Lane Matthews (PhD 3rd Year)

Henley Business School

University of Reading

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Innovation Disclosure and the Cost of Equity Capital: An Economic-based Perspective

Abstract: This paper examines innovation disclosure effects on the cost of equity capital. Innovation disclosure is recognised as corporate reporting information relating to the organizational ambidexterity (OA) process. This combines two main types of innovation disclosure: *exploration* and *exploitation*. Using a longitudinal unbalanced panel database of 1024 firm-year observations of FTSE 350 firms for the period 2011 - 2016, we ran a series of fixed effect panel-regression analyses while fixing for firm and time effects. Two main findings were observed. Firstly and intriguingly: firms on average disclose more exploration than exploitation, when in fact the most significant reductions in the cost of equity capital arise from exploitation disclosure rather than from exploration disclosure – with the notable exception of R&D firms where they enjoy significant benefits from exploration disclosure. Secondly, low analyst following firms, R&D firms, and large-sized firms enjoy significant benefits from OA disclosure that are greater than the average benefits of the entire sample. This paper provides novel empirical evidence to the disclosure literature by demonstrating that the two types of innovation disclosure have different effects on the cost of equity capital.

Keywords: innovation disclosure, organizational ambidexterity, cost of equity capital, content analysis, longitudinal analysis.

1. Introduction

The current study examines the economic effects associated with innovation disclosure on the cost of equity capital. With the shift of western and global economies from industrial to knowledge-based economies, innovation is increasingly becoming one of the major determinants of corporate survival and success, as well as being an important driver of economic growth and societal wellbeing (O'Reilly and Tushman, 2013, Organisation of Economic Co-Operation and Development, 2010a, Organisation of Economic Co-Operation and Development, 2010b, OECD/Eurostat). Given such significance, the integrated reporting framework issued in 2013 posits that encouraging a culture of innovation is a key activity in the value creation process of the business model. Despite providing no clear definition of innovation, the IR framework 2013 further added that the managing and fair reporting of such activity is the responsibility of those charged with governance. 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). Innovation, normally involving 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), is a core part of the firms' intellectual capital (Bellora and Guenther, 2013, Edvinsson and Malone, 1997) and a main building block of the intangibles value (FASB, 2001).

Leveraging on insights from the organizational behaviour literature (Cao et al., 2009, He and Wong, 2004, Tushman and O'Reilly, 1996), we identify innovation disclosure as any information, in any form of corporate communication tool, relating to *explorative* and *exploitative* innovations. The exploitative trend relates to creating incremental improvements or enhanced solutions based on reuse of existing knowledge, whereas the explorative trend involves experimentation and creating radically new ideas and solutions. The combined disclosure of explorative and exploitative innovations - recognized hereafter as the organizational ambidexterity (OA) disclosure - is information outlining the firms' strategy to pursue both types of innovation simultaneously in a systematic process (Cao et al., 2009, Uotila et al., 2009, Tushman and O'Reilly, 1996). Being a significant part of the broad intellectual capital, it is posited that incentive of innovation disclosure decisions are comparable to those of IC disclosure. Beattie and Smith (2012) argue that capital market considerations (i.e. cost of capital and level of analyst following) and avoiding competitive disadvantage are the strongest incentives to IC disclosure decisions. That is in line with the economic-based lenses of disclosure theory which argues that corporate disclosure decisions are economically motivated (Verrecchia, 2001). Similarly, it is expected that innovation disclosure decisions will be motivated more by capital market incentives and avoiding competitive disadvantage. Henceforth, and in line with previous IC disclosure literature (Beattie and Smith, 2012, Mangena et al., 2016), the economic-based disclosure theory is an appropriate umbrella to explain the innovation disclosure phenomena. Consistently, we posit that OA disclosure is an informative corporate narrative intended at reducing the cost of equity capital by reducing information asymmetry and the perceived risk. However, because the effect of disclosure on the cost of equity capital is information type-dependent (Botosan, 2006), we assume that innovation disclosure will have a unique pattern of effect on the cost of equity capital that might vary according to the type of disclosed innovation. In order to examine such a claim, we measure innovation disclosure by conducting a computer-aided content analysis of the annual reports of FTSE 350 firms for the period 2011 - 2016. To identify and measure disclosure levels of explorative and exploitative innovations, we borrowed a list of keywords developed by (Uotila et al., 2009, Heyden et al., 2015) that we then further modified by adding 59 exploitation and 23 exploration indicative keywords. The final dictionary of exploitative and explorative innovation was 131 and 87, respectively, which was run through NVIVO software to generate respective word frequencies and percentages of total documents. Subsequently, we ran a series of fixed effects panel-regression analyses to assess the effect of explorative and exploitative innovation disclosures, as well as their combined OA disclosure, on the cost of equity capital of the sample companies. The fixed effects panel regression design allows us the advantage of controlling for unobserved heterogeneity by fixing for time and firm specific effects.

Our main findings indicate that OA disclosure is negatively associated with the cost of equity capital. Furthermore, firms on average disclose more exploration than exploitation, although the bulk of market benefits of reduced cost of equity capital are earned by exploitative rather than by explorative disclosures – except for R&D firms that enjoy significant benefits from explorative disclosures. Furthermore, above-average benefits of reduced cost of equity capital from OA disclosure were earned by firms of low analyst followings, firms of R&D expenditure, and large-sized firms.

The present study seeks to provide contributions to both the corporate disclosure and organizational ambidexterity (OA) research. Our contributions seek to extend to the OA literature by addressing the ambidexterity question from a corporate disclosure point of view by inferring from the levels of exploration and exploitation disclosure. Our findings contribute to the ongoing balanced vs. combined controversy of OA constructs (Cao et al., 2009) – discussed in the following section – as we find evidence from corporate annual reports supporting the combined construct of OA. The main contributions towards the corporate disclosure literature are twofold. First, we introduce a tool which is novel in accounting, but well-established in organizational behaviour literature to identify and measure exploitative and explorative innovation disclosures. Second, we longitudinally examine - separately from other IC disclosures - the economic consequences of exploitative, explorative and OA disclosures. There is a rich literature on intellectual capital (IC) disclosure that produced valuable insights on the IC disclosure and the cost of equity capital associations (Mangena et al., 2016, Bontis et al., 2007, Orens et al., 2009). However, there seems to be no study to date that has explored the economic effects of, specifically, innovation disclosure on the cost of equity capital. By doing so, we address the ambiguity concerns surrounding the capturing and interpretation of innovation information prevalent in many IC disclosure studies (Beattie and Thomson, 2007), where innovation is marginalized and treated as a generic component, with no clear attached meanings, under the structural IC subcategory.

The study proceeds as follows. Section 2 presents a literature review and hypotheses development. Section 3 outlines and motivates our methodological approach. Section 4 discusses the empirical analyses. Finally, the fifth section concludes the paper and presents venues for further research.

2. Literature Review and Hypothesis Development

2.1 Explorative vs. Exploitative Innovation - Organizational Ambidexterity

We draw on the concept of organizational ambidexterity to explore innovation disclosure. Organizational ambidexterity, deemed as necessary for long-term firm survival and organizational sustainability, is generally recognized as a systematic ability to simultaneously exploit current resources and capabilities to achieve incremental innovations while continuing to explore for and create radical innovations (March, 1991, Jansen et al., 2013, O'Reilly and Tushman, 2008, O'Reilly and Tushman, 2011, Raisch et al., 2009, Tushman and O'Reilly, 1996, Jansen et al., 2009, Cao et al., 2009, Uotila et al., 2009, Simsek, 2009, Simsek et al., 2009). Exploitation behaviour is about efficiency, control, certainty, and variance reduction, all of which are vital for current viability. However, 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, He and Wong, 2004, Jansen et al., 2006, Uotila et al., 2009). Notions of exploitation, exploration, and ambidexterity have long evolved as research themes in technology and innovation management (Benner, 2010, Benner and Tushman, 2002, Benner and Tushman, 2003, McGrath, 2001), organizational learning and strategy (Siggelkow and Levinthal, 2003, Levinthal and March, 1993, Vera and Crossan, 2004, March, 1991), entrepreneurship (Shane and Venkataraman, 2000), strategic management (He and Wong, 2004), organization theory (Holmqvist, 2004), and managerial economics (Ghemawat and Ricart Costa, 1993).

With remarkable technological breakthroughs and global markets becoming ever more competitive, a fundamental need has emerged for firms to peruse innovations ambidextrously by simultaneously balancing or combining both explorative and exploitative innovation strategies (Tushman and O'Reilly, 1996, He and Wong, 2004, Jansen et al., 2006, Uotila et al., 2009). The extant body of research provides evidence of positive links between ambidexterity and organizational performance. For example, O'Reilly and Tushman (2013) presents comprehensive review of empirical studies that reported positive associations of ambidexterity performance with growth, firm survival, market valuation, subjective performance ratings, and innovation performance. Consequently, we posit that ambidexterity disclosure - involving both explorative and exploitative innovations – is an inevitable necessity.

Definitions, conceptualized dimensions and operationalization of the ambidexterity construct at various levels (i.e., organizational, business unit, and individual level) have been the subjects of long standing controversies (Simsek et al., 2009, Cao et al., 2010, Jansen et al., 2012, Lubatkin et al., 2006, He and Wong, 2004, Birkinshaw and Gibson, 2004). The dimension controversy is of interest to this paper. Previous research shows that the ambidexterity construct varies in two distinct dimensions - balanced and combined (Cao et al., 2009). The balanced dimension of ambidexterity proposes that explorative and exploitative activities are inherently conflicting and the opposite of each other (Smith and Tushman, 2005, Sidhu et al., 2004, Sidhu et al., 2007, Auh and Menguc, 2005). Managers must therefore exert equally balanced efforts in pursuit of both forms of innovation in order to achieve ambidexterity (Cao et al., 2009). The combined dimension, however, proposes that explorative and exploitative trends are orthogonally independent (Cao et al., 2009, Lubatkin et al., 2006, Jansen et al., 2006, Gupta et al., 2006) and that it ultimately requires the firms' capacity and desire to undertake both of them at high levels concurrently to achieve ambidexterity by combining both trends (Cao et al., 2009, Lubatkin et al., 2006).

Reflecting on the OA construct from a disclosure point of view, we posit that firms communicate relative disclosures corresponding to the actual level of innovation performance in a given period. Hence, finding a statistically significant difference between disclosures of explorative and exploitative innovations would support the combined dimension. However, the absence of statistical differences would support the balanced dimension of OA. This absence leads to our first hypothesis, stated as the alternative form:

H1: There are statistically significant differences between the levels of exploitative innovation disclosure and explorative innovation disclosure.

2.2 Corporate Disclosure and the Cost of Equity Capital

Throughout the paper, we apply an economic-based theoretical lens with regards to the corporate disclosure effects; complying with the notion that disclosure activity is inherently economically motivated (Verrecchia, 2001). Hence, we posit that informative innovation disclosure will reduce the cost of equity capital by reducing information asymmetry (Verrecchia, 2001, Lambert et al., 2007) and therefore reducing the risk perceived by investors (Lambert et al., 2007, Hughes et al., 2007), which lowers adverse selection problems, which in turn lowers the cost of equity capital and enhances equity valuation and market liquidity of the shares, ultimately allowing more access to funding (Verrecchia, 2001, Healy and Palepu, 2001).

Empirical evidence of the association of disclosure and the cost of equity capital, however, is inconclusive; not always in line with the theory and mostly dependent upon the type of information disclosed (Botosan, 2006). Most prior research on the links between disclosure and the cost of equity capital focussed on financial disclosures (Dhaliwal et al., 2011, Healy and Palepu, 2001), but the mechanisms and the underlying assumptions apply to both financial and 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 equity capital effect from the financial to nonfinancial disclosures (i.e., IC disclosure, CSR disclosure, and voluntary disclosure) is not always obvious. This point is particularly true when the nonfinancial disclosures 1- are subject to less regulation, 2- are less useful due to issues of non-comparability, and 3- suffer from potential credibility issues due to the opportunistic behaviours of firms. Therefore, the link between various types of non-financial disclosures and the cost of equity capital ultimately remains an empirical question.

In the disclosure literature, a number of value-relevant disclosure types are already well-identified in theoretical and empirical studies. For instance, empirical evidence of disclosure studies documents a negative association with the cost of equity capital specifically from aggregate disclosures and financial information (Botosan, 1997, Botosan and Plumlee, 2002a, Botosan and Plumlee, 2002b, Botosan, 2006), intellectual capital information (Mangena et al., 2016, Orens et al., 2009, Bontis et al., 2007, Singh and Mitchell Van der Zahn, 2007, Campbell and Rahman, 2010, Beattie and Thomson, 2007, Bozzolan et al., 2003, Brennan, 2001, Guthrie and Petty, 2000), environmental information (Plumlee et al., 2015, Plumlee et al., 2009), voluntary information (Plumlee et al., 2015, Plumlee et al., 2009, Hail, 2002, Graham et al., 2005, Francis et al., 2008, Francis et al., 2005, Dhaliwal et al., 2011), and strategic disclosures (Gietzmann and Ireland, 2005). However, CSR information is found to have a positive association with the cost of equity capital (Richardson and Welker, 2001, Al-Tuwaijri et al., 2004, Dhaliwal et al., 2011). The collective evidence of this literature supports the notion that disclosure and the cost of equity capital association is information type-dependent (Botosan, 2006).

When considering intellectual capital (IC) disclosure, all of the empirical studies used a content analysis method for a comprehensive checklist/index of IC components to measure IC disclosure. Beattie and Thomson (2004) identified 128 IC disclosure items using a detailed content analysis of the IC literature, whereas (Li et al., 2008) developed a checklist of 61 items for the same three main IC sub-categories. Methodologically, innovation disclosure, despite its nature-specific importance, was marginalized within the broad scope of IC disclosures throughout literature. Implicated with all of the methodological limitations surrounding IC disclosure measurement, innovation is usually considered as only a single, lower-level category of the structural intellectual capital. Furthermore, Beattie and Thomson (2007), expressed a number of concerns over the content analysis-based measurement of IC disclosure, commonly applied in literature, as to falling short on transparency, specificity, uniformity and rigour, which leads to confounding and generally non-comparable evidence. Hence, the measurement of innovation disclosure within IC disclosure research remains unclear and inconsistent with respect to what sort of information researchers used to capture it (Beattie and Thomson, 2007).

In a survey of finance directors' views of 93 UK companies, Beattie and Smith (2012) find that, out of 28 possible incentives for IC disclosure decisions, the cost of capital benefits/incentives was of mid-ranking importance, which is possibly explained by the inherent uncertainty surrounding the interpretation of many IC disclosures impeding the cost of capital benefits. This point suggests a further need to separately examine the economic effects of various parts of IC disclosure on the cost of equity capital. This also applies to innovation disclosure as a sub-category of IC disclosure and a core building block of intangibles value.

For instance, Mangena et al. (2016), using the checklist of (Li et al., 2008) to measure IC disclosure for a cross-sectional sample of 125 UK listed firms, find that IC disclosure is negatively associated with the cost of equity capital. However, the estimated coefficients are very marginal despite their significance, which could be due to either the limited cross-sectional sample or to the inherent uncertainty surrounding the interpretation of many IC disclosures as suggested earlier by (Beattie and Smith, 2012).

Bontis et al. (2007), using a sample of 95 firms from four European countries, find that IC disclosure and financial disclosure are negatively and positively associated with the cost of equity capital, respectively. Orens et al. (2009), based on a sample of 267 firms from four European countries, find evidence of a negative relationship between web-based IC disclosure and both the cost of debt and the cost of equity capital. Bontis et al. (2007) measured IC disclosure using a weighted scale of 11 IC items, four of which were related to exploration innovation, whereas Orens et al. (2009) measured IC disclosure using a weighted index of 42 IC items, which accounted for aspects of exploration and exploitation innovations scattered across the three IC sub-categories. A general drawback of (Mangena et al., 2016, Bontis et al., 2007, Orens et al., 2009) is that there is no clear distinction of innovation disclosure from other IC disclosures and no recognition of various types of innovation disclosure. Hence, the economic effects of innovation disclosure (exploration, exploitation, and OA) remain ambiguous because they are not solidly and separately identified.

Given the information type-dependency of the disclosure-cost of equity capital link (Botosan, 2006), we expect innovation disclosure to have specific peculiarities with respect to the cost of equity capital. This remains, however, a question to be empirically examined. Consistent with the economic-based disclosure theory, we posit that, through the means of annual reporting, firms will aim to depict an informative picture of their innovation strategies, operations and performance. Given the importance of both types of innovation as well as their overall level in the value creation process and organizational performance (O'Reilly and Tushman, 2013, Lev, 2000), we posit that their respective disclosures will have negative associations with the cost of equity capital, thus leading to our second hypothesis, which is stated in three alternative forms as follows:

H2a: There is a statistically significant negative association between explorative disclosures and the cost of equity capital.

H2b: There is a statistically significant negative association between exploitative disclosures and the cost of equity capital.

H2c: There is a statistically significant negative association between OA disclosures and the cost of equity capital.

The above-mentioned hypotheses will be tested once for the entire available sample and then retested for subsamples of firms according to three main criteria: 1- firms of high analyst following vs. low analyst following, 2- R&D firms, and 3- large vs. small-sized firms. The role of analyst following, for instance, is emphasized by previous studies such as (Botosan, 1997, Richardson and Welker, 2001, Botosan, 2000, Botosan and Plumlee, 2002b). Having applied similar sub-sampling techniques, they find that greater disclosures by firms with low analyst following are rewarded with greater reductions in the cost of equity capital than are those of high analyst following. This result is reasoned by the possibility that greater analyst following contributes a better information environment. However, the R&D firms are characterized by high expenditures on innovation activities and thus can have a different or stronger pattern of benefits of reduced cost of equity capital from innovation disclosures. Finally, Cao et al. (2009) suggest that the size affects firms' capability of pursuing OA innovation due to the scarcity of resources in smaller firms; this implies that the size can affect the cost of equity capital benefits from innovation disclosure for groups of different sizes.

3. Research Methods

3.1. Sample and Data

To examine our hypotheses, data of the UK's FTSE 350 firms were collected for the six-year period (2011 – 2016). Lists of FTSE 350 firms were retrieved from the Bloomberg database for December 31st of each year. This period was primarily chosen to minimize as much as possible the confounding effects of the 2008 financial meltdown on the sample observation[1].

Furthermore, the UK department of business innovation and skills issued the 'innovation and research strategy for growth' in December (2011) which was followed by the UK governments' science and innovation strategy in (2014). This extra motivates our choice of the UK as a context for this study and this specific period. The focus on UK firms only also has the methodological advantage of holding cultural and country specific factors constant in regression analysis.

We chose the UK FTSE 350 firms due to their highly capitalized nature, which gives them larger resources to pursue various types of innovation than smaller-sized firms (Cao et al., 2009). The UKIS (2012), UKIS (2014), UKIS (2016) have consistently reported that the share of large-sized firms engaging in innovation activities is higher than that of the small and medium-sized firms (SMEs) during the period of 2008-2014. This motivates our choice of FTSE 350 firms, which have the highest capitalized nature of all UK listed firms and thus enjoy greater capacity to pursue innovation.

To rule out survivorship bias, we initially pooled all firms of the UK's FTSE 350 of the 10 ICB industries (ICB: industry classification benchmark) for the study period totalling a 2120 year-firm observation as detailed in Table 1. After deleting observations with incomplete or missing data, the sample filters to only 1832 year-firm observations. The most notable elimination occurred in the financial sector of approximately 281 year-firm observations that are mostly investment trusts that have no publicly available data.

3.2.Measuring Innovation Disclosure

To measure innovation disclosure, we use the computer-aided textual analysis (CATA) approach. The CATA approach 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 judgement, the CATA approach enables content analysis of large textual databases to construct indicators from key-word lists (Krippendorff, 2004, Belderbos et al., 2017). It builds on the notion that the occurrence, absence and re-occurrence of keywords depict the underlying themes, whereas co-occurrences reveal associations between them (Heyden et al., 2015, Duriau et al., 2007). Belderbos et al. (2017) argue that the usage of words in narratives describing firms' activities in annual reports, press releases or any other means of corporate communication to the public

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[1] The UKIS 2012. First findings from the UK innovation survey 2011 (revised). *In:* SKILLS, U. D. F. B. I. (ed.). report a fall in product and process innovations as well as a fall in the overall share of businesses engaging in innovation activities during the period 2008-2010; suggesting that the financial turmoil of 2008 have negatively impacted innovation performance and innovation output in the UK. However, the UKIS 2014. First findings from the UK innovation survey 2013: knowledge and innovation analysis. *In:* SKILLS, U. D. F. B. I. (ed.), UKIS 2016. UK innovation survey 2015: headline findings. *In:* SKILLS, U. D. F. B. I. (ed.). report improved innovation performance with steady increase in the post-crisis environment of the UK, henceforth; reasoning the choice of our panel data for the period 2011-2016.

can provide valuable insights about the firms' long-term strategies and perceptions. Thus, the presence, absence, and frequencies of a specific wordlist dictionary yield insights about the firms' strategic orientation concerning the phenomenon in question.

Belderbos et al. (2017) indicate that two techniques are generally used in selecting keywords: deductively by inferring from theoretical concepts and inductively by searching the body of text under analysis to derive meaningful, relevant keywords. The keywords of (Heyden et al., 2015, Uotila et al., 2009) have arguably covered the deductive method in full and the inductive method to some extent. We extended their original keywords by inductively adding a total of 82 words – 23 exploration and 59 exploitation[2].

Heyden et al. (2015) extended the original keywords of Uotila et al. (2009) by adding 66 and 75 words for the two main nodes of exploration and exploitation, respectively. After slight changes in the wordlist of (Heyden et al., 2015), only 64 and 72 words remain for exploration and exploitation lists, respectively[3]. These words were adopted and combined with the inductively derived 23 exploration and 59 exploitation words as outlined above.

A number of content validity checks for the added words were conducted[4]. Validity checks included expert judgment of face validity, validity of key-word appropriateness by examining key-words-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)[5].

For the keyword-in-context-analysis check, we checked the added words individually and recognized and removed keywords that generated inconsistencies or irrelevant feedback. We ran a preliminary text-search query for each added word independently, and a minimum of 10 instances of the results were manually checked[6]. This phase of validation was conducted in multiple iterative stages to ascertain reliability, which is consistent with (Krippendorff, 2004, Heyden et al., 2015, Uotila et al., 2009, Belderbos et al., 2017).

The overall complete dictionary for each node 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 overall dictionary accuracy in capturing the themes of exploration and exploitation. This phase of validity checks resulted in no words being removed. After concluding all alternations, additions and content validity

[2] For the final list of original and added words, please see **Appendix A**

[3] For details on changes made to the original list, please see the note to **Appendix A**

[4] Validity checks for the original list of words HEYDEN, M. L., OEHMICHEN, J., NICHTING, S. & VOLBERDA, H. W. 2015. Board Background Heterogeneity and Exploration-Exploitation: The Role of the Institutionally Adopted Board Model. *Global Strategy Journal,* 5**,** 154-176. are already made by them.

[5] Dr. Mariano (Pitòsh) Heyden, a co-author of ibid., kindly examined the added words for an expert judgement of face validity check.

[6] 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. Hence, it required a number of iterations for the KWIC checks.

checks, 87 and 131 keywords for exploration and exploitation nodes, respectively, were analysed on the NVIVO text-search query.

Annual reports numbering 1756 were downloaded from companies' websites and text-searched with NVIVO software for wordlists of each node independently. NVIVO generated word frequencies and coverage percentages for each available year-firm annual reports. The coverage percentages are used to proxy for disclosures of explorative innovation and exploitative innovation in the later longitudinal unbalanced fixed-effects panel regression. The corresponding coverage percentages of OA disclosure are obtained by taking the square root of the product of the exploration and exploitation coverage percentages [7]. This operationalization of the OA concept is consistent with the combined dimension of the ambidexterity literature.

Unlike some other means of disclosure, annual reports are mandatory and widely distributed. Although the annual report is not the only corporate means of disclosure, it is the main one (Bozzolan et al., 2004, Guthrie et al., 2006). Hope (2003) finds a positive association between annual report disclosure and the accuracy of analysts' earnings forecasts, and Li Eng and Kiat Teo (1999) found that analysts do revise their earnings forecasts after the release of annual reports. Furthermore, the analysis of annual reports has attained a wide consensus as a useful, unobtrusive source of documented textual data (Eggers and Kaplan, 2009, Uotila et al., 2009, Heyden et al., 2015).

3.3. Measuring Cost of Equity Capital

The cost of equity capital is defined as the minimum rate of return required by equity investors for providing capital to the firm. As there is no directly observable measure, it is 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 of measurement, the CAPM in this regard, uses predetermined priced risk factors, which yields explicit estimates of the cost of equity capital based on historical stock market values (Botosan, 2006). Another approach is to use analysts' forecasts of future earnings, which yields implied estimates of the cost of equity capital (Easton, 2004). The later approach uses analysts' forecasts of future earnings to estimate the internal rate of return that equates the markets' expectation of future cash flows to the current stock price. There are three methods of estimating the implied cost of equity capital available in the literature: 1- residual income valuation model (RIV) as developed by (Gebhardt et al., 2001), 2- abnormal earnings growth model (AEG) as presented by (Gode and Mohanram, 2003, Ohlson and Juettner-Nauroth, 2005), and 3- modified price earnings growth model (PEG) as developed by (Easton, 2004).

For the purpose of this study, the cost of equity capital will be derived using two alternative measures: the CAPM model and PEG model. The CAPM employs a historical perspective, while the PEG model engages a forward-looking approach. Although the cost of

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

equity models of the latter approach are arguably superior in efficiently capturing risk factors (Botosan, 2006, Botosan, 2000, Mangena et al., 2016), which makes them more suitable to address the disclosure-cost of equity capital questions, the historical-based CAPM estimate is by far the most commonly used in practice (Botosan, 2006, Jacobs and Shivdasani, 2012). As this paper aims to give insights for practice, we are compelled to use CAPM estimates in our modelling. Due to potential bias and measurement errors in the various estimation models of the cost of equity capital (Easton and Monahan, 2005, Li, 2010), we use the average of CAPM estimates and Easton estimates as a proxy for the cost of equity capital.

According to the CAPM model, as developed by (Sharpe, 1964), the cost of equity capital is the minimum required return rate on equity investment and comprises the risk-free interest rate and a premium rate for the non-diversifiable risk of the firm, as shown in the following equation:

$$COE = RF + \beta * [RM - RF] \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Ready CAPM-based estimates of the cost of equity capital were directly drawn from the Bloomberg database, in which 'β' 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 is the market's expected return.

Conversely, for the future-based approaches, we use the (Easton) model for cost of equity capital due to its common use in academic research (Botosan, 2006). The wide academic use of the Easton model is mostly justified by its simplicity of application and the questionable applicability of CAPM estimates in examining disclosure-cost of equity capital links (Botosan, 2006). The Easton model is arguably advantageous compared with the CAPM (Botosan, 2006) because it assumes that the cost of equity capital is 'not a function of a predetermined set of priced risk factors' (p. 33), and it produces estimates that are associated with several measures of risk in a theoretically predictable and stable manner (Botosan, 2006, Botosan and Plumlee, 2005). Additionally, estimates of the three future-based cost of equity capital measures, namely RIV, AEG and PEG, are fairly similar and positively correlated (Botosan and Plumlee, 2005). The formula for the (Easton) PEG Model is outlined as follows:

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

Where EPS2 is the analysts' consensus of the two-year forward EPS, EPS1 is the analysts' consensus of the one-year forward EPS, and P0 is the firms' share price at the end of the financial year. Data for calculating the COE of Easton model were drawn out from Bloomberg database. Looking at the Easton model, a mathematical limitation emerges from the fact that EPS2 must be greater than EPS1, which is not always the case for all firms.

3.4.Empirical Model

Following previous studies (Mangena et al., 2016, Gebhardt et al., 2001, Dhaliwal et al., 2011, Easton, 2004, Botosan, 2006, Botosan and Plumlee, 2002b, Richardson and Welker, 2001, Plumlee et al., 2015, Plumlee et al., 2009), the following baseline model was developed:

$$COE_{i.t} = \beta 0 + \beta 1. Innov.D_{i.t-1} + \beta 2. ESGScr_{i.t-1} + \beta 3. BETA_{i.t-1} + \beta 4. LogTotAss_{i.t-1} + \beta 5. B2M_{i.t-1} + \beta 6. Debt2Assets_{i.t-1} + \beta 7. ROA_{i.t-1} + \beta 8. Analyst_{i.t-1} + \beta 9. Growth_{i.t-1} + (\beta 10. - \beta 14). \text{Year. dummies} + \varepsilon_{i.t} \ldots . (3)$$

Where COE is the cost of equity capital for the company i. at period t. The cost of equity capital is taken as the average estimate of CAPM and PEG model. *Innov.D* denotes innovation disclosure level of firm i. in period t-1. The Innov.D has three measures: explorative, exploitative, and OA disclosure. The Innov.D measures are the coverage percentages produced by NVIVO textual analysis software. The coverage percentage of NVIVO represent word frequencies of innovation disclosure as a percentage of the total words in the annual report document. The ESGScr stands for the Bloomberg disclosure score of environmental, social, and governance practices[8]. The ESGScr is used here as a control variable for ESG disclosure given the empirical evidence of its association with the cost of equity capital as demonstrated in the disclosure literature (Dhaliwal et al., 2011, Richardson and Welker, 2001, Plumlee et al., 2015, Plumlee et al., 2009). The model also controls for other related variables such as market BETA, the natural logarithm of total assets as a proxy for size, B2M ratio (Botosan and Plumlee, 2002b, Botosan and Plumlee, 2013), financial leverage (Total Debt/Total Assets), profitability (ROA) (Gebhardt et al., 2001), analyst coverage (Botosan and Plumlee, 2005) and forecasted long-term growth rate of earnings (Botosan and Plumlee, 2013, Gebhardt et al., 2001)[9]. 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 hypotheses are tested using fixed effects panel regression with a large-scale longitudinal unbalanced panel dataset for the period 2011–2016. The use of fixed effects estimation is recommended by (Nikolaev and Van Lent, 2005) given the endogenous nature of disclosure and the cost of capital association. We ran the Hausman test for all models to decide between fixed effects and random effects estimations and the decision is based on the significance of Hausmans' 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, Gujarati, 2009, Wooldridge, 2010).

All of the right-hand side variables are one-year lags to control for endogeneity issues arising from reverse causality bias. The use of unbalanced panel data is aimed at controlling for survivorship bias by treating missing data as exogenous according to the missing at random hypothesis. The longitudinal unbalanced panel setting will also control for unobserved

[8] The environmental, social and governance ESG disclosure score is readily available and directly drawn from the Bloomberg database. The ESG score is a weighted percentage score of three percentage sub-scores, namely environmental disclosure score, social disclosure score, and governance disclosure score. Previous studies QIU, Y., SHAUKAT, A. & THARYAN, R. 2016. Environmental and social disclosures: Link with corporate financial performance. *The British Accounting Review,* 48**,** 102-116, BERNARDI, C. & STARK, A. W. Ibid.Environmental, social and governance disclosure, integrated reporting, and the accuracy of analyst forecasts. had used Bloomberg ESG disclosure scores and provided adequate descriptions of how they are derived.

[9] 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.

heterogeneity and endogeneity issues arising from omitted variable bias. Fixing for firm and time effects, the fixed effects setting will entirely capture the time non-varying omitted variables, such as industry classification, sector type, cross-listing status and regional and geographical location. Furthermore, robust-standard errors are used to control for heteroscedasticity and autocorrelation bias (Wooldridge, 2010, Petersen, 2009). The longitudinal panel design is crucial in understanding the strategic policy effects (Baltagi, 2008, Wooldridge, 2010), including innovation disclosure policy effects on the cost of equity capital.

4. Results Analysis and Discussion

4.1. Descriptive and Univariate Analysis

Descriptive statistics of the 1832 year-firm observations for dependent and independent variables are provided in Table 2. The mean and (median) of the cost of equity capital is 10% and (9.4%) which are relatively similar to the 9.95% and (9.02%), respectively, reported in (Mangena et al., 2016). However, the innovation disclosure measures for exploration (Explr.t-1), exploitation (Explt.t-1) and ambidexterity (OA.t-1) appear to have relatively very low variances compared to the cost of equity capital and ESG disclosure scores. The exploration disclosure Explr.t-1, however, appears to have the highest descriptive parameters amongst the three innovation disclosure measures, with the range parameter (31.7%) standing out as the highest of the three. By contrast, the relatively higher parameters of ESG disclosure are because it is derived with a different scale: a comprehensive index of ESG disclosure items as designed and collected by Bloomberg, compared with a word list index, as is used to measure innovation disclosure in this paper.

The strategic mean trends of cost of equity capital and disclosure scores over the study period are presented in Table 3. The time trend of the cost of equity capital shows a consistent and steady decrease over time, compared with all the disclosure measures (exploration, exploitation, OA and ESG) which are showing a consistent, steady increase over time.

Table 4 displays the Pearson correlations of variables with a star denoting significance at the 5% level. Innovation disclosures (Exploitation and OA) and ESG disclosure are significantly positively correlated. All three measures of innovation disclosures (exploration, exploitation and OA) appear to have significant negative correlations with the cost of equity capital. ESG disclosure, shows significant positive correlation with the cost of equity capital, indicating that innovation disclosure might have a favourable effect on the cost of capital compared with the ESG disclosure.

Table 5 presents the paired t-test comparisons of exploration and exploitation disclosure scores whereby we test our first hypotheses. At a 5% significance level, the paired T-test shows that firms, on average, disclose more exploration innovation (mean = 0.023) than exploitation innovation (mean = 0.014). This result is robust even at the 99% and 99.9% significance levels. This result is also robust at the 95%, 99% and 99.9% significance levels, even when exploration and exploitation disclosures are either trimmed or winsorized for the highest 5% or 1% of outliers. It is also robust at the industry level for each of the 10 ICB industrial classification of the full sample. This finding supports a decision in favour of the first alternative hypothesis - that there are statistically significant differences (-.0091898***) between the disclosure levels of exploitation and exploration. This indicates that firms, on an actual performance scale, are perhaps not seeking to balance efforts of exploitation and exploration, and they reflect that by placing more emphasis on exploration disclosures. In fact, this finding suggests that firms are trying to communicate that they are more explorative than exploitative oriented; an evidence that complies with the combined dimension of ambidexterity.

4.2. Multivariate Analysis

Table 6 displays results of the fixed effect regression models of innovation disclosures on the cost of equity capital. Due to severe multi-collinearity issues, we could not combine exploration, exploitation and OA disclosures in a single model. Therefore, the initial model for the full sample is designed once to have both exploration and exploitation as individual independent variables and another time when OA disclosure (the combined innovation disclosure score of exploration and exploitation) is used instead of the individual independent variables. Then, the design of initial models of the full sample were retested for subsamples of firms that have high and low analyst following, R&D firms, and firms of large and small size.

Based on the estimates of model 2, the combined OA disclosure shows significant benefits (-0.754***) of reduced cost of equity capital for the full sample, which mainly stems from the exploitation disclosure benefit (-0.768***) as shown in Model 1. This indicates that with each 1% increase in exploitation and OA disclosure, there is a benefit of (-0.768***) and (-0.754***) respectively, in the form of reduced cost of equity capital.

When subsampled by analyst following, as shown in Model 4, there is evidence of significant benefits (-0.649**) from OA disclosure for the high analyst following firms, stemming mostly from benefits of (-0.731***) exploitation disclosure. Model 6 shows even greater benefits (-0.998*) from OA disclosure for the low analyst following firms, than that of high analyst following firms (-0.649**). This finding, despite the weak significance, is in line with previous evidence (Botosan, 1997, Botosan, 2000) that firms of low analyst following enjoy greater benefits of reduced cost of equity capital from expanded disclosures than do firms of high analyst following. Furthermore, the weakly significant benefits (-0.998*) from OA disclosure for the low analyst following are greater than that of the full sample (-0.754***).

With regard to R&D firms, Model 8 shows significant benefits of (-1.286**) from OA disclosure, which is 70% higher than the average benefits (-0.754***) of OA disclosure for the entire sample shown in Model 2. Looking at Model 7, the benefits of (-0.729**) from exploration disclosure are significant but the benefits from exploitation disclosure are not. However, the significant benefits (-1.286**) of combined OA disclosure outweigh the individual significant benefits (-0.729**) of exploration disclosure, which highlights the synergistic benefit of both exploration and exploitation disclosures as well as their combined importance for R&D firms. This result is consistent with previous findings (Merkley, 2013) that innovation-related disclosure is vital for R&D firms.

When subsampled by size, Model 10 shows significant benefits of (-0.798**) from OA disclosure for large-sized firms, which is slightly (5.8%) higher than the average benefits (-0.754***) of OA disclosure for the entire sample. The significant benefits of (-0.798**) from OA disclosure stem mainly from the significant benefits of (-0.78**) from exploitation disclosure as presented in Model 9. Small-sized firms, as shown in Models 11 and 12, seem to earn no significant benefits from exploration, exploitation or OA disclosures. This finding is consistent with the arguments that highly capitalized firms are entitled to more resources to pursue desired innovations and, therefore, are able to earn more benefits from innovation outcomes and their respective disclosures (Cao et al., 2009).

To conclude the overall results, we find empirical evidence to support the second alternative hypothesis in all of its forms (H2a, H2b, and H2c). Hypothesized benefits from exploitation and combined OA disclosures (H2b and H2c respectively) are supported by the full sample and throughout most of the models whereas hypothesized benefits from exploration disclosures (H2a) are mainly supported by evidence from R&D firms. This suggests that exploration disclosure for non-R&D firms are generally implicated with potential issues of reliability and value-relevance as described by (Wyatt, 2008).

Two main findings stand out based on the overall picture of analysis. First, evidence shows that, on average, the significant benefits of reduced cost of equity capital stem from exploitation rather than exploration disclosure - except for R&D firms - when, in fact, firms on average disclose more exploration than exploitation according to the paired T-test results in Table 5. Second, firms with low analyst followings, R&D firms, and large-sized firms enjoy benefits from the combined OA disclosure greater than the average of the entire sample.

4.3. Robustness Checks

We performed a number of tests to check robustness in three main respects. Firstly, we ran tests to check whether endogeneity bias is confounding our results. Secondly, we checked the robustness of our results to various measures of innovation disclosure as well as cost of equity capital. Thirdly, we added control variables to the model one by one to see if the omission of any control variable severely affected the results. All of the results of this section – not reported here – are all available from authors upon request.

As described by previous studies (Nikolaev and Van Lent, 2005), the relationship between the cost of capital and disclosure is subject to endogeneity concerns arising from reverse causality and omitted variable bias. The use of one-year lag for all right-hand side variables is intended to mitigate the reverse causality bias, whereas the use of fixed effects estimations is intended to control for omitted variable bias.

To check for the sufficiency of one-year lags in controlling for reverse causality bias, we ran a fixed effect regression test of the baseline model using two-year lags and found that the results are qualitatively robust. We also ran three separate fixed effects regression tests of innovation disclosures on the one-year lag of the cost of equity capital and all control variables as in the baseline model to see if the cost of equity capital is, in fact, a significant explanatory variable for innovation disclosure. For all three models (exploration, exploitation, and OA disclosures), the results consistently show that the one-year lag of the cost of equity capital is not a significant explanatory variable for the three innovation disclosures. While the one-year lags and two-year lags of innovation disclosures are significant explanatory variables of the cost of equity capital (see Table 6), we are reassured that reverse causality bias is not endogenously confounding our results.

With respect to the various measures of innovation disclosure, we tested for robustness by 1- using the natural log of word frequencies for exploration and exploitation instead of coverage percentages as measures of their respective disclosures and, 2- using the product of coverage percentages of exploration disclosure and exploitation disclosure, without square-rooting it, as a measure of OA disclosure. Results of using natural log of words show exact similarity with those reported in Table 6. While using the simple product of coverage percentages as a measure of OA disclosure shows exact significance levels with the dependent variable but with much exaggerated coefficients due to the incompatibility of functional forms.

As for alternative measures of cost of equity capital, we employed the abnormal earnings growth model (AEG) as developed and applied by (Gode and Mohanram, 2003, Ohlson and Juettner-Nauroth, 2005) and obtained only 689 firm-year observations for 261 firms. We then created two new proxies for cost of equity capital: 1- by averaging estimates from CAPM, PEG and AEG models and, 2-by averaging estimates only from PEG and AEG models. Fixed effects regression results from using the two new proxies of cost of equity capital are qualitatively similar to those reported in Table 6. Furthermore, fixed effects regression results from the individual estimates of cost of equity capital from CAPM, PEG and AEG models are qualitatively similar to the results in Table 6. Furthermore, using winsorised or trimmed version of cost of equity capital proxy at the 1^{st} and 99^{th} percentile gives qualitatively similar results.

The third phase of tests was aimed at examining the sensitivity of results to omissions of any of the control variables and the results are qualitatively consistent with those reported in Table 6.

5. Conclusions

This paper aims to address the strategic cost of equity capital-based economic consequences of innovation disclosure. Two types of innovation disclosure are recognised: exploration and exploitation. The combined disclosure of both, however, is the so-called organizational ambidexterity (OA) disclosure. Following the premise of the economic-based disclosure theory, we tested for the hypothesis that exploration, exploitation, and combined OA disclosures are associated with significant benefits in the form of reduced cost of equity capital. Using a longitudinal unbalanced panel database of UK FTSE 350 firms for the period 2011 - 2016, we ran a series of fixed effects panel regression analyses while fixing for time and firm effects. The fixed effects panel regression is vital to understanding the strategic effects of innovation disclosure policies on the cost of equity capital. The results from cost of equity capital, however, present empirical evidence in two respects. First, the bulk of significant benefits in terms of reduced cost of equity capital emerge from exploitation rather than exploration disclosure - with the notable exception of R&D firms. This finding contrasts with the fact that firms on average disclose more exploration than exploitation according to results of the paired T-test. Second, three sub-samples enjoy higher than average benefits of reduced cost of equity capital arising from combined OA disclosure: firms of low analyst following, R&D firms, and large-sized firms.

These findings offer valuable insights for ongoing academic debates on both disclosure and OA literatures and have significant implications for practitioners and standard-setters such as the IIRC. This study, however, is subject to a number of limitations, and we encourage future research that would overcome them partially or completely. In terms of methodological limitations, the use of different measurement tools to measure innovation disclosure could perhaps yield different results. For instance, a different set of keywords for exploration and exploitation or a different categorization of innovation disclosure (i.e., similar to that of (Bellora and Guenther)) could lead to a different set of findings. In addition, using a different type for cost of capital (e.g. cost of debt capital) may yield 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, presentations and reports to analysts, or different stock markets from around the world.

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Appendix A[10]

Exploration wordlist with the new added words

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

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 new added words

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.

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*

[10] For the exploration list, the words ‘Vary*’ and ‘being_the_first’ were removed, and the word ‘play’ was modified to ‘play_role’. However, for the exploitation list, the words ‘adaption*’, ‘Current’, and ‘stabil*’ were removed. Variations of the word new were added specifically (i.e., newer, newest, and newly) to avoid capturing irrelevant instances such as the word ‘news’. Instead of ‘stabil*’, we added ‘stabilize*’ and ‘stabilise*’ specifically. Further changes to the exploitation list also included transforming ‘optimize’ to ‘optimi*’, ‘Up-date’ to ‘updat*’, ‘efficiency’ to ‘efficien*’, and adding an asterisk ‘*’ to words such as fast, speed, and choice.

Tables

Table 1: Sample Composition by Industry vs. Year

Industry Composition by Year								
Industry: ICB codes	Total FTSE 350	2011	2012	2013	2014	2015	2016	Available FTSE 350
Basic Materials	152	34	31	25	22	18	22	152
Consumer Goods	167	25	26	29	29	29	29	167
Consumer Services	389	58	58	61	70	71	68	386
Financials	703	60	65	68	71	77	81	422
Health Care	74	8	10	12	14	14	15	73
Industrials	384	62	63	66	65	63	64	383
Oil & Gas	94	22	19	17	15	11	10	94
Technology	70	15	15	13	10	8	7	68
Telecommunications	43	9	8	8	7	6	5	43
Utilities	44	8	7	7	8	7	7	44
Total	2,120	301	302	306	311	304	308	1,832

Table 2: Descriptive Statistics

Descriptive Statistics								
Stats	**Mean**	**Median**	**SD**	**Variance**	**N**	**Range**	**Min**	**Max**
Explr.t-1	0.024	0.023	0.010	0.000	1756	0.317	0.003	0.320
Explt.t-1	0.015	0.014	0.004	0.000	1756	0.046	0.003	0.049
OA.t-1	0.018	0.018	0.004	0.000	1756	0.043	0.004	0.047
ESGScrt1	0.336	0.318	0.119	0.014	1760	0.661	0.033	0.694
COE	0.100	0.094	0.032	0.001	1693	0.358	0.040	0.397
See notes to Table 6 for variable definitions								

Table 3: General Time Trends

Time-Mean Trends						
Fiscal Year	2011	2012	2013	2014	2015	2016
mean(Explr.t-1)	0.0222	0.0230	0.0235	0.0251	0.0246	0.0245
mean(Explt.t-1)	0.0139	0.0142	0.0144	0.0148	0.0153	0.0152
mean(OA.t-1)	0.0174	0.0179	0.0182	0.0187	0.0192	0.0191
mean(ESGScr.t-1)	0.3223	0.3250	0.3276	0.3497	0.3496	0.3417
mean(COE)	0.118	0.107	0.100	0.095	0.092	0.088
See notes to Table 6 for variable definitions						

Table 4: Pearson Correlation

	Explr.t-1	**Explt.t-1**	**OA.t-1**	**ESGScr.t-1**	**COE**
Explr.t-1	1				
Explt.t-1	0.1849*	1			
OA.t-1	0.6766*	0.7723*	1		
ESGScr.t-1	0.0138	0.0725*	0.0588*	1	
COE	-0.0876*	-0.051*	-0.1035*	0.1044*	1
Note: * indicates significant correlation at the 5% level. See notes to Table 6 for variable definitions					

Table 5: Paired T-test

Paired T-test	**Expltt1**	**Explrt1**	**Diff(Expltt-1 – Explrt-1)**
Mean	0.0146491	0.0238389	-0.0091898***
Observation	1756	1756	T = -39.9038

Table 6: Cost of Equity Capital Results

	Cost of Equity Capital											
	Initial Model		Analysts Following				Log.R&D/Sales		Size			
			High		Low				High		Low	
	1	2	3	4	5	6	7	8	9	10	11	12
Explr.t-1	-0.0312	--	0.0646	--	-0.057*	--	-0.729**	--	-0.054	--	0.38	--
	(0.038)	--	(0.254)	--	(0.0332)	--	(0.326)	--	(0.039)	--	(0.24)	--
Explt.t-1	-0.768***	--	-0.731***	--	-0.863	--	-0.544	--	-0.78**	--	-0.342	--
	(0.212)	--	(0.281)	--	(0.628)	--	(0.474)	--	(0.4)	--	(0.254)	--
OA.t-1	--	-0.754***	--	-0.649**	--	-.998*	--	-1.286**	--	-0.798**	--	-0.024
	--	(0.255)	--	(0.316)	--	(0.55)	--	(0.510)	--	(0.381)	--	(0.36)
ESGScr.t-1	-0.0264	-0.026	-0.05**	-0.047**	-0.0078	-0.01	-0.0298	-0.0291	-0.031	-0.031	0.001	-0.002
	(0.0218)	(0.0217)	(0.022)	(0.022)	(0.0561)	(0.056)	(0.035)	(0.035)	(0.0285)	(0.0283)	(0.03)	(0.03)
Beta.t-1	0.0052	0.0051	0.01*	0.01*	-0.016	-0.016	0.0021	0.0018	0.001	0.0006	0.01	0.01
	(0.0056)	(0.0056)	(0.006)	(0.006)	(0.014)	(0.014)	(0.0122)	(0.012)	(0.0082)	(0.0081)	(0.007)	(0.007)
LogTotAssets.t-1	-0.0368***	-0.035***	-0.024**	-0.023**	-0.046*	-0.044	-0.0439*	-0.0421	--	--	--	--
	(0.0138)	(0.013)	(0.012)	(0.011)	(0.027)	(0.027)	(0.0252)	(0.026)	--	--	--	--
B2M.t-1	0.0243***	0.0243***	0.03***	0.03***	0.001	0.0003	0.0294**	0.0296**	0.025***	0.025***	0.013	0.014
	(0.0055)	(0.0056)	(0.006)	(0.006)	(0.047)	(0.005)	(0.013)	(0.013)	(0.007)	(0.007)	(0.009)	(0.009)
Debt/Assets.t-1	0.0302**	0.0304**	0.0136	0.014	0.0002	0.001	0.0178	0.0163	0.041	0.041	0.011	0.012
	(0.0141)	(0.0141)	(0.016)	(0.016)	(0.031)	(0.031)	(0.0194)	(0.0194)	(0.027)	(0.027)	(0.016)	(0.016)
ROA.t-1	-0.05**	-0.0481**	-0.0437*	-0.041*	-0.087**	-0.083**	-0.0423**	-0.0443**	-0.036	-0.034	-0.049**	-0.047**
	(.0228)	(0.0226)	(0.026)	(0.025)	(0.045)	(0.04)	(0.0214)	(0.0212)	(0.036)	(0.036)	(0.021)	(0.021)
Analysts.t-1	-0.0003	-0.0003	--	--	--	--	-0.0003	-0.0003	-0.0003	-0.0003	-0.0005	-0.0005
	(0.0002)	(0.0002)	--	--	--	--	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0003)	(0.0003)
Growth.t-1	-0.0032	-0.0033	0.005*	0.005*	-0.025	-0.025	0.0132	0.0132	-0.0044	-0.0045	0.0047	0.004
	(0.0068)	(0.0068)	(0.003)	(0.003)	(0.017)	(0.017)	(0.0098)	(0.0098)	(0.01)	(0.01)	(0.004)	(0.004)
LogR&D/Sales.t-1	--	--	--	--	--	--	0.0026	0.0019	--	--	--	--

	--	--	--	--	--	--	(0.007)	(0.007)	--	--	--	--
Constant	0.234***	0.231***	0.188***	0.186***	0.283***	0.281***	0.285***	0.277***	0.104***	0.106***	0.076***	0.08***
	(0.0546)	(0.0539)	(0.05)	(0.05)	(0.102)	(0.10)	(0.096)	(0.099)	(0.019)	(0.019)	(0.016)	(0.02)
Year Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
R-sq within	0.2226	0.2219	0.2391	0.2371	0.3234	0.3272	0.2007	0.1954	0.1909	0.1924	0.3418	0.3323
R-sq between	0.0012	0.0008	0.0436	0.0468	0.0469	0.0458	0.0048	0.0045	0.0172	0.0168	0.1311	0.1308
R-sq overall	0.0002	.0006	0.0472	0.0526	0.0320	0.0292	0.000	0.0001	0.0543	0.0559	0.17	0.01681
F-stat	10.65***	10.57***	8.46***	8.34***	6.46***	5.77***	5.38***	5.35***	5.26***	5.43***	11.98***	11.34***
No. of observations	1024	1024	677	677	342	342	333	333	605	605	419	419
No. of groups	295	295	201	201	177	177	96	96	160	160	157	157
Hausman Chi2	140.72***	138.46***	75.72***	80.38***	N/A	341.06***	48.61***	44.75***	114.44***	117.7***	21.10*	27.49***

I. Cost of equity capital is estimated by taking the average of CAPM-based estimates and Easton-based estimates of the cost of equity capital. Robust standard errors are reported in parentheses. Significance at levels 10%, 5%, and 1% are starred with *, **, and ***, respectively.

II. Explr.t-1 and Explt.t-1 denote the one-year lag of exploration and exploitation disclosure-coverage percentages, respectively, as obtained from NVIVO-based text-search of the relevant wordlists from annual reports. OA.t-1 is the square root of the product of Explr.t-1 and Explt.t-1; the square rooting used here to achieve a comparable percentile functional form. Severe collinearity issues prevented the joint inclusion of Explr.t-1, Explt.t-1, and OA.t-1 in a single overall model, which is why OA.t-1 was modelled separately from Explr.t-1 and Explt.t-1. ESGScr.t-1 is the one-year lag of the Bloomberg-based ESG disclosure score. The ESGScr.t-1 is used here as a control variable for ESG disclosure given the empirical evidence of its association with cost of equity capital (Dhaliwal et al., 2011, Richardson and Welker, 2001, Plumlee et al., 2015, Plumlee et al., 2009).

III. To control for other related variables, we included market BETA (based on weekly data for 5 years), the natural logarithm of total assets as a proxy for size, B/M ratio (Botosan and Plumlee, 2002b, Botosan and Plumlee, 2013), financial leverage (Total Debt/Total Assets), profitability (ROA) (Gebhardt et al., 2001), analyst coverage (Botosan and Plumlee, 2005), and forecasted growth rates of earnings (Botosan and Plumlee, 2013, Gebhardt et al., 2001). 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. LogR&D/Sales represents the natural logarithm of the relative R&D expenditure to the value of total revenues.

IV. Estimations are obtained using fixed effects panel regression while fixing for time and firm specific effects with a longitudinal unbalanced panel dataset for the period 2011–2016. The longitudinal unbalanced panel setting helps to control for unobserved heterogeneity and endogeneity issues arising from omitted variable bias. The fixed effects setting will capture entirely the time non-varying omitted variables, such as industry classification, sector type, and regional and geographical location (Baltagi, 2008, Wooldridge, 2010). All of the control variables are one-year lag to ensure that we control for endogeneity issues arising from reverse-causality bias.

V. Due to severe collinearity issues between the market capitalization (as a proxy of size), market beta, and all disclosure scores of exploration, exploitation, OA, and ESGScr, the natural logarithm of total assets is used as a proxy of size instead of market capitalization. This choice helped reduce the mean VIF down from 35 or over to less than 10; a threshold that is argued to be an acceptable limit (Baltagi, 2008, Wooldridge, 2010, Gujarati, 2009).

VI. The subsampling was made by the median observation for analyst following (median = 13) and size (median total assets = £2142.91m).

VII. For model 11, the Hausman Chi2 is weakly significant at 10% level and results from the fixed effects and random effects estimations are similar. We, however, report results of fixed effects estimation just to be consistent and accurate in our reporting.

VIII. For model 5, stata.15 produced a negative Hausman Chi2 result because the model did not meet the asymptotic assumption of the Hausman test, which is due to a small sample or misspecification of model or both together. However, we report the available fixed effects estimation in model 5 with cautiousness, since model 6 (an amended version of model 5) reported Hausman Chi2 of 341.06***. In addition, upon removing any control variable or year dummies from model 5, the reported Hausman Chi2 is positive and significant at 1% level.