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CAPITAL MARKET RESPONSES TO EXPLORATION AND EXPLOITATION DISCLOSURE

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Abstract

We draw on information risk theory and paradox theory to examine the additive and combined effects of disclosing exploration and exploitation information on cost of equity capital. We build on theory that presupposes that the information disclosed by a firm about its innovation activities will reduce information risk of investors. However, we contend that disclosure of exploration and exploitation innovation activities could convey potentially paradoxical expectations about a firm's future value. Based on longitudinal data of the UK FTSE 350 firms from 2011–2016, we show that firms tend to disclose more information related to exploration than exploitation. However, the bulk of market benefits are driven by exploitation rather than exploration disclosures—except for R&D-active firms that are rewarded for exploration disclosure. We also find that the combined disclosure is negatively associated with cost of equity capital, with the sub-population of R&D-active firms particularly accruing synergies from combined disclosure of *both* exploration and exploitation. These findings suggest that the market differentiates between exploration and exploitation information in addressing information risk, more so than previously assumed. We discuss implications for information-type-dependency in information-risk theory, the outward projection of internal paradoxes, capital market valuations of disclosure by R&D-active firms, opportunity-seeking by large publicly listed corporations, and policy implications.

Keywords: *ambidexterity, content analysis, cost of capital, disclosure, exploitation, exploration, information risk.*

1 Introduction

Investors require information about the innovation activities of a firm (Benner, 2010; Botosan, 2006; Hussinger & Pacher, 2019). Innovation involves both the creation, adoption, and diffusion of novel or significantly improved products; technological processes; as well as organizational practices (Organisation of Economic Co-Operation and Development, 2010). While innovation is crucial for firm value, uncertainty surrounding innovation activities increases information asymmetry and estimation risk for investors (Jia, 2018; Mc Namara & Baden-Fuller, 2007). To the extent that information disclosure of key activities is important for reducing information risk through decreased information asymmetry and increased precision of risk estimates (Botosan, 2006; Botosan & Plumlee, 2002b), disclosure about different innovation activities may affect a firm's ability to secure favorable external financing.

Exploration and exploitation represent two prominent innovation strategies that firms can pursue (Jansen, Van Den Bosch, & Volberda, 2006; March, 1991). Exploitation innovation activities involve incremental improvements to existing solutions, while exploration innovation activities represent the introduction of radically new concepts (Quintana-García & Benavides-Velasco, 2008; P. Wang, Van De Vrande, & Jansen, 2017). Scholars have shown that the ability to pursue both types of innovation activities can be advantageous (Koryak, Lockett, Hayton, Nicolaou, & Mole, 2018; Revilla & Rodríguez-Prado, 2018). However, these innovation activities inherently differ in their risk profiles, horizon for returns, and logical organizational arrangements (Andriopoulos & Lewis, 2010; Fourné, Rosenbusch, Heyden, & Jansen, 2019). Thus, although information about innovation activities is important for investors (Jia, 2019), information disclosed about exploration and exploitation activities may convey different, and potentially paradoxical, expectations about a firm's value.

In this study, we draw on information risk theory and paradox theory to examine how disclosure of exploration and exploitation activities, separately and combined, influences cost of equity capital. Information-risk theory suggests that disclosure about organizational activities reduces estimation risk and information asymmetry (Botosan, 2006; Healy & Palepu, 2001; Hughes, Liu, & Liu, 2007), which should benefit the company through lower cost of capital (Bellora & Guenther, 2013; Botosan, 2006; Mangena, Li, & Tauringana, 2016). This literature generally assumes that more disclosure is generally beneficial, but has devoted less attention to how capital markets account for information about inherently different innovation activities. In turn, the paradox literature has been concerned with the internal reconciliation of contradictory activities (Andriopoulos & Lewis, 2009; Papachroni, Heracleous, & Paroutis, 2015; Schad, Lewis, Raisch, & Smith, 2016), but less so with how outsiders, such as investors, respond to seemingly paradoxical information. By combining these perspectives, we can advance theory on capital market implications of disclosing information about a firm's exploration and exploitation activities.

Against these theoretical assertions, we develop and test corresponding hypotheses on a longitudinal sample of FTSE 350 firms for the period 2011–2016, apply a computer-aided textual analysis to measure exploration and exploitation disclosure (Heyden, Oehmichen, Nichting, & Volberda, 2015; Uotila, Maula, Keil, & Zahra, 2009), and estimate the cost of equity capital using the price-earnings growth (*PEG*) model of Easton (2004). Our findings suggest that firms, on average, disclose more exploration than exploitation. However, the bulk of capital market benefits are earned by exploitation rather than exploration disclosures—except for R&D-active firms that are rewarded for exploration disclosure. We also find that the combined disclosure is negatively associated with cost of equity capital more generally, with the sub-sample of R&D-active firms particularly accruing synergies from combined exploration and exploitation disclosures. Our theoretical grounding and allied findings allow us to offer several notable contributions.

First, we contribute to literature on information risk by showing that the effect of innovation disclosure on the cost of capital is information-type-dependent (Botosan, 2006). Prior studies have traditionally emphasized the *level* of disclosure in theorizing the informational environment of investors (Botosan, 1997), whereas we additionally emphasize the importance of the *type* of information disclosed about different innovation activities. Our theory and findings underscore the information-type-dependent nature of the disclosure and cost of capital link, as the market *does* seem to differentiate between exploration and exploitation information in their pricing responses, more so than previously assumed (cf. Hussinger & Pacher, 2019).

Second, we advance the paradox perspective on ambidexterity by adding a market-based complement. Paradox theory has alluded to the synergistic potential of exploration and exploitation in innovation activities (Papachroni et al., 2015; Schad et al., 2016). Although this literature's core thesis is that firms can thrive by embracing paradoxes, it has been largely internally-focused (e.g., Knight & Paroutis, 2017). For instance, scholars usually look at how information sourced *from* the external environment nourishes paradoxical innovation activities within organizations (Bei, 2019; Carayannopoulos & Auster, 2010; Kobarg, Stumpf-Wollersheim, & Welpe, 2019). However, less is known about how investors cope with paradoxical innovation information that firms emit *outwards.* Through use of this complementary viewpoint, we can connect paradox theory with scholarship acknowledging capital market actors' responses to innovation more broadly (e.g., Benner, 2010). Although the latter suggest that the market tends to pressure firms to disclose unambiguous (Epstein & Schneider, 2008; Hussinger & Pacher, 2019) and short-term focused information (Benner, 2007, 2010), we show that capital markets not only differentiate between information pertaining to different innovation strategies, but also seem to recognize potential synergies for certain types of firms.

Finally, we argue that different types of firms may vary in the expected implications from disclosure of exploration and exploitation (Chan, Lakonishok, & Sougiannis, 2001; Mc Namara & Baden-Fuller, 2007; Oehmichen, Heyden, Georgakakis, & Volberda, 2017). We add an important boundary condition by suggesting that information risk is heightened around R&D activity (Eberhart, Maxwell, & Siddique, 2004). Given that some have argued that ambiguities around R&D-active firms may be amplified through disclosure, which could intensify rather than mitigate information risk (see Kothari, Li, & Short, 2009; Rogers, Skinner, & Van Buskirk, 2009), the extent to which disclosure of different types of innovation activities by R&D-active firms influences cost of capital remains largely unresolved. By acknowledging the heightened information risk around R&D-activity, we add new evidence that R&D-active firms may particularly benefit from combined disclosure of exploration *and* exploitation information.

The study proceeds as follows. Section 2 presents the conceptual background and hypotheses development. Section 3 outlines our data and methodological approach. Section 4 documents our key empirical findings and additional analytical considerations. Finally, the fifth section concludes the paper with an elaboration on our theoretical contributions to the literature on information risk (disclosure literature), additive and combined innovation strategies (paradox-ambidexterity literature), contextual considerations for R&D-activity (R&D literature), opportunity-seeking dispositions of large publicly-listed firms (entrepreneurial orientation literature), and implications for policy and practice.

2 Conceptual Background and Hypotheses

2.1 Disclosure and the Cost of Equity Capital

Cost of equity capital is the minimum rate of return required by equity investors. Information risk is a non-diversifiable risk that is priced-in by the capital market in the costings of equity capital (Easley & O'Hara, 2004). By reducing information risk for investors, firms can expect to be rewarded with a lower cost of capital and higher stock valuation (Healy & Palepu, 2001; Hughes et al., 2007; Verrecchia, 2001). Disclosure is argued to improve the informational environment for investors, which is linked to the cost of capital through two main mechanisms: (1) estimation risk and (2) information asymmetry (Blanco, Garcia Lara, & Tribo, 2015; Botosan, 2006). Estimation risk denotes the uncertainty associated with estimating the asset's future returns. In turn, information asymmetry denotes the potential risk of trading with better-informed investors, including insiders. Together, estimation risk and information asymmetry constitute what is generally referred to as information risk (De George, Li, & Shivakumar, 2016). The economics-based disclosure literature posits that enhanced disclosure reduces overall information risk by providing information of either greater volume or higher quality (De George et al., 2016; Easley & O'Hara, 2004). As such, disclosure reduces information asymmetry by adding transparency in the informational environment (Easley & O'Hara, 2004; Verrecchia, 1983, 2001) and alleviates estimation risk by increasing precision of expectations for investors (Lambert, Leuz, & Verrecchia, 2007).

Although research on the association between disclosure and cost of capital has focused mainly on financial disclosures (Botosan, 1997, 2006; Botosan & Plumlee, 2002a, 2002b), both the mechanisms and underlying assumptions can also be informative for theorizing non-financial disclosures (Dhaliwal, Li, Tsang, & Yang, 2011). For instance, studies have documented empirical evidence on disclosure of corporate social responsibility (Al-Tuwaijri, Christensen, & Hughes, 2004; Dhaliwal et al., 2011; Richardson & Welker, 2001), environmental initiatives (Plumlee, Brown, Hayes, & Marshall, 2015), and mandatory versus voluntary reporting requirements (Blanco et al., 2015; Francis, Nanda, & Olsson, 2008; Hail, 2002). However, aside from innovation outcomes such as new product announcements (Lee & Chen, 2009) and proprietary intellectual capital (Baruffaldi & Simeth, 2020; Mangena et al., 2016), less is known about disclosure of underlying and ongoing innovation activities

(Tushman, Smith, Wood, Westerman, & O'Reilly, 2010). This is crucial because to the extent that disclosure affects the cost of capital, (a) investors want to get in early on the innovative potential of a firm (Engel & Keilbach, 2007) and (b) disclosing innovating activities will bear on the ability of the firm to sustain investments in streams of innovation activities that are rewarded by the market (Andriopoulos & Lewis, 2009).

Innovation activities may differ in nature. Dhaliwal et al. (2011) argued that a straightforward generalization of the cost of capital effect from financial disclosure to non-financial disclosures is not always the case. This is especially true when non-financial disclosures are (1) subject to fewer regulations (i.e., discretionary), (2) subject to idiosyncrasies of non-comparability, and (3) suffer from potential credibility issues due to opportunistic behavior of firms. Therefore, the link between various types of information disclosures and the cost of capital may depend not only on the amount but also the type of information disclosed (Botosan, 2006).

2.2 Information Disclosure of Paradoxical Innovation Activities – Exploration and Exploitation

March (1991) recognized a fundamental challenge facing organizations: engaging in activities that exploit existing resources and capabilities to create incremental improvements, while exerting exploration efforts to devise radical solutions. Exploration activities are linked to search, discovery, risk-taking, and radical technological change, all of which are vital for long-term viability. In turn, exploitation activities revolve around efficiency, control, routine, certainty, and variance reduction, all of which are crucial for continuity (O'Reilly & Tushman, 2013; Wilden, Hohberger, Devinney, & Lavie, 2018). While organizations require both innovation strategies to survive in the short term and thrive in the long run (Junni, Sarala, Taras, & Tarba, 2013; Uotila et al., 2009), exploration and exploitation activities compete for finite resources at any point in time (Fourné et al., 2019; Jansen et al., 2006; Koryak et al., 2018).

Accordingly, exploration and exploitation strategies are often experienced as paradoxical in organizations—inherently logical and consistent in isolation, but incoherent or even absurd in conjunction (Andriopoulos & Lewis, 2010; Papachroni et al., 2015; Schad et al., 2016).

The paradox perspective on ambidexterity has emerged as a conceptual lens through which to examine the coexistence of persistent contradictions between interdependent elements of exploration and exploitation (Papachroni et al., 2015). The theoretical value of this perspective rests in acknowledging and tackling challenges that arise from coexisting dualities in organizations by finding synergies in their interdependencies (see Schad et al., 2016 for a review). The competing demands between exploration and exploitation activities have been at the core of empirical studies in this tradition (e.g., Andriopoulos & Lewis, 2009, 2010; Farjoun, 2010; Papachroni, Heracleous, & Paroutis, 2016). However, despite an increased understanding of the synergistic potential of embracing paradoxes, the literature is inherently inward-focused (Andriopoulos & Lewis, 2009; Fourné et al., 2019; Knight & Paroutis, 2016), remaining silent on how outsiders account for paradoxical information emanating from the innovation activities of firms. Thus, we identify an important need to examine how outsiders, starting here with investors, respond to information about the paradoxical innovation activities of firms.

As previously noted, disclosure is one of the main mechanisms through which firms bridge informational gaps between internal activities and capital market actors (Botosan & Plumlee, 2002b). Studies suggest that market actors favor clear and unambiguous information in their valuations of companies (Epstein & Schneider, 2008; Hussinger & Pacher, 2019; Rogers et al., 2009). For investors, then, increasing transparency related to *paradoxical* rationales of innovation (Andriopoulos & Lewis, 2009; Papachroni et al., 2015), may convey contradictory expectations of business risk (March, 1991; Uotila et al., 2009), profitability and future growth prospects (Fagiolo & Dosi, 2003; Jia, 2017), and estimates of future cash flows

(Levitas & McFadyen, 2009). That is, disclosure of different innovation activities may have contrasting implications for investors' information risk (i.e., information asymmetry and estimation risk), creating potentially contradicting capital market expectations of the firm's value (Jia, 2017).

Taken together, to the extent that firms disclose information about their internal activities (Botosan, 2006), and these activities may be inherently paradoxical (Andriopoulos & Lewis, 2009; Papachroni et al., 2015), the capital market may assess exploration and exploitation as fundamentally different, and perhaps paradoxical, innovation strategies. We engage with this underexamined plausibility by hypothesizing how disclosure of exploration and exploitation innovation, additively and combined, influences cost of equity capital.

2.2.1 Disclosing Exploration

Recent studies report consistent evidence which reinforces the projected capital market preference for short-term exploitation outputs (Jia, 2017, 2018, 2019). Some evidence further suggests that firms are less likely to conduct exploration when investors are risk-averse (Levinthal & March, 1993; Smith & Tushman, 2005). This finding is echoed by studies focusing on a different capital market participant affecting the informational environment—the financial analysts following the firm. For instance, Benner (2010) reports consistent evidence that financial analysts are more attentive and positive towards exploitation strategies that extend and preserve existing technologies than towards exploration strategies regarding new technologies. J. J. He and Tian (2013) examine the impact of financial analyst coverage on innovation quantity (number of patents) and quality (citations per patent) and report that greater analyst coverage is linked to lower quantity and quality of innovation output. As a vital bloc of capital market participants, financial analysts play an active monitoring role that pressures managers to meet short-term targets with heavy exploitation efforts, impeding the firms' investment in long-term exploration innovations (J. J. He & Tian, 2013).

Jia (2019) documents evidence that the choice of innovation strategy has a direct and significant influence on corporate disclosure policy. For instance, exploration strategy entails taking on more risk by investing in discovery of radically new innovations for the sake of long-term sustainability. This relates directly to the core essence of innovation strategy; exploration entails a high degree of risky investments compared to exploitation strategy which focuses on risk-mitigation by introducing continuous refinements and cost savings. Specifically, exploration activities have been linked with lower Tobin's Q (Uotila et al., 2009), high volatility of earnings (Jia, 2017; Levinthal & March, 1993; Uotila et al., 2009), and informational uncertainty (Jia, 2017), indicating that investors negatively price in the risks of exploration strategy, which is reflected in higher cost of capital. Hence,

HYPOTHESIS 1 (H1): *There is a positive association between disclosure of exploration information and cost of equity capital (i.e., investors penalize exploration disclosure).*

2.2.2 Disclosing Exploitation

Exploitation strategy attends to mitigating risks and reducing costs by introducing incremental refinements on a continuing basis, a strategy that improves short-term profits and potentially reduces the cost of capital. Hence, the expected exploitation outcome is more stable, predictable, and understandable (Z.-L. He & Wong, 2004; March, 1991; Uotila et al., 2009) and there tends to be more information about this type of innovation in the past performance records (Jia, 2019). Exploitation disclosure, therefore, informs investors about the appropriateness of current strategies in generating stable and predictable returns, keeping risks minimal, and meeting short-term targets. This helps market participants in predicting future returns and better estimating firm value.

Empirical evidence further suggests that an exploitation strategy is associated with lower probability of stock-crash risk and lower failure-to-success ratio (Jia, 2018), indicating that the market responds more favorably to the low-risk nature of exploitation strategy.

Furthermore, exploitative firms are associated with lower analyst forecast error and forecast dispersion (Jia, 2017, 2019) and higher analyst following (Jia, 2017), indicating that these firms foster less opaque informational environments, facilitating more precise estimations of the anticipated added value of their innovation activities. In short, disclosing exploitation information reduces the cost of capital due to less information asymmetry and increased precision of estimation. Thus, it can be expected that the capital market rewards exploitation disclosure with lower-cost equity capital. Hence,

HYPOTHESIS 2 (H2): *There is a negative association between disclosure of exploitation information and cost of equity capital (i.e., investors reward exploitation disclosure).*

2.2.3 Combined (Ambidextrous) Disclosure

The literature suggests that a combined exploration-exploitation strategy may generally be beneficial for performance (Junni et al., 2013). Indeed, O'Reilly and Tushman (2013) summarized evidence of a positive association of this 'ambidexterity' with growth, firm survival, market valuation, and subjective performance ratings. However, from a paradox theory perspective (Andriopoulos & Lewis, 2009; Papachroni et al., 2015), the information conveyed through exploration and exploitation may seem incompatible. For instance, exploration disclosure can be expected to signal long-term value whereas exploitation disclosure is more focused on short-term value. The expected structural organizational arrangements and costs that best support either innovation strategy may also differ (Csaszar, 2013; Fourné et al., 2019), as well as the anticipated cash-flow risk profile of more radical versus more incremental innovation projects (Cabrales, Medina, Lavado, & Cabrera, 2008). The simultaneous pursuit of both strategies is closely related to firm's short- and long-term performance, growth, long-term survival, and market valuation (O'Reilly & Tushman, 2013); but also requires consolidation of seemingly incompatible features of different innovation strategies (Fourné et al., 2019).

Literature also shows that combining exploration with exploitation can be synergistic (Cao, Gedajlovic, & Zhang, 2009; Floyd & Lane, 2000). For instance, an exploitation strategy capitalizes on current resources to add further improvements, refinements, cost savings, and larger economies of scale, all of which entitle the firm to additional resources to conduct exploration projects. Thus, exploration disclosure may be penalized through higher cost of capital (H1), unless it is combined with commensurate levels of exploitation (H2) that provide investors with the confidence of internal cash-flow and efficiency gains that can be leveraged to fuel exploration activities. Thus, exploration may be better received in conjunction with exploitation disclosure, as the latter gives context and certainty, while the former alludes to longevity. When this is the case, the favorable effects of combined (ambidextrous) innovation strategy for firm performance should also be reflected in a lower cost of capital. Combined disclosure would inform investors about the firm's strategy to balance short-term targets and long-term survival. That is, the short-term appetite of the market is addressed while stabilizing long-term prospects. Such an informative overall picture is crucial to alleviate uncertainties surrounding the firm's ambidextrous strategy by revealing valuable information about how much returns and synergies the firm expects to generate from combining exploration and exploitation. Thus,

HYPOTHESIS 3 (H3): *There is a negative association between combined disclosure of exploration and exploitation information and cost of equity capital (i.e., investors will reward combined disclosure).*

2.2.4 Disclosure of paradoxical innovation activities by R&D-active firms

Adding theoretical depth and nuance to the aforementioned, we proceed to argue that information risk may vary for different types of firms. In particular, investors may experience heightened information risk around R&D activity (Eberhart et al., 2004; Mc Namara & Baden-Fuller, 2007). For investors, a key appeal of investing in R&D-active firms is an anticipated "big pay day" in the future, as compared to non-R&D-active firms that devote these resources to providing stability of consistent marginal returns for shareholders (Bah & Dumontier, 2001; Gugler, 2003). As such, capital markets often expect R&D-active firms to be more explorative in their innovation activities (Benner, 2007, 2010). However, the market expectations on R&D-active firms to deliver breakthrough innovations carries the risk of over-exploration traps (Levinthal & March, 1993), as firms may escalate commitment to overly risky initiatives in their efforts to recover sunk costs in trying to deliver on these expectations (Mañez & Love, 2020; H. Wang & Li, 2008). Indeed, Oehmichen et al. (2017, p. 286) note that the effectiveness of the innovation process for these types of firms "requires explorative mechanisms to identify and support promising new products, while simultaneously having exploitative filters to terminate unsuccessful product streams and avoid escalation of commitment" (see also Tsinopoulos, Yan, & Sousa, 2019). We thus propose that R&D activity, is an important boundary condition in the innovation disclosure–cost of equity capital link.

Disclosing information pertaining to exploration and exploitation innovation activities by R&D-active firms may have varying implications for how the mechanisms from information-risk theory (i.e. information asymmetry and estimation risk) factor into expectations of future value (Jia, 2017). First, information asymmetry with investors may be even greater for R&D-active firms (Aboody & Lev, 2000; Dhaliwal et al., 2011; Jia, 2017), as the production function is embedded in complex and substantial body of specialized knowledge (Oehmichen et al., 2017). Not all of this input, however, is transformed into tangible outcomes for the firm, in part because the innovation-production function is causally ambiguous (see also Ambrosini & Bowman, 2010; Konlechner & Ambrosini, 2019; Zahra & George, 2002), with hard to define appropriability boundaries (Laursen & Salter, 2014; O'Mahony & Vecchi, 2009). As Hussinger and Pacher (2019) note, the inherent process of R&D creates ambiguous information, even to insiders involved (Kim, Kotha, Fourné, & Coussement, 2019; Potter &

Lawson, 2013). As such, investors may face even greater information opaqueness for firms with R&D activity (Chan et al., 2001; Coff, 2003; Hussinger & Pacher, 2019).

Second, in terms of estimation risk, investors need to evaluate the future potential of present R&D activity. R&D activity usually conveys an expectation that a firm strategy is grounded in the pursuit of long-term breakthroughs (Hussinger & Pacher, 2019; Jia, 2017) and conveys intentions to differentiate competitively, in part, through radical innovation (Godoe, 2000; Gupta, Dutta, & Chen, 2014). However, R&D-active firms face greater uncertainty in the timelines for their expected returns, given unpredictability in the discovery process (Aboody & Lev, 2000; Lev, 2000; Merkley, 2013). Investors usually do not know when the next commercially viable breakthrough will actually occur (Aboody & Lev, 2000; Lev, 2000), as even insiders may not be able to accurately predict this (Godoe, 2000; Yaqub, 2018). Thus, due to this uncertainty about the timeline of returns (Mañez & Love, 2020), which makes it more difficult for investors to accurately price the future value of current innovation activities, estimation risk is greater when investing in R&D-active firms.

Against the aforementioned, we expect combined disclosure to be particularly synergistic for R&D-active firms, as these firms need to provide information that is consistent with expectations for breakthrough innovations (exploration), as well as information helpful in appeasing short-term continuity concerns (exploitation). R&D-active firms, "need to renew their knowledge base by continuously exploring new knowledge for developing innovative products and services, while simultaneously exploiting their established competencies to improve current offerings" (Oehmichen et al., 2017, p. 284). By disclosing both exploration and exploitation innovation, R&D-active firms appease informational risk of over-exploration while creating assurance of their continuity through their efforts to *also* generate short-term cash flow. Thus, HYPOTHESIS 4 (H4): *The negative association between combined disclosure of exploration and exploitation information and cost of equity capital will be stronger for R&D-active firms (i.e., investors particularly reward combined exploration and exploitation disclosure by R&D-active firms).*

3 Data and Methodology

3.1 Sample and Data

We test our hypotheses on an unbalanced panel of UK's FTSE 350 firms. The full list of FTSE 350 companies was retrieved from the Bloomberg database for the 31st of December of each year during the period of 2011 to 2016. The choice of post-crisis period is made to minimize the confounding effects caused by the 2008 financial meltdown. During this period, UK firms have experienced great improvement in innovation (UKIS, 2014, 2016), in part encouraged by the UK Department of Business Innovation and Skills's *Innovation and Research Strategy for Growth* from 2011, which was followed by the UK government's *Science and Innovation Strategy* in 2014, which can be expected to be associated with greater variation in innovation disclosure[2]. We further chose FTSE 350 firms due to their highly capitalized nature, meaning that they have relatively larger resources to pursue various types of innovation than do smaller-sized firms, as well as more reliable documentation of their disclosures between firms and over time (Cao et al., 2009; see also Gupta et al., 2014).

Annual reports, collected directly from firms' websites, are used to measure innovation disclosures. Although the annual report is not the only means of corporate disclosure, it is often the main one (Bozzolan, O'Regan, & Ricceri, 2004; Guthrie, Petty, & Ricceri, 2006). The

[2] The annual rankings of the Global Innovation Index as issued by the World Intellectual Property Organization show the UK as having presented a fertile environment for innovation in the 2008 post-crisis era. From 2012 onwards, the UK reigns as one of "the world's five most-innovative nations" (Wunsch-Vincent, Lanvin, & Dutta, 2015, p. xvii). The UK maintained a leading position, even ahead of the U.S.A, during the period of 2012–2016, and demonstrated "a strong rise from the 10th in 2011 to the 2nd position in 2014 and 2015" (Wunsch-Vincent et al., 2015, p. 22). 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.

analysis of annual reports is now widely seen as a useful, unobtrusive source of documented textual data (Eggers & Kaplan, 2009; Heyden et al., 2015; Heyden, Sidhu, & Volberda, 2018; Uotila et al., 2009). All relevant data required for measuring the cost of equity capital and control variables were retrieved from the Bloomberg database. To rule out survivorship bias, all firms with available data were included in our sample. After dropping observations of missing data, we were left with 1,832 firm-year observations from 406 firms as a final sample. The most notable elimination, consisting of approximately 281 firm-year observations that are mostly investment trusts with no publicly available data, occurred in the financial sector. Table 1 details the sample distribution by industry and year.

****Insert Table 1 Here****

3.2 Measuring Innovation Disclosures

To measure innovation disclosures, we use a computer-aided textual analysis (CATA) approach. The CATA approach requires searching archived texts for a comprehensive dictionary composed of a collection of theoretically meaningful keywords that reflect the phenomenon of interest. Combining the strengths of computer reliability and expert human judgment, CATA enables the processing of large textual data to construct quantitative indicators from frequencies of keywords (Belderbos, Grabowska, Leten, Kelchtermans, & Ugur, 2017; Krippendorff, 2004). It builds on the notion that the occurrence, absence, and recurrence of keywords reflect theoretically meaningful underlying themes, whereas co-occurrences reveal underlying associations between them (Duriau, Reger, & Pfarrer, 2007; Heyden et al., 2015). 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 can provide valuable insights about the firms' long-term strategies and perceptions. Thus, the presence, absence, and frequencies of theoretically meaningful keywords can 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: deductive, through inference from theoretical concepts, and inductive, by search of the body of text under analysis to derive meaningful and relevant keywords. The validated dictionaries of Uotila et al. (2009) and Heyden et al. (2015), which were used as our starting point, have arguably covered the deductive method in full and the inductive method to some extent. Heyden et al. (2015) built on the original keywords of Uotila et al. (2009) by adding 66 and 75 words for the two main nodes of exploration and exploitation, respectively. As Heyden et al. (2015) tailored their dictionary for the pharmaceutical industry, we generalized their keywords and improved them with a number of changes. After our slight alterations in the original wordlist of Heyden et al, only 62 and 72 words remained for exploration and exploitation lists, respectively[3]. They were adopted and further extended by inductively adding a total of 76 words: 23 of exploration and 53 of exploitation.

A number of content validity checks were performed for the added words. Validity checks include validity of keywords' appropriateness by examining keywords-in-context (KWIC) (Belderbos et al., 2017; Krippendorff, 2004), expert judgment of face validity and validity of the overall dictionary in terms of accurately demonstrating the underlying phenomenon (Belderbos et al., 2017). With the KWIC, we checked each of the added words individually. Keywords that generated inconsistencies or irrelevant feedback were recognized and removed. We ran a preliminary text-search query for each added word independently and retrieved all instances from a random sample of 256 annual reports. A minimum of 20 instances

[3] For instance, words like 'astound' and 'fantasy' were removed for not retrieving any relevant references.

of the results were manually checked[4]. When the majority of the 20 KWIC were considered to correspond to either node (> 60%; cf. Belderbos et al. (2017) whose lowest inductive threshold was 67%), we kept them in the dictionary. This phase of validation was conducted in multiple iterative stages to ascertain reliability consistent with prior studies (Belderbos et al., 2017; Heyden et al., 2015; Krippendorff, 2004; Uotila et al., 2009).

Finally, the overall complete dictionary for each node was retrieved in a text-search query for the same random sample of 256 annual reports (approximately 14.6% 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. After a number of iterations, this phase resulted in no words being removed, indicating a level of saturation. After concluding all alterations, additions, and content validity checks, a total of 85 keywords for exploration and 125 for exploitation were included in our final search dictionary. The updated final dictionary used in this study can be found in Appendix A and a sample of extracted references from annual reports is presented in Appendix B.

To apply the CATA approach, we used the NVIVO- based text-search query to generate word frequencies and coverage percentages (i.e., extracted words expressed as a percentage of the total text) of each wordlist for each firm-year annual report. We used the coverage percentage of exploration (*Explr*) and exploitation (*Explt*) nodes as reflective of their respective disclosures. Then, the combined disclosure (*SqrootOA*) was obtained by square-rooting the product of exploration and exploitation coverage percentages. The square-rooting was conducted to transform the functional form of the variable back to a percentile scale for normality purposes. This operationalization of the combined disclosure concept is consistent with the combined dimension of ambidexterity literature (i.e., higher scores reflect higher

[4] In the KWIC 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, this phase resulted in more words being added than removed; hence, a number of KWIC iterations were required.

coexistence of exploration and exploitation; see also Cao et al., 2009; Lubatkin, Simsek, Ling, & Veiga, 2006, p. 656). We also used a conventional measure of the combined disclosure and computed it as a simple product of exploration and exploitation coverage percentages, which we used for sensitivity tests.

3.3 Dependent Variable: Cost of Equity Capital

Recall that the cost of equity capital is defined as the minimum rate of return required by equity investors. Since there is no directly precise and observable measure, it is rather estimated based on analysts' forecasts, a factor referred to as the implied cost of equity capital (Botosan, 2006). This implied approach is useful in capturing variation in expected returns and, therefore, presents a better alternative to measuring the cost of equity capital (Pástor, Sinha, & Swaminathan, 2008). The literature has proposed various measures of the implied cost of equity capital. We use the price earnings growth (*PEG*) model devised by Easton (2004) for this study, which is widely used in academic research due to both its straightforward application and interpretation (Botosan, 2006).

Previous empirical evidence finds that *PEG* estimates are associated with risk measures in a theoretically predictable and stable manner (Botosan, 2006; Botosan & Plumlee, 2005; Botosan, Plumlee, & Wen, 2011; Easton & Monahan, 2005). Additionally, the other implied cost-of-capital measures, such as the abnormal earnings growth model (*AEG*) as presented by Ohlson and Juettner-Nauroth (2005) and D. Gode and Mohanram (2003) and the modified price earnings growth model (*MPEG*) as developed by Easton (2004) are fairly similar and positively correlated with the *PEG* model (Botosan & Plumlee, 2005). The *PEG* model is estimated as follows:

$$PEG = \sqrt{[(EPS2 - EPS1) \div P0]} \ldots\ldots\ldots\ldots\ldots (1)$$

where *PEG* is the implied cost of equity capital; *EPS2* is the analysts' consensus of the two-year forward earnings per share (*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. However, a mathematical limitation of the *PEG* model is that *EPS2* must be greater than *EPS1,* which is not always the case for all firms. Thus, the *MPEG* model is used as an alternative measure to check for robustness[5]. Moreover, due to potential bias and measurement errors in the implied estimations of the cost of equity capital (Blanco et al., 2015; Easton & Monahan, 2005), we use the average of closing bid-ask spread and the volatility of stock returns as alternative measures for extra robustness checks[6]. Finally, we also use the capital assets pricing model (*CAPM*) estimates as an alternative measure of the cost of equity capital for a robustness check since *CAPM* is the most commonly used in practice (Botosan, 2006; Jacobs & Shivdasani, 2012)[7].

3.4 Contingency Effects of R&D-activity (H4)

We adopted complementary approaches to test the contingent effect of R&D activity posited in H4. The first approach was a sub-group analysis to distinguish our hypothesized effects for firms with and without R&D activity, separating firms reporting R&D expenditure and those with no reported values for R&D activity in a given year. For the subsample of R&D-active firms, we also included R&D intensity (*LogRD.Expend/Sales*) to control for within-sub-group variation. For robustness, as firms may also vary in their tendency to invest consistently in R&D, we also conducted the sub-sampling based on R&D expenditure averaged over three years (Koryak et al., 2018). That is, R&D-active firms were also identified as those whose

[5] See

Appendix ***C*** for details on estimating the implied cost of equity capital using the *MPEG*.

[6] See

Appendix ***C*** for details on the return volatility and the average of closing bid-ask spreads.

[7] See

Appendix ***C*** for details on the *CAPM* model.

three-year average R&D expenditure (*3-year average R&D*) is greater than 0. Non-R&D-active firms are defined as those whose three-year average R&D expenditure is 0.

The second approach captures sensitivity to marginal changes in R&D activity, as capital markets have been shown to be sensitive to *changes* in R&D expenditure (Eberhart et al., 2004). Hence, we expect that increases in R&D intensity (*R&D change*) may be another important way to capture variation in R&D-activity. Together, these complementary approaches allow us to dig deeper into our data and comprehensively test multiple interpretations of the boundary condition proposed in H4 (i.e., influence of R&D activity *between* and *within* sub-samples of R&D-active firms).

3.5 Control Variables

We included a number of other control variables. We controlled for the disclosure score of environmental, social, and governance practices (*ESGScr*)[8] given empirical evidence of its association with the cost of equity capital (Plumlee et al., 2015; Plumlee, Brown, & Marshall, 2009; Richardson & Welker, 2001). We also controlled for the market systematic risk (*Beta*), the natural logarithm of the total assets representing the firm size (*LogSize*), and firm growth-related risk book-to-market ratio (*B2M*) following Botosan and Plumlee (2002b, 2013). Additionally, the financial leverage measured by the total debt to total assets (*Leverage*) and firm profitability (*ROA*) is controlled for following Gebhardt, Lee, and Swaminathan (2001). A binary variable (*High_analyst*) representing high analyst coverage is used to control for the quality of the informational environment (Botosan & Plumlee, 2005; Botosan et al., 2011; D. D. Gode & Mohanram, 2001). Analyst coverage represents the number of total analyst forecasts of earnings per share obtained for a given firm from all of its following analysts. The binary control (*High_analyst*) takes the value of 1 for firms who have analyst-following equal to or higher than the median value of analyst coverage and 0 otherwise. The forecasted long-

[8] The ESG disclosure score is readily available and directly drawn from the Bloomberg database.

term growth rate of earnings (*Growth*) is added to control for analyst expectations of future growth prospects following in line with several influential studies (e.g., Botosan & Plumlee, 2013; Easton & Monahan, 2005; Gebhardt et al., 2001). We control for proprietary costs as captured by the Herfindahl-Hirschman index (*HH.Index*). High (low) values of the *HH.Index* indicate weaker (stronger) industry competition (Rhoades, 1993). Finally, a binary control for new financing (*New_Financing*) is added to take the value 1 if the firm issued new long-term debt and/or common stocks and 0 otherwise (Dhaliwal et al., 2011). Firms planning to issue for external financing are better motivated to enhance their disclosures (including innovation information) in order to reap potential benefits of lowering the cost of capital. Variable definitions are provided in

Appendix ***C***.

3.6 Empirical Model

To examine the effect of innovation disclosure on the cost of equity capital, we employed the following equations using fixed effects panel regression with firm-fixed effects and year-fixed effects:

$$
\begin{aligned}
PEG_{i.t} = {} & \beta_0 + \beta_1 Explr_{i.t-1} + \beta_2 Explt_{i.t-1} + \beta_3 ESGScr_{i.t-1} + \beta_4 Beta_{i.t-1} \\
& + \beta_5 LogSize_{i.t-1} + \beta_6 B2M_{i.t-1} + \beta_7 Leverage_{i.t-1} \\
& + \beta_8 ROA_{i.t-1} + \beta_9 High\_analyst_{i.t-1} + \beta_{10} Growth_{i.t-1} \\
& + \beta_{11} R\&D_{i.t-1} + \beta_{12} HH.Index_{i.t-1} + \beta_{13} New\_Financing_{i.t-1} \\
& + \sum_n \beta_n \text{Year. Controls} + \sum_i \beta_i \text{Firm. Controls} + \varepsilon_{i.t}
\end{aligned}
\tag{2}
$$

$$
\begin{aligned}
PEG_{i.t} = {} & \beta_0 + \beta_1 SqrootOA_{i.t-1} + \beta_2 ESGScr_{i.t-1} + \beta_3 Beta_{i.t-1} \\
& + \beta_4 LogSize_{i.t-1} + \beta_5 B2M_{i.t-1} + \beta_6 Leverage_{i.t-1} + \beta_7 ROA_{i.t-1} \\
& + \beta_8 High\_analyst_{i.t-1} + \beta_9 Growth_{i.t-1} + \beta_{10} R\&D_{i.t-1} \\
& + \beta_{11} HH.Index_{i.t-1} + \beta_{12} New\_Financing_{i.t-1} \\
& + \sum_n \beta_n \text{Year. Controls} + \sum_i \beta_i \, Firm.\text{Controls} + \varepsilon_{i.t}
\end{aligned}
\tag{3}
$$

where, *PEG* is the price-earnings growth estimates of the cost of equity capital of firm (i) in year (t). The variables of interest in equation 2 are *Explr* and *Explt*, which stand for the coverage percentages of exploration and exploitation, respectively. A positive (negative) sign of each would suggest an adverse (beneficial) effect according to hypothesis H1 (H2). The variable of interest in equation 3 is *SqrootOA* which stands for the combined disclosure and is derived by square-rooting the product of exploration and exploitation coverage percentages.

Once again, a negative sign of the coefficient would suggest a beneficial effect according to hypothesis H3.

All of the right-hand side variables are one-year lag (*t-1*) to control for endogeneity issues arising from reverse causality bias. Robust standard errors clustered at the firm level are used to control for heteroscedasticity and autocorrelation bias (Petersen, 2009; Wooldridge, 2010)[9]. The firm-fixed effects estimation eliminates biases caused by time-invariant omitted variables while year-fixed effects estimation eliminates biases caused by omitted variables that vary across years but are constant across firms (Wooldridge, 2010). 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. Furthermore, the Hausman test for both models suggests that fixed effects estimation is a better fit than random effects estimation.

4 Analyses and Results

4.1 Univariate and Bivariate Analysis

Descriptive statistics of all variables are presented in

Table **2**. The mean (median) of the cost of equity capital (*PEG*) is 9.5% (8.4%) which is slightly lower than 9.95% (9.02%) as reported in the UK sample of Mangena et al. (2016). The mean (median) of the combined innovation disclosure (*SqrootOA*) is 1.9% (1.8%). Exploration disclosure (*Explr*) appears to have a higher mean (2.4%) and median (2.3%) than those of exploitation disclosure (*Explt*), suggesting potentially significant differences between the disclosure levels of exploration and exploitation. Hence, a paired t-test was conducted to check for statistically significant differences and the results are presented in Table 3. At a 1% significance level, the results indicate that the full sample and firms from all industries disclose

[9] Petersen (2009) suggests that the use of robust standard errors clustered by firms is best to address autocorrelations caused by firm effects. Also, Wooldridge (2010) recommends robust standard errors to correct for bias caused by any heteroskedasticity or serial correlation, given T is small and N is large.

more exploration than exploitation information. This is evident by looking at the significant mean differences and the large positive T-value in the last two columns of Table 3.

****Insert Table 2 and 3 here****

Table 4 displays the Pearson correlation coefficients. All three innovation disclosures (*Explr*, *Explt,* and *SqrootOA*) have negative correlations with the *PEG* estimates of the cost of equity capital. For R&D-active firms, however, the (*LogRD.Expend/Sales)* shows a notable significant positive correlation with all three measures of innovation disclosure. This indicates that the presence of R&D activity is associated with higher disclosures of exploration and exploitation; indicatively attesting to its importance as a boundary condition in the informational environment. Furthermore, the (*LogRD.Expend/Sales)* shows significant negative correlations with financial leverage (*Leverage*), profitability (*ROA*) and analyst-following (*High_analyst*), suggesting that R&D-active firms rely less on risky financing from creditors, endure worsening profitability/performance, and, overall, operate in a lower quality informational environment. Finally, firms with high analyst-following (*High_analyst*) have non-significant negative (significant positive) correlation with exploration (exploitation) disclosures, suggesting that financial analysts might emphasize exploitation, rather than exploration, information.

****Insert Table 4 here****

4.2 Fixed Effects Regression Analysis: Evidence of the Full Sample (H1-H3)

Table 5 reports the baseline models of fixed effects regressions of the full sample for the effect of innovation disclosures on the cost of equity capital. For H1, we expected that exploration disclosure would be penalized by the market, as reflected in higher cost of capital. Our findings document a negative sign of exploration disclosure (coefficient: -0.018), but not at a statistically significant level (as per Model 4). Accordingly, we reject H1 and find no association in the full sample between exploration disclosure and cost of capital. In turn, for

H2, we expected that exploitation disclosure would be favorably rewarded by the market through lower cost of capital. Our findings show that exploitation disclosure is indeed associated with significant reductions in the cost of equity capital as shown in Model 2 (coefficient: -1.220, p-value < .01) and Model 4 (coefficient: -1.194, p-value < .01). This indicates that a 1% increase in exploitation disclosure will result in an approximate 1.194% decrease in the cost of equity capital. Economically, one standard deviation increase in exploitation disclosure is associated with a 9.2% standard deviation decrease in the implied cost of equity capital. Accordingly, we find support for H2.

****Insert Tables 5 about here****

For H3, we expected that combined disclosure would be rewarded by the market through lower cost of capital. We find statistical support for this notion, as the combined disclosure is associated with significant reductions in the cost of equity capital; (coefficient: -1.057, p-value < .05) as shown in Model 3 and (coefficient: -1.110, p-value < .01) in Model 5. This suggests that a 1% increase in combined disclosure is associated with a 1.11% decrease in the cost of equity capital. The economic significance of an increase in combined disclosure by one standard deviation is 8.5% standard deviation decrease in the implied cost of equity capital. Interestingly, it is worth noting that although the combined disclosure effect size is superior than the non-significant effect of exploration disclosure alone, the effect size is also somewhat less than the effect size of disclosing exploitation alone for the overall sample.

Taken together, based on the PEG estimates, both exploitation and combined disclosure show consistent and significant benefits at 1% level, thereby extending support to H2 (exploitation disclosure) and H3 (combined disclosure), but not to H1 (exploration disclosure). These results provide us with the baseline to proceed to unpack the sub-group differences for R&D-active and non-R&D-active firms.

4.3 Contingency Analysis for H4

4.3.1 Subsampling by R&D- and Non-R&D-active Groups

Table *6* displays the results for both R&D- and non-R&D-active subsamples. Following recent exemplars (e.g., Maskus, Milani, & Neumann, 2019), we also apply the Chow Test to check whether the blocks of coefficients are statistically different between R&D-active and non-R&D-active subgroups. As inferred from the results in Models 6–7, R&D-active firms earn significant and considerably higher benefits from exploration (b= -1.459, p-value < .01; Chow test F-stat= 8.71***) and combined disclosures (coefficient: -2.572, p-value < .01; Chow test F-stat= 4.49**). This means that 1% of exploration (combined) disclosure creates a 1.459% (2.572%) decrease in the cost of equity capital for R&D-active firms. Whilst the sign of exploitation disclosure is negative (coefficient: -1.021; Chow test F-stat= 0.01), there is no evidence from the *PEG* estimates to support such benefits at any level. The strong significance of the Chow tests for exploration and combined disclosures shows that the coefficients are statistically different between R&D-active and non-R&D-active subgroups, suggesting that the split-sample application here provides a cleaner display of results.

Furthermore, evidence from Model 7 shows that the benefits of combined disclosure are greater than those from exploration disclosure separately, which underlines the synergistic benefits from combining exploration and exploitation disclosures in the case of R&D-active firms. Table 7 presents results of R&D vs. non-R&D subsamples using three-year average R&D expenditure (*3-year average R&D*) as the cut-off point (Koryak et al., 2018), to capture whether companies with an enduring tendency of R&D-activity display consistent effects. The results are consistent with those in Table 6, further supportive of H4.

Finally, increases in R&D expenditures can be expected to increase information risk. The literature suggests that the market is sensitive to increases in R&D expenditure (Eberhart et al., 2004; Penman & Zhang, 2002). We re-ran our regressions by classing R&D-active firms based on changes in R&D intensity (*R&D change*). The results of Models 14 and 15 in

Table **8** show that R&D-active firms with increased R&D intensity get high beneficial effects from exploration information (but not exploitation information) and even higher beneficial effects (synergies) from combined disclosure. The above results, together with our other analyses, provides compelling support for H4[10].

****Insert Tables 6-8 about Here****

4.3.2 Other Robustness Checks

We conducted several additional robustness checks, unreported here due to space constraints but all available from authors upon request. We re-ran our main regressions using four alternative measures of the dependent variable: the *MPEG* and *CAPM* estimates of cost of equity capital, the average of closing bid-ask spread percentages, and returns volatility. Results of the four measures are qualitatively similar to those reported in Table 5 and 6. We also conducted two main sensitivity analyses for the baseline models, treatment of outliers and exclusion of the financial sector. The effect of outliers was examined across 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. The unreported results are robust across the three cases. Therefore, the regressions reported in Table 5-8 are left untreated for outliers. Finally, the baseline models were retested for a sample excluding the financial sector observations and the results stand robust. Therefore, the financial sector was kept in the full sample for the results as reported in Table 5-6.

We further checked for the sensitivity of results to omissions of any of the control variables; step hierarchical regressions were run by adding one control variable at a time.

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[10] Belderbos, Carree, and Lokshin (2006) state that 'A synergy, or complementarity … is assumed to exist if the implementation of one practice or strategy
increases the marginal return to the other practices' (p.402). Our assumption here is consistent with this premise, that synergetic effects of exploration and exploitation disclosure can be obtained when the disclosure of the two types of innovation strategies coexist, compared to when they are disclosed individually. However, this interpretation of synergy does not hinge on the assumptions of "strict" complementarity (or supermodularity), as discussed by Milgrom and Roberts (1990). Rather, the estimation of the synergetic use of combined disclosure is expected to be above the baseline of their individual effects. Our approach thus assumes that the baselines (exploration and exploitation) can generally co-exist independently, while some firms seem to garner synergies when the corresponding information is disclosed jointly. We thank an anonymous reviewer for encouraging us to clarify this point.

Unreported results from the hierarchical regressions show robust and qualitatively consistent evidence with that reported in the main models (1–9). Second, we checked 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 was used to measure their respective disclosure instead of coverage percentages. The results are qualitatively similar as those in the baseline models (1–9).

Regarding the functional form of combined disclosures, we also used the simple product of coverage percentages of exploration disclosure and exploitation disclosure without square-rooting as a measure of combined disclosure. Results replicate significance levels with the dependent variable but with somewhat exaggerated coefficients. The simple product functional form as a measure of combined disclosures is not compatible with that of the cost of equity capital. This is why the magnitude of coefficients can become exaggerated when the simple product is used as a functional form. All in all, these additional considerations provide compelling assurance of the veracity of our theoretically focal results. Our main findings, robustness checks, and sub-sample analyses have important implications and contributions.

5 Discussion

5.1 Key Findings and Conclusions

The innovation activities of firms are often poorly observable from outside the firm. As such, firms have to disclose information about their innovation activities so investors can price-in the future value of different innovation efforts. From an information risk perspective, two key mechanisms have been demonstrated to underpin the information disclosure–cost of capital link: information asymmetry and estimation risk. Disclosure is expected to both reduce information asymmetry through increased transparency about the inner workings of the firm and help to increase precision in estimation, ensuring that the cost of capital reflects the innovation potential of the firm. However, not all innovation activity is alike. Notably, exploration and exploitation innovation activities may convey distinct, and potentially paradoxical, expectations of future value.

Drawing on information risk theory and paradox theory, we empirically tested the extent to which exploration and exploitation disclosure, additively and combined, would be associated with the cost of equity capital. Using a dataset of UK FTSE 350 firms for the period 2011–2016, we ran a series of fixed effects panel regressions while fixing for firm-effects and year-effects. We find important boundary conditions on how combined disclosure of exploration and exploitation activities influences cost of capital. Our main findings reveal that, on average of the full sample, firms disclose more exploration than exploitation when, in fact, the bulk of market rewards stem from exploitation disclosure—with the notable exception of R&D-active firms that enjoy significant rewards from exploration disclosure. Interestingly, R&D-active firms attain the greatest synergistic benefits from combining exploration and exploitation disclosures, as compared to firms in the non-R&D active sub-sample.

Our findings provide rich and novel evidence to the information-type-dependency argument in the disclosure-cost of capital literature (Botosan, 2006), as our study would be among the first to robustly document the effects of disclosing exploration and exploitation information on the cost of equity capital. Additionally, our study allows us to advance new propositions to paradox perspectives on ambidexterity by proposing that the bases of synergies of exploration and exploitation innovation disclosure vary across types of firms. Notably, more generally, the benefits underpinning combined disclosure appear to be relatively equivalent to those sourcing from the effectiveness of exploitation disclosure in reducing information risk, while, for R&D-active firms, benefits of the combined disclosure shows considerable synergies which most likely accrue through information that counterbalances their risks, such as overexploration traps. These insights allow us to offer several contributions and implications.

5.2 Contributions and Implications

5.2.1 Disclosure and Information Risk

First, we contribute to the information-risk literature by showing that the effect of innovation disclosure on the cost of capital is information-type-dependent (Botosan, 2006); thus, the effect of disclosure in mitigating information risk varies according to the type of innovation activity disclosed. Although the literature has examined effects of innovation disclosure under the broad umbrella of intellectual capital disclosures (Beattie & Smith, 2012; Mangena et al., 2016), it has mostly focused on how the market responds to codified innovation *outputs* (Baruffaldi & Simeth, 2020; Saidi & Žaldokas, 2020), which reflect some of the commercially successful outcomes of innovation processes. Although the literature on innovation disclosure has generally assumed that more information is better, it has not sufficiently recognized disclosure effects of ongoing exploration and/or exploitation activities in the innovation process, and the different attributes conveyed through disclosure of activities that are (in)consistent with different innovation strategies.

Furthermore, the current disclosure literature focuses on various drivers of innovation disclosure (Bellora & Guenther, 2013) or how the choice of innovation strategy affects corporate disclosure policy (Jia, 2019), but neglects the effect of paradoxical information disclosed on the cost of capital. Considering the results from the paired t-test, it is intriguing to find that firms disclose more exploration than exploitation when, in fact, the market, on average, tends to reward exploitation rather than exploration disclosure. However, prior studies report evidence suggesting that firms are more likely to conduct exploitation rather than exploration when investors are risk-averse (Levinthal & March, 1993; Smith & Tushman, 2005) and that the financial analysts in the capital markets encourage firms towards more exploitation rather than exploration strategies (Benner, 2010; J. J. He & Tian, 2013). Our study provides an important addition, as although the disclosure literature would predict that 'more is better', our study highlights the value-relevance of disclosure and the differential capital market pricing of information risk associated with exploration and exploitation, which may help clarify mixed results about innovation disclosure on cost of capital (Botosan, 2006; Dhaliwal et al., 2011; Plumlee et al., 2015).

5.2.2 Paradox Perspective on Ambidexterity Disclosure

Second, we contribute to the paradox perspective on ambidexterity (Andriopoulos & Lewis, 2009, 2010; Papachroni et al., 2015). Although ambidexterity is believed to be beneficial for firms (Junni et al., 2013), the search for synergies between exploration and exploitation remains challenging (Fourné et al., 2019; Koryak et al., 2018). We contribute to the exploration, exploitation, and ambidexterity literature by uncovering another dimension of ambidexterity— that is the disclosure of exploration and exploitation activities to outsiders. Aided by development in computer-assisted codification of exploration and exploitation information disclosure, key ambidexterity studies have established several organizational correlates of exploration and exploitation disclosed in annual reports (Oehmichen et al., 2017; Ugur, 2013; Uotila et al., 2009). These studies are part of a growing research stream that relies on narrative disclosures of exploration and exploitation, but has not yet considered the value-relevance of such disclosures in mitigating information risk of *outsiders*. In doing so, we inform the ambidexterity literature that combined disclosure is crucial for revealing the firm's potential synergies to investors, helping to mitigate uncertainties surrounding the innovation process.

Although studies typically look at accounting-based outcomes of ambidexterity (Junni et al., 2013), the disclosure–cost of capital link represents an important omission, as it captures the ongoing source of financing for the firm's ambidextrous pursuit of innovation. That is, the current literature on ambidexterity has paid considerably less attention to how firms can ensure continued market-based financing of their innovation activities (Cao et al., 2009; Z.-L. He & Wong, 2004; O'Reilly & Tushman, 2013; Tushman & O'Reilly, 1996). Interestingly, the magnitude of coefficients (which represents the average market benefits) for exploitation, on the one hand, and combined disclosures, on the other, are relatively similar: 1.194% and 1.11%, respectively. This suggests that there are no synergies of combining exploration and exploitation disclosure across the full sample but rather indicate a slight erosion of benefits as the combined (1.11%) shows lower rewards than the exploitation (1.194%) disclosure.

Taken together, we advance a market-based view of innovation paradoxes, as a first attempt to complement internally-focused perspectives on ambidexterity. This is important, as although we know a lot about how information consumed by firms from their environment feeds into different innovation strategies (e.g., Carayannopoulos & Auster, 2010; Kobarg et al., 2019; Terjesen & Patel, 2017), less is known about how firms' *outward* disclosures affect the informational environment. This is a crucial omission in the ambidexterity literature, as outsiders (such as investors) rely in large part on disclosed information in making judgments about the company and its future. In turn, through the nature of information disclosed, investors can manage their information risk, which is expected to result in more favorable financing for the company (which is essential for continuation of its innovation activities). Thus, we advance the paradox perspective on ambidexterity (Papachroni et al., 2015), by highlighting the implications of outward information dissemination of paradoxical activities, complementing studies that have focused on the internal resolution of paradox (Fourné et al., 2019). Ultimately, our market-based complement offers a launching pad for research on outsiders' valuations of paradoxical activities inside organizations.

5.2.3 Contextualized Implications for R&D-active Firms

Third, an important dimension of firms' variation is the knowledge intensity within the firm (Oehmichen et al., 2017). However, the literature on disclosure by R&D-active firms has provided mixed results. For instance, Merkley (2013) reports that disclosures by R&D-active firms, by lowering information asymmetry, forecast error, and dispersion, are indeed informative for capital market participants, consistent with Mc Namara and Baden-Fuller (2007) who documented favorable market responses to announcements by R&D-active firms. Others, like Hussinger and Pacher (2019), caution that ambiguities around R&D activities may be amplified through disclosure, which in some cases does not mitigate but, rather, intensifies information risk for investors (see also Kothari et al., 2009; Rogers et al., 2009).

We have argued that information risk is heightened around R&D activity. A by-product of engaging in R&D is thus that insiders have more information about the internal innovation process, including managers, who have an informational advantage compared to outsiders (Aboody & Lev, 2000; Hussinger & Pacher, 2019; Lev, 2000). Greater consumption and processing of information by a firm increases information risk for outsiders, as it may be unclear to outsiders how this information is used and transformed into value-added outcomes (Zahra & George, 2002). We show that the combined disclosure of exploration and exploitation is vital for R&D-active firms in mitigating information risk and reducing the cost of equity capital, presumably because exploration disclosure turns out to be hugely beneficial for R&D-active firms; so much that they earn considerable synergies of the combined disclosure.

R&D-active companies have a long-documented history of specific challenges, such as exploration traps (Levinthal & March, 1993). Our study emphasizes that innovation disclosure needs to be considered in conjunction with the strategy of firms, notably highlighting that, although R&D-active firms' natural inclination is towards exploration, they need to ensure they do not lose out on the informational benefits of disclosing exploitation.

5.2.4 *Investor Responses to Pursuit of New Opportunities by Large Publicly Listed Firms*

Our study further resonates with a broader literature that has addressed the tendencies of firms to pursue opportunities for new value creation. In particular, the entrepreneurial orientation (EO) field has proposed innovativeness, proactivity, and risk-taking as some key (and even desirable) dimensions of well-performing organizations (Engelen, Kube, Schmidt, & Flatten, 2014; McKenny, Short, Ketchen Jr, Payne, & Moss, 2018; van Doorn, Heyden, & Volberda, 2017; X. Wang, Dass, Arnett, & Yu, 2020). For instance, Gupta et al. (2014, p. 159) suggest that "EO encompasses specific entrepreneurial decision-making practices and methods guiding the pursuit of new opportunities." This line of thinking praises exploration-type activities to combat the inherent risk of inertia, which may be a particular challenge for large publicly listed organizations (McKenny et al., 2018; Tripsas, 2009). Our study adds to evidence based on EO, following Gupta et al. (2014) who note that "few studies have investigated the benefits of EO in large publicly traded firms and almost nothing has been published on this using longitudinal data" (page 158), despite this population of companies being particularly reliant on outsider support, notably investors (see also Benner, 2007).

Our study draws attention to how investors in large publicly listed corporations may assess information that is thematically consistent with certain innovation strategies (e.g., proactiveness, risk-taking, and innovativeness with exploration). Indeed, Gupta et al. (p. 159) note that "[t]he dominant conceptualization of what it means to be entrepreneurial is a strong commitment to concurrently take risks in trying out new products, innovate to rejuvenate market offerings, and become more proactive than rivals…" As these compatible elements mutually reinforce each other over time (e.g., innovativeness, risk-taking, proactiveness), they may also accentuate contrasting dualities with inconsistent forces, such as efficiency, reliability, and routine (i.e., strong EO may accentuate perceived tensions between exploration and exploitation activities). Although this raises a call for more research bridging these traditions, the immediate implication of our findings may be that high EO companies may need to pay particular attention to their information disclosure policy, as they may otherwise be missing out on the benefits of also disclosing exploitation information, since innovation strategy and the EO construct are relevant to large firms which draw on capital markets for funding[11].

5.2.5 Practical and Policy Implications

Finally, the findings are relevant for regulators, policy-makers, and standard-setters such as the International Integrated Reporting Council (IIRC). The paper shows the role of exploration and exploitation disclosures in mitigating information risk. In particular, the varying effectiveness of exploration and exploitation information highlights the importance of information type in eliciting capital market responses. We thus elucidate exploration and exploitation information disclosure as strategic in nature, further delving into the data to uncover key contingent effects (i.e., R&D vs Non-R&D-active firms) that may provide actionable managerial insights into innovation disclosure policy. Exploitation disclosure appears to have a significant effect here, although exploration, which is on average more disclosed than exploitation, reflects this significance 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 may fail to document a beneficial effect. These conclusions offer 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, in terms of exploration and exploitation, as previously defined by (OECD, 2010; OECD/Eurostat). Such a reporting framework would be uniquely useful if it included a guide to which specific disclosures qualify as exploration and which as exploitation types of information.

5.3 Limitations and Future Research

Our study is subject to a number of limitations, and we encourage future research that would overcome them partially or completely. For instance, in terms of methodological

[11] We thank an anonymous reviewer for raising this suggestion and highlighting this avenue.

limitations, using a different type for cost of capital (e.g. cost of debt capital) may yield a complementary overview of the full range of financing options for firms. We also encourage future research linking research on disclosure with other important dispositions that also relate to innovation, such as EO (van Doorn et al., 2017) and market orientation (Randhawa, Wilden, & Gudergan, 2021). Future studies may also link our study to the managerial microfoundations of exploration and exploitation disclosure, considering the characteristics of managers (Knight & Paroutis, 2017; Randhawa, Nikolova, Ahuja, & Schweitzer; Tuncdogan, Van Den Bosch, & Volberda, 2015), different domains of exploration and exploitation (Mehrabi, Coviello, & Ranaweera, 2021; Sidhu, Commandeur, & Volberda, 2007), as well as the hierarchical sources of different innovation strategies (Heyden, Fourné, Koene, Werkman, & Ansari, 2017; Heyden, Wilden, & Wise, 2020). Context limitations, conversely, could also generate different findings if various contexts were to be examined (i.e. initial public offerings [IPOs] vs. seasoned equity offerings [SEOs]), mergers and acquisitions, presentations and reports to analysts, or even comparisons of different stock markets from around the world. Taken together, we call for a research program on the drivers and consequences of exploration and exploitation disclosure, especially across global contexts.

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7 Appendices

Appendix A[12]**:** Revised search dictionaries for nodes of exploration and exploitation

Exploration wordlist with the newly 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, 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 *Added words.* 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 newly 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 *Added words.* Accreditation*, Augment*, Advanced, Advancing, Boost*, Capitalize_on, Capitalise_on, Cost_control, Cultivat*, Discipline*, Enhanc*, Executed, Executing, Foster*, Lead_time, Modular, Maximi*, Minimi*, Nurtur*, Progress*, Reap, Reaped, Reaping, Reform*, Redesign*, Restructur*, Reorgani*, Renovat*, Upgrad*, Better, Bigger, Cost_saving, Clearer, Easier, Efficien*, Economies_of_Scale, Economies_of_Scope, Grow*, Larger, Healthier, Rapid*, Resilience*, Responsive*, Shorter, Synergy*, Stronger, Superior, Stabilize*, Stabilise*, Long-established, Well-established, Well_positioned, Quick*

[12] 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.

Appendix B: A sample of extracted examples of keywords in annual report

Exploration
"Furthermore, faster-developing economies, such as China, India, and Brazil, offer new opportunities for the industry…"
"… 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 … the skills and capabilities to take advantage of these opportunities and turn them into long-term value through the research, development and …"
Exploitation
"As our businesses become more efficient we will better utilise our production facilities, reduce our working capital requirements and…"
"number of schemes and simplified operating procedures administration has become easier and more efficient."
"Capital cost advantage through economies of scale and not paying the final assembly margin…"

Appendix C: List of all variables

Variables	Variable Definition
PEG	Easton (2004)'s model for the implied cost of equity capital. It is derived by square-rooting the ratio of forecasted short-term growth in earnings to the current share price.
Explr	The coverage percentage of the exploration words as retrieved by NVivo textual analysis software from firm-year annual reports. The coverage percentage is the ratio of total word frequencies of the exploration words to the total words in the annual report document.
Explt	The coverage percentage of the exploitation words as retrieved by NVivo textual analysis software from firm-year annual reports. The coverage percentage is the ratio of total word frequencies of the exploitation words to the total words in the annual report document.
SqrootOA	Derived by square rooting the product of the respective exploration and exploitation coverage percentages. For comparison purposes, the square-root is only intended as a functional transformation of the variable back to a percentile scale.
ESGScr	A weighted percentage score of three percentage sub-scores, namely environmental, social and governance disclosure scores. The assigned source definition states "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".
Beta	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.
Size	The book value of total assets (in £million) reported by the firm in a given year.
LogSize	The natural logarithm of the book value of total assets reported by the firm in a given year.
B2M	The ratio of the firms' closing book value of equity to the closing market value of equity.
Leverage	The ratio of total debt to total assets.
ROA	The ratio of return to total assets.
High_analyst	Takes the value of 1 when the analyst coverage of the firm ≥ its median value and 0 otherwise. The analyst coverage is the number of total analyst forecasts of earnings per share obtained for a given firm from all its following analysts. The median value of analyst coverage is 13.
Growth	Analysts forecast of long-term growth as compiled and provided by Bloomberg. The source definition states that it is "Received directly from contributing analysts…. 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."
LogRD.Expend/Sales	The natural logarithm of R&D intensity (*R&D Expenditure/Sales*) which is the ratio of R&D expenditure divided by the net sales of the firm in a given year. Missing values are treated as zero.
R&D	Takes the value 1 if the firm reports R&D expenditure and 0 otherwise.

3-year average R&D	Estimated as [R&D expenditure in year t + R&D expenditure in year t-1 + R&D expenditure in year t-2]/3. Missing values are treated as zero.
Log3-year average R&D	The natural logarithm of *3-year average R&D*.
R&D change	R&D intensity (*R&D Expenditure/Sales*) in year t minus R&D intensity in year t-1.
HH.Index	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. The index is estimated based on the ten industry classification benchmark ICBs.
New_Financing	Takes the value 1 for firms issuing new long-term debt and/or common stocks and 0 otherwise.
Alternative measures for the implied cost of equity capital PEG	
MPEG	To derive the MPEG estimates for the implied cost of equity capital, the following formula is applied: $COE = A + \sqrt{\left[A^2 + \left((EPS2 - EPS1) \div P0\right)\right]}$; $A = \left[\frac{DPS1}{2P0}\right]$, where DPS1 is the one-year-ahead forecast of dividends per share.
CAPM	According to the CAPM, the cost of equity capital comprises the risk-free interest rate and a premium rate for the non-diversifiable risk of the firm, as shown in the following equation: $COE = RF + \beta * [RM - RF]$. Ready CAPM-based estimates of the cost of equity capital were directly drawn from Bloomberg database.
Volatility	Returns volatility is measured as the standard deviation of daily returns for a time span of 360 days. Data for the returns volatility were drawn directly from Bloomberg database.
Spread%	The closing bid-ask spread percentage is derived by scaling the difference between the bid and ask prices over their averages; and then averaged for all trade transactions occurred on the closing week of the financial year. Data for the average of closing bid-ask spreads were drawn directly from Bloomberg database.

8 Tables

Table 1: Sample composition by industry vs. year

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

Reported in parentheses are the number of observations with missing values. ICB stands for the industry classification benchmark.

Table 2: Descriptive statistics

Stats	N	Mean	Median	St.Dev	Min	Max
PEG	1688	0.095	0.084	0.052	0.004	0.675
Explr	1710	0.024	0.023	0.009	0.005	0.32
Explt	1710	0.015	0.015	0.004	0.002	0.049
SqrootOA	1710	0.019	0.018	0.004	0.004	0.047
ESGScr	1759	0.341	0.322	0.112	0.066	0.694
Beta	1826	0.880	0.830	0.353	0.061	2.359
Size (£million)	1832	32653.820	2142.910	155982.500	38.544	1923844
LogSize	1832	3.472	3.331	0.767	1.586	6.284
B2M	1797	0.544	0.419	0.433	0.001	5.764
Leverage	1832	0.213	0.195	0.182	0.000	1.656
ROA	1824	0.071	0.057	0.137	-0.535	2.355
High_analyst	1832	0.531	1.000	0.499	0.000	1.000
Growth	1409	0.110	0.082	0.262	-3.673	3.025
R&D	1832	0.313	0.000	0.463	0.000	1.000
LogRD.Expend/Sales	547	0.044	0.133	0.919	-2.468	3.317
HH.Index	1816	0.546	0.011	2.288	0.000	34.766
New_Financing	1832	0.760	1.000	0.427	0.000	1.000

Refer to
Appendix C for definitions of variables.

Table 3: Paired T-test of exploration-exploitation disclosure

Paired T-test	N	Mean *(Explr)*	Mean *(Explt)*	Mean Diff. *(Explr – Explt)*	T-value
Full Sample	1710	0.024	0.015	0.009***	40.377
R&D firms	524	0.026	0.016	0.010***	34.130
Non-R&D firms	1186	0.024	0.015	0.009***	29.277
Basic Materials	142	0.022	0.015	0.007***	12.082
Consumer Goods	166	0.024	0.015	0.009***	19.746
Consumer Services	378	0.025	0.014	0.011***	11.967
Financials	408	0.023	0.014	0.009***	32.484
Healthcare	67	0.031	0.016	0.015***	14.357
Industrials	368	0.025	0.016	0.009***	28.238
Oil & Gas	70	0.023	0.015	0.008***	15.184
Technology	44	0.027	0.015	0.012***	13.872
Telecommunications	32	0.024	0.015	0.009***	8.383
Utilities	35	0.023	0.015	0.008***	7.075

N stands for the number of observations, *** indicates significance at 1% level. Only firms that report R&D expenditure are classed as R&D-active firms.

Table 4: Pearson correlations

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1|PEG	1														
2|Explr	-0.070*	1													
3|Explt	-0.043	0.160*	1												
4|SqrootOA	-0.093*	0.657*	0.771*	1											
5|ESGScr	0.009	-0.018	0.062*	0.024	1										
6|Beta	0.211*	-0.021	0.113*	0.055*	0.319*	1									
7|LogSize	0.036	-0.015	-0.059*	-0.050*	0.570*	0.386*	1								
8|B2M	0.240*	-0.087*	-0.039	-0.126*	0.120*	0.216*	0.332*	1							
9|Leverage	-0.016	-0.068*	-0.031	-0.079*	0.141*	-0.034	0.105*	0.023	1						
10|ROA	-0.151*	0.018	-0.014	0.012	-0.099*	-0.084*	-0.283*	-0.238*	-0.139*	1					
11|High_analyst	-0.063*	-0.108	0.065*	0.039	0.365*	0.293*	0.389*	-0.015	0.066*	-0.057*	1				
12|R&D	-0.094*	0.109*	0.114*	0.179*	0.139*	-0.021	-0.039	-0.252*	0.019	0.014	0.026	1			
13|LogRD.Expend/Sales	-0.238*	0.498*	0.204*	0.442*	-0.310*	-0.174*	-0.370*	-0.280*	-0.411*	-0.103*	-0.119*	-	1		
14|Growth	0.027	-0.026	0.021	-0.01	-0.118*	-0.004	-0.073*	-0.039	-0.107*	0.047	-0.013	-0.041	-0.092	1	
15|HH.Index	-0.016	-0.016	0.027	0.004	0.148*	0.056*	0.273*	0.0246	-0.006	-0.063*	0.178*	0.004	0.025	-0.035	1
16|New_Financing	-0.146*	0.051*	-0.008	0.039	0.132*	-0.016	0.158*	-0.070*	0.131*	-0.112*	0.062*	0.087*	-0.048	-0.001	0.055*

* indicates significance at 5% level. Refer to Appendix C for definitions of variables.

Table 5: Baseline models for the implied cost of equity capital (*PEG*) and innovation disclosures- (full sample)

	1	2	3	4	5
	PEG	**PEG**	**PEG**	**PEG**	**PEG**
ESGScr	-0.046			-0.042	-0.042
	(0.039)			(0.038)	(0.038)
Beta	-0.017*			-0.019**	-0.019**
	(0.009)			(0.009)	(0.009)
LogSize	-0.039*			-0.043**	-0.041*
	(0.022)			(0.021)	(0.021)
B2M	0.029***			0.030***	0.030***
	(0.008)			(0.008)	(0.008)
Leverage	0.022			0.032	0.033
	(0.025)			(0.024)	(0.024)
ROA	-0.076**			-0.080**	-0.077**
	(0.038)			(0.039)	(0.039)
High_analyst	-0.004			-0.003	-0.003
	(0.002)			(0.002)	(0.002)
Growth	0.001			0.002	0.002
	(0.008)			(0.009)	(0.009)
R&D	0.003			0.002	0.004
	(0.007)			(0.006)	(0.007)
New_Financing	-0.000			-0.001	-0.001
	(0.003)			(0.003)	(0.003)
HH.Index	-0.004**			-0.004*	-0.004**
	(0.002)			(0.002)	(0.002)
Explr		-0.022		-0.018	
		(0.065)		(0.056)	
Explt		-1.220***		-1.194***	
		(0.441)		(0.356)	
SqrootOA			-1.057**		-1.110***
			(0.428)		(0.409)
Intercept	0.247***	0.104***	0.105***	0.280***	0.270***
	(0.087)	(0.007)	(0.009)	(0.085)	(0.085)
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes
N observations	1028	1295	1295	1017	1017
N firms	297	343	343	295	295
R-sq	0.119	0.028	0.026	0.136	0.134

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Reported in parentheses are robust standard errors clustered at the firm level to control for heteroscedasticity and autocorrelation. All independent variables are one year lag (*t-1*). Refer to
Appendix C for definitions of variables.

Table 6: Baseline models for the implied cost of equity capital (*PEG*) and innovation disclosures- R&D vs. non-R&D-active firms

	6	**7**	**8**	**9**
	PEG	**PEG**	**PEG**	**PEG**
	R&D	**R&D**	**Non-R&D**	**Non-R&D**
ESGScr	-0.036	-0.034	-0.033	-0.033
	(0.061)	(0.061)	(0.043)	(0.043)
Beta	-0.035*	-0.036*	-0.017*	-0.019*
	(0.021)	(0.020)	(0.01)	(0.010)
LogSize	-0.069	-0.065	-0.021	-0.018
	(0.048)	(0.049)	(0.022)	(0.023)
B2M	0.033	0.034	0.027***	0.027***
	(0.023)	(0.023)	(0.009)	(0.009)
Leverage	0.042	0.039	0.022	0.024
	(0.031)	(0.031)	(0.031)	(0.032)
ROA	-0.035	-0.039	-0.090	-0.090
	(0.036)	(0.036)	(0.06)	(0.06)
High_analyst	-0.004	-0.004	-0.004	-0.004
	(0.004)	(0.004)	(0.003)	(0.003)
Growth	0.023	0.023	-0.005	-0.005
	(0.014)	(0.014)	(0.012)	(0.012)
New_Financing	-0.001	-0.001	-0.002	-0.002
	(0.005)	(0.005)	(0.004)	(0.004)
HH.Index	0.011	0.011	-0.005**	-0.006***
	(0.007)	(0.007)	(0.002)	(0.002)
LogRD.Expend/Sales	0.011	0.010	-	-
	(0.013)	(0.013)		
Explr	-1.459***		0.037	
	(0.504)		(0.052)	
Explt	-1.021		-1.264***	
	(0.773)		(0.480)	
SqrootOA		-2.572***		-0.723
		(0.881)		(0.472)
Intercept	0.416**	0.400**	0.200**	0.183**
	(0.183)	(0.188)	(0.086)	(0.088)
Year Fixed Effect	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes
N observations	331	331	686	686
N firms	97	97	202	202
R-sq	0.180	0.174	0.166	0.160

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. Models 6-7 present results of the subsample of R&D-active firms that have R&D expenditures greater than 0. Models 8-9 present results of the subsample of non-R&D-active firms that have 0 R&D expenditures. Reported in parentheses are robust standard errors clustered at the firm level to control for heteroscedasticity and autocorrelation. All independent variables are one year lag (*t-1*). Refer to Appendix C for definitions of variables.

Table 7: Subsampling R&D and non-R&D-active firms by 3-year average R&D expenditure

	10	11	12	13
	PEG	**PEG**	**PEG**	**PEG**
	If 3-year average R&D>0		**If 3-year average R&D=0**	
ESGScr	-0.033	-0.032	-0.033	-0.033
	(0.061)	(0.062)	(0.043)	(0.043)
Beta	-0.034	-0.035	-0.017	-0.019
	(0.021)	(0.020)	(0.010)	(0.010)
LogSize	-0.067	-0.064	-0.021	-0.018
	(0.048)	(0.049)	(0.022)	(0.023)
B2M	0.033	0.033	0.027	0.027
	(0.024)	(0.024)	(0.009)	(0.009)
Leverage	0.045	0.042	0.022	0.024
	(0.030)	(0.031)	(0.031)	(0.032)
ROA	-0.039	-0.042	-0.090	-0.087
	(0.036)	(0.036)	(0.060)	(0.060)
High_analyst	-0.004	-0.004	-0.004	-0.004
	(0.004)	(0.004)	(0.003)	(0.003)
Growth	0.023	0.023	-0.005	-0.006
	(0.014)	(0.014)	(0.012)	(0.012)
HH.Index	0.011	0.011	-0.006	-0.006
	(0.008)	(0.007)	(0.002)	(0.002)
Log3-year average R&D	0.000	0.000	-	-
	(0.009)	(0.009)		
New_Financing	-0.001	-0.001	-0.002	-0.002
	(0.005)	(0.005)	(0.004)	(0.004)
Explr	-1.318***		0.037	
	(0.466)		(0.052)	
Explt	-1.037		-1.264***	
	(0.713)		(0.480)	
SqrootOA		-2.439***		-0.723
		(0.762)		(0.472)
Intercept	0.405	0.392	0.200	0.183
	(0.181)	(0.185)	(0.086)	(0.088)
Year Fixed Effect	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes
N observations	335	335	682	682
N firms	97	97	198	198
R-sq	0.179	0.174	0.166	0.160

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. In models 10 and 11, the R&D-active firms are modelled with a conditional requirement of (if 3-year average R&D > 0). While in models 12 and 13, the non-R&D-active firms are modelled with a conditional requirement of (if 3-year average R&D =0). Reported in parentheses are robust standard errors clustered at the firm level to control for heteroscedasticity and autocorrelation. All independent variables are one year lag (*t-1*). Refer to **Appendix C** for definitions of variables.

Table 8: Subsampling R&D-active firms by yearly changes in R&D intensity

	14	15	16	17
	PEG	**PEG**	**PEG**	**PEG**
	If R&D change >0		**If R&D change ≤0**	
ESGScr	-0.204	-0.205	0.097	0.125
	(0.085)	(0.085)	(0.075)	(0.086)
Beta	-0.019	-0.019	0.002	0.001
	(0.021)	(0.021)	(0.024)	(0.023)
LogSize	-0.054	-0.043	-0.008	-0.001
	(0.043)	(0.044)	(0.069)	(0.075)
B2M	0.038	0.039	0.050	0.044
	(0.034)	(0.034)	(0.036)	(0.036)
Leverage	0.099	0.092	-0.013	-0.023
	(0.048)	(0.052)	(0.044)	(0.038)
ROA	-0.127	-0.127	-0.019	-0.076
	(0.045)	(0.045)	(0.067)	(0.054)
High_analyst	0.000	0.000	0.007	0.008
	(0.005)	(0.005)	(0.008)	(0.009)
Growth	0.093	0.100	0.021	0.017
	(0.038)	(0.037)	(0.012)	(0.014)
LogRD.Expend/Sales	0.024	0.02	-0.006	-0.015
	(0.025)	(0.024)	(0.020)	(0.018)
HH.Index	-0.001	0.000	-0.020	-0.027
	(0.010)	(0.009)	(0.016)	(0.018)
New_Financing	-0.008	-0.006	-0.004	-0.006
	(0.006)	(0.006)	(0.011)	(0.011)
Explr	-2.139**		-1.293	
	(0.883)		(0.839)	
Explt	-1.237		2.259	
	(0.805)		(1.714)	
SqrootOA		-3.371***		0.234
		(1.229)		(0.978)
Intercept	0.437	0.390	0.064	0.041
	(0.178)	(0.181)	(0.224)	(0.249)
Year Fixed Effect	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes
N observations	191	191	140	140
N firms	83	83	75	75
R-sq	0.392	0.380	0.365	0.329

*, **, and *** indicates significance at 10%, 5%, and 1% levels respectively. In models 14 and 15, firms with increasing R&D intensity are modelled with a conditional requirement of (if R&D change> 0). While in models 16 and 17, firms with decreasing R&D intensity are modelled with a conditional requirement of (if R&D change≤0). Reported in parentheses are robust standard errors clustered at the firm level to control for heteroscedasticity and autocorrelation. All independent variables are one year lag (*t-1*). Refer to **Appendix C** for definitions of variables.