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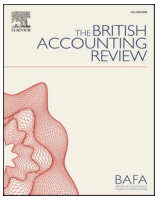

Textual dimensions of sustainability information, stock price informativeness, and proprietary costs: Evidence from integrated reports☆

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ABSTRACT

We examine whether integrated report quality, IRQ, is negatively associated with stock price synchronicity, an inverse measure of firm-specific information, and the extent to which the relation between IRQ and synchronicity is attenuated by proprietary costs. We measure IRQ using machine-based textual analysis along four dimensions: textual attributes, topical content, integrated reporting capitals, and financial versus sustainability information. We find that measures of IRQ based on seven textual attributes are negatively related to synchronicity, which is consistent with higher quality text containing more firm-specific content. Using PhraseLDA to identify topics in integrated reports, we find that contents related to the three most common categories—governance, performance, and risks and opportunities—are negatively associated with synchronicity. We find similar results for all integrated report capitals, except manufactured capital. Further, we find that sustainability information has a larger negative association with synchronicity than financial information. We also find that proprietary costs stemming from product market competition attenuate the association between IRQ and synchronicity, which suggests the informativeness of integrated reports varies with a firm's competitive environment. Our results may inform the International Sustainability Standards Board as it considers the role of the Integrated Reporting Framework in developing sustainability standards.

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1. Introduction

Prior research documents capital market benefits associated with 'integrated reports' that combine financial and sustainability information (Barth, Cahan, Chen, & Venter, 2017; Wang, Chua, Simnett, & Zhou, 2024; Zhou, Simnett, & Green, 2017).[1] However, stock prices reflect firm-specific and common (e.g., industry-level and/or market-wide) information. Although the prior literature reasons that these capital market benefits may flow from the improved information environment emanating from integrated reporting, a market-wide adoption of integrated reporting affects both firm-specific and common information. For example, firms in the same industry face similar sustainability-related risks and opportunities, and isomorphic forces may cause them to include similar disclosures in their integrated reports. Therefore, whether the capital market benefits associated with integrated reporting can be attributed to more firm-specific information is unclear.

To provide insights into this attribution, we address two related research questions. First, we determine whether higher integrated report quality (IRQ) is associated with lower stock price synchronicity, where lower synchronicity reflects less co-movement of a firm's stock price with common information and greater co-movement with firm-specific information. Second, we examine whether, and the extent to which, the relation between IRQ and stock price synchronicity is attenuated by proprietary costs.[2]

The answers to these questions are not obvious. Although integrated reports can contain new value relevant information about a firm, the aim of integrated reporting is to improve investors' holistic understanding of the firm by reducing information acquisition and processing costs and facilitating the incorporation of all value relevant information into stock prices. Collectively, we refer to both new value relevant information and investors' improved understanding of the firm as "firm-specific information." Evidence on the ability of integrated reports to communicate and/or improve capital providers' understanding of firm-specific information is important.

If integrated reporting achieves its aim and firms implement it as the Integrated Reporting Framework (hereafter "the Framework") intends, we expect that higher quality integrated reports contain more firm-specific information that results in lower stock price synchronicity. However, when a firm is similar to its industry peers, synchronicity is high (Ye, Guan, & Zhang, 2021). In this case, the firm has little information to offer that differentiates it from its peers. Thus, even if the firm has high IRQ—which otherwise suggests its integrated report contains considerable firm-specific information—IRQ might not be associated with lower synchronicity. Also, firms use disclosures by other firms in their industry to inform their investment decisions, which makes the firms more similar to one another (Bernard, Blackburne, & Thornock, 2020). Thus, over time firm-specific information can become common information. In addition, firm-specific information in integrated reports might not be relevant to investors and therefore not incorporated into stock prices.

The effect of proprietary costs on the relation between IRQ and synchronicity also is not obvious. Proprietary costs generally constrain full disclosure because proprietary information can be used by the disclosing firm's competitors, thereby undermining the firm's position in the product market (Darrough & Stoughton, 1990; Hayes & Lundholm, 1996; Verrecchia, 1983; Wagenhofer, 1990). To the extent that this constraint is binding, a firm with higher proprietary costs has incentives to disclose less firm-specific information. However, a firm's disclosures affect the capital market as well as the firm's product markets (Kim, Su, Wang, & Wu, 2021). As the cost of proprietary disclosure increases, firms have incentives to substitute non-proprietary information that helps the capital market for proprietary information that could help product market competitors. Because the scope of disclosure in integrated reports is broad, integrated reports provide firms with more opportunities to make this substitution. As a result, a higher quality integrated report could reveal more firm-specific information that is not proprietary, which means that higher proprietary costs need not weaken the negative relation between IRQ and synchronicity.

Prior research on synchronicity and proprietary costs of disclosure focuses on a limited number of traditional financial disclosures, such as management earnings forecasts and Forms 10-K (Kim et al., 2021). In contrast, our focus is on integrated reports, which include a wide variety of disclosures—financial and sustainability—that explain how firms use their financial, manufactured, intellectual, human, social and relationship, and natural capitals to create value (IIRC, 2013a). Thus, focusing on integrated reports broadens our understanding of the role of disclosure in providing firm-specific information to the capital market and whether proprietary cost concerns inhibit firms from disclosing this information.

Similar to prior studies on integrated reporting (Barth et al., 2017; Bernardi & Stark, 2018; Zhou et al., 2017), our empirical evidence is

[1] According to the Integrated Reporting Framework, the aim of an integrated report is to provide insight about the resources and relationships used and affected by a firm—these are collectively referred to as "the capitals." The six capitals are financial, manufactured, intellectual, human, social and relationship, and natural. Sustainability issues—such as environmental, social, and governance (ESG) activities—relate to all capitals—including human, social, and natural capital. Sustainability-related information is referred to in practice and the academic literature using various terms, including Corporate Social Responsibility, ESG, sustainability, and non-financial information. We avoid using "non-financial" when referring to sustainability information because sustainability-related information that is relevant to investors' resource allocation decisions has financial implications.

[2] Although the evidence in prior literature on integrated reporting is based on firm-level analyses, no prior studies consider firm-specific information as an outcome variable. Various variables related to firms' information environments are used in the literature, including firm value, stock liquidity, cost of capital, expected future cash flows, and analyst forecast errors and dispersion. We focus on stock price synchronicity for two reasons. First, Grewal et al. (2021) contend that stock price synchronicity is a preferred proxy for firm-specific information over other proxies for firms' information environments, including bid-ask spread, illiquidity, and zero return days. Second, although analyst forecasts provide a direct capital market outcome (Muslu, Mutlu, Radhakrishnan, & Tsang, 2019), they focus on sophisticated investors and ignore a large portion of capital market participants. Wang et al. (2024) find that the move from the "enhanced business review" to "strategic reporting" in the U.K. is associated with lower bid-ask spreads and cost of capital, but not analyst forecast errors and dispersion. This finding suggests that capital market participants other than analysts could benefit from alternative reporting formats.

based on a sample of South African firms listed on the Johannesburg Stock Exchange (JSE). This sample has two advantages in addressing our research questions. First, although firms in many countries voluntarily issue integrated reports, firms that have a primary listing on the JSE are mandated to do so. Thus, our inferences are less affected by self-selection that stems from voluntary reporting incentives. Second, whereas prior research generally examines the effect of proprietary costs on voluntary disclosure (e.g., Ryou, Tsang, & Wang, 2022), we examine the effect of proprietary costs on mandatory disclosure. Because voluntary and mandatory disclosures are affected by different incentives, it is unclear whether prior research findings based on voluntary disclosure apply to mandatory disclosure.

In contrast to most prior research on integrated reporting, we measure IRQ using a machine-based textual analysis of the content of integrated reports.[3] In particular, following Dyer, Lang, and Stice-Lawrence (2017), we measure seven textual attributes related to the informativeness of integrated reports, namely disclosure length, readability, boilerplate language, redundant language, specific language, language that is sticky over time, and hard information. Using these attributes, we construct two measures of IRQ. Our primary IRQ measure is the average percentile ranks across the seven attributes. We also measure IRQ based on a factor analysis that identifies three factors of informativeness associated with obfuscation, complexity, and detail in information.

In addition, we use a natural language processing technique, PhraseLDA (El-Kishky, Song, Wang, Voss, & Han, 2014), to identify the topical content of the integrated reports. By focusing on phrases rather than unigram words as does the more common Latent Dirichlet Allocation (LDA) method, PhraseLDA provides a more interpretable and accurate description of the report's topical content. We group the PhraseLDA identified topics across three dimensions. The first dimension relates to topics related to the Framework that are discussed in our sample reports with the greatest frequency. This process identifies three common topical categories in integrated reports—governance, performance, and risks and opportunities. The second dimension relates to the six integrated reporting capitals and a seventh category for multiple capitals. The third dimension is financial and sustainability information.

Our results can be summarized as follows. First, we find a significant negative relation between synchronicity and our primary IRQ measure based on the seven textual attributes. This finding reveals that higher IRQ is associated with more firm-specific information reflected in firms' stock prices. Further, we find that the first two IRQ factors—obfuscation and complexity—are associated with synchronicity. The obfuscation factor is positively related to synchronicity and the complexity factor is negatively related.

Second, we find a significant positive relation between synchronicity and the interaction between IRQ and proprietary cost measures. This finding reveals that incentives of managers to provide firm-specific information in integrated reports are weaker when proprietary costs of disclosure are higher. We also find significant relations between the interactions of the obfuscation and complexity factors and proprietary costs associated with product market competition. The signs of these interactions are opposite to their main effects, which provides additional evidence that proprietary costs related to product market competition reduce the incentives of managers to provide firm-specific information in integrated reports.

Third, relating to our analysis of the topical content of integrated reports, we find that high quality disclosure on governance, performance, and risks and opportunities are related to lower synchronicity, which indicates that these categories contain firm-specific information useful to investors. Further, we find significant relations between the interactions of these content categories and our proprietary cost measures. The signs of these relations again suggest that proprietary costs can reduce the incentives of managers to provide firm-specific information in integrated reports related to these topic areas.

Fourth, regarding the six capitals, we find that higher disclosure quality in integrated reports related to all capitals, except manufactured capital, tend to contain more firm-specific information. We also find evidence broadly consistent with our main results relating to the moderating effect of proprietary costs for all integrated report capitals, except manufactured and social capital.

Fifth, we find that sustainability information is more closely related to synchronicity than financial information. This is an important finding because one purpose of integrated reports is to combine sustainability information with traditional financial information (e.g., financial statements). Thus, our findings reveal that sustainability disclosures in integrated reports can provide firm-specific information beyond the firm-specific information in financial disclosures. However, consistent with our other findings, proprietary costs can reduce the incentives for managers to provide firm-specific sustainability disclosures. Overall, our findings suggest that the informativeness of integrated reports can vary with a firm's competitive environment.

We conduct sensitivity tests including a changes analysis, an alternative proxy for IRQ based on external assurance, and alternative proxies for proprietary costs. These tests largely support our main inferences.

Our study contributes to the literature in four main ways. First, we contribute to the growing literature on the capital market benefits associated with integrated reporting (Barth et al., 2017; Bernardi & Stark, 2018; Serafeim, 2015; Wang et al., 2024; Zhou et al., 2017). Although this literature generally finds positive capital market consequences associated with integrated reporting, no study considers whether these benefits arise from more firm-specific information or more common information. Our finding that higher IRQ is associated with lower stock price synchronicity is consistent with integrated reports providing firm-specific information to investors that facilitates more informed decision making. The relations we document include controls for the issuance of a standalone Corporate Social Responsibility (CSR) report, accounting quality, and general disclosure quality. Thus, our evidence shows that higher IRQ is associated with lower stock price synchronicity incremental to those associated with existing reports.

Second, we contribute to the literature on disclosure and proprietary costs (Callen, Fang, & Zhang, 2020; Kim et al., 2021). Our study is among the first to consider this issue in the context of mandatory disclosure of sustainability information. Our finding that the association between IRQ and synchronicity is less negative for firms with higher proprietary costs gives credence to concerns that

[3] One exception is Caglio et al. (2020) who consider three textual attributes in integrated reports, i.e., length, readability, and tone. We extend their work by examining seven textual attributes as well as the topical content and financial and sustainability orientation of the content in integrated reports. Additionally, Caglio et al. (2020) do not examine stock price synchronicity or proprietary costs.

integrated reports could reveal proprietary information when product market competition is high. This finding is inconsistent with firms that have higher proprietary costs substituting the disclosure of non-proprietary information that generates capital market benefits for proprietary information that may aid competitors. Consequently, proprietary cost concerns seem to dominate capital market benefits when firms make disclosure choices in their integrated reports.

Third, we contribute to the literature on sustainability disclosures (Bochkay, Hales, & Serafeim, 2021; Christensen, Hail, & Leuz, 2021; Grewal, Hauptmann, & Serafeim, 2021). Our evidence suggests that sustainability information can convey firm-specific information, which is inconsistent with the concern that such disclosures are vague and easily manipulated. Also, whereas prior research focuses on voluntary sustainability standards (Bochkay et al., 2021), which allow flexibility in terms of adoption, we focus on mandated integrated reporting, a form of disclosure regulation. Our study responds to the call for more research on the effects of sustainability reporting, especially in settings in which this reporting is mandated (Christensen et al., 2021).

Fourth, we make a methodological contribution to the literature on integrated and sustainability reporting by developing machine-based measures of information disclosure quality. In the context of integrated reporting, prior studies do not directly consider textual content (e.g., Barth et al., 2017; Wang et al., 2024; Zhou et al., 2017) when assessing the quality of integrated reports. As Wang et al. (2024) observe, using textual analysis to move beyond proprietary third-party proxies for disclosure quality may contribute to the extant evidence. Consequently, we consider four dimensions of the textual content of integrated reports: (1) textual attributes associated with the language and length of the reports, (2) topical categories discussed in the reports, (3) capitals discussed in the reports, and (4) the financial or sustainability orientation of disclosures in the reports. Whereas Barth et al. (2017) and Wang et al. (2024) use a measure of IRQ based on expert opinion, a limitation of that approach is that only firms rated by the experts can be included in the sample. In contrast, our approach can be applied to large samples including international samples of firms from many countries.

2. Institutional background and motivation

The International Integrated Reporting Council (IIRC) was established in 2010 to develop a framework for integrated reporting to achieve two primary goals.[4] The first goal is to improve the quality of information available to outside providers of financial capital to facilitate more efficient capital allocation. The second is to support integrated internal thinking, decision-making, and actions that create value for the firm. Integrated reports are comprehensive, standalone reports, and their use continues to increase.[5]

The Framework's fundamental concepts require the firm to provide integrated financial and sustainability information to explain how it uses six capitals to create, preserve, or erode value over time. The Framework also sets out seven guiding principles and eight content elements that characterize high-quality integrated reports. The guiding principles underpin the preparation of the integrated report, including how information is presented. They are strategic focus and future orientation; connectivity of information; stakeholder relationships; materiality; conciseness; reliability and completeness; and consistency and comparability.[6] The content elements specify what the firm should explain in its integrated report. They are organizational overview and external environment; governance; business model; risks and opportunities; strategy and resource allocation; performance; outlook; and basis of preparation and presentation.[7]

Integrated reports are more comprehensive in scope in terms of the capitals they address than traditional standalone financial and CSR reports because integrated reports combine financial and sustainability information in a single report. Because financial capital is one of the six capitals in the Framework, a firm's financial statements, prepared according to applicable financial reporting standards, is a key element of integrated reports. However, unlike financial statements, integrated reports focus on integrating financial and sustainability-related information that is not typically included in financial statements. Although elements of such sustainability-related information may be addressed in voluntary standalone CSR reports, such as environmental issues, it is presented out of the context of the firm's strategy, business model, and financial performance. This makes it difficult for investors to connect sustainability

[4] See Barth et al. (2017) for a more complete discussion of integrated reporting.

[5] In January 2021, the IIRC reported that 2500 firms in more than 70 countries use the Framework to prepare integrated reports (See IIRC publishes revisions to International <IR> Framework to enable enhanced reporting).

[6] As described in the Framework, strategic focus and future orientation refers to providing insight into the firm's strategy, and how the strategy relates to the firm's ability to create value and its use of, and effects on, its capitals. Connectivity of information refers to showing a holistic picture of the combination, interrelatedness, and dependencies between factors that affect the firm's ability to create value. Stakeholder relationships refers to providing insight into the nature and quality of the firm's relationships with its key stakeholders, including how and to what extent the firm understands, considers, and responds to their legitimate needs and interests. Materiality refers to disclosing information about matters that substantively affect the firm's ability to create value. Conciseness refers to a balance between disclosing relevant information without overburdening users with less relevant information. Reliability and completeness refers to including all material matters, positive and negative, in a balanced way and without material error. Consistency and comparability refers to presenting information consistently over time and in a way that enables comparison with other firms to the extent it is material to the firm's ability to create value.

[7] Following the Framework, organizational overview and external environment refer to what the firm does and the circumstances under which it operates. Governance refers to how the firm's governance structure supports its ability to create value. Business model refers to how a firm uses various capitals as inputs and through its business activities converts them to outputs and outcomes. Risks and opportunities refers to the specific risks and opportunities that affect the firm's ability to create value and how the firm is dealing with them. Strategy and resource allocation refers to where the firm wants to go and how it intends to get there. Performance refers to the extent to which the firm achieved its strategic objectives for the period and what its outcomes are in terms of effects on its capitals. Outlook refers to challenges and uncertainties the firm is likely to encounter in pursuing its strategy, and what the potential implications are for its business model and future performance. Basis of presentation refers to how the firm determines what matters to include in the integrated report and how such matters are quantified or evaluated.

performance to financial performance. Therefore, the objective of integrated reports is to address all resources and relationships that impact the ability of the firm to create value in the short, medium, and long term.

The principle of information connectivity is at the heart of integrated reporting. The Framework describes connectivity as the ability of an integrated report to show "a holistic picture of the combination, interrelatedness and dependencies between the factors that affect the organization's ability to create value over time" (IIRC, 2021). Simply combining traditional standalone financial and CSR reports will not meet the requirements of the Framework because the information will not be connected.

Connecting financial and sustainability-related information is important because investor interest in sustainability-related information, which extends beyond financial capital, has increased dramatically in recent years.[8] In response to the increase in investor interest in sustainability-related information, sustainability reporting and disclosure initiatives are rapidly developing globally. In March 2021, the European Commission (EC) and the European Financial Reporting Advisory Group (EFRAG) met with international sustainability reporting standard setters, including the IIRC and Sustainability Accounting Standards Board (SASB), to discuss the future of European sustainability standards.[9] In November 2022, the Council of the European Union (EU) approved the Corporate Sustainability Reporting Directive (CSRD) tasking the EFRAG with the development of European Sustainability Reporting Standards (ESRS).[10] In June 2023 the EC adopted a set of 12 ESRS for mandatory application by firms subject to the CSRD.[11] The CSRD became effective in January 2023 with large listed firms, banks, insurance firms, and non-EU listed firms (all with more than 500 employees) required to comply with the ESRS for the 2024 financial year, with the first sustainability statement to be published in 2025.[12]

The concepts and principles of integrated reporting remain influential in these European developments. For example, paragraph 118 of ESRS 1, *General Requirements*, requires that a firm provide information that "enables users of its sustainability statement to understand the connections between different pieces of information in the statement and the connections between the information in the sustainability statement and other information that the undertaking discloses in other parts of its corporate reporting." Consequently, as is the case in the Framework, connectivity of information is a general principle of ESRS.

In June 2022, the EFRAG Financial Reporting Board (EFRAG FRB) approved the addition of a project on the connectivity between financial and sustainability-related disclosures to EFRAG's proactive research agenda. In February 2023, the EFRAG FRB approved the formation of an advisory panel on the connectivity between financial reporting and sustainability reporting (EFRAG CAP) to support the research activities and advise the EFRAG Financial Reporting Technical Expert Group (FR TEG) on the project.[13] In February 2024, the EFRAG FR TEG and Sustainability Reporting Technical Expert Group released the "Connectivity Principles Issues Paper" based on the discussions from their joint public meeting held in December 2023. This report highlights that between 2013 and 2017 the principle of connectivity has been considered by more than 4000 European firms that annually prepared an integrated report in terms of the Framework.

Alongside the EU developments, in June 2021, the IIRC and SASB merged to form the Value Reporting Foundation (VRF).[14] In August 2022, the International Financial Reporting Standards Foundation (IFRSF) consolidated the VRF into the IFRSF to support the work of the Foundation's newly established International Sustainability Standards Board (ISSB), a sister board to the International Accounting Standards Board (IASB), to develop a comprehensive global baseline of sustainability disclosures for the capital markets.[15]

From the onset, the ISSB has stated that the Framework will continue to inform its deliberations.[16] In June 2023, the ISSB issued its first two standards, namely IFRS S1, *General Requirements for Disclosure of Sustainability-related Financial Information*, and IFRS S2, *Climate-related Disclosures*.[17] At the official launch of the standards, the Chair of the ISSB, Emmanuel Faber, emphasized the need for sustainability information to explain the "relationships and dependencies" between the capitals identified in the Framework and explained that the standards embrace the "language" used in the Framework.[18] In May 2024, the IFRSF released a guide to assist firms that wish to apply both the Framework and the IFRS Sustainability Disclosure Standards, which the Foundation views as complementary tools for investor-focused communications.[19]

[8] For example, EY's (2020) survey of nearly 300 institutional investors reveals that in 2020 72% of investors surveyed conduct a structured and methodical evaluation of sustainability performance based on corporate disclosures compared to 32% in 2018.

[9] See EFRAG meets with international sustainability reporting standard setters and other related initiatives.

[10] See Council gives final green light to corporate sustainability reporting directive.

[11] See The Commission adopts the European Sustainability Reporting Standards.

[12] See Corporate sustainability reporting.

[13] See EFRAG Connectivity Advisory Panel (EFRAG CAP).

[14] See IIRC and SASB form the Value Reporting Foundation, providing comprehensive suite of tools to assess, manage and communicate value.

[15] See IFRS Foundation completes consolidation with Value Reporting Foundation.

[16] See Integrated Reporting—articulating a future path.

[17] See ISSB issues inaugural global sustainability disclosure standards.

[18] See ISSB Chair Emmanuel Faber at the IFRS Foundation Conference: A new common language to build more resilient economics.

[19] The objective of integrated reporting is consistent with the objective of sustainability-related financial disclosures in terms of IFRS S1, *General Requirements for Disclosure of Sustainability-related Financial Information*. Specifically, paragraph 2 of IFRS S1 states that "[i]nformation about sustainability-related risks and opportunities is useful to primary users because an entity's ability to generate cash flows over the short, medium and long term is inextricably linked to the interactions between the entity and its stakeholders, society, the economy and the natural environment throughout the entity's value chain. Together, the entity and the resources and relationships throughout its value chain form an interdependent system in which the entity operates. The entity's dependencies on those resources and relationships and its impacts on those resources and relationships give rise to sustainability-related risks and opportunities for the entity." The IFRS Foundation's (2024) guide, "Transition to integrated reporting: a guide to getting started," directly links the six capitals of the Framework to the "resources and relationships" referred to in paragraph 2 of IFRS S1.

3. Theory, related research, and hypotheses

3.1. Theory

Corporate disclosure is the primary mechanism through which firms publicly reveal otherwise private firm-specific information (Healy & Palepu, 2001). If firms credibly disclose this information, investors have relatively low-cost access to it, which reduces investors' reliance on common information signals when assessing firms' values (Haggard, Martin, & Pereira, 2008). This low-cost access to firm-specific information reduces the synchronicity of a firm's stock price (Veldkamp, 2006). In contrast, firms' information opacity reduces the availability of firm-specific information and forces investors to rely largely on public information, which increases synchronicity (Jin & Myers, 2006).

Absent costs, value-maximizing managers have incentives to disclose fully otherwise private firm-specific information, because doing so reduces information asymmetry and increases liquidity of the firm's shares (Bartov & Bodnar, 1996; Healy & Palepu, 2001). Disclosure can affect a firm's competitive position because publicly disclosed information is observable not only by a firm's investors, but also by its competitors. Therefore, firms trade off the benefits and costs of revealing proprietary information (Kim et al., 2021; Lang & Lundholm, 1993; Verrecchia, 1983).

3.2. Related research

Our study relates to three main streams of literature. The first, starting with Dhaliwal, Li, Tsang, and Yang (2011), examines the capital market consequences of voluntary standalone CSR reports.[20] Although integrated and sustainability reports both include sustainability-related information, integrated reporting is broader in scope than standalone sustainability reports because it connects financial and sustainability-related information that is relevant to investors' capital allocation decisions (see Section 2). We contribute to the literature on voluntary standalone sustainability reporting by investigating mandatory integrated reporting. Our investigation is timely in that IFRS S1 paragraph 61 identifies integrated reports as a possible disclosure location for sustainability-related financial disclosures required by IFRS Sustainability Disclosure Standards.

The second stream of literature examines integrated reporting's role in providing information to outside capital providers. Empirical studies in this literature largely are based on firms in South Africa because integrated reporting is mandatory in that country (De Villiers, Venter, & Hsiao, 2017). These studies generally conclude that integrated reporting is associated with capital market benefits for firms, such as higher firm value, higher share liquidity, lower cost of capital, and lower analyst earnings forecast errors (Barth et al., 2017; Bernardi & Stark, 2018; Caglio, Melloni, & Perego, 2020; Lee & Yeo, 2016; Zhou et al., 2017).[21] A few integrated report studies use data outside of South Africa, showing that firms voluntarily practising integrated reporting have more long-term oriented investors and lower agency costs (Obeng, Ahmed, & Cahan, 2021; Serafeim, 2015). Collectively, these studies suggest that integrated reporting is associated with an improved information environment. However, none of these studies addresses whether this improvement is associated with more firm-specific information. We contribute to the literature on integrated reporting by examining the association between IRQ and stock price synchronicity.[22]

The third stream of related literature studies stock price synchronicity.[23] This literature generally concludes that transparency is negatively associated with synchronicity (Hutton, Marcus, & Tehranian, 2009; Jin & Myers, 2006; Morck, Yeung, & Yu, 2000). In addition, this literature shows that synchronicity is negatively related to the transparency and the frequency of reporting in a country (Barth, Landsman, Lang, & Williams, 2018; Kim & Shi, 2012; Wang & Yu, 2015; Watanabe, Imhof, & Tartaroglu, 2019). Regarding sustainability information, Grewal et al. (2021) find that voluntary disclosure of ESG information that SASB standards identify as financially material is associated with lower synchronicity. Whereas Grewal et al. (2021) study voluntary ESG disclosure, we study mandatory integrated reports. A reporting mandate can act as a commitment device because firms could be required to disclose information they otherwise would not disclose (Christensen et al., 2021). Because integrated reports cover a broad range of topics and firm activities that are difficult to measure,

[20] See Christensen et al. (2021), Stuart, Fuller, Heron, and Riley (2023) and Tsang, Frost, and Cao (2023) for an overview of the broader voluntary sustainability disclosure literature. Clarkson et al. (2020) and Muslu et al. (2019) are examples of studies in this literature that examine the textual attributes of voluntary sustainability disclosures.

[21] See Barth, Cahan, Chen, and Venter (2020) for an overview.

[22] In a concurrent working paper, Ferreira and Martins (2020) examine the effect of voluntary adoption of integrated reporting on information asymmetry, stock price synchronicity, and earnings predictability. However, they focus on the adoption of integrated reporting. In contrast, we use machine-based analysis to understand how different textual dimensions of integrated reports relate to stock price synchronicity. Further, we focus on mandatory integrated reporting and consider the moderating role of proprietary costs.

[23] This literature is extensive. Thus, we focus our discussion on studies that relate to corporate reporting and disclosure. Other studies in this literature focus on board gender diversity (Gul, Srinidhi, & Ng, 2011), antitakeover provisions (Ferreira & Laux, 2007), ownership structure (Boubaker, Mansali, & Rjiba, 2014; Brockman & Yan, 2009), shareholder coordination (Kim, Pantzalis, & Wang, 2018), analyst activity (Chan & Hameed, 2006; Piotroski & Roulstone, 2004), product market competition (Gaspar & Massa, 2006), press freedom (Kim, Zhang, Li, & Tian, 2014), and corporate social responsibility (Becchetti, Ciciretti, & Hasan, 2015; Mishra & Modi, 2013).

the extent to which mandated sustainability information is associated with synchronicity is an open question.[24]

Research on the relation between synchronicity and proprietary costs is sparse (Callen et al., 2020; Kim et al., 2021). Kim et al. (2021) find that synchronicity is higher following the adoption of the Inevitable Disclosure Doctrine (IDD) by state courts in the U.S., which is consistent with firms having more incentives not to disclose proprietary firm-specific information following the IDD implementation.[25] In our setting, proprietary costs are likely to be pertinent because integrated reports can include process-oriented disclosures that generally are not included in financial statements (Christensen et al., 2021). These disclosures likely contain proprietary information. Thus, whether mandated integrated reports elicit more firm-specific information for firms with higher proprietary costs is an empirical question.

3.3. Hypotheses

Our first hypothesis relates to the association between IRQ and stock price synchronicity. Integrated reporting is a channel through which firms can convey to investors firm-specific information about future performance. Thus, higher quality disclosures in integrated reports could lower the cost of collecting, processing, and trading on firm-specific information.

There are several reasons to believe that high quality integrated reports contain value relevant firm-specific information. The Framework is principles-based without specific disclosure requirements, which makes it difficult for firms to issue boilerplate disclosures that are low in information content. Instead, the Framework requires a firm to present its value creation story in its integrated report following broad guiding principles and content elements. As the Framework explains, an integrated report is a "concise communication about how an organization's strategy, governance, performance and prospects, in the context of its external environment, lead to the creation of value over the short, medium and long term" (IIRC, 2013a). In essence, the objective of integrated reports is to explain how a firm's business model uses resources, i.e., its capitals, as inputs to create outputs and what related outcomes, i.e., effects, this may have. This is a firm-specific narrative that could provide value relevant information for investors.

Perhaps the most important principle of an integrated report is the connectivity between financial and sustainability information, which could reduce the costs of processing this information relative to its separate presentation. Thus, integrated reports could increase both the availability and quality of firm-specific information. To the extent that integrated reporting improves firms' information environments by facilitating the flow of firm-specific information to investors at low cost, investors are likely to rely more on firm-specific information than on common information when assessing firm value. This leads to hypothesis H1, which is stated in the alternative:

H1. Higher integrated report quality is associated with lower stock price synchronicity.

Despite our prediction in H1, it is possible that IRQ and synchronicity are not negatively related. Ye et al. (2021) explain that when a firm is similar to its industry peers, synchronicity is high and there is little firm-specific information the firm has to disclose. Thus, even though a firm may have higher IRQ, the firm is unable to use the integrated report to differentiate the firm from its peers and, consequently, the firm's higher IRQ would not be associated with lower synchronicity. In addition, to the extent that a firm uses disclosures by its industry peers to inform its decision-making, the firm and the industry peers become more similar. This, too, limits firms' ability to provide firm-specific information. For example, Bernard et al. (2020, p. 760) explain that peer firms' public disclosures inform investment and product decisions such as acquisitions and product differentiation strategies. This process can result in the firms becoming more similar over time, which would result in firm-specific information becoming industry-level information.

Our second hypothesis relates to the effect of proprietary costs on the association between integrated report quality and stock price synchronicity. Disclosure outcomes reflect trade-offs between expected benefits and costs. Proprietary costs arise from a firm's loss of competitive position in the product market associated with disclosing proprietary information, e.g., company secrets (Graham, Harvey, & Rajgopal, 2005). Ryou et al. (2022) find that when product market competition is more intense, firms are less likely to issue standalone CSR reports and issue shorter reports. However, our interest is not in the direct relation between proprietary costs and the extent to which stock prices reflect firm-specific information. Rather, we are interested in how proprietary costs affect the association between integrated report quality and firm-specific information reflected in stock prices.[26]

[24] Inferences from mandatory settings are not subject to the same concerns about self-selection that stems from incentives for voluntary reporting. Exercising discretion in deciding to publish a report and how to implement mandatory reporting requirements are different. For example, the application of International Financial Reporting Standards (IFRS) is mandatory in many countries, yet firms have discretion in implementing the standards' requirements. The implications of firms exercising this discretion is the subject of many studies (see, e.g., Barth, Landsman, & Lang, 2008). A firm's integrated report quality reflects how it exercises discretion in implementing the requirements of integrated reporting.

[25] Hope et al. (2016) find that firms with higher proprietary costs provide less specific Form 10-K qualitative risk factor disclosures. Consistent with greater specificity, and thus potentially more firm-specific information, benefiting users of financial reports, the study also finds that when the disclosures are more specific, the market reaction to the Form 10-K filing is more positive and analysts are better able to assess a firm's fundamental risk.

[26] A firm's total information set could consist of value relevant proprietary and non-proprietary firm-specific information. Firms facing high proprietary costs could reveal less value relevant firm-specific information, regardless of whether the information is proprietary or non-proprietary, than firms facing low proprietary costs. This would result in a positive association between proprietary costs and synchronicity. Alternatively, firms facing high proprietary costs could reveal more value relevant non-proprietary information than firms facing low proprietary costs. This would result in a negative association between proprietary costs and synchronicity. Consequently, we do not have a prediction regarding the sign of the main effect of proprietary costs on synchronicity. Our interest is in the moderating effect of proprietary costs on the association between IRQ and synchronicity.

Integrated reports contain a broad set of financial and sustainability information that explains how the firm uses its various capitals to create value. From the onset of integrated reporting, preparers have raised concerns that complying with the Framework could result in revealing proprietary information that could harm a firm's competitive position (IIRC, 2013b). Consequently, the Framework exempts a firm from disclosing information in its integrated report if disclosure of the information would cause significant competitive harm (IIRC, 2013a). This exemption enables firms with high proprietary costs to issue high-quality integrated reports that comply with the Framework without disclosing "company secrets."[27]

Given that the objective of integrated reporting is to improve the understanding of how firms use the six capitals to create value by connecting financial and sustainability-related information, managers may be reluctant to reveal firm-specific information in the integrated report. This is because connecting firm-specific information to the six capitals, the business model, and value creation may make such information revealed within an integrated report more beneficial to competitors than the same information revealed outside the integrated report. That is, the integrated report can convert non-proprietary firm-specific information into proprietary firm-specific information.

Thus, the question we address is whether firms facing higher proprietary costs reveal less firm-specific information in the integrated report, thereby attenuating the relation between IRQ and synchronicity. This leads to hypothesis H2, which is stated in the alternative:

H2. The association between integrated report quality and stock price synchronicity is less negative for firms with higher proprietary costs.

However, there are reasons to believe that our prediction in H2 may not be borne out. As the cost of proprietary disclosure increases, firms could disclose non-proprietary information as a substitute for proprietary information to reduce information asymmetry for capital market participants, while not revealing competitive information to peer firms (Kim et al., 2021). For example, in the context of financial information, management forecasts is non-proprietary information that may be useful to investors because it helps them predict future cash flows, but may not be useful to competitors because it does not contain detailed product market information (e.g., customer lists, business plans, and formulas).

Firms facing high proprietary costs could follow a similar strategy in integrated reports. By substituting non-proprietary information for proprietary information in the integrated report, a firm could have high IRQ without weakening the relation between integrated report quality and stock price synchronicity. Kim et al. (2021) consider firms using non-proprietary management earnings forecasts and disclosures in Forms 10-K as disclosure substitutes for proprietary information. We consider this substitution in integrated reports, which contain a much broader set of information—financial and sustainability—that firms can use to manage the revelation of proprietary information.

4. Research Design

4.1. Estimation equations

To test H1, i.e., whether higher IRQ is associated with lower stock price synchronicity, we estimate equation (1):

$$\begin{aligned} Synch_{t+1} = \; & \alpha_0 + \alpha_1 IRQ\_TA_t + \alpha_2 Size_t + \alpha_3 II\_Net_t + \alpha_4 MTB_t + \alpha_5 Earn\_Vol_t + \\ & \alpha_6 Trade\_Vol_t + \alpha_7 LowAQ_t + \alpha_8 ReadPR_t + \alpha_9 CSR\_SA_t + \alpha_{10} Prime_t \\ & + \alpha_{11} MBeta1_{t+1} + \alpha_{12} MBeta2_{t+1} + \sum \alpha_j Year + \sum \alpha_k Ind + \varepsilon_{t+1} \end{aligned} \tag{1}$$

where *Synch* is stock price synchronicity (see Section 4.2), *IRQ_TA* is the integrated report quality score calculated using textual attributes of integrated reports (see Section 4.3), and the remaining variables are controls (see Section 4.4). We omit firm subscripts. Our coefficient of interest is α_1. If higher integrated report quality is associated with lower stock price synchronicity, i.e., more firm-specific information reflected in stock price, we expect α_1 is negative.

To take account of cross-sectional and time-series dependence in residuals from estimating equation (1), and equation (2) that follows, we cluster standard errors by firm and by year (Gow, Ormazabal, & Taylor, 2010).[28] Variable definitions are provided in Appendix 1. We winsorize variables, except indicators, *IRQ_TA*, and *LowAQ*, at the 1st and 99th percentiles of the distribution for each estimation pooled across years.

To test H2, i.e., whether proprietary costs attenuate the relation between IRQ and synchronicity, we estimate equation (2):

$$\begin{aligned} Synch_{t+1} = \; & \alpha_0 + \alpha_1 IRQ\_TA_t + \alpha_2 IRQ\_TA \times Prop_t + \alpha_3 Prop_t + \alpha_4 Size_t + \\ & \alpha_5 II\_Net_t + \alpha_6 MTB_t + \alpha_7 Earn\_Vol_t + \alpha_8 Trade\_Vol_t + \alpha_9 LowAQ_t + \\ & \alpha_{10} ReadPR_t + \alpha_{11} CSR\_SA_t + \alpha_{12} Prime_t + \alpha_{13} MBeta1_{t+1} + \\ & \alpha_{14} MBeta2_{t+1} + \sum \alpha_j Year + \sum \alpha_k Ind + \varepsilon_{t+1} \end{aligned} \tag{2}$$

[27] Although the Framework provides firms with high proprietary costs the opportunity to issue high-quality integrated reports without revealing proprietary information, in practice, it remains possible that proprietary costs could affect the quality of integrated reports. We address this further in Section 7.5.

[28] Although cluster-robust methods can over-reject a true null when the number of clusters is small, bootstrapping can overcome the small cluster concern (Cameron, Gelbach, & Miller, 2008). Thus, because we have only seven-time clusters, we double cluster standard errors based on bootstrapping of 10,000 iterations.

where *Prop* is one of two proprietary cost measures (see Section 4.5). Our coefficient of interest is α_2. If firms with higher proprietary costs reveal less firm-specific information in their integrated reports, we expect α_2 is positive, consistent with higher synchronicity.

4.2. Measure of synchronicity

Following an established literature, we use synchronicity as our measure of the proportion of firm-specific information reflected in a firm's stock price.[29] Stock prices reflect firm-specific, industry-level, and market-wide information (Piotroski & Roulstone, 2004; Roll, 1988). Thus, synchronicity typically is calculated based on the explanatory power of market and industry returns for firm returns.[30] Lower synchronicity indicates that firm-specific return variation represents a larger proportion of the firm's total return variation (Li, Rajgopal, & Venkatachalam, 2014).

In emerging markets, including industry returns in the market model is problematic because the economy is dominated by a few industries, which makes it difficult to distinguish between industry and market information (Chan & Hameed, 2006). This is the case in South Africa, where a few industries dominate the JSE.[31] Thus, we follow Chan and Hameed (2006) and calculate *Synch* based on equation (3), which we estimate by firm-year:

$$RET_w = \alpha_1 + \beta_1 MARET_w + \beta_2 MARET_{w-1} + \varepsilon_w \tag{3}$$

where *RET* is the firm's return, *MARET* is the market return, and *w* denotes week. The market return is the return on the JSE All-share Index (ALSI).[32] We winsorize returns at the 5th and 95th percentiles of the firm-year return distribution. Because the R^2 from equation (3) is bounded by zero and one, following Morck et al. (2000), we transform it into an unbounded continuous variable using equation (4):

$$Synch_{t+1} = \log\left(\frac{R^2}{1 - R^2}\right). \tag{4}$$

We estimate equation (3) for each firm-year with a minimum of 25 weekly observations from the day after the release of year *t*'s integrated report to the release date of year $t + 1$'s integrated report to ensure that the information contained in the integrated report is publicly available. Because this estimation window begins after the firm's report for year *t* is released, and to maintain consistency with prior synchronicity studies, we use $t + 1$ as the time subscript for the synchronicity measure in equation (4).

4.3. Measure of IRQ

To develop a measure of IRQ based on textual attributes, we first extract the texts of integrated reports from PDF files and perform preprocessing steps to clean the texts. We use the XPDF python library to extract raw text from PDF files. The extracted raw text of each integrated report comprises a series of text lines. We follow Lang and Stice-Lawrence (2015) and Miller (2010) and remove lines with fewer than 50 alphabetic characters and lines with fewer than 20 characters or 15 alphanumeric characters. These steps mainly remove lines consisting of numbers and page or section headings.

Next, we use the LINGUA::EN::SENTENCE Perl module to group the lines into sentences. We perform two procedures on the sentences. First, to remove tables, tabulated texts, and financial statements, we delete sentences with more than 50% non-alphabetic characters. Second, to remove paragraphs containing foreign language characters or symbols added by conversion error, we delete sentences with more than 20% non-alphanumeric characters.

Following prior accounting research on textual attributes of corporate disclosures (Dyer et al., 2017; Lang & Stice-Lawrence, 2015), we calculate our measure of IRQ based on seven textual attributes of integrated reports:

(1) *Length* is the number of words in the integrated report divided by 1000. All else equal, we expect longer integrated reports to contain more information and reflect higher IRQ.
(2) *Boilerplate* is the percentage of boilerplate words in the integrated report. This is calculated by dividing the number of boilerplate words by the total number of words. Following Lang and Stice-Lawrence (2015), boilerplate words are words contained in sentences that include at least one four-word phrase that is shared by at least 75 percent of all firms in a given financial year. Boilerplate language refers to standardized disclosures that are less informative and can create unnecessary information

[29] See, for example, Barth et al. (2018), Boubaker et al. (2014), Crawford et al. (2012), Durnev, Morck, Yeung, and Zarowin (2003), Ferreira and Laux (2007), Grewal et al. (2021), Hutton et al. (2009), Jin and Myers (2006), Kim and Shi (2012), Kim et al. (2021), and Piotroski and Roulstone (2004).

[30] Studies use the R^2 of the relation between a firm's returns and market and industry returns because it reflects the extent to which variation in the firm's returns is explained by industry and market returns. A higher R^2 implies higher synchronicity and lower firm-specific information reflected in the firm's stock price.

[31] Based on data obtained from the JSE, as of 31 December 2017, using the Industry Classification Benchmark (ICB) in effect on that date, 71.2% of the ordinary shares listed on the JSE main board relate to firms from only three industries, namely financials including real estate, industrials, and basic materials.

[32] The ALSI represents 99% of the market capitalization of ordinary securities listed on the JSE main board, subject to minimum free float and liquidity criteria. Shares are selected and weighted to ensure the index is investable (FTSE Russell, 2020).

processing costs for users (Dyer et al., 2017; Lang & Stice-Lawrence, 2015). All else equal, we expect integrated reports with a lower proportion of boilerplate words to indicate higher IRQ.

(3) *Fog* (readability) is the Gunning Fog Index. This index indicates the number of years of formal education required for a reader of average intelligence to comprehend the text at first reading. Therefore, we expect a higher index, which represents poorer readability, to indicate lower IRQ because investors may find less readable reports more difficult to process.

(4) *Hardinfo* is the number of informative numbers (dates and section numbers are excluded) in the report, scaled by the total number of words, and then multiplied by 1000. Numerical disclosure is considered informative, and such information is likely to be more objective and easier to verify.[33] Therefore, we expect a higher proportion of hard information to be indicative of higher IRQ.

(5) *Redundancy* is the percentage of redundant words in the integrated report. As in Dyer et al. (2017), redundant words are the number of words in sentences that are repeated verbatim elsewhere in the integrated report. Given the length of integrated reports, a higher proportion of redundant words is indicative of lower IRQ.

(6) *Specificity* is the number of words related to entity-specific information scaled by the total number of words, and then multiplied by 1000. As in Hope, Hu, and Lu (2016), we define entity-specific information as the number of words in the integrated report that the Stanford Named Entity Recognizer (NER) tool identifies as being specific. Hope et al. (2016) find that the specificity of risk factor disclosures is positively and significantly associated with both the market reaction to, and abnormal trading volume around, Form 10-K filings, which suggests that specificity is positively related to disclosure quality. Thus, we expect that greater *Specificity* is reflective of higher IRQ.

(7) *Stickiness* is the percentage of sticky words in the integrated report. Stickiness refers to how a firm's report varies from year to year. As in Dyer et al. (2017), we define sticky words as the number of words in sentences that include at least one 8-word phrase that is identical to a phrase used in the prior year's report. Prior studies document the impacts of disclosure modifications on stock prices (Brown & Tucker, 2011; Cohen, Malloy, & Nguyen, 2020), which suggests that disclosure modifications are informative. We expect greater stickiness to indicate lower IRQ.

IRQ_TA is a composite measure that we calculate based on the average score of the seven textual attributes. First, we convert the seven attributes into percentile ranks. For attributes that are expected to be positively related to IRQ (i.e., *Length*, *Hardinfo*, and *Specificity*), we calculate the percentile ranks as (firm rank – 1)/(number of firms – 1). A higher percentile rank indicates higher IRQ. Conversely, for attributes that are expected to be negatively related to IRQ (i.e., *Boilerplate*, *Fog*, *Redundancy*, and *Stickiness*), we calculate the percentile ranks as 1 – [(firm rank – 1)/(number of firms – 1)]. A higher percentile rank indicates a lower raw value and higher IRQ. *IRQ_TA* is the average percentile rank of the seven attributes. *IRQ_TA* ranges from zero to one and increases in integrated report quality.[34]

4.4. Control variables

Based on prior literature, we include variables in equations (1) and (2) as controls for other factors that may be correlated with synchronicity or IRQ. *Size*, firm size, is the logarithm of end-of-year total assets. We include *Size* as a control for a firm's information environment, a firm's effect on market returns, and omitted firm characteristics (Chan & Hameed, 2006; Piotroski & Roulstone, 2004). *II_Net*, net long-term institutional investors, is the difference between the percentages of shares held by long-term and short-term oriented institutional investors. We include *II_Net* because long-term oriented institutional investors have greater access to internal, firm-specific information and are attracted to firms issuing integrated reports (Piotroski & Roulstone, 2004; Serafeim, 2015). Following Crawford, Roulstone, and So (2012) and Grewal et al. (2021), we also include *MTB*, the market-to-book ratio.

Earn_Vol, earnings volatility, is the standard deviation of the ratio of income before extraordinary items to total assets from years t – 4 to t. We include *Earn_Vol* because performance of firms with volatile earnings is less likely to reflect market-wide factors (Piotroski & Roulstone, 2004). *Trade_Vol*, trading volume, is the logarithm of the firm's annual shares traded. We include *Trade_Vol* because illiquidity hinders stock prices from changing when market-wide information changes (Gassen, Skaife, & Veenman, 2020) and prices of actively traded shares react rapidly and more synchronously than inactively traded shares (Chan & Hameed, 2006).

Following Barth et al. (2017), we include *LowAQ*, *ReadPR*, *CSR_SA*, and *Prime*. *LowAQ*, low accounting quality, is the percentage over the prior four years of small earnings surprises, which are differences from 0 to 0.01 between net income in years t and t – 1, scaled by end-of-year t – 2 total assets. To construct *LowAQ*, we require at least three earnings surprises. We include *LowAQ* because liquidity is negatively associated with earnings management (Lang, Lins, & Maffett, 2012) and as a control for the quality of financial information included in the report. *ReadPR* is the Gunning Fog Index of the firm's press releases made during the year on the JSE Stock Exchange News Service (SENS), multiplied by minus one to be increasing in readability. We include *ReadPR* because it is a measure of disclosure quality separate from IRQ. *CSR_SA* is an indicator variable that equals one if a firm issues a standalone CSR report, and zero otherwise. We include *CSR_SA* as a control for sustainability information available in another firm-issued standalone report.[35] *Prime* is

[33] Several recent studies have documented benefits of numerical disclosures, including decrease in information asymmetry, stronger market reaction, higher institutional ownership, and lower likelihood that the firms would receive comment letters from regulators (Ahn, Hoitash, & Hoitash, 2022; Campbell, Zheng, & Zhou, 2021; Siano, 2020; Steffen, 2022).

[34] Appendix A provides evidence on the association between *IRQ_TA* and the IRQ measure in Barth et al. (2017), which is based on expert opinions.

[35] CSR reports are voluntary as to issuance and content. Typically, they include sustainability information relating to environmental and social factors, which closely correspond to those captured by the term ESG.

an indicator variable that equals one for firms with a primary JSE listing, and zero otherwise. As Section 1 explains, only firms whose primary listing is the JSE are mandated to issue integrated reports. Thus, we include *Prime* as a control for differences between mandatory integrated report issuers and other firms.

MBeta1 and *MBeta2*, market betas, are the logarithms of the squared coefficients on $MARET_w$ and $MARET_{w-1}$ in equation (3). We use *MBeta1* and *MBeta2* at $t+1$ to be consistent with our use of *Synch* at $t+1$, which is based on the R^2 from equation (3). We include these variables because synchronicity could capture noise in returns, as well as firm-specific information. Li et al. (2014) show that the systematic risk reflected in synchronicity measures could bias inferences and recommends including betas as control variables when estimating cross-sectional synchronicity relations.[36]

Equations (1) and (2) also include year and industry fixed effects. We use Global Industry Classification Sectors (GICS) to define industries.[37]

4.5. Measures of proprietary costs

We employ two proprietary costs measures that primarily reflect product market competition. The first measure is the Herfindahl-Hirschman index (*HHI*). *HHI* is the sum of squared market shares of firms in the firm's industry, where industry is based on GICS and market share is a firm's sales divided by total industry sales. The second measure is the four-firm industry concentration ratio, which is the sum of the market shares of the four largest firms in the industry. Theory predicts that greater competition from existing rivals discourages voluntary disclosure (Clinch & Verrecchia, 1997).[38] Li (2010) shows that because firms in less concentrated industries and industries with larger firms typically face more competition, lower HHI and lower four-firm industry concentration ratios reflect greater competition among existing rivals. Thus, we multiply HHI and the four-firm concentration ratio by negative one so that higher values are associated with greater competition (Dhaliwal, Huang, Khurana, & Pereira, 2014; Li, 2010). *HHI* and *4Firm* are indicator variables that equal one when the inverse values of HHI and the four-firm concentration ratio are above the median of the full sample distribution, and zero otherwise. We require at least 10 observations within an industry-year to calculate *HHI* and *4Firm*.

5. Sample, data, and descriptive statistics

Our sample period is from 2011 to 2017. We begin in 2011 because integrated reporting became mandatory in South Africa for JSE primary listed firms in 2010 and the EY integrated reporting awards commenced in 2012 for 2011 reports. Our sample is based on the top 100 JSE firms by market capitalization for which EY evaluates integrated report quality annually.[39] We obtain integrated reports from firms' websites and remaining data from Compustat Global, Refinitiv Worldscope, and Refinitiv Datastream.

Table 1 details our sample. Panel A reveals that we have EY IRQ data for 141 (700) firms (firm-year observations). Incomplete data for our tests results in our sample comprising 125 (585) firms (firm-year observations). Panel B reveals the Materials and Financials GICS represent the largest proportions of observations, 21.71% and 20.34%. The sample we use to estimate equation (2) when *HHI* and *4Firm* are the proprietary cost measures comprises 534 firm-year observations because of additional data restrictions.

Table 2 presents descriptive statistics for the variables we use in our analyses. It reveals that mean (median) *Synch* is −1.85 (−1.67), which corresponds to an R^2 from equation (3) of 0.14 (0.16). Mean (median) *IRQ_TA* is 0.50 (0.50), which is consistent with *IRQ_TA* being a rank variable that ranges from zero to one. For the individual attribute of *IRQ_TA*, firms on average include 46,380 words (*Length*) in their annual integrated report, of which 10%, on average, relates to boilerplate phrases (*Boilerplate*). Based on the Gunning Fog Index, reading and understanding an average integrated report requires approximately 18 years of formal education (*Fog*). For every 1000 words, an average integrated report includes 140 informative numbers (*Hardinfo*) and 41 specific terms (*Specificity*). On average, 29% of words in sentences of an integrated report are repetitive phrases and 45% contain sticky phrases. Compared with Forms 10-K issued by U.S. firms (e.g., Table 1 in Dyer et al., 2017), our sample integrated reports are longer and more readable, and

[36] Following prior research described in Section 3.2, we interpret lower synchronicity as attributable to public availability of more firm-specific information. However, Xing and Anderson (2011) show that lower synchronicity could be attributable to private firm-specific information being incorporated into stock prices through informed trading for firms with poor information environments. This is unlikely to explain our results because our sample firms are the largest 100 firms listed on the JSE, which likely have strong information environments. In addition, we measure synchronicity over a year subsequent to the public release of the firm's integrated report, which is the firm's annual report to shareholders.

[37] GICS identifies eleven sectors: energy, materials, industrials, consumer discretionary, consumer staples, health care, financials, information technology (IT), communication services, utilities, and real estate. Because of small sample sizes, we combine energy and materials and we combine health care, IT, and communication services. We consider health care, IT, and communication services as technology firms. In South Africa, mining firms are classified as materials, and there are no utilities firms in our sample. Thus, we have seven industry groups.

[38] In contrast, theory predicts that competition from potential entrants encourages disclosure (Darrough & Stoughton, 1990). Capital intensity is often used as a measure of barriers of entry to a market (Cohen, 2008). Because this measure is not suitable for financial firms, which forms a large part of our sample, we do not include a proprietary cost measure related to competition from potential entrants.

[39] We use textual attributes of integrated reports to construct a proxy for IRQ. However, we require EY IRQ ratings for our sample firms to facilitate comparisons between our study and the related prior research based on those ratings. In addition, availability of those ratings enables us to externally validate our textual analysis based measures of IRQ. See Appendix A.

Table 1
Sample composition.

Panel A: Sample selection		
	Firms	Firm-years
EY observations	141	700
Firm-year observations with missing data	(16)	(115)
Sample	125	585
Panel B: Industry composition		
GICS sector	Firm-years	%
Energy	7	1.20
Materials	127	21.71
Industrials	52	8.89
Consumer (discretionary)	75	12.82
Consumer (staples)	86	14.70
Health care	29	4.96
Financials	119	20.34
Information technology	10	1.71
Communication services	21	3.59
Real estate	59	10.09
Sample	585	100.00

Table 1 presents a reconciliation of the sample between the EY data available to us and the sample of 585 firm-year observations for 125 firms from 2011 to 2017 that we use in our analyses. It also presents the industry composition of the final sample.

Table 2
Descriptive statistics.

	Mean	Q1	Median	Q3	Std. dev.
$Synch_{t+1}$	−1.85	−2.45	−1.67	−1.00	1.23
IRQ_TA	0.50	0.40	0.50	0.61	0.15
Boilerplate	0.10	0.07	0.09	0.13	0.04
Fog	17.60	17.21	17.66	18.11	0.81
Hardinfo	140.50	132.00	139.00	147.30	12.80
Length	46.38	31.31	40.71	55.69	22.79
Redundancy	0.29	0.17	0.28	0.40	0.15
Specificity	41.00	33.05	39.65	46.72	11.58
Stickiness	0.45	0.31	0.46	0.60	0.18
Size	10.47	9.55	10.29	11.08	1.18
II_Net	−34.27	−48.59	−33.63	−18.68	20.39
MTB	2.96	1.25	1.96	3.64	2.58
Earn_Vol	0.04	0.01	0.02	0.05	0.04
Trade_Vol	12.21	11.43	12.33	13.04	1.27
LowAQ	0.15	0.00	0.00	0.25	0.23
ReadPR	−18.98	−20.57	−19.16	−17.45	2.22
CSR_SA	0.40	0.00	0.00	1.00	0.49
Prime	0.88	1.00	1.00	1.00	0.32
$MBeta1_{t+1}$	−1.02	−1.68	−0.68	0.03	1.62
$MBeta2_{t+1}$	−3.97	−5.03	−3.60	−2.41	2.27
HHI	0.51	0.00	1.00	1.00	0.50
4Firm	0.49	0.00	0.00	1.00	0.50

Table 2 presents descriptive statistics for variables used in our analyses. See Appendix 1 for variable definitions. The sample includes 585 firm-year observations for 125 firms from 2011 to 2017.

contain fewer boilerplate phrases, fewer sticky phrases, and more hard information.[40] However, our sample reports include more redundant words and less specific information.

Mean (median) *II_Net* is −34.21 (−33.63), which suggests that institutional investors are, on average, short-term oriented. Mean (median) *ReadPR* is −18.98 (−19.16), which suggests that a reader needs approximately 19 years of formal education to understand the SENS announcements on first reading, similar to that of an integrated report. Table 2 also reveals that 88% of the observations relate to firms with a primary listing on the JSE and 40% relate to firms that issue a standalone CSR report. In addition, the means of *MBeta1* and *MBeta2*, –1.02 and −3.97, correspond to coefficients of 0.60 and 0.14 in equation (3) in unlogged terms.

[40] It is possible that the higher *Hardinfo* for integrated reports than for Forms 10-K partly may be attributable to different report formats. Dyer et al. (2017) extracts texts from formatted and labelled html files, whereas we extract texts from pdf files, which are unformatted. As a result, we may not accurately identify and remove all the time, dates, and sections numbers, which would result in a higher *Hardinfo*.

Table 3
Correlations of main variables in regressions.

Panel A: Correlations of main variables in regressions

	$Synch_{t+1}$	IRQ_TA	Size	II_Net	MTB	Earn_Vol	Trade_Vol	LowAQ	ReadPR	CSR_SA	Prime	$MBeta1_{t+1}$	$MBeta2_{t+1}$	HHI	4Firm
$Synch_{t+1}$		**0.08**	**0.46**	−0.00	**0.16**	**−0.12**	**0.26**	**0.11**	0.03	**0.20**	**−0.09**	**0.82**	**0.09**	−0.01	−0.02
IRQ_TA	0.06		**0.33**	**−0.21**	**−0.14**	**0.13**	**0.34**	0.00	**0.20**	**0.36**	**−0.11**	**0.18**	−0.02	**−0.11**	**−0.11**
Size	**0.39**	**0.32**		0.05	**0.17**	−0.04	**0.57**	**0.12**	**0.19**	**0.40**	**−0.29**	**0.43**	**−0.09**	−0.03	−0.04
II_Net	−0.02	**−0.20**	0.08		0.01	0.05	**−0.21**	0.03	−0.05	−0.02	−0.08	−0.00	0.03	**0.17**	**0.18**
MTB	**0.12**	**−0.09**	**0.13**	−0.03		**−0.27**	−0.07	**0.11**	0.07	**−0.09**	**0.22**	0.06	−0.03	**−0.17**	**−0.23**
Earn_Vol	**−0.11**	**0.13**	−0.04	**0.15**	**−0.19**		0.04	**−0.43**	**0.26**	0.06	**−0.21**	0.05	**0.09**	**−0.25**	**−0.23**
Trade_Vol	**0.27**	**0.34**	**0.53**	**−0.22**	−0.01	0.05		0.07	**0.16**	**0.25**	**−0.16**	**0.26**	−0.05	**0.10**	**0.09**
LowAQ	**0.15**	0.04	**0.17**	**0.08**	0.05	**−0.33**	**0.15**		**−0.11**	0.07	0.00	−0.00	−0.08	**0.18**	**0.22**
ReadPR	−0.02	**0.20**	**0.22**	−0.02	**0.20**	**0.21**	**0.15**	**−0.15**		0.04	**−0.39**	**0.10**	0.01	**−0.32**	**−0.31**
CSR_SA	**0.19**	**0.35**	**0.41**	−0.02	**−0.10**	**0.09**	**0.25**	**0.09**	0.02		**−0.22**	**0.27**	0.04	**−0.19**	**−0.20**
Prime	−0.06	**−0.10**	**−0.38**	**−0.09**	**0.13**	**−0.20**	**−0.16**	0.03	**−0.38**	**−0.22**		−0.06	0.01	−0.01	0.00
$MBeta1_{t+1}$	**0.83**	**0.19**	**0.36**	−0.05	0.03	0.06	**0.29**	0.05	0.08	**0.24**	−0.04		**0.12**	**−0.17**	**−0.18**
$MBeta2_{t+1}$	**0.14**	−0.03	−0.06	0.05	0.01	0.02	**−0.09**	−0.07	0.00	0.03	0.02	**0.09**		**−0.15**	**−0.13**
HHI	0.00	**−0.12**	−0.07	**0.16**	**−0.21**	**−0.21**	**0.10**	**0.24**	**−0.31**	**−0.19**	**−0.01**	**−0.14**	**−0.14**		**0.93**
4Firm	−0.01	**−0.11**	**−0.09**	**0.17**	**−0.27**	**−0.19**	**0.09**	**0.28**	**−0.32**	**−0.20**	0.00	**−0.15**	**−0.13**	**0.93**	

Panel B: Correlations of textual attributes

	Boilerplate	Fog	Hardinfo	Length	Redundancy	Specificity	Stickiness
Boilerplate		**0.31**	**−0.28**	**0.10**	**0.38**	−0.01	**0.44**
Fog	**0.32**		**−0.20**	**0.32**	**0.34**	0.04	**0.31**
Hardinfo	**−0.28**	**−0.36**		**−0.09**	**−0.28**	**0.15**	**−0.24**
Length	0.07	**0.27**	−0.06		0.08	0.05	0.03
Redundancy	**0.35**	**0.36**	**−0.31**	0.04		0.02	**0.80**
Specificity	−0.02	0.07	0.06	0.05	0.06		−0.03
Stickiness	**0.41**	**0.33**	**−0.26**	−0.01	**0.79**	−0.01	

Table 3, Panel A, presents Pearson (Spearman) correlations above (below) the diagonal for all the variables used in our analyses. Table 3, Panel B, reports correlations of textual attributes. Correlations in Bold are significant at least at the 5 percent level, two-tailed. See Appendix 1 for variable definitions. The sample includes 585 firm-year observations for 125 firms from 2011 to 2017.

Table 3 presents Pearson (Spearman) univariate correlations between the variables above (below) the diagonal. Significant correlations are in bold font. Table 3 reveals that *Synch* is significantly positively correlated with *IRQ_TA*, *Size*, *MTB*, *Trade_Vol*, *LowAQ*, *CSR_SA*, *MBeta1*, and *MBeta2*, and significantly negatively correlated with *Earn_Vol* and *Prime*. The correlations between *Synch* and *II_Net* and *ReadPR* are insignificant. Regardless, we base our inferences on multivariate analyses.

6. Main findings

6.1. Integrated report quality and synchronicity

Table 4 presents summary statistics from estimating equation (1). As predicted in hypothesis H1, the findings reveal that firms with higher IRQ have lower synchronicity. In particular, the *IRQ_TA* coefficient is significantly negative (*t*-stat. = −1.98). In terms of economic significance, the *IRQ_TA* coefficient of −0.4651 reveals that a one standard deviation higher *IRQ_TA* is associated with 0.07 lower *Synch* (−0.4651 × 0.15 from Table 2), which is 5.7% of the *Synch* standard deviation (−0.07/1.23 from Table 2). Stated differently, the *IRQ_TA* coefficient reveals that *Synch* of the highest integrated report quality firm is 0.4651 less than *Synch* of the lowest integrated report quality firm, which is 27.9% (0.4651/1.67 from Table 2) lower than the median *Synch*.

Regarding the control variables, Table 4 reveals that the *Size* coefficient is significantly positive, which suggests that larger firms have higher synchronicity, which is consistent with their greater influence on market returns. The *Earn_Vol* coefficient is significantly negative, which, as expected, indicates that stock prices of firms with more volatile earnings have lower synchronicity. In addition, consistent with Li et al. (2014), the *MBeta1* and *MBeta2* coefficients are significantly positive, which underscores the importance of including controls for systematic risk. The other control variable coefficients are not significantly different from zero.[41]

6.2. Integrated report quality and proprietary costs

Table 5 presents summary statistics from estimating equation (2) for each proprietary cost measure. The table reveals, consistent with the findings in Table 4, that the *IRQ_TA* coefficient is significantly negative in both estimations. The table also reveals that the *Prop* coefficients are negative and significant for both proprietary cost measures, *HHI* and *4Firm* (*t*-stats. = −2.44 and −2.33). These findings suggest that firms facing high proprietary costs have more firm-specific information reflected in share prices than firms with low proprietary costs (see footnote 26).

More importantly for our research question, Table 5 reveals that the *IRQ_TA* × *Prop* coefficients are significantly positive for *HHI* and *4Firm* (*t*-stats. = 3.57 and 3.55). These findings indicate that the association between IRQ and synchronicity is less negative for firms with higher proprietary costs associated with product market competition. In addition, Table 5 reveals that the sums of the *IRQ_TA* and *IRQ_TA* × *Prop* coefficients are insignificantly different from zero for *HHI* and *4Firm*. These findings indicate that for firms with higher proprietary costs associated with product market competition, IRQ is not associated with significantly lower synchronicity.

Taken together, these findings are consistent with firms with higher proprietary costs availing themselves of the Framework's exemption from providing proprietary information in their integrated reports or exercising their discretion to avoid revealing information with high proprietary costs. Regardless, the findings support the prediction in hypothesis H2 that the relation between integrated report quality and synchronicity is less negative for firms with higher proprietary costs.[42,43]

[41] To test the effect of peers on our inferences relating to H1, we construct a variable, strategic similarity (*Similar*), that captures high (*Similar* = 1) or low (*Similar* = 0) degree of strategic similarity within an industry. Following Ye et al. (2021), we base this variable on firms' realised resource allocation in the dimensions of research and development intensity, plant and equipment, nonproduction overheads, inventory levels, and financial leverage. A higher *Similar* suggests that firms in the industry share a more similar strategy, and hence firm-specific information, which tends to become industry-level information over time, thereby reducing the information's association with synchronicity. Untabluated findings reveal that the coefficient on *IRQ_TA* × *Similar* is positive and marginally significant (*t*-stat. = 2.32), which supports this line of reasoning.

[42] Untabulated findings reveal that the inferences we draw from Tables 4 and 5 are unaffected by using daily returns instead of weekly returns and including board of director quality as a control for corporate governance. Higher quality boards can improve the transparency of disclosures, which in turn results in more firm-specific information reflected in share prices. We measure the board of director quality based on the mean of four characteristics, namely independence, expertise, size, and activity. Each characteristic is coded as a binary variable. Independence: a firm is coded as 1 if the percentage of independent non-executive board members is above the sample mean, and zero otherwise. Expertise: a firm is coded as one if the percentage board members with accounting and/or financial qualifications ranges between 40% and 60%, and zero otherwise. Size: A firm is coded as 1 if the number of directors on the board is below the sample mean, and zero otherwise. Activity: the activity variable accounts for two factors: (1) the frequency of the board meetings and (2) the attendance of of meetings. A firm is coded as one if the number of board meetings held is above the sample mean, and zero otherwise. In addition, a firm is coded as one if the meeting attendance is above the sample mean, and zero otherwise. The final activity variable is the average between these two binary variables. Our inferences in Table 5 are unaffected by including the number of product segments or geographic segments if product segments are not available (Lee & Yeo, 2016) as a control for firm complexity.

[43] It is possible that in highly competitive industries, the information within the industry is already widely accessible, diminishing the significance of firm-specific information. Such a possibility predicts a positive association between *Prop* and *Synch*. In addition, such a possibility predicts an insignificant coefficient on the interaction between *IRQ* and *Prop* because the ability of managers to reveal or conceal firm-specific information in the integrated report is restricted given that the information is already widely accessible. Our results do not support this explanation.

Table 4
Integrated report textual quality and synchronicity.

Variable	Pred.	(1) Baseline	(2) no FEs	(3) Ind FEs	(4) Year FEs
IRQ_TA	–	−0.4651**	−0.6958***	−0.6116***	−0.6006**
		(−1.98)	(−2.48)	(−2.97)	(−1.88)
Size		0.1350***	0.1134**	0.1243**	0.1209**
		(2.91)	(2.14)	(2.45)	(2.46)
II_Net		−0.0010	0.0003	−0.0009	0.0004
		(−0.56)	(0.21)	(−0.48)	(0.23)
MTB		0.0264	0.0368**	0.0344*	0.0308*
		(1.58)	(2.12)	(1.91)	(1.75)
Earn_Vol		−2.2425*	−3.3499***	−2.4005*	−3.3412***
		(−1.71)	(−2.64)	(−1.79)	(−2.60)
Trade_Vol		−0.0056	0.0219	−0.0126	0.0320
		(−0.15)	(0.61)	(−0.34)	(0.89)
LowAQ		0.2407	0.2648	0.1899	0.3083
		(1.14)	(1.21)	(0.92)	(1.41)
ReadPR		−0.0297	−0.0545*	−0.0368	−0.0492
		(−1.12)	(−1.80)	(−1.45)	(−1.58)
CSR_SA		−0.0015	−0.0677	0.0083	−0.0773
		(−0.03)	(−1.08)	(0.16)	(−1.21)
Prime		−0.1223	−0.2513	−0.1443	−0.2467
		(−0.76)	(−1.55)	(−0.89)	(−1.50)
$MBeta1_{t+1}$		0.6366***	0.6075***	0.6357***	0.6028***
		(16.59)	(17.85)	(15.58)	(18.53)
$MBeta2_{t+1}$		0.0535***	0.0441***	0.0530***	0.0440***
		(4.50)	(2.91)	(4.41)	(3.06)
Adjusted R^2		0.775	0.744	0.759	0.757
Industry FE		Y	N	Y	N
Year FE		Y	N	N	Y
N		585	585	585	585

Table 4 presents regression results for equation (1) with *t*-statistics in parentheses. The dependent variable is $Synch_{t+1}$. See Appendix 1 for variable definitions. Standard errors are clustered by firm and by year based on bootstrapping methods using 10,000 iterations. *, **, and *** denote significance at a 10%, 5%, and 1% level based on a two-tailed test, except for *IRQ_TA*, which is based on a one-tailed test. The sample comprises 585 firm-year observations for 125 firms from 2011 to 2017.

7. Additional analyses

In this section we provide insights into whether our main findings apply to the entire integrated report or only to particular textual attributes, report categories, capitals, and type of information, i.e., financial versus sustainability. We also assess whether IRQ mediates the relation between proprietary costs and synchronicity.

7.1. Factor analysis of textual attributes

Our Tables 4 and 5 findings reveal a significant negative relation between IRQ and synchronicity using *IRQ_TA*, our composite measure that considers simultaneously the seven textual attributes using equal weights. To determine which attributes contribute more or less to this relation, we employ factor analysis to summarize the main variation in textual attributes. We use Stata's factor command with the pcf option to perform this analysis. Our data reveal a Kaiser-Meyer-Olkin measure of 0.67, which indicates that the data are adequate for factor analysis.

Table 6 presents the findings. Panel A presents the eigenvalues and variation explained by the factors. Among the seven factors generated from the analysis, there are three with eigenvalues greater than one, which is the criterion for determining a factor's validity. Separately, the three factors explain 36.7%, 16.6%, and 14.6% of the total variation in the textual attributes. Together, they account for 67.9%.

Panel B presents the factor loadings of the three factors, excluding those less than 0.3 (Kline, 1993). The first factor has positive loadings on *Boilerplate*, *Fog*, *Redundancy*, and *Stickiness*, and a negative loading on *Hardinfo*. This factor may reflect the management's strategy to confuse investors by presenting more standardized, complicated, repetitive, and imprecise information, which increases investors' information processing costs. Thus, we interpret Factor 1 as the obfuscation component of IRQ and expect it to be negatively related to IRQ. We label this factor *Opaque* and predict that it is positively associated with stock price synchronicity because opaque reports are likely to include less value relevant firm-specific information.

Factor 2 has positive loadings on *Fog*, *Length*, and *Specificity*, and a negative loading on *Stickiness*. Longer reports contain more information, highly specific reports contain more entity-specific information, and less sticky reports contain new information compared to prior period reports. The direction of loadings of *Length*, *Specificity*, and *Stickiness* are all consistent with higher IRQ.

Table 5
Integrated report textual quality, proprietary costs, and synchronicity.

		(1)	(2)
Variable	Pred.	*Prop=HHI*	*Prop=4Firm*
IRQ_TA	–	−1.6030***	−1.5751***
		(−3.23)	(−3.23)
IRQ_TA×Prop	+	1.6085***	1.5649***
		(3.57)	(3.55)
Prop		−0.4894***	−0.4694***
		(−2.44)	(−2.33)
Size		0.1596***	0.1619***
		(3.44)	(3.42)
II_Net		−0.0007	−0.0006
		(−0.48)	(−0.43)
MTB		0.0258*	0.0296*
		(1.70)	(1.72)
Earn_Vol		−2.6397**	−2.7294**
		(−2.36)	(−2.30)
Trade_Vol		−0.0027	0.0004
		(−0.07)	(0.01)
LowAQ		0.1368	0.1004
		(0.64)	(0.43)
ReadPR		−0.0233	−0.0253
		(−0.87)	(−0.94)
CSR_SA		0.0095	0.0165
		(0.25)	(0.48)
Prime		−0.1410	−0.1506
		(−0.91)	(−0.98)
$MBeta1_{t+1}$		0.6042***	0.6028***
		(18.34)	(18.55)
$MBeta2_{t+1}$		0.0584***	0.0567***
		(4.02)	(3.98)
Adjusted R^2		0.776	0.775
Industry FE		Y	Y
Year FE		Y	Y
N		534	534
Wild-bootstrap *t*-statistic			
IRQ_TA + *IRQ_TA×Prop*		−0.20	−0.23

Table 5 presents regression results for equation (2) with *t*-statistics in parentheses. The dependent variable is $Synch_{t+1}$. The sample in columns (1) and (2) comprises 534 firm-year observations for 116 firms from 2011 to 2017. See Appendix 1 for variable definitions. Standard errors are clustered by firm and by year based on bootstrapping methods using 10,000 iterations. *, **, and *** denote significance at a 10%, 5%, and 1% level based on a two-tailed test, except for *IRQ_TA*, *IRQ_TA×Prop*, and their sum, which are based on a one-tailed test.

Although the literature often associates higher *Fog* with obfuscation, Bushee, Gow, and Taylor (2018) suggest that the use of complex language also is consistent with the disclosure of complex information. Given that Factor 2 encompasses *Fog* and other factors associated with high quality information, we interpret the role of *Fog* in Factor 2 consistent with information complexity. Overall, the directional loadings of the components of Factor 2 are consistent with high IRQ reflecting complex, but relevant information. We label this factor *Complex* and predict that it is negatively associated with stock price synchronicity because these reports are likely to include more value relevant firm-specific information.

Factor 3 has positive loadings on *Hardinfo* and *Specificity*. Because *Hardinfo* relates to numeric disclosures and *Specificity* relates to entity-specific words, both factors are expected to be related to more detailed reports. Therefore, we interpret Factor 3 as the detailedness of an integrated report and label it *Detail*. We predict that *Detail* is negatively associated with stock price synchronicity, because detailed reports are likely to include more value relevant firm-specific information.

Table 6, Panel C, presents the results. For H1, column (1) reveals that the coefficient on *Opaque* is positive and marginally significant (*t*-stat. = 1.47), and the coefficient on *Complex* is negative and significant (*t*-stat. = −2.33). The coefficient on *Detail* is not significant (*t*-stat. = 0.41). Consistent with our predictions, these results reveal that firms with more opaque integrated reports have higher synchronicity, and firms with more complex integrated reports have lower synchronicity. For H2, the coefficients on the interactions between the factors and proprietary costs in columns (2) and (3) are significantly negative (positive) for *Opaque* (*Complex*), but not significant for *Detail*. The findings suggest that high proprietary costs firms refrain from disclosing complex firm-specific proprietary information in their integrated reports. This, in turn, results in less opaque, i.e., more transparent, disclosure of firm-specific information.

Table 6
Integrated report textual attribute factors and synchronicity.

Panel A: Eigenvalues and variance explained by factors

Factor	Eigenvalue	Proportion	Cumulative
Factor1	2.57	36.7%	36.7%
Factor2	1.16	16.6%	53.3%
Factor3	1.02	14.6%	67.9%
Factor4	0.80	11.5%	79.4%
Factor5	0.69	9.9%	89.3%
Factor6	0.55	7.9%	97.2%
Factor7	0.20	2.9%	100.0%

Panel B: Factor loadings (|loadings| < 0.3 are blank)

Variable	*Opaque*	*Complex*	*Detail*
Boilerplate	0.65		
Fog	0.66	0.43	
Hardinfo	−0.57		0.35
Length		0.82	
Redundancy	0.83		
Specificity		0.35	0.87
Stickiness	0.82	−0.33	

Panel C: Regression of textual attribute factors and synchronicity

		(1)	(2)	(3)
Variable	Pred.	Baseline	*Prop = HHI*	*Prop = 4Firm*
Opaque	+	0.0548*	0.1847***	0.1837***
		(1.47)	(2.76)	(2.75)
Opaque×Prop	–		−0.1743***	−0.1739***
			(−2.76)	(−2.79)
Complex	–	−0.0717**	−0.1986***	−0.1956***
		(−2.33)	(−4.17)	(−4.27)
Complex×Prop	+		0.1718***	0.1681***
			(3.76)	(3.51)
Detail	–	0.0101	0.0086	0.0199
		(0.41)	(0.28)	(0.58)
Detail×Prop	+		0.0341	0.0212
			(0.74)	(0.43)
Prop			0.2816***	0.2762***
			(4.20)	(3.70)
Size		0.1329***	0.1643***	0.1627***
		(3.14)	(3.90)	(3.86)
II_Net		−0.0008	−0.0007	−0.0006
		(−0.45)	(−0.51)	(−0.43)
MTB		0.0234	0.0213	0.0241
		(1.42)	(1.47)	(1.46)
Earn_Vol		−2.3519*	−2.9319***	−2.9969***
		(−1.83)	(−2.72)	(−2.63)
Trade_Vol		−0.0032	−0.0100	−0.0072
		(−0.08)	(−0.26)	(−0.18)
LowAQ		0.2819	0.2008	0.1719
		(1.47)	(0.99)	(0.80)
ReadPR		−0.0310	−0.0238	−0.0258
		(−1.17)	(−0.89)	(−0.96)
CSR_SA		0.0045	0.0213	0.0277
		(0.08)	(0.47)	(0.63)
Prime		−0.1483	−0.1822	−0.1892
		(−0.87)	(−1.08)	(−1.14)
$MBeta1_{t+1}$		0.6321***	0.5967***	0.5958***
		(16.94)	(19.70)	(19.72)
$MBeta2_{t+1}$		0.0540***	0.0583***	0.0563***
		(4.44)	(4.12)	(4.12)
Adjusted R^2		0.777	0.780	0.779
Industry FE		Y	Y	Y
Year FE		Y	Y	Y
N		585	534	534

(*continued on next page*)

Table 6 (*continued*)

Panel C: Regression of textual attribute factors and synchronicity				
		(1)	(2)	(3)
Variable	Pred.	Baseline	*Prop = HHI*	*Prop = 4Firm*
Wild bootstrap *t*-statistic				
Opaque + Opaque×Prop			0.30	0.24
Complex + Complex×Prop			−0.74	−0.79
Detail + Detail×Prop			0.87	0.68

Table 6, Panel A, presents factor loadings for the first three factors based on the seven integrated report textual attributes from 585 reports for 125 firms from 2011 to 2017. Loadings with an absolute value less than 0.3 are left blank. The estimates are produced using Stata's factor command with the pcf option. Table 6, Panel B, shows eigenvalues and variation explained by the factors. Table 6, Panel C, presents regression results for equations (1) and (2) with *t*-statistics in parentheses. The dependent variable is $Synch_{t+1}$. The sample in column (1) (columns (2) and (3)) comprises 585 (534) firm-year observations for 125 (116) firms from 2011 to 2017. See Appendix 1 for variable definitions. Standard errors are clustered by firm and by year based on bootstrapping methods using 10,000 iterations. *, **, and *** denote significance at a 10%, 5%, and 1% level based on a two-tailed test, except for *Opaque*, *Complex*, and *Detail* and their related interactions with *Prop*, and their sum, which are based on a one-tailed test.

7.2. Integrated report categories

We next assess the extent to which disclosures related to different integrated report categories are associated with synchronicity in the same way. We use PhraseLDA (El-Kishky et al., 2014) to identify latent topics discussed in the integrated reports.[44] We manually group 100 PhraseLDA identified topics into integrated report categories. Based on this analysis, we identify three categories related to the Framework that are discussed in integrated reports with the greatest frequency: governance, performance, and risks and opportunities. We also identify a fourth category—other—that includes other Framework content elements that are discussed with less frequency.

Next, we calculate the textual attributes of each of the four categories based on the sentences identified by PhraseLDA. We then calculate disclosure scores for each category using the same method that is used to calculate *IRQ_TA* (see Section 4.3). To determine whether our findings are more pronounced for particular categories, we estimate four versions of equations (1) and (2) in which we replace *IRQ_TA* with the textual attributes score for each of the four integrated report categories.

Table 7 presents the results. For H1, column (1) reveals that coefficients on IRQ related to risks and opportunities, governance, and performance—*IRQ_Riskoppor*, *IRQ_Governance*, and *IRQ_Performance*—are significantly negative (*t*-stats. = −2.74, −1.79, and −1.86), and the coefficient on IRQ related to the other category—*IRQ_Other*—is insignificant (*t*-stat. = −1.02). In terms of the association between synchronicity and IRQ of specific categories, the coefficients reveal that risks and opportunities has the highest level of significance and magnitude, followed by governance and performance. For H2, columns(2) and (3) reveal that when *HHI* and *4Firm* are included in the equation the coefficients on IRQ are negative and significant for the three main categories as well as *IRQ_Other*, and all of the coefficients on the interactions between IRQ and *Prop* are positive and significant. These findings suggest that our main results in Tables 4 and 5 are not restricted to a particular integrated report disclosure category.

7.3. Capitals

To shed further light on the effect of financial and sustainability information disclosed in integrated reports on stock price synchronicity, we use the 100 topics generated from PhraseLDA described in Section 7.2 and identify the predominant integrated reporting capital addressed by each of the topics. If a topic addresses multiple capitals without one being predominant, we classify the topics as "multiple capitals." We calculate the textual attributes and disclosure scores of each of the seven capital categories based on the sentences identified by PhraseLDA using the same method that is used to calculate *IRQ_TA* (see Section 4.3). We estimate seven versions of equations (1) and (2) in which we replace *IRQ_TA* with the textual attributes score for each of the seven capital categories.

Table 8 presents the results. The results in column (1) for H1 reveal that coefficients for all capitals are negative, as we expect. The coefficients on human, intellectual, and social capital are significantly so (*t*-stats. range from −2.39 to −2.25), and that on multiple capitals is marginally significant (*t*-stat. = −1.34). The coefficients on financial, manufactured, and natural capital are not significant (*t*-stats. range from −1.23 to −0.41).

Columns (2) and (3) for H2 reveal that the *IRQ* main effect is negative for all capitals and significantly so (*t*-stats. range from −3.16 to −1.70), except for manufactured capital (*t*-stats. = −0.05 and −0.01). The coefficients on the interactions between *IRQ* and *Prop* are positive for all capitals, except for manufactured capital, which are insignificantly negative (*t*-stats. = −0.35 and −0.42). The interaction coefficients are significant for financial (*t*-stats. = 1.91 and 1.74) and human capitals (*t*-stats. = 1.98 and 1.89) and marginally significant for natural capital (*t*-stats. = 1.57 and 1.43). For intellectual capital, the coefficient is marginally significant when *4Firm* is the proprietary costs proxy (*t*-stat. = 1.31), but insignificant when the proxy is *HHI* (*t*-stat. = 1.07). Regarding multiple capitals, the coefficient on the interaction is positive and significant when *HHI* is the proxy for proprietary costs and marginally significant when *4Firm* is the proxy (*t*-stats. = 1.79 and 1.51). The coefficient on the interaction is insignificant for social capital (*t*-stats. = 0.83 and 0.61).

Overall, these findings are consistent with the results in Tables 4 and 5 and provide granular evidence related to each integrated reporting capital.

[44] Appendix A describes this process.

Table 7
Integrated report categories and synchronicity.

Variable	Pred.	(1) Baseline	(2) *Prop = HHI*	(3) *Prop = 4Firm*
IRQ_Riskoppor	–	−0.7778***	−1.8695***	−1.8239***
		(−2.74)	(−4.00)	(−4.03)
IRQ_Riskoppor×Prop	+		1.4626***	1.4166***
			(3.34)	(3.25)
Wild bootstrap *t*-statistic				
IRQ_Riskoppor + IRQ_Riskoppor×Prop			−1.35	−1.35
IRQ_Governance	–	−0.5692**	−1.6104***	−1.5557***
		(−1.79)	(−2.52)	(−2.52)
IRQ_Governance×Prop	+		1.4961***	1.4323***
			(2.80)	(2.67)
Wild bootstrap *t*-statistic				
IRQ_Governance + IRQ_Governance×Prop			−0.49	−0.56
IRQ_Performance	–	−0.4423**	−1.8285***	−1.7600***
		(−1.86)	(−3.42)	(−3.51)
IRQ_Performance×Prop	+		1.8822***	1.7915***
			(3.45)	(3.31)
Wild bootstrap *t*-statistic				
IRQ_Performance + IRQ_Performance×Prop			−0.17	−0.23
IRQ_Other	–	−0.2538	−1.1683***	−1.0533***
		(−1.02)	(−2.95)	(−2.76)
IRQ_Other×Prop	+		1.4810***	1.3019***
			(3.46)	(2.88)
Wild bootstrap *t*-statistic				
IRQ_Other + IRQ_Other×Prop			0.39	0.08

Table 7 presents regression results in which *IRQ_TA* is replaced in equations (1) and (2) by a measure of integrated report quality for each integrated report category, with *t*-statistics in parentheses. The dependent variable is $Synch_{t+1}$. The sample in column (1) (columns (2) and (3)) comprises 585 (534) firm-year observations for 125 (116) firms from 2011 to 2017. All versions include the control variables and industry and year fixed effects. See Appendix 1 for variable definitions. Standard errors are clustered by firm and by year based on bootstrapping methods using 10,000 iterations. *, **, and *** denote significance at a 10%, 5%, and 1% level based on a one-tailed test.

7.4. Financial versus sustainability information

One of the key aspects of integrated reporting is the combination of financial and sustainability information in an annual report. Thus, we assess whether the association between IRQ and synchronicity differs for financial and sustainability information. Based on the categories identified in Section 7.2, we calculate our IRQ measure using the approach outlined in Section 4.3 separately for financial disclosure (*IRQ_Fin*) based on the performance and IFRS categories, and for sustainability disclosure (*IRQ_Sust*) based on the governance and risks and opportunities categories.[45]

We do not include *IRQ_Fin* and *IRQ_Sust* in the analysis simultaneously because untabulated statistics reveal that they are highly correlated (corr. = 0.79). To test whether the association between IRQ and synchronicity differs for sustainability and financial information in integrated reports, we construct *IRQ_ratio*, which is *IRQ_Sust* divided by *IRQ_Fin*. We then estimate equation (1) including *IRQ_ratio* and *IRQ_TA* as a control for the overall quality of the firm's integrated report. A negative coefficient on *IRQ_ratio* means that synchronicity is lower for firms with higher quality sustainability information than financial information. In addition, we use the modified Gram-Schmidt procedure (Golub & Van Loan, 1996) to transform *IRQ_Fin* and *IRQ_Sust* into orthogonal variables, *IRQ_Fin_orth* and *IRQ_Sust_orth*, which we include together in equation (1).

Table 9 presents the results. Column (1) reveals that the coefficients on *IRQ_ratio* and *IRQ_TA* are both significantly negative (*t*-stats. = −2.02 and −2.65). These findings indicate that higher quality of sustainability information than financial information is associated with lower synchronicity, incremental to the quality of the integrated report in its entirety. This evidence is consistent with high quality sustainability information in integrated reports conveying value relevant firm-specific information. Column (2) reveals

[45] We do not include other in financial or sustainability because other includes several topics that are both financial and sustainability, and it only accounts for a small portion of integrated reports (on average, 5.43%). Untabulated tests in which we classify other into sustainability information reveal the same inferences as our tabulated findings. As we explain in Appendix A, the IFRS category includes sentences in integrated reports relating to financial statement disclosures.

Table 8
Integrated report capitals and synchronicity.

Variable	Pred.	(1) Baseline	(2) *Prop = HHI*	(3) *Prop = 4Firm*
IRQ_Financial	–	−0.3414	−1.3721***	−1.2902**
		(−1.23)	(−2.49)	(−2.32)
IRQ_Financial×Prop	+		1.3936**	1.2784**
			(1.91)	(1.74)
Wild bootstrap *t*-statistic				
IRQ_Financial + IRQ_Financial×Prop			−0.22	−0.35
IRQ_Manufactured	–	−0.1097	−0.0191	−0.0041
		(−0.44)	(−0.05)	(−0.01)
IRQ_Manufactured×Prop	+		−0.1837	−0.2094
			(−0.35)	(−0.42)
Wild bootstrap *t*-statistic				
IRQ_Manufactured + IRQ_Manufactured×Prop			−1.23	−1.21
IRQ_Human	–	−0.7307***	−1.4742***	−1.4511***
		(−2.36)	(−3.16)	(−3.05)
IRQ_Human×Prop	+		1.0664**	1.0572**
			(1.98)	(1.89)
Wild bootstrap *t*-statistic				
IRQ_Human + IRQ_Human×Prop			−1.66*	−1.59*
IRQ_Intellectual	–	−0.5799**	−1.1134***	−1.1867***
		(−2.25)	(−2.40)	(−2.61)
IRQ_Intellectual×Prop	+		0.8755	1.0316*
			(1.07)	(1.31)
Wild bootstrap *t*-statistic				
IRQ_Intellectual + IRQ_Intellectual×Prop			−0.95	−0.80
IRQ_Natural	–	−0.1339	−0.7806**	−0.7444**
		(−0.41)	(−1.72)	(−1.70)
IRQ_Natural×Prop	+		0.9015*	0.9098*
			(1.57)	(1.43)
Wild bootstrap *t*-statistic				
IRQ_Natural + IRQ_Natural×Prop			−0.72	−0.60
IRQ_Social	–	−0.4950***	−0.7496**	−0.6966**
		(−2.39)	(−1.96)	(−1.78)
IRQ_Social×Prop	+		0.4852	0.4073
			(0.83)	(0.61)
Wild bootstrap *t*-statistic				
IRQ_Social + IRQ_Social×Prop			−1.54*	−1.57**
IRQ_Multiple	–	−0.2978*	−0.8714**	−0.7871**
		(−1.34)	(−2.03)	(−1.75)
IRQ_Multiple ×Prop	+		1.0962**	0.9392*
			(1.79)	(1.51)
Wild bootstrap *t*-statistic				
IRQ_ Multiple + IRQ_ Multiple×Prop			−0.33	−0.49

Table 8 presents regression results in which *IRQ_TA* is replaced in equations (1) and (2) by a measure of integrated report quality for each integrated report capital, with *t*-statistics in parentheses. The dependent variable is $Synch_{t+1}$. The sample in column (1) (columns (2) and (3)) comprises 585 (534) firm-year observations for 125 (116) firms from 2011 to 2017. All versions include the control variables and industry and year fixed effects. See Appendix 1 for variable definitions. Standard errors are clustered by firm and by year based on bootstrapping methods using 10,000 iterations. *, **, and *** denote significance at a 10%, 5%, and 1% level based on a one-tailed test.

that the coefficients on *IRQ_Fin_orth* and *IRQ_Sust_orth* also are negative and that on *IRQ_Sust_orth* (*IRQ_Fin_orth*) is significantly (marginally significantly) so.

7.5. Proprietary costs: moderation versus mediation

H2 predicts that proprietary costs moderate the relation between IRQ and synchronicity and, thus, a positive relation between *Synch* and *IRQ_TA* × *Prop* in equation (2). Table 5 reveals evidence consistent with this prediction. Although we do not predict the relation between proprietary costs and synchronicity, IRQ could mediate the relation between proprietary costs and synchronicity, which would lead to the same prediction. We examine this possibility in this section. For the sake of brevity, we do not tabulate our findings.

We conduct a mediation test with *Prop* as the independent variable, *IRQ_TA* as the mediating variable, and *Synch* as the dependent variable. The test partitions the coefficient on *Prop* from a regression of *Synch* on *Prop*—the total coefficient, *c*—into its indirect and

Table 9
Integrated report financial information quality and synchronicity.

		(1)	(2)
Variable	Pred.	Ratio	Orthogonal
IRQ_ratio	–	−0.4869**	
		(−2.02)	
IRQ_TA	–	−0.2841***	
		(−2.65)	
IRQ_Fin_orth	–		−0.5317*
			(−1.55)
IRQ_Sust_orth	–		−1.4576***
			(−3.44)
Size		0.1309***	0.1258***
		(2.95)	(2.92)
II_Net		−0.0009	−0.0006
		(−0.50)	(−0.36)
MTB		0.0298*	0.0327*
		(1.76)	(1.87)
Earn_Vol		−2.2906*	−2.3805*
		(−1.76)	(−1.86)
Trade_Vol		0.0005	−0.0011
		(0.01)	(−0.03)
LowAQ		0.2365	0.2530
		(1.14)	(1.22)
ReadPR		−0.0314	−0.0275
		(−1.22)	(−1.06)
CSR_SA		−0.0052	−0.0061
		(−0.09)	(−0.10)
Prime		−0.1342	−0.1818
		(−0.84)	(−1.12)
$MBeta1_{t+1}$		0.6373***	0.6381***
		(17.01)	(17.08)
$MBeta2_{t+1}$		0.0542***	0.0525***
		(4.54)	(4.42)
Adjusted R^2		0.776	0.778
Industry FE		Y	Y
Year FE		Y	Y
N		585	585
F-statistic:			
IRQ_Fin_orth = *IRQ_Sust_orth*			1.8384*

Table 9 presents regression results from re-estimating equation (1) by adding *IRQ_ratio* in column (1), and replacing *IRQ_TA* with *IRQ_Fin_orth* and *IRQ_Sust_orth* in column (2), with *t*-statistics in parentheses. The dependent variable is $Synch_{t+1}$. The sample consists of 585 firm-year observations for 125 firms from 2011 to 2017. See Appendix A for variable definitions. Standard errors are clustered by firm and by year based on bootstrapping methods using 10,000 iterations. *, **, and *** denote significance at a 10%, 5%, and 1% level based on a two-tailed test, except for *IRQ_ratio*, *IRQ_TA*, *IRQ_Fin_orth,* and *IRQ_Sust_orth*, and the test of equality of coefficients, which are based on a one-tailed test.

direct components. The indirect component is estimated from two regressions. The first estimates the coefficient on *Prop*—the coefficient, *a*—from a regression of *IRQ_TA* on *Prop*. The second estimates the coefficient on *IRQ_TA*—the coefficient, *b*—from a regression of *Synch* on *IRQ_TA*. The coefficient on the indirect effect of *Prop* is $a \times b$, and the coefficient of the direct effect is $c - a \times b$. We use the Sobel-Goodman mediation test to determine the significance of the total, direct, and indirect coefficients on *Prop*.

Untabulated findings reveal that coefficient *a* is insignificant for both proxies of proprietary costs (*p*-vals. = 0.14 and 0.37).[46] Consistent with the main results in Table 4, the untabulated findings also reveal that for both proprietary cost proxies coefficient *b* is significant (*p*-vals. = 0.03). The findings also reveal that coefficient *c* is insignificant (*p*-vals. = 0.39 and 0.77). These findings reveal that the coefficients on both the direct and indirect effects of *Prop* are insignificant (*p*-vals. range from 0.22 to 0.68). Taken together, these findings alleviate concerns that firms with higher proprietary costs have lower quality integrated reports.

8. Sensitivity analyses

We include three sensitivity analyses in Appendix A. First, our main analyses on the level of synchronicity and integrated report quality could be affected by time-invariant correlated omitted variables. We estimate a changes specification in which we find that

[46] We use the same control variables that we include in equation (1).

positive changes in integrated report quality are associated with decreases in synchronicity. Second, we use the quality of the external assurance of integrated reports as an alternative proxy for IRQ. Although weaker, these results are consistent with our main analysis for H1 and H2. Third, we compute three alternative measures of proprietary costs related to growth opportunities and intangible assets: the market-to-book ratio, recognized intangible assets net of goodwill scaled by total assets, and whether the firm is a member of one of the seven Fama and French 48 industries in which the redaction of contract information in mandatory disclosures in the U.S. is most prevalent. Estimations of equation (2) that include interactions between each of these measures and *IRQ* reveal that none of the coefficients is significant. These findings indicate that in our context proprietary costs related to product market competition are more relevant than proprietary costs related to growth opportunities and intangible assets. We acknowledge that measuring proprietary costs is inherently difficult because of the complex nature of the underlying construct. Consequently, our inferences should be viewed with caution.

9. Conclusion

The questions we address are whether integrated report quality, IRQ, is negatively associated with stock price synchronicity, an inverse measure of firm-specific information, and to what extent the relation between IRQ and synchronicity is attenuated by proprietary costs. To address these questions, we use a machine-based textual analysis on four dimensions—textual attributes, topical content, capitals, and financial versus sustainability orientation—to measure different aspects of IRQ.

We find that a measure of IRQ based on seven textual attributes is negatively related to synchronicity, which is consistent with higher quality integrated reports containing more firm-specific information than lower quality integrated reports. We also find that higher disclosure quality relating to three common categories in integrated reports that can be directly linked to the Framework—governance, performance, and risks and opportunities—and higher disclosure quality relating to most integrated report capitals are associated with lower synchronicity. Further, we find sustainability information has an incrementally larger negative association with synchronicity than financial information. Finally, we find that proprietary costs associated with product market competition weaken the relation between IRQ and synchronicity. This finding suggests that integrated reports may not fulfill their potential when competitive concerns are high. Our results may be of interest to the International Sustainability Standards Board as it considers the role of the Framework in developing sustainability standards.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.bar.2024.101512.

Appendix 1. Variable definitions

Variable	Definition
Dependent variable:	
Synch	Natural logarithmic transformation of R^2, i.e., log ($R^2/(1-R^2)$), from estimation of equation (3): $RET_w = \alpha + \beta_1 MARET_w + \beta_2 MARET_{w-1} + \varepsilon_w$, which we estimate annually for each firm from the day after the release of year t's integrated report to the release date of year $t+1$'s integrated report. *RET* is the firm's weekly stock return adjusted for capital actions and reinvestment of dividends and *MARET* is the weekly market return for the JSE All-share Index. We require at least 25 weekly return observations.
Test variables:	
IRQ_TA	The mean percentile ranks of the following textual attributes of integrated reports: *Length*, *Boilerplate*, *Fog*, *Hardinfo*, *Redundancy*, *Specificity*, and *Stickiness*. For *Length*, *Hardinfo*, and *Specificity*, the percentile ranks are calculated as (firm rank − 1)/(number of firms − 1). For *Boilerplate*, *Fog*, *Redundancy*, and *Stickiness*, the percentile ranks are calculated as 1 − (firm rank − 1)/(number of firms − 1).
Opaque	The first factor generated from the factor analysis of the following textual attributes using Stata's factor command with pcf option: *Length*, *Boilerplate*, *Fog*, *Hardinfo*, *Redundancy*, *Specificity*, and *Stickiness*. This factor has positive loadings on *Boilerplate*, *Fog*, *Redundancy*, and *Stickiness*, and a negative loading on *Hardinfo*.
Complex	The second factor generated from the factor analysis of the following textual attributes using Stata's factor command with pcf option: *Length*, *Boilerplate*, *Fog*, *Hardinfo*, *Redundancy*, *Specificity*, and *Stickiness*. This factor has positive loadings on *Fog*, *Length*, and *Specificity*, and a negative loading on *Stickiness*.
Detail	The third factor generated from the factor analysis of the following textual attributes using Stata's factor command with pcf option: *Length*, *Boilerplate*, *Fog*, *Hardinfo*, *Redundancy*, *Specificity*, and *Stickiness*. This factor has positive loadings on *Hardinfo* and *Specificity*.
IRQ_Riskoppor	*IRQ_TA* of the risks and opportunities report category.
IRQ_Governance	*IRQ_TA* of the governance report category.
IRQ_Performance	*IRQ_TA* of the performance report category.
IRQ_Other	*IRQ_TA* of the other report category.
IRQ_Manufactured	*IRQ_TA* of the manufactured capital category.
IRQ_Human	*IRQ_TA* of the human capital category.
IRQ_Intellectual	*IRQ_TA* of the intellectual capital category.
IRQ_Social	*IRQ_TA* of the social capital category.
IRQ_Multiple	*IRQ_TA* of the multiple capitals category.
IRQ_Fin	The mean *IRQ_TA* scores of the performance and IFRS report categories.

(*continued on next page*)

(*continued*)

Variable	Definition
IRQ_Sust	The mean *IRQ_TA* scores of the governance and risks and opportunities report categories.
IRQ_ratio	The ratio is *IRQ_Sust/IRQ_Fin*.
IRQ_Fin_orth	*IRQ_Fin* transformed to a variable that is orthogonal to *IRQ_Sust* based on the modified Gram-Schmidt procedure.
IRQ_Sust_orth	*IRQ_Sust* transformed to a variable that is orthogonal to *IRQ_Fin* based on the modified Gram-Schmidt procedure.
Textual attributes variables:	
Length	The number of words in integrated reports divided by 1000.
Boilerplate	The number of boilerplate words scaled by the total number of words. Boilerplate words are words contained in sentences that include at least one four-word phrase that is shared by at least 75 percent of all firms in a given financial year.
Fog	Gunning Fog Index. The Fog Index indicates the number of years of formal education required for a reader of average intelligence to comprehend the text at first reading.
Hardinfo	The number of informative numbers (dates and section numbers are excluded) in the report, scaled by the total number of words, and then multiplied by 1000.
Redundancy	The number of redundant words scaled by the total number of words. Redundant words are the number of words in sentences that are repeated verbatim elsewhere in the integrated report.
Specificity	The number of words related to entity-specific information scaled by the total number of words, and then multiply by 1000. Entity-specific information is the number of words in the integrated report the Stanford Named Entity Recognizer (NER) tool identifies as being specific.
Stickiness	The number of sticky words scaled by the total number of words. Sticky words are the number of words in sentences that include at least one eight-word phrase that is identical to a phrase used in the prior year's report.
Proprietary cost variables:	
HHI	An indicator variable that equals one if the Herfindahl-Hirschman index (HHI) (multiplied by negative one) is above the median of the full sample distribution, and zero otherwise. For each year, HHI is the sum of squares of market shares in an industry, where the market share of a firm is its sales divided by the total sales of all firms in the industry. HHI is multiplied by negative one so that higher values indicate greater competition.
4Firm	An indicator variable that equals one if the four-firm concentration ratio (multiplied by negative one) is above the median of the full sample distribution, and zero otherwise. For each year, the four-firm concentration ratio is the sum of the market shares of the four largest firms in an industry, where the market share of a firm is its sales divided by the total sales of all firms in the industry. The four-firm concentration ratio is multiplied by negative one so that higher values indicate greater competition.
Control variables:	
CSR_SA	An indicator variable that equals one if a firm issued a standalone CSR report, and zero otherwise. We hand collect this data item from Corporate Register (www.corporateregister.com) and firms' websites.
Earn_Vol	Standard deviation of the ratio of income before extraordinary items to total assets from years $t-4$ to t.
ReadPR	Robert Gunning Fog index, multiplied by minus one, of the press releases a firm announced through the JSE Stock Exchange News Service (SENS) during the year, where the fog index is 0.4 x (average number of words per sentence + percentage of complex words). Complex words are those with two or more syllables.
II_Net	The difference between the percentage shares held by long-term orientated institutional owners and the percentage of shares held by short-term orientated institutional owners. Long-term institutional owners are banks and trusts, endowment funds, foundations, government agencies, insurance firms, pension funds, and sovereign wealth funds. Short-term institutional owners are hedge funds, investment advisors, and mutual funds.
LowAQ	Percentage over the prior four years of small earnings surprises, where a small surprise is a difference between 0 and 0.01 of net income in year t minus net income in year $t-1$, scaled by total assets at the end of year $t-2$. We require at least three earnings surprises.
MBeta1	Natural logarithm of the squared estimate of β_1 from equation (3) of the current week's market beta. Also, refer to the definition of *Synch* above.
MBeta2	Natural logarithm of the squared estimate of β_2 from equation (3) of the previous week's market beta. Also, refer to the definition of *Synch* above.
MTB	Equity market-to-book ratio calculated as the number of common shares outstanding multiplied by end-of-year stock price, divided by the book value of common shareholders' equity.
Prime	An indicator variable that equals one if a firm's primary listing is on the JSE, and zero otherwise.
Size	Natural logarithm of total assets at the end of the year.
Trade_Vol	Natural logarithm of the firm's annual shares traded.

Data availability

The authors do not have permission to share data.

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