Start_Up, Strength*_Pipeline, Stress, Tacit_knowledge, Transform*, Uncertain*, Variation*, Vary, Wide_background
Exploitation wordlist (Heyden et al. 2015)
Accelerat*, Adaption*, Adjust*, Applied_research, Automat*, Aversion_to_risk, Blockbuster_revenue, Bureaucr*, Caution*, Centraliz*, Certain*, Certification, Choice, Clarity, Codification, Commercial_alliance, Continu*, Control*, Correct*, Cost_reduction, Current, Customer_loyalty, Deep_background, Defend*, Differentiat*, Directives, Efficiency, Execute, Execution, Existing, Exploit*, Extens*, Fast, Formalization, Implement*, Improv*, Incremental_innovation*, Inertia, Localsearch, Low_cost, Modular_production, Operational_strateg*, Optimize, Perfect*, Planning, Practicality, Precision, Predictability, Procedure, Programm*, Proxim*, Prudence, Rational*, React*, Reduction_of_costs, Refine*, Reliab*, Restyl*, Result_based_objective, Routin*, Rules, Select*, Serial_production, Shareholder_value, Short_run, Short_term, Short_time_horizon, Shorten, Speed, Stabil*, Standard*, Streamline, Up-date, Variant*, Verification
Exploration terms removed from the original list (Uotila et al. 2009)
Discover*, Experiment*, Explor*, Flexib*, Innovat*, Play*, Risk*, Search*, Variation*
Exploitation terms removed from the original list (Uotila et al. 2009)
Choice*, Efficien*, Execut*, Exploit*, Implement*, Production*, Refine*, Select*

A2 Content Validity Checks: Amendments to Heyden's Wordlists

Original Exploration Wordlist	**Nature of change**	**Alternative wording**	**Explanations of change**
being_the_first	Removed		Relevant but inconsistent; it retrieves all instances of the words 'being', 'the', and 'first'
play	Modified to	play_role	the alternative word captures relevant instances more efficiently
vary*	Removed		Relevant but inconsistent
Original Exploitation Wordlist			
adaption*	Removed		Relevant but inconsistent
choice	Modified to	choice*	The asterisk is added to capture a wider range of relevant instances
current,	Removed		Relevant but inconsistent
efficiency	Modified to	efficien*	The asterisk is added to capture a wider range of relevant instances
execute*	Modified to	execution*	The original word captures irrelevant instances such as executives
fast	Modified to	fast*	The asterisk is added to capture a wider range of relevant instances
optimize	Modified to	optimi*	ditto
speed	Modified to	speed*	ditto
stabil*	Removed/and replaced with	stabilize* and stabilise*	Clearly stated in the added words to be more effective
up-date	Modified to	updat*	The asterisk is added to capture a wider range of relevant instances

A3 Content Validity Checks: Added Words

Exploration Wordlist	**Explanations of Change**
acquisition*	Relates to a core activity for exploration; making new acquisitions and adding new resources to explore opportunities
agile*	Relates to the inherent nature of exploration; fostering corporate agility to enhance adaptation to constantly changing conditions
being_the_only	Added and removed. Relevant but inconsistent; it retrieves all instances of the words ‘being’, ‘the’ and ‘only’
breakthrough	Relates to exploration in terms of creating innovative solutions
copyright	An outcome for exploration activities
entrepreneur	Relates to the inherent nature of exploration; taking the lead in creating new opportunities and championing change
evolv*	Relates to exploration in terms of adapting to new changes
intellectual_property	An outcome of exploration activities
market_portfolio	Relates to exploration in terms of exploring new markets
newer	A variation of the word ‘new’, stated clearly to avoid retrieving irrelevant instances such as the word ‘news’
newest	ditto
newly	ditto
opportunities	Relates to exploration in terms of exploring new opportunities
radical	Relates to exploration in terms of creating innovative solutions
reconfigure*	Relates to exploration in terms of re-exploring innovative solutions
research_alliance	Relates to exploration in terms of exploring innovative solutions

research_development_alliance	ditto
research_development_outsource*	ditto
research_outsourc*	ditto
research_portfolios	ditto
trademark	An outcome for exploration activities
UK_leading	Relates to exploration in terms of creating leading innovative solutions
unique*	Relates to exploration in terms of creating innovative solutions
world_leading	Relates to exploration in terms of creating leading innovative solutions
Exploitation Wordlist	
accreditation*	Relates to exploitation in terms of improving existing standards to higher quality or accreditation level
advanced	Relates to exploitation in terms of improving existing standards or processes to higher quality
advancing	ditto
augment*	ditto
better	Relates to exploitation in terms of improving existing standards or processes
bigger	ditto
boost*	Relates to exploitation in terms of improving existing standards or processes to higher quality
capitalise_on	Relates to exploitation in terms of capitalizing on existing opportunities to generate cost savings
capitalize_on	ditto
clearer	Relates to exploitation in terms of improving existing standards or processes

coordinat*	Added and removed. Relevant but inconsistent
cost_control	Relates to exploitation in terms of downward managing costs to generate cost savings
cost_saving	Relates to exploitation in terms of practices aimed at creating cost savings
cultivat*	Relates to exploitation in terms of improving existing standards or processes
discipline*	ditto
easier	ditto
economies_of_scale	Relates to exploitation of existing large economies for opportunities to generate cost savings
economies_of_scope	Relates to exploitation of existing large economies for opportunities to generate cost savings
efficien*	Relates to exploitation in terms of improving existing standards or processes
enhanc*	ditto
executed	Relates to exploitation in terms of executing plans and generating profits or cost savings
executing	ditto
foster*	Relates to exploitation in terms of improving existing standards or processes
grow*	Relates to the exploitation of existing growth opportunities to generate higher profits
healthier	Relates to exploitation in terms of improving existing corporate position
iterat*	Relates to exploitation in terms of establishing iterative routines leading to greater quality and more cost savings
larger	Relates to exploitation in terms of improving existing corporate position
lead_time	Relates to exploitation in terms of improving existing processes for a shorter lead time
long-established	Relates to exploitation of existing corporate strengths

maximi*	Relates to exploitation in terms of maximizing advantageous features
minimi*	Relates to exploitation in terms of minimizing disadvantages
modular	Relates to exploitation in terms of improving existing processes for a smoother flow
nurtur*	Relates to exploitation in terms of improving existing standards or processes
proficien*	ditto
progress*	ditto
quick*	ditto
rapid*	Relates to exploitation in terms of accelerating positive performance
ready*	Relates to exploitation in terms of improving existing corporate position
reap*	Added and replaced with 'reap', 'reaped' and 'reaping'. Relates to exploiting existing opportunities, clearly stating the alternative words to avoid irrelevant words such as 'reappoint*'
redeploy*	Relates to exploitation in terms of reallocating resources for better added-value opportunities
redesign*	Relates to exploitation in terms of improving existing standards or processes
reengineer*	ditto
reform*	ditto
reinvent*	ditto
renovat*	ditto
reorgani*	ditto
resilience*	Relates to exploitation in terms of improving existing corporate position
responsive*	ditto

restructur*	Relates to exploitation in terms of improving existing standards or processes
shorter	ditto
stabilise*	Replaces ‘stabil*’ from the original list
stabilize*	ditto
stronger	Relates to exploitation in terms of improving existing standards or processes
superior	ditto
synergy*	Relates to exploitation of existing synergies for opportunities to generate cost savings
upgrad*	Relates to exploitation in terms of improving existing standards or processes
well_positioned	Relates to exploitation of existing corporate strengths
well_established	ditto

Appendix B

B1 List of All Study Variables

Code	Name	Variable Definition
Analyst.High.Dummy	A proxy for the quality of the information environment	Takes the value of 1 when analyst-followings ≥ the median observation and 0 otherwise.
Analysts	Analyst coverage	The number of total analyst forecasts of earnings per share obtained for a given firm from all its following analysts.
B2M	Book-to-market ratio	A proxy for both growth prospects and risk. It is measured as the ratio of the firms' closing book value of equity to the closing market value of equity.
Beta	Historical beta	Raw (historical) beta measures the volatility of the stock price relative to the volatility in the market index. Beta is the percentage change in the price of the stock given a 1% change in the market index. The default setting of the beta calculation is two years of weekly data. Historical beta represents the systematic risk of the firm.
CAPM	Historical-based measure for the cost of equity capital.	The minimum required rate of return on equity investment which comprises the risk-free interest rate and a premium rate for the non-diversifiable risk of the firm. CAPM-based estimates of the cost of equity capital were directly drawn from the Bloomberg database, in which beta is the raw historical beta of the firm, and defined as the systematic risk of a firm relative to the systematic risk of the overall market. FR is the UK's 10-year rate of return for

		the risk-free sovereign debt, and RM-RF is the market's expected return. Note that beta is calculated using two years of weekly historical data.
CoDebt_AT	The after-tax cost of debt capital	The following narrative explanation defining the calculation of the after-tax cost of debt is extracted from the Bloomberg Database: "After-tax weighted average cost of debt for the security, calculated using government bond rates, a debt adjustment factor, the proportions of short and long-term debt to total debt, and the stock's effective tax rate. The debt adjustment factor represents the average yield above government bonds for a given rating class. The lower the rating, the higher is the adjustment factor. The debt adjustment factor (AF) is only used when a company does not have a fair market curve (FMC). When a company does not have a credit rating, an assumed rate of 1.38 (the equivalent rate of a BBB+ Standard & Poor's long-term currency issuer rating) is used. The exact calculation of the debt adjustment factor is a Bloomberg proprietary calculation. Cost of Debt = [[(SD/TD) * (CS * AF)] + [(LD/TD) * (CL * AF)]] * [1-TR] (28) Where SD = Short-Term Debt, TD = Total Debt, CS = Pre-Tax Cost of Short-Term Debt, AF = Debt Adjustment Factor, LD = Long-Term Debt, CL = Pre-Tax Cost of Long-Term Debt, and TR = Effective Tax Rate."
COE	An alternative measure of the cost of equity capital.	The average measure of PEG and CAPM estimates for the cost of equity capital.
Debt2Assets	The ratio of total	A proxy for leverage, measured as the ratio of total debt to total assets.

	debt to total assets	
ESGScr	Environmental, social and governance disclosure score	The ESG score is a weighted percentage score of three percentage sub-scores, namely environmental , social and governance disclosure scores. "Proprietary Bloomberg score based on the extent of a company's Environmental, Social, and Governance (ESG) disclosure. Companies that are not covered by the ESG group will have no score and will show N/A. Companies that do not disclose anything will also show N/A. The score ranges from 0.1 for companies that disclose a minimum amount of ESG data to 100 for those that disclose every data point collected by Bloomberg. Each data point is weighted in terms of importance, with data such as Greenhouse Gas Emissions carrying greater weight than other disclosures. The score is also tailored to different industry sectors. In this way, each company is only evaluated in terms of the data that is relevant to its industry sector. This score measures the amount of ESG data a company reports publicly and does not measure the company's performance on any data point."
Explr	Exploration disclosure	Measured as the coverage percentage of the exploration wordlists as retrieved by NVivo textual analysis software from firm-year annual reports. The coverage percentage is the ratio of total word frequencies of the wordlist to the total words in the annual report document.
Explt	Exploitation disclosure	Measured as the coverage percentage of the exploitation wordlists as retrieved by NVivo textual analysis software from firm-year annual reports. The coverage percentage is the ratio of total word frequencies of the wordlist to the total words in the annual report document.
ForecastDispersion	Dispersion in	Measured as the standard deviation of the one-year ahead forecasts of EPS scaled by the mean

	analyst forecasts of earnings	consensus forecast. The Bloomberg definition of the standard deviation of EPS forecast is "A statistical measure of the dispersion of the contributed Earnings Per Share (EPS) estimates around their mean value expressed in the same units as the data. The standard deviation of a consensus expresses the level of agreement amongst the contributed data. A consensus with a high standard deviation would represent more dissent while a lower standard deviation would represent concurrence. Available for consensus only."
ForecastError	The accuracy of analyst' forecasts of earnings	Derived by taking the absolute value of the difference between forecast and actual EPS scaled by the actual EPS.
HH Index	A proxy for proprietary costs via the level of industry competition	The Herfindahl-Hirschman (HH) index is taken as the sum of squared market shares. The market share is calculated by dividing the firm's annual sales value by the sum of sales for all firms in the same industry for a given year.
LGTM_GROWTH	The forecasted long-term growth rate	Received directly from contributing analysts; not calculated by BEst. While different analysts apply different methodologies, the Long-Term Growth Forecast generally represents an expected annual increase in operating earnings per share over the company's next full business cycle. In general, these forecasts refer to a period of three to five years.
Liquidity2	The size of the closing trading volume to the	The ratio of closing trading volume is used as an alternative proxy of liquidity and is measured as the ratio of VWAP volume to the number of common shares outstanding at year end. This ratio is inversely related to information asymmetry: the higher the ratio of trading

	outstanding number of common shares.	volume to common stock outstanding, the lower the information asymmetry. The Bloomberg definition of VWAP volume is "the number of shares used to determine the VWAP. Volume Weighted Average Price (VWAP) is a trading benchmark. VWAP is calculated by adding up the value traded for every transaction (price times shares traded) and then dividing by the total shares traded for the day.",Shares outstanding are "all the shares of a corporation that have been authorized, issued, purchased, and held by investors as of period end date. Net of treasury shares which are shares held by the corporation itself if the number is disclosed."
Log.NewFinancing	Value of total new financings	The total value of new financings, either long-term debt or equity capital, issued during the year.
Log.RD_Expend/ NetSales	R&D scale	The natural logarithm of the ratio of R&D expenditure divided by the net sales of the firm in a given year.
MarketCap	Market capitalization	The closing value of the market value of equity, which is the product of closing share price and number of shares outstanding.
New.Financing. Dummy	A binary metric for the issuance of new financings	It takes the value 1 if the firm issued new long-term debt or common stocks and 0 otherwise.
PEG	Implied cost of equity capital	Easton (2004) model for the implied cost of equity capital. It is derived by square-rooting the ratio of forecast short-term growth in earnings to the current share price.
R&D.Dummy	R&D information asymmetry	Takes the value 1 if the firm reports R&D expenditure and 0 otherwise.

ROA	Ratio of total return to total assets	A proxy for performance, measured as the ratio of return to total assets.
Size.Dummy	A proxy for large-sized firms	It takes the value 1 when the total assets ≥ the median observation and 0 otherwise.
Size.Dummy1	An alternative proxy for large-sized firms	It takes the value 1 when the market capitalization ≥ the median observation and 0 otherwise.
Spread%	Average of closing bid-ask percentages	A proxy for liquidity, positively related to information asymmetry. The lower the average of closing bid-ask percentages, the lower the information asymmetry. The Bloomberg-calculated Average Bid-Ask Spread Percentage is "Average of all bid-ask spreads taken as a percentage of the mid-price. The bid/ask points used for the computation correspond to the quotes received for the period indicated by Calc Interval (PX393, CALC_INTERVAL) (default value is five days) ending in the complete trading day prior to the date indicated by End Date Override (PX392, END_DATE_OVERRIDE) (default value is the latest completed trading day). For a trading day to contribute to the calculation, there should be at least ten valid bid/ask spread points on that day. The field returns values only if more than 50% of trading days in the period are eligible to contribute to the calculation. The Calc Interval (PX393, CALC_INTERVAL) override will only support periods from one day (1D) up to 30 days (30D)."
SqrootOA	Combined	Derived by square rooting the product of the respective exploration and exploitation coverage

	disclosures of exploration and exploitation	percentages. For comparabison purposes, the square-root is only intended as a functional transformation for the variable back to a percentile scale.
TotAssets	Total Assets	The book value of total assets reported by the firm in a given year.
Volatility	Share price volatility over a window of 360 days.	Measure of the risk of price moves for a security calculated from the standard deviation of day to day logarithmic historical price changes. The 360-day price volatility equals the annualized standard deviation of the relative price change for the 360 most recent trading day's closing price, expressed as a percentage. When looking at the current value, the last price point will be the most recently traded price of the security.

B2 Pearson Correlation of All Study Variables

	Variable	1	2	3	4	5	6	7	8	9	10
1	Explr.t-1	1									
2	Explt.t-1	0.1604*	1								
3	SqrootOA.t-1	0.6570*	0.7709*	1							
4	ESGScr.t-1	0.0138	0.0725*	0.0588*	1						
5	Beta	-0.0205	0.1132*	0.0563*	0.3223*	1					
6	TotAssets	-0.0265	-0.0760*	-0.0668*	0.2333*	0.2312*	1				
7	B2M	-0.0870*	-0.0347	-0.1180*	0.1226*	0.2155*	0.2856*	1			
8	Debt2Assets	-0.0679*	-0.0315	-0.0789*	0.1408*	-0.0352	-0.0387	-0.0542*	1		
9	ROA	0.0177	-0.0142	0.0117	-0.0995*	-0.0817*	-0.0890*	-0.2293*	-0.1393*	1	
10	Analysts	-0.0268	0.0258	0.0018	0.4926*	0.3349*	0.1687*	-0.0166	0.0514*	-0.0226	1
11	RD_Expend/NetSales	0.0635*	0.0771*	0.1155*	-0.0635*	-0.0161	-0.0156	-0.045	-0.0642*	-0.1319*	-0.0751*
12	LGTM_GROWTH	-0.0258	0.0215	-0.0104	-0.1180*	-0.0067	0.0037	-0.0447	-0.1068*	0.0468	-0.0135
13	HH Index	-0.0158	0.0269	0.0042	0.1478*	0.0553*	0.1075*	0.0291	-0.0061	-0.0635*	0.1777*
14	NewFinancing	-0.0461	-0.0561*	-0.0768*	0.3530*	0.1556*	0.2838*	0.0963*	0.0945*	-0.0788*	0.3471*
15	PEG	-0.0699*	-0.0427	-0.0930*	0.0093	0.2114*	0.0579*	0.2263*	-0.0165	-0.1508*	-0.0795*
16	CAPM	-0.0591*	0.0268	-0.0354	0.1603*	0.7045*	0.1393*	0.2028*	-0.023	-0.0617*	0.2337*
17	COE	-0.0787*	-0.012	-0.0805*	0.0895*	0.4549*	0.1059*	0.2152*	-0.0196	-0.1288*	0.0722*
18	ForecastError	-0.0268	-0.0256	-0.0424	0.0543*	0.0965*	0.1046*	0.2054*	0.1210*	-0.2407*	-0.0183
19	ForecastDispersion	-0.0105	-0.0155	-0.0273	-0.0076	0.0173	0.0279	0.0118	0.0075	-0.0075	-0.0199
20	BidAskSpread%	-0.0574*	0.0021	-0.0434	-0.4036*	-0.2617*	-0.2020*	0.0135	-0.0557*	0.0008	-0.5159*
21	Liquidity2	-0.0665*	0.0996*	0.021	0.1290*	0.3421*	-0.0485*	0.0983*	0.0115	-0.0756*	0.2961*
22	Volatility	-0.1005*	0.0517*	-0.0561*	-0.1333*	0.4547*	0.0125	0.2296*	-0.0878*	-0.1274*	-0.1320*
23	CoDebt_AT	-0.0828*	-0.0217	-0.1091*	0.1391*	0.1123*	-0.0598*	0.0856*	0.2833*	-0.1435*	-0.0149

continued

continuation

	Variable	11	12	13	14	15	16	17	18	19	20	21	22	23
11	RD_Expend/NetSales	1												
12	LGTM_GROWTH	0.0106	1											
13	HH Index	-0.0115	-0.0351	1										
14	NewFinancing	-0.0113	-0.0424	0.1751*	1									
15	PEG	-0.0035	0.0266	-0.0164	0.0532*	1								
16	CAPM	-0.0394	-0.0357	0.0301	0.0721*	0.1937*	1							
17	COE	-0.0508	0.022	-0.0054	0.0703*	0.9008*	0.5676*	1						
18	ForecastError	-0.0153	-0.0745*	0.0377	0.1147*	0.1101*	0.0765*	0.0983*	1					
19	ForecastDispersion	-0.0017	-0.014	0.0025	0.0197	0.0271	-0.0125	0.0349	0.0359	1				
20	BidAskSpread%	0.038	-0.0338	-0.2075*	-0.2514*	0.0998*	-0.1409*	-0.0134	-0.0186	0.0376	1			
21	Liquidity2	-0.0501	0.0008	0.0098	-0.0418	0.0993*	0.2939*	0.1958*	0.0854*	-0.0294	-0.2525*	1		
22	Volatility	0.0796*	0.0700*	-0.0624*	-0.0580*	0.4042*	0.3897*	0.4048*	0.1283*	0.04	0.2131*	0.3212*	1	
23	CoDebt_AT	-0.0443	0.0113	-0.0184	0.0147	0.1289*	0.1889*	0.1839*	0.0721*	0.0446	0.0007	0.0559*	0.0154	1

* indicates significance at 5% level. Refer to Appendix B1 for definitions of variables.