Annual report readability and equity mispricing

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ABSTRACT

This study examines the association between annual report readability and equity mispricing. Consistent with low annual report readability impeding the efficient and accurate assimilation of information into stock prices, less readable annual reports are associated with greater equity mispricing. This association extends to both equity underpricing and equity overpricing. Cross-sectional analysis indicates that the association between less readable annual reports and equity underpricing is accentuated when individual investors' share ownership is high, whereas the association between less readable annual reports and equity overpricing is attenuated when more experienced financial analysts follow a firm. Overall, our findings contribute to the literature on readability and equity mispricing and serve to inform managers about the underlying consequences of issuing less readable annual reports and regulators about the need for additional projects that enhance the understandability of financial reporting.

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1. Introduction

Given that the fundamental role of annual reports is to provide users with information that allows them to make informed economic decisions, it is critical to consider not only the type of information that is communicated in these reports but also the effectiveness of such communication. Recent studies, however, raise concerns regarding the relevance of information in annual reports in the modern business environment (Balachandran and Mohanran, 2011; Lev and Gu, 2016) and provide evidence of increasingly longer (You and Zhang, 2009) and more complex (Li, 2008) annual reports. In addition, both regulators (Securities and Exchange Commission [SEC], 1998) and researchers (You and Zhang, 2009; Rennekamp, 2012; Lawrence, 2013) have called for improving the readability of these reports for investors.

Prior research demonstrates that low readability in a financial reporting context can affect the market valuation of firms by investors. In this regard, Bloomfield's (2002) incomplete revelation hypothesis (IRH), which assumes that the costs associated with extracting useful information from publicly available data prevent markets from revealing the meaning of such information fully, can explain this effect. Accordingly, less readable annual reports hinder investors' ability to process and assimilate information in an efficient, accurate manner (Hirshleifer and Teoh, 2003; Eppler and Mengis, 2004; Tan et al., 2014), contributing to greater uncertainty in equity valuation.

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Equity mispricing represents a deviation between a firm's intrinsic and market value partly caused by information asymmetry between management and investors (Healy and Palepu, 2001). It is critical to identify the factors that drive equity mispricing because of its negative stakeholder implications including the inefficient allocation of resources by investors (Healy and Palepu, 2001), the refusal of valuable investment opportunities by management (Myers and Majluf, 1984), damage to firm reputation (Chi and Gupta, 2009) and the outright destruction of firm value (Jensen, 2005). Therefore, in this study, we examine whether a firm's annual report readability is associated with the mispricing of its equity. Equity mispricing comprises either underpricing or overpricing,[1] each of which is driven by investor perceptions of a firm's value that diverge from its intrinsic value.

Using a sample from the United States of 10,867 firm-year observations for 1994–2016, we find that firms with less readable annual reports are associated with greater equity mispricing, which extends to both overpricing and underpricing. This finding indicates that the complexity associated with low annual report readability increases the information asymmetry between firm management and investors, thereby contributing to greater deviation between the firm's intrinsic and market value. To mitigate endogeneity concerns, we show that our results hold in a propensity score-matched sample and a changes model. Our results are also robust to alternative specifications of annual report readability and equity mispricing.

To provide a more extensive overview of the scenarios in which low annual report readability is associated with greater mispricing of equity, we also examine cross-sectional variations of the association. Specifically, we expect firm ownership structure and financial analyst experience to be associated with investors' ability to price a firm in line with its intrinsic value when the readability of its annual report is low.

Our cross-sectional analysis reveals the following. First, greater firm ownership by individual investors accentuates the association between low annual report readability and equity underpricing, which we attribute to individual investors' lack of both investment experience and access to private information (Hunton and McEwen, 1997; Fredrickson and Miller, 2004; Ke and Petroni, 2004). Second, experienced financial analysts following a firm attenuate the association between poor annual report readability and equity overpricing. We attribute this finding to informative analyst recommendations reducing investors' information disadvantage relative to firm management (Mikhail et al., 2003; Clement et al., 2007).

Overall, this study makes several contributions to the related literature. One such contribution is that it extends the literature on the capital market implications of annual report readability, including studies that examine investor responses to complex information. For example, You and Zhang (2009) find evidence of stock price drift during the 12-month period after annual report (i.e., 10-K) filings, with such investor underreaction stronger for firms with lengthier 10-K reports. Lee (2012) finds that more difficult-to-read quarterly (i.e., 10-Q) reports prolong both the price discovery process and the post-earnings announcement drift (PEAD), while Kim et al. (2019) show that less readable 10-K reports are associated with higher stock price crash risk. Notably, our study differs from these studies on several fronts. First, these studies focus on the ways in which financial reporting complexity influences the impounding of information into stock prices, whereas we investigate the role of financial reporting complexity in the deviation between a firm's intrinsic and market value. Even after information has been impounded into stock prices, the stock price does not necessarily reflect intrinsic value, with prior literature acknowledging that price diverges from value (see, e.g., Ali et al., 2003; Badertscher, 2011; Warr et al., 2012; Bonaimé et al., 2014) and that "price does not always perfectly reflect intrinsic value" (Lee et al., 1999, at 1694). Thus, although these studies examine how poor readability hinders the impounding of information into stock prices, they do not examine whether, and the extent to which, poor readability causes a deviation between a firm's market value and its intrinsic value. However, our study extends this stream of literature by directly examining whether mispricing arises when annual reports have poor readability.

Second, the aforementioned studies also assume that after a market correction necessitated by poor readability, regardless of whether the correction is in the form of a stock price drift or a stock price crash, the market value is closer to the intrinsic value than before the correction. Caution must be exercised in making this assumption. In support, prior studies consistently find that market-based metrics, such as the market-to-book ratio, are a weak measure of mispricing (Lee et al., 1999), given that these measures capture other effects, including growth options and debt overhang (Warr et al., 2012; Bonaimé et al., 2014). Further, Frankel and Lee (1998) report that an alternative measure, intrinsic firm value, measured using Ohlson's (1995) residual income model, explains more than 70% of the cross-sectional variation in stock prices, and that the price-to-intrinsic-value ratio, which captures the divergence between intrinsic and market firm value, is a strong predictor of one-year ahead cross-section of returns. Moreover, Ali et al. (2003) reveal that after controlling for risk factors, the price-to-intrinsic-value ratio continues to be a significant predictor of future returns. Given these findings, the price-to-intrinsic value ratio is a robust measure of mispricing, which warrants its use (or, for our purposes, its reciprocal, the intrinsic value-to-price ratio).

The second contribution of our study is to literature on the drivers of, and the solutions to mitigate, equity mispricing. Extant research identifies the information advantage of managers over investors (Healy and Palepu, 2001) and the ambiguity surrounding the valuation implications of newly released information (Nanda and Narayanan, 1999; Zhang, 2006) as drivers of misvaluation. Thus, propositions to mitigate mispricing include increased analyst following (Healy and Palepu, 2001), stronger corporate governance mechanisms (Becker-Blease and Irani, 2008), and higher-quality disclosures to provide investors with detailed, transparent information for equity valuation (Brown and Hillegeist, 2007). This study extends this literature by identifying low annual report readability as a factor associated with equity mispricing. Therefore, ensuring

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[1] The terms "underpricing" ("overpricing") and "undervaluation" ("overvaluation") are used interchangeably in this study.

information contained within annual reports is relevant and understandable to the average investor would serve to reduce the detrimental effects associated with equity mispricing.

The third contribution of our study is to literature on the relevance of annual reports. By indicating that the accuracy of investor valuation judgements is contingent on the readability of a firm's annual report, the results support the notion that annual reports provide information incremental to that contained in alternate firm-issued disclosures (You and Zhang, 2009; Brown and Tucker, 2011; Loughran and McDonald, 2011). In a broader sense, the findings contribute to the literature that asserts the continued relevance of accounting information to firm valuation in the modern business environment (Gassen and Schwedler, 2010; Davern et al., 2019) by establishing an association between the presentation and complexity of accounting information and investors' propensity for firm misvaluation.

The remainder of this paper is organised as follows. Section 2 reviews relevant literature and develops hypotheses. Section 3 details the sample and research design. Section 4 provides the results and discussion of all analyses undertaken. Last, Section 5 concludes the paper.

2. Literature review and hypothesis development

2.1. Readability in a financial reporting context

The concept of readability, defined by Dale and Chall (1948), is referred to by Tefki (1987, p. 262) as "the sum total (including interactions) of all the elements with a given piece of printed material that affects the success which a group of readers have with it." In terms of financial reporting, readability represents the words, sentences, and formatting of a document, which affects the ability of a firm's stakeholders to use it for informed economic decision-making (SEC, 1998). Regulatory initiatives, including the SEC's *Plain English Rule* (1998), aim to ensure financial documentation is made more understandable and relevant to the average investor through the replacement of legalese and jargon with "Plain English" (SEC, 1998).[2]

Notably, the IRH (Bloomfield, 2002) asserts that information that is costly to extract from publicly available data is less completely revealed in market prices. In a review of literature on disclosure processing costs,[3] Blankespoor et al. (2020) note that the awareness, acquisition, and integration of disclosures involve both explicit and opportunity costs, for the processing of a given disclosure consumes resources that could otherwise be allocated elsewhere.[4] Therefore, as per rational inattention theory (Sims, 2010), the inherent limitations on investors' processing capacity can result in their disregard of disclosures that are difficult or costly to process, leading such information to remain unpriced by the market. Investors' limited capacity for processing information pertains to both good and bad news. However, managerial actions to enhance the presentation and clarity of disclosures, such as improving the understandability of text and highlighting transitory items, may assist investors to process information, both good and bad, which is relevant to firm value (Riedl and Srinivasan, 2010; Curtis et al., 2014; Lundholm et al., 2014). To the extent that such information about a firm assists in understanding its intrinsic value, yet is unpriced by the market, a deviation between the firm's intrinsic and market value is likely.

Consistent with the IRH, the limited cognitive resources of financial statement users mean they are more likely to neglect aspects of critical information when it is less readable, which thereby constrains their ability to use such information for economic decision-making (Hirshleifer and Teoh, 2003). Eppler and Mengis (2004) attribute this response to the effects of "information overload" or the simple notion of receiving too much information to process accurately and efficiently. Through an experiment that manipulates the readability of financial disclosures based on the SEC's *Plain English Handbook* guidelines, Rennekamp (2012) finds that less readable financial disclosures elicit weaker reactions from investors and reduce perceptions of management's credibility. Further, Elliott et al. (2015) show that investors feel less comfortable evaluating a firm when its disclosures have poor readability and use abstract language to discuss performance.

Despite regulators' efforts to ensure publicly available information is understandable and useful to investors, recent literature provides evidence that annual report complexity (Li, 2008) and length (You and Zhang, 2009) is increasing. Prior research also provides evidence of the capital market implications of annual report readability. Specifically, less readable annual reports reduce both investment likelihood (Lawrence, 2013) and trading volume (Miller, 2010) by increasing the costliness of assimilating information in the short window surrounding the filing date. Further, poor readability reduces market efficiency in the form of a post-filing stock price drift (You and Zhang, 2009), a prolonged price discovery process (Lee, 2012), and the heightened risk of a stock price crash (Kim et al., 2019). Thus, the readability of firm-issued disclosures directly influences the capital market's ability to process information in an efficient, timely manner.

However, the capital market implications of low annual report readability may vary if investors' experience to identify, and their access to, relevant information also varies. Specifically, the findings of reduced trading volume (Miller, 2010), lower investment likelihood (Lawrence, 2013), and extended PEAD (Lee, 2012) associated with low annual report readability are found to be primarily driven by individual investors. This is due to their lack of experience and information access relative

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[2] Linguistic suggestions for enhancing readability provided by the SEC (1998) include (a) writing in the positive form, (b) the use of common vs. complex words, and (c) the use of active, rather than passive, voice. Formatting suggestions include the use of tables, clear headings, and appropriate line spacing to facilitate ease of processing.

[3] Blankespoor et al. (2020) define disclosure processing costs as the significant costs of monitoring for, acquiring, and analysing firm disclosures.

[4] Awareness occurs when investors become aware that a disclosure has been made; acquisition occurs when they have this information in a useable format; and integration occurs when they use this information to make trading decisions (Blankespoor et al., 2020).

to their professional counterparts, which makes them the primary beneficiaries of more readable annual reports. Consistent with this notion, Tan et al. (2014) demonstrate that investor sophistication mediates the effects of both the language sentiment and the readability of financial disclosures. In addition, Asay et al. (2017) find that when investors encounter less readable annual reports they incorporate outside information sources into their valuation decisions to a greater extent, of which institutional investors and financial analysts have greater access. Therefore, low annual report readability additionally serves to exacerbate the information advantage of institutional investors and financial analysts over individuals.

2.2. Equity mispricing

Equity mispricing is a direct consequence of variations in the perceptions of underlying firm value between investors and managers, assuming the market is semi-strong form efficient (Chi and Gupta, 2009). It is reflected in the deviation between a firm's market value and its intrinsic value, thereby causing its equity to be either undervalued or overvalued. These effects are primarily driven by a lack of financial transparency owing to investor access to relevant information being limited, or the information to which they do have access is of poor quality relative to that of firm insiders (Doukas et al., 2010).

In this regard, Healy and Palepu (2001) primarily attribute equity misvaluation to unresolved information asymmetry between managers and investors. The respective directional mispricing effects[5] are driven by the managerial and investor reactions to low financial transparency, serving to either deflate or inflate firm market value. In addition, Zhang (2006) proposes that equity underpricing is driven by investor underreactions to newly issued information when there is greater ambiguity about its implications for firm value. Such underreactions are especially apparent for firms with a high degree of information uncertainty, since scepticism surrounding newly released information leads to more conservative valuation decisions (Nanda and Narayanan, 1999). Conversely, Jensen (2005) attributes equity overvaluation to the expectations and incentives for managers to beat financial targets, ultimately leading to behaviours that mask the inherent uncertainty of their business. These behaviours can range from overinvestment through acquisitions and expansions, whereby the manager believes high stock valuations to be justified (Heaton, 2002), to income-increasing earnings management or outright financial fraud (Jensen, 2005). This is specifically illustrated by the corporate collapses of Enron and WorldCom, where the significant overvaluation of these companies led to the destruction of their core value (Jensen, 2005). Overall, the failure to disclose relevant, firm-specific information in a manner that allows investors to make informed economic decisions is a key determinant in both the overpricing and underpricing of equity.

Prior literature also provides evidence on ways that firms may correct the negative effects of equity misvaluation, many of which relate to enhanced information quality and availability. For instance, Becker-Blease and Irani (2008) indicate that strong corporate governance mechanisms can reduce the effects of mispricing by aligning the interests of managers and shareholders more closely. Moreover, Healy and Palepu (2001) argue that greater financial analyst following serves to identify and disseminate managers' superior information in order to enhance investors' understanding of fundamental firm value. Further, higher-quality disclosures, which are both transparent and credible, diminish the information asymmetry between investors and managers and, thus, serve to reduce the misvaluation of a firm's stock price (Brown and Hillegeist, 2007). The literature, therefore, indicates that both the nature of, and the means of communicating, publicly issued information can either contribute to or mitigate the asymmetry within a firm's information environment which, in turn, affects the mispricing of equity.

2.3. The role of annual report readability in facilitating equity mispricing

Overall, investors require high-quality information, which clearly conveys firm performance, managerial decision-making, and future cash flows, in order to price stocks accurately at their intrinsic value. Less readable annual reports[6] are inherently more difficult to interpret and process (Hirshleifer and Teoh, 2003; Eppler and Mengis, 2004), which reduces market efficiency (Bloomfield, 2002) and contributes to a less transparent information environment between investors and firm insiders (Healy and Palepu, 2001). As poor-quality disclosures serve as a key driver of information asymmetry (Brown and Hillegeist, 2007), the increased complexity associated with less readable annual reports is expected to result in a greater deviation between a firm's market and intrinsic value. This deviation is expected to extend to both the overpricing and the underpricing of equity on the basis that the presentation and clarity of information relevant to firm value is associated with investors' ability to process both good and bad news (Riedl and Srinivasan, 2010; Curtis et al., 2014; Lundholm et al., 2014). Thus, we posit the following hypothesis:

H1: Firms with less readable annual reports are associated with greater equity mispricing.

As it is hypothesised that low annual report readability is associated with both overpricing and underpricing of a firm's equity, it is necessary to understand the factors that may exacerbate and attenuate the directional mispricing effects. There-

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[5] The term "directional mispricing effects" used in this study refers to both equity overpricing and equity underpricing.

[6] Prior literature shows that although a significant amount of information would have already been disclosed to, and assimilated by, the public prior to the annual report release date, there is a stock price response to the public release of the annual report (You and Zhang, 2009; Brown and Tucker, 2011; Loughran and McDonald, 2011), thereby implying that the document remains relevant to equity valuation.

fore, in the subsequent sections, we will discuss firm-specific factors that likely exacerbate or attenuate the association between annual report readability and the overpricing and underpricing of a firm's equity.

2.4. The role of ownership structure in exacerbating equity underpricing and overpricing

A firm's equity can be undervalued by the market owing to ambiguity surrounding newly issued information (Zhang, 2006), which leads to greater investor scepticism and more conservative pricing (Nanda and Narayanan, 1999). Annual reports may have poor readability because of the inherent difficulty describing complex aspects of business operations (Lim et al., 2018) or poor performance, including losses and transitory income (Bloomfield, 2008). The consequences of low annual report readability include investor underreactions to relevant information (You and Zhang, 2009; Lee, 2012) and decreases in trading volume (Miller, 2010) and in perceptions of managerial credibility (Rennekamp, 2012), which ultimately contribute to equity underpricing.

Further, a firm's ownership structure can exacerbate equity underpricing through the disparity in experience and information between investors, such that non-professional investors are more susceptible than professional investors to the uncertainty surrounding ambiguous information. Non-professional investors assimilate information in an unstructured manner (Hunton and McEwen, 1997), perceive more prominent information, rightly or wrongly, as having greater valuation importance than less prominent information (Maines and McDaniel, 2000), and rely on simple, heuristic-based valuation models in their decision-making (Fredrickson and Miller, 2004). Further, they lack access to the private channels available to institutions and financial analysts, such as conference calls and private communications with firm management (Ke and Petroni, 2004). Consistent with institutional investors' access to precise, private pre-disclosure information, firms with a higher institutional holding experience a smaller market reaction following earnings releases (El-Gazzar, 1998). Therefore, when the information content of annual reports is presented in a complex manner, non-professional investors have less competence and capability to digest, interpret, and understand its equity valuation implications, resulting in conservative pricing (Nanda and Narayanan, 1999; Rennekamp, 2012).

It can be further argued that a high level of non-professional investor ownership may accentuate the association between low annual report readability and equity overpricing. Specifically, the lack of investment experience and information access of less financially literate investors elicits inflated valuation judgements when disclosure readability is low (Tan et al., 2014). Therefore, when annual reports are less readable, non-professional investors are less able than their experienced counterparts to distinguish relevant information from extraneous information presented in a positive light.

For the purposes of this study, and consistent with prior literature (Miller, 2010; Lee, 2012), non-professional investors are proxied by individuals as shareholders and professional investors are proxied by institutional shareholders. In sum, these arguments lead to the following hypothesis:

H2: Firms with less readable annual reports are associated with greater equity underpricing and overpricing when they have high levels of individual investor share ownership.

2.5. The role of experienced analysts in attenuating equity underpricing and overpricing

A firm's financial analyst following can mitigate equity underpricing by interpreting complex information to provide informative valuation recommendations to investors. The informativeness of analyst recommendations is derived from their investing expertise (Frankel et al., 2006) and access to private information, which "levels the playing field" between individual and institutional investors (Kimbrough, 2007). Experienced analysts have greater knowledge of the intricacies of a firm's operations (Clement, 1999), benefit from "learning by doing" (Mikhail et al., 1997), and have a reduced tendency to undertake herding behaviours relative to their less-experienced counterparts (Clement and Tse, 2005). Indeed, empirical evidence suggests that analyst experience is associated with greater forecast accuracy (Mikhail et al., 1997; Clement, 1999; Clement et al., 2007), a reduced likelihood of underreaction to earnings information (Mikhail et al., 2003), and a more comprehensive consideration of private information (Clement and Tse, 2005). As experienced financial analysts' comprehensive knowledge of firm operations reduces their reliance on publicly issued disclosures, they can provide accurate, unbiased forecasts of future cash flows despite low annual report readability. Further, individual investors faced with less readable annual reports are more likely to rely on outside information sources, including analyst reports, when making valuation judgements (Asay et al., 2017). Thus, experienced analysts help the market to assimilate complex information into stock prices, mitigating the effects of poor annual report readability on equity underpricing.

When experienced financial analysts follow a firm, they may also attenuate the association between low annual report readability and equity overpricing. Through their comprehensive understanding of a firm's operations and their access to private information, they can provide recommendations more reflective of intrinsic firm value. As external information sources, including analyst reports, are more heavily relied upon by investors when they face low annual report readability (Asay et al., 2017), experienced analysts help reduce the inflated investor perceptions of firm value.

From these arguments pertaining to underpricing and overpricing, we formulate the following hypothesis:

H3: Firms with less readable annual reports are associated with lower equity underpricing and overpricing when followed by experienced financial analysts.

3. Sample and methodology

3.1. Data and sample

The sample comprises firm-year observations from the United States for 1994–2016. All data used is publicly available. Financial data is collected from Compustat and returns data from the Centre for Research in Securities Prices (CRSP). Readability data is available from the website of Brian Miller, co-author of the Bog Index readability measure (Bonsall et al., 2017).[7] Firm ownership structure data is obtained from Thomson Reuters' 13F institutional holdings and financial analyst data from Institutional Brokers' Estimate System (I/B/E/S).

We start with 178,706 firm-year observations with Bog Index readability data between 1994 and 2016. Of this sample, 161,785 firm-year observations are excluded primarily due to missing cost of equity data required to calculate Ohlson's (1995) residual income model (RIM), the study's measure of intrinsic firm value used to determine equity mispricing. A further 6,054 firm-year observations are excluded due to missing data required to construct the study's control variables. This results in a final sample of 10,867 firm-year observations. Of this sample, 6,125 (4,742) firm-year observations are underpriced (overpriced) by the market using a value-to-price ratio (*VPRIM*) of greater (less) than 1 as the cut-off.

3.2. Measuring annual report readability

We employ Bonsall et al.'s (2017) Bog Index to measure annual report readability. The Bog Index was selected as the study's main measure of annual report readability as it captures more of the plain English attributes included in the SEC's *Plain English Handbook*[8] than the Fog Index, which uses only average sentence length and number of multi-syllable words to determine readability (Bonsall et al., 2017). Additionally, the Bog Index alleviates the primary criticism of the Fog Index in an accounting context - the use of syllable count to determine word complexity. As per Loughran and McDonald (2014), words such as "depreciation" and "liability" are denoted as complex by the Fog Index despite being readily understandable to the average investor. The Bog Index mitigates this issue by considering the familiarity and precision of a given word when determining its complexity. The Bog Index is computed as the sum of three multifaceted components:

$$BOG = Sentence\ Bog + Word\ Bog - Pep \tag{1}$$

Where *Sentence Bog* is equal to the average sentence length of the document. This value is then squared and scaled by a standard long sentence limit, which is equal to 35 words per sentence;

Word Bog is equal to the sum of two subcomponents. The first of these is the sum of plain English style problems[9] multiplied by 250 and divided by the total number of words contained in the document. The second subcomponent is the difficulty of general vocabulary (such as heavy words), abbreviations, and specialist terms used.[10] The difficulty of words is calculated based on a proprietary list of 200,000 words, whereby penalties between zero and four points[11] are assigned to words based on a combination of familiarity and precision; and

Pep is equal to the sum of writing attributes that facilitate the understanding of text by readers, including the use of names, interesting words and conversational expressions. This value is multiplied by 25 and scaled by the number of words in the document plus sentence variety.[12]

Overall, a higher (lower) value for *BOG* is indicative of a less (more) readable annual report.

3.3. Measuring equity mispricing

We use Ohlson's (1995) RIM to measure equity mispricing, which has been extensively used in prior studies to estimate equity misvaluation (Warr et al., 2012; Bonaimé et al., 2014). In particular, the RIM is chosen as the study's primary measure of equity mispricing as it is one of the most recognised and versatile firm valuation measures developed in the accounting literature (Frankel and Lee, 1998). The RIM has also received strong support from prior literature as an indicator of mispricing that effectively predicts future returns by filtering out growth or time-varying risk factors, making it superior to aggregate book-to-market ratios (Frankel and Lee, 1998; Lee et al., 1999; Ali et al., 2003; Rhodes-Kropf et al., 2005). The RIM is

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[7] The Bog Index data is publicly available for download at: https://kelley.iu.edu/bpm/activities/bogindex.html.

[8] As per Bonsall et al. (2017), the Bog Index specifically captures plain English attributes including sentence length, passive voice, weak verbs, overused words, complex words, and jargon.

[9] Plain English style problems are those issues highlighted by the SEC's *Plain English Handbook* (1998) and include abstract words, passive verbs, wordy phrases, and hidden words.

[10] As per Bonsall et al. (2017), heavy words include "proximal" and "postprandial". Abbreviations include LTIP (Long-Term Incentive Plan) and ESOP (Employee Stock Option Plan). Specialist terms include "ontology", "sublingual", and "syntactical".

[11] Abstract words receive higher scores (Bonsall et al., 2017).

[12] Sentence variety is equal to the standard deviation of sentence length, multiplied by ten, and scaled by the average sentence length of the document (Bonsall et al., 2017).

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estimated by adding discounted expected earnings in excess of the expected return on book value to the book value of equity. Following Bonaimé et al. (2014), firm valuation is calculated using the following equation:

$$V_{RIM} = B_0 + \sum_{t=1}^{n} \frac{E_t - r \times B_{t-1}}{(1+r)^t} + \frac{E_t - r \times B_{t-1} + E_{t+1} - r \times B_t}{2 \times r \times (1+r)^n} \tag{2}$$

Where $VRIM$ is the value of the firm's equity at time zero;
$B0$ is the book value of equity at time zero;

r is the cost of equity estimated following the approach of Gebhardt et al. (2001); and

Et is the expected future earnings for year t at time zero.

The intrinsic value of the firm's stock ($VRIM$) is then compared to its market value at time zero ($P0$) to identify any misvaluation, where $P0$ is measured three months after financial year-end to coincide with the point in time that U.S. firms generally release their annual reports. Thus, equity mispricing is calculated as follows:

$$VPRIM = VRIM/P0 \tag{3}$$

In the absence of mispricing, $VPRIM$ equals 1. As per Elliott et al. (2007) and Warr et al. (2012), a $VPRIM$ value greater than 1 indicates that the firm is undervalued by the market (EU) while a $VPRIM$ value less than 1 indicates that the firm is overvalued by the market (EO). To ascertain the degree of equity mispricing, $VPRIM$ is subtracted by 1 (i.e., $VPRIM - 1$). This serves to isolate the deviation between a firm's market value and its intrinsic value. We then take the absolute value of $VPRIM - 1$ so that our measure of mispricing (EM) captures the absolute deviation between market and intrinsic value.

3.5. Empirical Model: Test of H1

The following empirical model tests the association between annual report readability and equity mispricing:

$$EM = 0 + 1BOG + 2LAGE +$$
$$3LNBSEG + 4LNGSEG + 5LOSS +$$
$$6EARN + 7EARNVOL + 8BETA +$$
$$9SIZE + 10BM + 11IVOL + 12DE +$$
$$13ALTZ + 14ANFOL + 15IMPCC + \tag{4}$$
$$16AQMJ + 17LNNITEMS + 18SI +$$
$$19MA + 20SEO +$$
$$INDUSTRY\ FIXED\ EFFECTS +$$
$$YEAR\ FIXED\ EFFECTS + \varepsilon$$

Where the dependent variable, EM, represents equity mispricing measured using the RIM and BOG represents annual report readability measured using the Bog Index. Hypothesis 1 predicts a positive coefficient on BOG for equation (4), indicating that lower annual report readability is associated with greater equity mispricing.

This study controls for known determinants of annual report readability to address concerns of correlated omitted variable bias, as these factors may also be associated with equity mispricing (Li, 2008; Lo et al., 2017). Specifically, we control for firm age ($LAGE$), as younger firms are more difficult to accurately value due to their uncertainty, volatility, and underperformance (Brown et al., 2006). We control for the natural logarithm of the number of business ($LNBSEG$) and geographic ($LNGSEG$) segments, as more complex firms require a more comprehensive understanding of all segments in which they operate (Li, 2008; Bentley et al., 2013) for accurate valuation. We also control for firm-year losses ($LOSS$), as they can complicate investors' earnings-based valuation models, leading to pessimistic valuation in spite of potential future prospects (Darrough and Ye, 2007). Finally, we control for earnings ($EARN$), as poor performing firms are more likely to undertake behaviours that mask the uncertainty surrounding the viability of future earnings (Li, 2008; Lo et al., 2017; Kim et al., 2019), resulting in misvaluation.

Additionally, we control for a range of risk factors identified by prior literature (Frankel and Lee, 1998; Ali et al., 2003) as determinants of equity mispricing. In particular, we control for systematic risk ($BETA$), as firms with higher systematic risk exhibit greater stock price variability and an increased likelihood of misvaluation. Controlling for firm size ($SIZE$) captures differences in firms' information environments, as smaller firms are typically associated with greater risk, uncertainty, and less accurate pricing. We control for book-to-market ratio (BM), as a higher ratio indicates greater future returns and higher risk, implying a greater likelihood of equity mispricing. We control for idiosyncratic risk volatility ($IVOL$), as those firms exhibiting greater non-systematic risk are associated with larger stock price variability, assuming the market prices such risk. Controlling for debt-to-equity ratio (DE) captures the greater risk and stock price volatility associated with greater leverage. We control for Altman's Z-score ($ALTZ$), as firms with a higher risk of financial distress are more likely to experience capital market misvaluation due to the uncertainty surrounding their future cash flows (Altman, 1968). We control for analyst following ($ANFOL$), as it impacts the variation in the amount and quality of information available to investors when making valuation judgements. We also control for implied cost of capital ($IMPCC$), which captures omitted risk variables to the

extent that the market compensates shareholders for risks not captured by firm characteristics. Finally, to ensure that the primary association being investigated is different from the effect of financial reporting quality on equity mispricing, we control for accruals quality (*AQMJ*) as a proxy of earnings quality, as poor accruals quality contributes to an opaquer information environment between a firm's management and investors. Finally, we include industry and year fixed effects when estimating equation (4) to alleviate concerns that results are driven by observations in a given industry or year. All variables are defined further in Appendix A.

3.6. Empirical Model: Tests of H2 and H3

To test H2 and H3, the equity mispricing (*EM*) sample is partitioned into an equity underpricing (*EU*) subsample of firms with a *VPRIM* ratio greater than 1 (Elliott et al., 2007; Warr et al., 2012) and an equity overpricing (*EO*) subsample of firms with a *VPRIM* ratio less than 1. Upon limiting the subsample to underpriced (overpriced) firms, the degree of equity underpricing (overpricing) for each subsample, as denoted by *EU* (*EO*), is equal to the firm-year specific value of *EM*. As *EM* captures the absolute deviation between market and intrinsic value, and given we contend that as *BOG* increases (i.e., annual reports become less readable) the degree of equity underpricing and overpricing increases (i.e., the absolute deviation between market and intrinsic value increases), we expect a positive association between *BOG* and *EU* and *BOG* and *EO*, respectively.[13]

For each subsample, the following regression model is used to test the effect of firm-specific factors, namely ownership structure and financial analyst experience, on the association between annual report readability and equity under/overpricing:

$$
\begin{aligned}
EU/EO = {}& 0 + 1BOG + 2BOG * VOI + 3VOI + \\
& 4AGE + 5LNBSEG + 6LNGSEG + 7LOSS + \\
& 8EARN + 9EARNVOL + 10BETA + 11SIZE + \\
& 12BM + 13IVOL + 14DE + 15ALTZ + 16ANFOL + \\
& 17IMPCC + 18AQMJ + 19LNNITEMS + 20SI + \\
& 21MA + 22SEO + INDUSTRY\ FIXED\ EFFECTS + \\
& \qquad YEAR\ FIXED\ EFFECTS + \varepsilon
\end{aligned}
\tag{5}
$$

To test H2, equation (5) is estimated whereby *VOI* is substituted for *INDOWN*, an indicator variable equal to 1 if a firm's proportion of shares owned by individual investors[14] is above the industry-year median of the full sample, 0 otherwise (Hong et al., 2015). As individual investors lack investing experience (Fredrickson and Miller, 2004), directed information search strategies (Hunton and McEwen, 1997), and access to private information relevant to firm value (Ke and Petroni, 2004), it is expected to be more difficult for them to accurately value a firm when faced with less readable annual reports. Therefore, it is predicted that the *BOG * INDOWN* interaction variable will be positively associated with both *EU* and *EO*, indicating that high individual firm ownership accentuates the positive association between annual report readability and equity underpricing and overpricing, respectively.

To test H3, equation (5) is estimated whereby *VOI* is substituted for *ANEXP*, an indicator variable equal to 1 if the experience of financial analysts following a firm[15] is above the industry-year median of the full sample, 0 otherwise. Experienced analysts following a given firm have a better understanding of the intricacies of its operations and can ascertain future cash flows despite the readability of annual reports (Mikhail et al., 2003; Clement et al., 2007) than less experienced analysts. Further, investors faced with less readable annual reports rely more heavily on information from sources independent of the firm, including analyst reports (Asay et al., 2017). As greater experience is expected to facilitate the provision of informative analyst recommendations reflective of fundamental firm value, it is expected that the *BOG * ANEXP* interaction variable will be negatively associated with both *EU* and *EO*, indicating an attenuating role of analyst experience on the positive association between annual report readability and equity underpricing and overpricing, respectively.

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[13] To illustrate, assume Firms A, B, C and D have a *VPRIM* ratio of 1.2, 1.3, 0.8 and 0.9, respectively. To capture the deviation between market value and intrinsic value for each firm we subtract 1, giving rise to Firm A's deviation equalling 0.20, Firm B's deviation equalling 0.30, Firm C's deviation equalling −0.20 and Firm D's deviation equalling −0.10. We then take the absolute value of each deviation. Consequently, Firms A, B, C and D have an absolute deviation between market and intrinsic value of 0.20, 0.30, 0.20 and 0.10, respectively, which for our purposes represents *EM* for these four firms within our *EM* sample. The higher is *EM*, the more mispriced these firms are. When limiting the subsample to underpriced (overpriced) firms, only Firms A and B (Firms C and D) would be included in the subsample, as their *VPRIM* ratios are greater (less than) 1. For Firms A and B, equity underpricing (*EU*) is equal to 0.20 and 0.30, respectively, representing the absolute deviation between market and intrinsic value (i.e., the same values for Firms A and B, respectively, as the *EM* full sample). The higher the values of *EU*, the more underpriced these firms are. For Firms C and D, equity overpricing (*EO*) equals 0.20 and 0.10, respectively, being the absolute deviation between market and intrinsic value. The higher the values of *EO*, the more overpriced these firms are. As greater absolute deviation between market and intrinsic value indicates greater *EM*, *EU* and *EO*, we expect a positive association between *BOG* and *EM*, *EU* and *EO*, respectively.

[14] Individual firm ownership is measured as the percentage of a firm's outstanding shares not held by institutional investors.

[15] Financial analyst experience is measured as the median number of prior quarters in which a firm's financial analysts have issued quarterly earnings forecasts (Mikhail et al., 2003).

4. Empirical results and discussion

4.1. Descriptive statistics

Table 1 reports the descriptive statistics for all variables by mean, median, standard deviation, lower quartile and upper quartile. Panel A reports the descriptive statistics for the dependent and test variables. The mean (median) value of *EM* is 1.031 (0.692), while the mean (median) values of *EU* and *EO* are 1.381 (0.938) and 0.579 (0.516), respectively. The mean (median) value of *BOG* is 86.307 (86.000), which is higher than that reported by Bonsall et al. (2017).[16] One potential explanation for this is that large firms generally have more complex annual reports (Li, 2008). Accordingly, prior studies (e.g., Li, 2008; Hasan, 2020) document a positive relationship between firm size and lack of readability of 10-K reports. Our estimation of implied cost of equity based on Gebhardt et al. (2001) requires data items from I/B/E/S, which covers relatively large firms (Doyle et al., 2003). As such, to the extent larger firms tend to have less readable annual reports, and our sample tends to comprise large firms due to the data requirements for estimating cost of equity, this potentially explains our sample mean value of *BOG*.

Panel B of Table 1 provides the descriptive statistics of the variables used to test H2 and H3. The mean value of *INDOWN* is 0.147, indicating that 14.7 percent of firms within the sample are above the industry-year median value of percentage of shares owned by individuals. *ANEXP* has a mean value of 0.523, indicating that 52.3 percent of firms within the sample are above the industry-year median value of the experience of analysts following that firm.

Panel C of Table 1 presents the descriptive statistics of the study's control variables. The mean value of the natural logarithm of firm age (*LAGE*) is higher than that reported by extant research at 2.873, which indicates that sample firms are, on average, older compared to prior studies (Lo et al., 2017; Lim et al., 2018).[17] The mean values of the natural logarithm of the number of business (*LNBSEG*) and geographic (*LNGSEG*) segments are 1.584 and 1.696, respectively, and are largely consistent with those reported by prior readability literature (Lim et al., 2018).[18] The mean value of *LOSS* is 0.248, indicating that 24.8 percent of firms within the sample period reported negative earnings for a given fiscal year, while the mean values of *EARN* and *EARNVOL* are 0.098 and 0.078, respectively. These values are consistent with prior readability literature (Lee, 2012; Lim et al., 2018).[19] A mean *BETA* of 1.163 indicates that the stock price of firms within the sample is, on average, 16.3 percent more volatile than the market. The mean value of the natural logarithm of firm size (*SIZE*) is 7.840, while book-to-market ratio (*BM*) has a mean value of 0.465, indicating that sample firms' book value is, on average, 46.5 percent of their market value. Debt-to-equity ratio (*DE*) has a mean value of 0.296, which indicates that sample firms' debt represents, on average, 29.6 percent of their equity. Our reported mean values are largely consistent with those reported by prior literature (Kim et al., 2011; Lee, 2012; Kim and Zhang, 2016; Lo et al., 2017).[20] The remaining control variables (and respective mean values), *IVOL* (0.023), *ALTZ* (0.851), *ANFOL* (12.269), *AQMJ* (0.345), *LNNITEMS* (5.663), *SI* (-0.015), *MA* (0.252), and *SEO* (0.061) are similarly consistent with those reported by prior literature (Francis et al., 2005; Hanlon, 2005; Li, 2008; Lim and Tan, 2008; Jiraporn et al., 2012; Hasan, 2020).[21]

4.2. Correlations

Table 2 reports the correlation among variables within equation (4), with Pearson (Spearman) correlations reported in the lower (upper) diagonal. Consistent with expectations, both correlation matrices indicate that equity mispricing (*EM*) is positively and significantly correlated with annual report readability (*BOG*) at the five percent or better level. To test for multicollinearity issues, the variance inflation factor (VIF) scores (untabulated) are calculated for all independent variables. The highest VIF is *SIZE* at 4.72, which is below the conservative threshold of five proposed by Kennedy (1992) beyond which multicollinearity is a concern.

4.3. Regression analysis main findings: Test of H1

Table 3 reports the results of our main analysis of the association between annual report readability (*BOG*) and equity mispricing (*EM*). The reported results indicate a positive and statistically significant coefficient of 0.004 (*t*-statistic = 2.50) for *BOG* at the five percent significance level. This finding is consistent with H1 and suggests that low annual report readability reduces investor information processing capacity (Hirshleifer and Teoh, 2003; Eppler and Mengis, 2004; Rennekamp, 2012) which, consistent with Bloomfield's (2002) IRH, inhibits the assimilation of relevant firm-specific infor-

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[16] Bonsall et al. (2017) report a mean Bog Index value of 81.63 over the period of 1994–2011. Median values are not reported.

[17] The raw mean values of firm age reported by Lo et al. (2017) and Lim et al. (2018) are 15.576 and 18.716 respectively, compared to a raw value of 25.501 in this sample.

[18] The raw mean values of number of business segments and number of geographic segments reported by Lim et al. (2018) are 5.386 and 6.503 respectively, compared to 5.732 and 6.995 in this sample.

[19] Lee (2012) reports a mean *LOSS* of 0.2163 while Lim et al. (2018) report a mean *EARN* of 0.055 and mean *EARNVOL* of 0.048.

[20] Mean *BETA* reported by Lee (2012) is 1.006. Mean *SIZE* reported by Lee (2012), Lo et al. (2017), and Lim et al. (2018) is 6.623, 5.768, and 5.886, respectively. Mean *BM* reported by Lee (2012) is 0.659. Mean *DE* reported by Kim and Zhang (2016) and Kim et al. (2011) is 0.228 and 0.202, respectively.

[21] The mean values of *IVOL* and *ALTZ* reported by Lim and Tan (2008) are 0.08 and 1.08, respectively. The mean value of *ANFOL* reported by Jiraporn et al. (2012) is 13.46. Francis et al. (2005) report mean accruals quality of 0.442. The mean value of *LNNITEMS* reported by Hasan (2020) is 5.587. The mean value of *SI* reported by Hanlon (2005) is −0.013. The mean values of *MA* and *SEO* reported by Li (2008) are 0.27 and 0.061, respectively.

Table 1
Descriptive statistics.

Variable	N	Mean	Median	Std. Dev.	Q1	Q3
Panel A: Dependent Variables and Test Variable						
EM	10,867	1.031	0.692	1.012	0.299	1.197
EU	6,125	1.381	0.938	1.192	0.371	2.360
EO	4,742	0.579	0.516	0.383	0.239	0.911
BOG	10,867	86.307	86.000	7.849	81.000	91.000
Panel B: H2-H4 Additional Test Variables						
INDOWN	10,867	0.147	0.000	0.354	0.000	0.000
ANEXP	10,867	0.523	1.000	0.499	0.000	1.000
Panel C: Control Variables						
LAGE	10,867	2.873	2.900	0.883	2.252	3.597
LNBSEG	10,867	1.584	1.386	0.823	1.099	2.303
LNGSEG	10,867	1.696	1.609	0.898	1.099	2.398
LOSS	10,867	0.248	0.000	0.432	0.000	0.000
EARN	10,867	0.098	0.123	0.154	0.075	0.176
EARNVOL	10,867	0.078	0.029	1.218	0.015	0.061
BETA	10,867	1.163	1.096	0.587	0.763	1.490
SIZE	10,867	7.840	7.899	1.792	6.589	9.166
BM	10,867	0.465	0.354	0.406	0.206	0.582
IVOL	10,867	0.023	0.019	0.014	0.013	0.028
DE	10,867	0.296	0.127	0.603	0.012	0.341
ALTZ	10,867	0.851	1.000	0.881	0.000	2.000
ANFOL	10,867	12.269	11.000	8.240	5.000	18.000
IMPCC	10,867	0.171	0.050	0.601	0.029	0.081
AQMJ	10,867	0.345	0.069	0.777	0.025	0.242
LNNITEMS	10,867	5.663	5.645	0.050	5.624	5.687
SI	10,867	−0.015	−0.002	0.066	−0.013	0.000
MA	10,867	0.252	0.000	0.434	0.000	1.000
SEO	10,867	0.061	0.000	0.240	0.000	0.000

This table presents the descriptive statistics for all variables used in the tests of H1-H3. The sample comprises firm-year observations over the period of 1994–2016 with non-missing values to construct variables. All variables are defined in Appendix A.

mation into stock prices (You and Zhang, 2009; Lee, 2012), resulting in higher information asymmetry (Brown and Hillegeist, 2007) and a greater deviation between a firm's market and intrinsic value. The coefficients on control variables generally take on the predicted direction and sign as per prior literature.

Despite being consistent with H1, it is unclear whether our main finding is driven by low annual report readability being associated with equity over or underpricing. To examine the respective directional mispricing effects, the sample is partitioned into an underpricing and overpricing subsample using a *VPRIM* ratio of 1 as the cut-off (Elliott et al., 2007; Warr et al., 2012), with results also presented in Table 3.[22] The coefficient of *BOG* is 0.005 for the equity underpricing (*EU*) subsample (*t*-statistic = 2.11), which is statistically significant at the five percent level, indicating that firms with less readable annual reports are more likely to have an intrinsic value (*V*) greater than their market price (*P*) and, therefore, be underpriced by the market. Similarly, the coefficient of *BOG* is 0.002 for the equity overpricing (*EO*) subsample (*t*-statistic = 2.47), which is statistically significant at the five percent level. This indicates that firms with less readable annual reports are also more likely to have an intrinsic value (*V*) less than their market price (*P*) and, thus, be overvalued by the market. Overall, these findings indicate that the positive association between low annual report readability and equity mispricing is not limited to either equity underpricing or overpricing, consistent with prior evidence indicating that the presentation and clarity of information relevant to firm value assists investors in processing both good and bad news (Riedl and Srinivasan, 2010; Curtis et al., 2014; Lundholm et al., 2014). In sum, our main findings support H1, and indicate that poor annual report readability is associated with equity mispricing, in the form of both underpricing and overpricing.

4.4. Cross-sectional tests: Test of H2

Table 4 provides the results of the regression analyses used to test the role of ownership structure (*INDOWN*) on the associations between *BOG* and *EU* and *BOG* and *EO*. The left-hand column of Table 4 indicates the results for the *EU* subsample. The interaction variable, *BOG* * *INDOWN*, has a coefficient of 0.011 (*t*-statistic = 1.98), which is statistically significant at the five percent level. Consistent with H2, this suggests an accentuating role of individual investor share ownership on the positive association between low annual report readability and equity underpricing. This is attributed to individual investors' lack of directed information search strategies (Hunton and McEwen, 1997), valuation experience (Fredrickson and Miller,

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[22] To ensure the association between annual report readability and the directional mispricing effects is not driven by the choice of over/underpricing definitions, untabulated additional analysis is undertaken which uses an alternative specification of equity overpricing and equity underpricing. When using median sample *VPRIM* (Warr et al., 2012) as an alternate cut-off for over and underpricing, the results remain quantitatively similar to the main findings.

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Table 2
Pearson (Spearman) correlations and variance inflation factors.

	EM	BOG	LAGE	LNBSEG	LNGSEG	LOSS	EARN	EARN_VOL	BETA	SIZE
EM		0.153	−0.148	−0.057	0.000	0.329	−0.196	0.317	0.158	−0.215
BOG	0.121		−0.184	0.096	−0.041	0.267	−0.369	0.175	0.101	−0.126
LAGE	−0.112	−0.185		0.165	0.154	−0.284	0.237	−0.356	−0.227	0.436
LNBSEG	−0.024	0.097	0.139		0.212	−0.119	0.023	−0.139	−0.009	0.110
LNGSEG	0.011	−0.071	0.166	0.162		−0.160	0.165	−0.103	0.068	0.257
LOSS	0.299	0.273	−0.282	−0.098	−0.181		−0.615	0.422	0.230	−0.436
EARN	−0.184	−0.399	0.287	0.063	0.270	−0.656		−0.255	−0.186	0.433
EARN_VOL	0.016	0.042	−0.056	−0.021	−0.045	0.057	−0.081		0.314	−0.406
BETA	0.147	0.124	−0.219	−0.028	0.018	0.246	−0.202	0.041		−0.170
SIZE	−0.222	−0.141	0.431	0.078	0.263	−0.454	0.492	−0.050	−0.163	
BM	0.235	0.003	−0.035	0.035	−0.024	0.287	−0.193	−0.006	0.087	−0.391
IVOL	0.298	0.188	−0.414	−0.114	−0.214	0.526	−0.520	0.063	0.361	−0.603
DE	0.154	0.006	−0.001	−0.008	−0.062	0.122	−0.017	−0.014	0.085	−0.124
ALTZ	0.129	0.203	−0.116	−0.002	−0.159	0.306	−0.316	−0.001	0.047	−0.222
ANFOL	−0.129	−0.209	0.286	−0.007	0.184	−0.328	0.431	−0.044	−0.109	0.743
IMPCC	−0.006	0.121	−0.087	−0.075	−0.101	0.247	−0.271	0.025	0.139	−0.148
AQMJ	0.030	0.138	−0.030	0.043	0.064	0.074	−0.090	0.007	0.046	−0.043
LNNITEMS	−0.150	−0.203	0.170	−0.097	−0.164	−0.124	0.116	−0.024	−0.267	0.187
SI	−0.164	−0.051	0.041	−0.010	−0.030	−0.268	0.050	−0.002	−0.022	0.110
MA	−0.065	−0.048	0.132	0.001	0.096	−0.141	0.154	−0.015	−0.074	0.287
SEO	0.063	0.238	−0.224	−0.078	−0.215	0.318	−0.486	0.083	0.124	−0.241

Table 2. Continued

	BM	IVOL	DE	ALTZ	ANFOL	IMPCC	AQMJ	LNNITEMS	SI	MA	SEO
EM	0.041	0.342	−0.057	0.097	−0.158	−0.195	0.146	−0.149	−0.136	−0.055	0.138
BOG	−0.029	0.142	−0.061	0.195	−0.198	0.016	0.190	−0.191	−0.105	−0.040	0.231
LAGE	0.043	−0.474	0.200	−0.113	0.296	0.026	−0.097	0.160	−0.002	0.133	−0.219
LNBSEG	0.089	−0.160	0.086	0.004	0.010	−0.015	0.022	−0.087	−0.038	0.008	−0.097
LNGSEG	−0.010	−0.173	−0.026	−0.161	0.178	−0.082	0.119	−0.178	−0.142	0.093	−0.191
LOSS	0.173	0.508	−0.069	0.301	−0.348	0.115	0.152	−0.118	−0.216	−0.141	0.318
EARN	−0.324	−0.383	−0.078	−0.428	0.420	−0.190	−0.100	0.070	0.049	0.147	−0.317
EARN_VOL	−0.080	0.588	−0.381	−0.012	−0.268	0.079	0.240	−0.227	−0.006	−0.141	0.295
BETA	0.023	0.399	−0.052	0.025	−0.103	0.062	0.108	−0.221	−0.058	−0.073	0.110
SIZE	−0.328	−0.618	0.122	−0.201	0.763	−0.161	−0.085	0.240	0.008	0.287	−0.230
BM		0.116	0.389	0.330	−0.214	0.330	−0.115	0.041	−0.092	−0.130	−0.202
IVOL	0.278		−0.205	0.128	−0.406	0.112	0.164	−0.153	−0.061	−0.179	0.283
DE	0.466	0.159		0.422	0.070	0.166	−0.164	0.338	−0.075	0.004	−0.203
ALTZ	0.327	0.182	0.344		−0.178	0.147	−0.034	0.141	−0.065	−0.100	0.069
ANFOL	−0.223	−0.391	−0.076	−0.180		−0.150	−0.107	0.215	0.013	0.230	−0.257
IMPCC	0.116	0.249	0.049	0.111	−0.092		0.014	0.083	−0.012	−0.063	0.062
AQMJ	−0.061	0.055	−0.060	−0.022	−0.075	0.070		−0.174	−0.074	−0.008	0.129
LNNITEMS	0.008	−0.111	0.136	0.164	0.197	−0.024	−0.159		0.106	0.100	−0.069
SI	−0.264	−0.130	−0.079	−0.112	0.043	−0.004	0.009	0.043		−0.026	0.045
MA	−0.129	−0.166	−0.060	−0.102	0.232	−0.027	−0.021	0.086	0.010		−0.061
SEO	−0.134	0.336	−0.095	0.073	−0.241	0.175	0.093	−0.057	0.011	−0.061	

This table presents the Pearson (Spearman) correlations for variables used in the main regression analysis at the lower (upper) diagonal. Significant correlations at the five percent or better level (two-tailed) are in bold. All variables are defined in Appendix A.

2004), and access to private information sources (Ke and Petroni, 2004), leading to greater firm undervaluation when annual reports are less readable.

The right-hand column of Table 4 provides the results for the *EO* subsample. The coefficient of the interaction variable, *BOG * INDOWN*, is not significantly associated with *EO*. This result fails to provide evidence supporting the contention that a higher proportion of individual investor share ownership accentuates the positive association between annual report readability and equity overpricing. Thus, H2 is not supported with respect to equity overpricing.

Our differing results for the *EU* and *EO* subsamples are consistent with the view that individual investors generally hold their value stocks and sell their winning stocks (Barber and Odean, 2000; Griffin et al., 2003). Therefore, our results can be interpreted as the information, and its readability, within annual reports is most useful to individual investors in underpriced stocks, as they are going to be held for a longer period. Whereas, for overpriced stocks individual investors plan to sell them. Thereafter, these firms' annual reports are less useful for individual investors' decision-making purposes.

4.6. Cross-sectional tests: Test of H3

Table 5 outlines the results of the regression analyses used to test the role of financial analyst experience (*ANEXP*) on the associations between *BOG* and *EU* and *BOG* and *EO*. The left-hand column of Table 5 provides the results for our *EU* subsample. The coefficient of *BOG * ANEXP* is insignificant, failing to provide evidence consistent with experienced financial analysts

Table 3

H1 regression analysis – The association between annual report readability (*BOG*) and equity mispricing (*EM*), equity underpricing (*EU*) and equity overpricing (*EO*).

Dependent Variable:	EM		EU		EO	
Variable	Coef.	*t*-stat.	Coef.	*t*-stat.	Coef.	*t*-stat.
Intercept	2.830	1.41	2.922	0.94	1.194	1.29
BOG	0.004**	2.50	0.005**	2.11	0.002**	2.47
LAGE	0.045***	3.82	0.078***	4.13	−0.014***	−2.60
LNBSEG	−0.011	−1.00	−0.011	−0.70	−0.008	−1.39
LNGSEG	0.019	1.57	0.007	0.37	−0.029***	−5.33
LOSS	0.363***	10.60	0.367***	7.96	0.066***	3.52
EARN	0.200**	1.99	−0.304	−1.63	−0.245***	−5.35
EARN_VOL	−0.001	−0.28	0.871***	3.54	0.000	1.02
BETA	0.048**	2.45	0.094***	3.00	0.032***	3.81
SIZE	−0.059***	−5.50	−0.067***	−4.07	−0.011**	−2.10
BM	0.185***	5.25	0.079*	1.67	−0.125***	−6.62
IVOL	4.358***	3.58	8.088***	4.01	2.815***	5.31
DE	0.125***	6.71	0.099***	4.90	−0.012	−0.63
ALTZ	0.060***	4.67	0.060***	3.07	0.018***	3.01
ANFOL	0.008***	4.13	0.008***	2.82	0.000	−0.07
IMPCC	−0.200***	−15.80	−0.737***	−4.49	0.043***	9.50
AQMJ	−0.002	−0.16	0.007	0.31	0.008	1.28
LNNITEMS	−0.278	−0.77	−0.256	−0.46	−0.089	−0.54
SI	−0.647***	−4.04	−0.914***	−5.15	0.184*	1.68
MA	−0.045**	−2.23	−0.021	−0.67	−0.009	−0.90
SEO	0.021	0.48	0.240**	2.16	0.040**	2.41
Industry fixed effect	Included		Included		Included	
Year fixed effect	Included		Included		Included	
N	10,867		6,125		4,742	
Adjusted R^2	0.2447		0.2927		0.4974	

This table presents the results of the regression analysis relating to the association between annual report readability (*BOG*) and equity mispricing (*EM*), equity underpricing (*EU*) and equity overpricing (*EO*). *, **, *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively. The sample comprises firm-year observations over the period of 1994 to 2016 with non-missing values for variable construction. All variables are defined in Appendix A.

attenuating the positive association between low annual report readability and equity underpricing. Thus, H3 is not supported with respect to equity underpricing.

The right-hand column of Table 5 reports the results for our *EO* subsample. The interaction variable, *BOG * ANEXP*, has a coefficient of −0.002, which is statistically significant at the ten percent level, indicating that financial analyst experience attenuates the positive association between annual report readability and equity overpricing. This finding provides some support for H3, as more experienced financial analysts following a firm mitigate the association between annual report readability and equity overpricing. We contend this finding is consistent with experienced analysts providing more informative stock recommendations to investors (Frankel et al., 2006), as they have a more thorough understanding of the specificities of a given firm's operations (Clement, 1999) by partly having better access to private information (Ke and Petroni, 2004; Kimbrough, 2007), than less experienced analysts. The coefficient of *BOG* is 0.002 (*t*-statistic = 2.52), which is statistically significant at the five percent level. We believe this indicates that, when analyst experience is low, managers use poor readability as a tool to strategically overprice stock.

Our differing results for the *EU* and *EO* subsamples are consistent with sell side analysts spending less effort on undervalued stocks. McNichols and O'Brien (1997) find that analysts' allocation of effort across firms depends on their expectations of each firm's future performance. Sell side analysts gather and disseminate less information for firms with poor stock returns, as these stocks tend to have lower trading volume and, consequently, generate fewer financial rewards for sell side analysts (Beyer and Guttman, 2011; Lehmer et al., 2022). Thereafter, in our setting, sell side analysts of undervalued firms may spend less effort in gathering and analysing information contained in the annual reports of underpriced firms, leading to their limited role in mitigating the effects of readability on underpricing.[23]

The findings relating to control variables for the cross-sectional tests are quantitatively consistent with those in Table 3.

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[23] In additional untabulated analyses, the cross-sectional tests of H2 and H3 re-estimated using subsamples partitioned on the respective interaction variables, per Kim et al. (2019). The results are quantitatively similar to the main findings.

Table 4

H2 Regression analysis – The effect of firm ownership structure (*INDOWN*) on the association between annual report readability (*BOG*) and equity underpricing (*EU*) and equity overpricing (*EO*).

Dependent Variable:	EU		EO	
Variable	Coef.	t-stat.	Coef.	t-stat.
Intercept	2.605	0.82	0.739	0.81
BOG	0.003	1.26	0.001	1.61
BOG * INDOWN	0.011**	1.98	0.001	0.97
INDOWN	−0.931*	−1.90	−0.111	−0.91
LAGE	0.078***	4.15	−0.015***	−2.75
LNBSEG	−0.014	−0.85	−0.009	−1.63
LNGSEG	0.009	0.49	−0.030***	−5.36
LOSS	0.367***	7.98	0.061***	3.29
EARN	−0.269	−1.43	−0.231***	−5.02
EARN_VOL	0.859***	3.51	0.000	0.96
BETA	0.096***	3.08	0.031***	3.73
SIZE	−0.066***	−4.05	−0.011**	−2.10
BM	0.088*	1.87	−0.116***	−6.10
IVOL	7.813***	3.88	2.648***	5.05
DE	0.103***	5.10	−0.008	−0.44
ALTZ	0.062***	3.16	0.021***	3.40
ANFOL	0.008***	2.93	0.000	−0.31
IMPCC	−0.724***	−4.46	0.042***	9.30
AQMJ	0.000	−0.01	0.005	0.87
LNNITEMS	−0.164	−0.29	0.007	0.04
SI	−0.910***	−5.12	0.193*	1.76
MA	−0.021	−0.68	−0.006	−0.65
SEO	0.227**	2.05	0.040**	2.44
Industry fixed effect	Included		Included	
Year fixed effect	Included		Included	
N	6,125		4,742	
Adjusted R^2	0.2937		0.5036	

The following table presents the results of the regression analysis relating to the effect of firm ownership structure (*INDOWN*) on the association between annual report readability (*BOG*) and equity underpricing (*EU*) and equity overpricing (*EO*). *, **, *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively. The sample comprises firm-year observations over the period of 1994 to 2016 with non-missing values for variable construction. All variables are defined in Appendix A.

5. Robustness tests

5.1. Propensity score matching

To mitigate concerns that the study's primary empirical model may suffer from an omitted variable that is correlated with both annual report readability (*BOG*) and equity mispricing (*EM*), a propensity score matching procedure is undertaken for the *EM*, *EU* and *EO* samples (Dehejia and Wahba, 2002). This procedure involves the development of a sample of firms with the same characteristics associated with *EM, EU* or *EO* but differ in terms of *BOG*. The procedure allows for the minimisation of variation in observable confounding variables to establish that differences in equity mispricing are clearly attributable to the readability of a firm's annual report.

To determine the propensity-matched samples, a separate regression of *BOG* on all control variables used in the main regression model is estimated using the *EM*, *EU* and *EO* samples, respectively. Based on coefficients from the model, for each of the *EM*, *EU* and *EO* samples a propensity score is determined for each firm-year observation, with firm-year observations with low *BOG* matched to those with high *BOG*,[24] with replacement, and with the closest propensity score based on a caliper width of 0.001. For the *EM* sample, the propensity score matching procedure yields a new sample of 3,989 matched pairs of firm-year observations with high and low *BOG* (totalling 7,978 firm-year observations). For the *EU* subsample, the propensity score matching procedure yields a new subsample of 2,178 matched pairs (totalling 4,356 firm-year observations), while for the *EO* subsample the propensity score matching procedure yields a sample of 1,446 matched pairs (totalling 2,892 firm-year observations).

The covariate balance between control variables is assessed by testing whether their mean values are significantly different between firms with high and low *BOG*, the results of which are reported in Appendix B. Overall, there are no significant differences in the mean values of any of the control variables within the *EM*, *EU* or *EO* propensity score matched samples, indicating that the matching procedure was successful across all samples.

As a final step, the main regression analysis examining the association between annual report readability (*BOG*) and equity mispricing (*EM*), equity underpricing (*EU*) and equity overpricing (*EO*), respectively, is re-estimated using each

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[24] Low (high) *BOG* is determined as a *BOG* value below (above) the median *BOG* of the matched sample.

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Table 5
H3 Regression analysis – The effect of financial analyst experience (*ANEXP*) on the association between annual report readability (*BOG*) and equity underpricing (*EU*) and equity overpricing (*EO*).

Dependent Variable:	EU		EO	
Variable	Coef.	*t*-stat.	Coef.	*t*-stat.
Intercept	2.140	0.68	0.720	0.78
BOG	0.004	1.37	0.002**	2.52
BOG * ANEXP	0.000	0.10	−0.002*	−1.76
ANEXP	−0.020	−0.07	0.118	1.49
LAGE	0.076***	3.76	−0.011*	−1.95
LNBSEG	−0.014	−0.83	−0.010*	−1.68
LNGSEG	0.008	0.41	−0.029***	−5.35
LOSS	0.368***	8.00	0.061***	3.30
EARN	−0.267	−1.42	−0.226***	−4.90
EARN_VOL	0.861***	3.50	0.000	0.57
BETA	0.096***	3.08	0.030***	3.57
SIZE	−0.067***	−4.06	−0.010*	−1.87
BM	0.085*	1.80	−0.114***	−5.99
IVOL	7.920***	3.94	2.675***	5.12
DE	0.101***	5.03	−0.007	−0.42
ALTZ	0.062***	3.19	0.021***	3.47
ANFOL	0.008***	2.75	0.000	−0.37
IMPCC	−0.732***	−4.48	0.042***	9.29
AQMJ	0.001	0.03	0.005	0.87
LNNITEMS	−0.098	−0.17	−0.007	−0.04
SI	−0.903***	−5.10	0.195*	1.79
MA	−0.021	−0.66	−0.006	−0.62
SEO	0.232**	2.09	0.038**	2.30
Industry fixed effect	Included		Included	
Year fixed effect	Included		Included	
N	6,125		4,742	
Adjusted R^2	0.2931		0.5043	

This table presents the results of the regression analysis relating to the effect of financial analyst experience (*ANEXP*) on the association between annual report readability (*BOG*) and equity underpricing (*EU*) and equity overpricing (*EO*). *, **, *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively. The sample comprises firm-year observations over the period of 1994 to 2016 with non-missing values for variable construction. All variables are defined in Appendix A.

propensity score matched sample, with results reported in Table 6. For the *EM* propensity score matched sample, the coefficient of *BOG* is 0.005 (*t*-statistic = 2.75), which is positive and statistically significant at the one percent level. For the *EU* propensity score matched sample, the coefficient of *BOG* is positive and statistically significant at the five percent level (0.005; *t*-statistic = 1.98), while for the *EO* propensity score matched sample the coefficient of *BOG* is also positive and statistically significant at the five percent level (0.002; *t*-statistic = 2.44). Consistent with our main findings, these results, collectively, provide evidence that firms with low annual report readability are associated with greater equity mispricing, equity underpricing and equity overpricing. Overall, the results from the propensity score matching procedure confirm the robustness of our main findings, and that our main findings are not driven by omitted variables correlated with both the dependent and test variables.

5.2. Alternate measure of annual report readability

To ensure our main results are not driven by our choice of readability measure, we substitute *BOG* for an alternative measure, 10-K file size, used by prior studies to examine readability in a financial reporting context (Loughran and McDonald, 2014; Ertugrul et al., 2017; Rjiba et al., 2021). Per Loughran and McDonald (2014), 10-K file size is measured as follows:

$$LNFISIZE = \log(FSIZE) \tag{6}$$

Where *FSIZE* is the file size of the SEC EDGAR complete submission text file for the 10-K filing, in megabytes.

A higher (lower) value for *LNFSIZE* indicates that the annual report is less (more) readable.

Table 7 presents the regression results of the association between *LNFSIZE* and *EM*, *EU* and *EO*. The coefficient of *LNFSIZE* for the *EM* analysis is 0.011 (*t*-statistic = 1.99), which is significant at the five percent level. The coefficient of *LNFSIZE* for the *EU* analysis is not significant. Finally, the coefficient of *LNFSIZE* for the *EO* analysis is 0.005 (*t*-statistic = 1.88), which is significant at the ten percent level. The findings for control variables are quantitatively similar to those reported in our main analysis. Overall, the results support the notion that greater time and effort is required by investors to process and assimilate information within larger annual reports require, thus leading to greater difficulty in pricing the firm in-line with its intrinsic value. However, annual report size is evidenced to primarily contribute to equity overvaluation by eliciting inflated perceptions of firm valuation by investors.

Table 6
Propensity score matching.

Dependent Variable:	EM		EU		EO	
Variable	Coef.	t-stat.	Coef.	t-stat.	Coef.	t-stat.
Intercept	1.996	0.86	1.592	0.44	1.212	1.03
BOG	0.005***	2.75	0.005**	1.98	0.002**	2.44
LAGE	0.042***	3.03	0.091***	3.93	−0.012*	−1.71
LNBSEG	−0.028**	−2.04	−0.021	−1.05	−0.007	−0.98
LNGSEG	0.021	1.46	0.001	0.03	−0.042***	−5.84
LOSS	0.342***	8.42	0.354***	6.42	0.073***	3.02
EARN	0.142	1.13	−0.454**	−2.04	−0.291***	−4.74
EARN_VOL	0.047	1.14	1.407***	2.87	−0.008	−0.56
BETA	0.058**	2.45	0.121***	3.20	0.022**	2.01
SIZE	−0.058***	−4.55	−0.045**	−2.26	−0.012*	−1.82
BM	0.185***	4.30	0.058	1.02	−0.138***	−5.85
IVOL	3.653**	2.49	7.209***	2.99	3.682***	5.38
DE	0.133***	4.48	0.083***	3.17	−0.026	−0.92
ALTZ	0.066***	4.29	0.073***	3.16	0.013*	1.71
ANFOL	0.009***	3.92	0.006*	1.84	0.001	0.70
IMPCC	−0.198***	−12.99	−0.806***	−5.74	0.040***	7.14
AQMJ	0.011	0.78	0.013	0.51	0.010	1.29
LNNITEMS	−0.139	−0.34	−0.050	−0.08	−0.108	−0.51
SI	−1.012***	−5.13	−1.031***	−4.87	0.120	0.84
MA	−0.051**	−2.18	−0.073**	−2.02	−0.006	−0.46
SEO	−0.003	−0.06	0.127	0.83	0.016	0.72
Industry fixed effect	Included		Included		Included	
Year fixed effect	Included		Included		Included	
N	7,978		4,356		2,892	
Adjusted R^2	0.2444		0.3011		0.5078	

This table presents the results of the regression analysis relating to the association between annual report readability (*BOG*) and equity mispricing (*EM*), equity underpricing (*EU*) and equity overpricing (*EO*) using propensity score matched samples. *, **, *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively. The sample comprises firm-year observations over the period of 1994 to 2016 with non-missing values for variable construction. All variables are defined in Appendix A.

Table 7
H1 Regression analysis – The association between annual report readability (*LNFSIZE*) and equity mispricing (*EM*), equity underpricing (*EU*) and equity overpricing (*EO*).

Dependent Variable:	EM		EU		EO	
Variable	Coef.	t-stat.	Coef.	t-stat.	Coef.	t-stat.
Intercept	2.597	1.25	2.955	0.92	1.567*	1.65
LNFSIZE	0.011**	1.99	0.009	1.22	0.005*	1.88
LAGE	0.039***	3.15	0.067***	3.42	−0.013**	−2.31
LNBSEG	−0.003	−0.23	0.000	0.03	−0.008	−1.32
LNGSEG	0.023*	1.83	0.011	0.57	−0.029***	−5.11
LOSS	0.362***	10.28	0.365***	7.68	0.069***	3.58
EARN	0.155	1.51	−0.371*	−1.93	−0.244***	−5.16
EARN_VOL	0.000	−0.21	0.857***	3.42	0.000	1.34
BETA	0.041**	1.97	0.075**	2.34	0.037***	4.24
SIZE	−0.058***	−5.31	−0.063***	−3.71	−0.011**	−2.12
BM	0.171***	4.68	0.057	1.17	−0.139***	−7.03
IVOL	4.603***	3.62	8.837***	4.20	2.740***	4.99
DE	0.136***	7.04	0.109***	5.25	−0.001	−0.07
ALTZ	0.058***	4.41	0.064***	3.20	0.019***	3.06
ANFOL	0.008***	4.29	0.008***	2.78	0.000	0.13
IMPCC	−0.198***	−15.01	−0.778***	−4.05	0.043***	9.33
AQMJ	−0.005	−0.37	0.004	0.18	0.011*	1.73
LNNITEMS	−0.203	−0.54	−0.208	−0.36	−0.137	−0.81
SI	−0.697***	−4.24	−1.003***	−5.52	0.165	1.45
MA	−0.038*	−1.79	−0.007	−0.22	−0.007	−0.67
SEO	0.032	0.69	0.265**	2.30	0.040**	2.31
Industry fixed effect	Included		Included		Included	
Year fixed effect	Included		Included		Included	
N	10,141		5,765		4,376	
Adjusted R^2	0.2428		0.2890		0.5027	

This table presents the results of the regression analysis relating to the association between annual report readability (*LNFSIZE*) and equity mispricing (*EM*), equity underpricing (*EU*) and equity overpricing (*EO*). *, **, *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively. The sample comprises firm-year observations over the period of 1994 to 2016 with non-missing values for variable construction. All variables are defined in Appendix A.

5.3. Alternate measure of equity mispricing

To establish that the identified association between annual report readability and equity mispricing is not contingent on our choice of equity mispricing measure, we apply an alternate measure of mispricing – the Rhodes-Kropf et al. (2005) (RKRV) approach – used by prior studies (Hertzel and Li, 2010; Bonaimé et al., 2014).

The RKRV approach calculates intrinsic firm value as a linear function of accounting variables (*b*, *NI*, and *LEVRKRV*) and their multiples ($\alpha 1jt$, $\alpha 2jt$, $\alpha 3jt$, $\alpha 4jt$) using the following model:

$$mit = \alpha 0jt + \alpha 1jtbit + \alpha 2jt \ln (NI)it + \alpha 3jtI < 0 \times In(NI)it + \alpha 4jtLEV(RKRV)it + \varepsilon it \qquad (7)$$

Where *mit* is predicted firm value at time zero;
b is the natural logarithm of book value of equity;
NI is the absolute value of net income;
I less than 0 is a negative net income dummy variable equal to 1 if *NI* is negative, 0 otherwise; and.
LEVRKRV is firm leverage calculated as follows:

$$LEVRKRV = 1 - Market\ value/(Market\ value + Assets - Deferred\ taxes - Equity) \qquad (8)$$

In untabulated analyses, equation (7) is then estimated annually for each of the Fama and French (1997) 48 industry classifications from 1994 to 2016, with firm value (*VRKRV*) representing the regression coefficients from equation (7). The intrinsic value of the firm's stock (*VRKRV*) is then compared to its market value at time zero (*P0*) in order to determine misvaluation. Accordingly, equity mispricing is calculated as follows:

$$VPRKRV = VRKRV/P0 \qquad (9)$$

Consistent with prior analyses, we, firstly, subtract *VPRKRV* by 1 (i.e., *VPRKRV* − 1) and, secondly, take the absolute value of *VPRKRV* – 1 to isolate the absolute degree of deviation between a firm's market and intrinsic value (*EM2*). As per Bonaimé et al. (2014), the industry-year median *V/P* ratio is then used to determine whether sample firms are underpriced or overpriced by the market. Specifically, if the firm-year value of *VPRKRV* is greater (less) than the industry-year median value of *VPRKRV*, the firm is undervalued (overvalued) by the market. Upon forming subsamples of underpriced (overpriced) firms, the degree of equity underpricing (overpricing) for each subsample, as denoted by *EU2* (*EO2*), is equal to the firm-year specific value of *EM2*.

Table 8 presents the regression results of the association between annual report readability (*BOG*) and equity mispricing (*EM2*), equity underpricing (*EU2*) and equity overpricing (*EO2*). The coefficient of *BOG* for the *EM2* analysis is 0.002 (*t*-statistic = 2.33), which is statistically significant at the five percent level. The coefficient of *BOG* for the *EU2* analysis is 0.006 (*t* = statistic = 5.02), which is statistically significant at the one percent level. Finally, the coefficient of *BOG* for the *EO2* analysis is 0.001 (*t*-statistic = 4.33), which is statistically significant at the one percent level. The findings related to control variables are quantitatively similar to those reported in our main analysis. Overall, the results provide further support for our contention that it is more difficult to interpret and process information within less readable annual reports in a timely and accurate manner, thereby inhibiting such information's assimilation into stock prices and enhancing the deviation between a firm's intrinsic and market value.

5.4. Change specification

We mitigate endogeneity concerns of unobserved correlated omitted variable bias by undertaking change specification analysis, which enables each firm to serve as its own control and negate time-invariant unobservable variables (Brown et al., 2011; Krishnan et al., 2011; Beck and Mauldin, 2014). To do this we, firstly, regress changes in equity mispricing (*ΔEM*) on changes in annual report readability (*ΔBOG*) and changes in control variables, with changes measured from time *t-1* to time *t*. Secondly, we partition firms into either an equity underpriced or equity overpriced subsample and regress changes in equity underpricing (*ΔEU*) and equity overpricing (*ΔEO*), respectively, on changes in annual report readability (*ΔBOG*) and changes in control variables, once again with changes measured from time *t-1* to time *t*. The results are reported in Table 9.

In relation to *ΔEM*, we find a positive and significant coefficient on *ΔBOG* (0.012, *t*-statistic = 2.10), indicating that as annual report readability declines equity mispricing increases. In relation to *ΔEU*, the coefficient of *ΔBOG* is 0.019 (*t* = statistic = 2.01), while the coefficient of *ΔBOG* for the *ΔEO* analysis is 0.011 (*t*-statistic = 2.02), with both coefficients being statistically significant at the five percent level and indicating that as annual reports become less readable equity underpricing and equity overpricing increases, respectively. Collectively, our change analysis supports our main findings of an association between low annual report readability and equity mispricing, whether in the context of underpricing or overpricing.

6. Conclusion

We examine whether firms with less readable annual reports are associated with greater equity mispricing. Using a sample of firm-year observations from the United States for 1994–2016, we find a positive association between low annual

Table 8

H1 Regression analysis – The association between annual report readability (*BOG*) and equity mispricing (*EM2*), equity underpricing (*EU2*) and equity overpricing (*EO2*).

Dependent Variable:	*EM2*				*EU2*		*EO2*
Variable	Coef.	*t*-stat.	Coef.	*t*-stat.	Coef.	*t*-stat.	
Intercept	−7.335***	−6.47	−10.922***	−7.15	−1.721***	−5.61	
BOG	0.002**	2.33	0.006***	5.02	0.001***	4.33	
LAGE	0.158***	28.74	0.148***	18.85	−0.014***	−8.54	
LNBSEG	−0.017**	−2.19	−0.022**	−2.25	−0.008***	−3.43	
LNGSEG	0.032***	5.01	0.022**	2.39	0.009***	4.64	
LOSS	0.125***	8.41	0.181***	8.30	0.034***	8.14	
EARN	−0.617***	−12.24	−1.175***	−15.17	−0.209***	−13.63	
EARN_VOL	0.464***	10.54	0.758***	10.05	0.064***	4.76	
BETA	−0.191***	−22.95	−0.130***	−10.37	0.015***	5.88	
SIZE	0.618***	93.32	0.955***	10.66	0.132***	64.84	
BM	0.387***	24.53	0.510***	20.22	0.085***	18.71	
IVOL	17.520***	33.89	21.619***	26.03	1.713***	11.34	
DE	0.093***	10.07	0.201***	13.01	0.012***	4.76	
ALTZ	0.110***	17.08	0.185***	19.85	0.025***	14.08	
ANFOL	0.047***	36.29	0.030***	20.37	0.007***	14.17	
IMPCC	0.059***	5.47	0.076***	4.05	−0.004	−1.37	
AQMJ	0.013*	1.79	0.016	1.50	0.000	0.16	
LNNITEMS	0.546***	2.71	0.712***	2.63	0.080	1.46	
SI	0.029	0.69	0.061	1.19	0.005	0.42	
MA	0.070***	5.17	0.001	0.08	0.006	1.62	
SEO	−0.067***	−3.63	−0.084***	−2.80	0.014***	2.59	
Industry fixed effect	Included		Included		Included		
Year fixed effect	Included		Included		Included		
N	48,695		28,768		19,927		
Adjusted R²	0.5565		0.5959		0.4007		

This table presents the results of the regression analysis relating to the association between annual report readability (*BOG*) and equity mispricing (*EM2*), equity underpricing (*EU2*) and equity overpricing (*EO2*) measured using the RKRV model. *, **, *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively. The sample comprises firm-year observations over the period of 1994 to 2016 with non-missing values for variable construction. All variables are defined in Appendix A.

Table 9

Change regression analysis - The association between changes in annual report readability (Δ*BOG*) and changes in equity mispricing (Δ*EM*), equity underpricing (Δ*EU*) and equity overpricing (Δ*EO*):

Dependent Variable:	Δ*EM*		Δ*EU*		Δ*EO*	
Variable	Coef.	*t*-stat.	Coef.	*t*-stat.	Coef.	*t*-stat.
Intercept	0.643***	8.42	0.631***	5.26	−0.003	−0.05
ΔBOG	0.012**	2.10	0.019**	2.01	0.011**	2.02
ΔLAGE	0.112	0.89	0.560*	1.89	−0.178	−0.92
ΔLNBSEG	−0.006	−0.14	−0.027	−0.34	0.003	0.08
ΔLNGSEG	−0.071	−1.27	−0.016	−0.17	−0.033	−0.58
ΔLOSS	0.090**	2.17	0.138**	2.30	−0.030	−0.58
ΔEARN	0.234	1.10	0.402	0.89	0.400**	2.10
ΔEARN_VOL	0.104	1.25	0.576	0.88	0.115**	2.42
ΔBETA	0.050*	1.87	0.070	1.49	0.037	1.38
ΔSIZE	−0.197***	−4.07	−0.442***	−4.66	−0.137***	−2.99
ΔBM	0.314***	4.19	0.256**	2.44	−0.406***	−3.85
ΔIVOL	−0.196	−0.12	−5.250	−1.44	−2.156	−1.42
ΔDE	0.040	1.17	−0.054	−1.22	−0.176***	−2.97
ΔALTZ	0.060**	2.11	0.101**	2.16	−0.012	−0.43
ΔANFOL	0.001	0.24	0.009	1.58	−0.003	−0.66
ΔIMPCC	−0.136***	−6.31	−0.793***	−5.64	0.103***	6.52
ΔAQMJ	0.028**	2.19	0.067***	3.35	0.038***	2.66
ΔLNNITEMS	−1.357	−1.30	−2.555	−1.56	−0.833	−0.76
ΔSI	−0.292	−1.58	−0.211	−0.75	0.065	0.36
ΔMA	0.009	0.45	0.047	1.47	0.048**	2.05
ΔSEO	0.051	0.96	−0.188	−1.28	−0.069	−1.59
Industry fixed effect	Included		Included		Included	
Year fixed effect	Included		Included		Included	
N	6,707		3,885		2,822	
Adjusted R²	0.1667		0.2946		0.1644	

This table presents the results of the regression analysis relating to the association between changes in annual report readability (Δ*BOG*) and changes in equity mispricing (Δ*EM*), equity underpricing (Δ*EU*) and equity overpricing (Δ*EO*). The changes in variables are measured from time *t-1* to time *t*. *, **, *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively. The sample comprises firm-year observations over the period of 1994 to 2016 with non-missing values for variable construction. All variables are defined in Appendix A.

report readability and equity mispricing – extending to both equity under and overpricing. Our findings remain invariant to alternate measures of equity mispricing and annual report readability, endogeneity tests and a range of control variables. Cross-sectional tests reveal that the positive association between low annual report readability and equity underpricing is accentuated by high individual investor ownership, while the positive association between low annual report readability and equity overpricing is attenuated by analyst experience.

The evidence presented in this study has implications for our understanding of the capital market effects of readability in a financial reporting context. This paper reconciles existing literature by demonstrating that low annual report readability is associated with both equity overpricing and underpricing, thereby compounding the potentially damaging effects of failing to communicate relevant firm-specific information in a clear and transparent manner. By exploring the role of firm-specific factors on the positive association between low annual report readability and equity over/underpricing, this paper suggests that the success of regulatory initiatives aimed at enhancing annual report readability will be dependent on the characteristics of a firm's business environment, including ownership structure and analyst features.

One area that warrants further research is potential alternative capital market implications of low annual report readability, such as its association with cost of debt capital or cost of equity capital. Further, it would be beneficial for future research to examine the valuation implications of the readability of specific sections of the annual report, such as the management discussion and analysis (MD&A) section of the annual report or the notes to the financial statements, to pinpoint the association between poor readability and equity misvaluation

Data availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A

Table A1
Definition and measurement of variables.

Variable	Definition
Panel A: Dependent and test variables	
EM	Equity mispricing estimated as the intrinsic value of a firm's stock (V) divided by the market price of a firm's stock (P), minus 1. Intrinsic value is calculated as per Ohlson (1995)'s Residual Income Model. To capture the overall effects of both directional mispricing effects, the absolute value of *VPRIM* -1 is taken.
EM2	Equity mispricing estimated as the intrinsic value (V) of a firm's stock divided by the market price of a firm's stock (P), minus 1. Intrinsic value is calculated based on the Rhodes-Kropf et al. (2005) Model. To capture the overall effects of both directional mispricing effects, the absolute value of *VPRKRV* -1 is taken.
EU	Equity underpricing, which takes the value of *EM* when *VPRIM* exceeds 1 (Elliott et al., 2007) and is a missing observation otherwise.
EU2	Equity underpricing, which takes the value of *EM2* when *VPRKRV* exceeds 1 (Bonaimé et al., 2014) and is a missing observation otherwise.
EO	Equity overpricing, which takes the value of *EM* when *VPRIM* is less than 1 (Elliott et al., 2007) and is a missing observation otherwise.
EO2	Equity overpricing, which takes the value of *EM2* when *VPRKRV* is less than 1 (Bonaimé et al., 2014) and is a missing observation otherwise.
BOG	Annual report readability measured using Bonsall et al. (2017)'s Bog Index. Bog calculation comprises three multifaceted components – sentence bog, word bog, and pep.
LNFSIZE	The natural logarithm of the file size of the SEC EDGAR 'complete submission text file' for the 10-K filing in megabytes (Loughran and McDonald, 2014).
Panel B: H2 and H3 Cross-sectional test variables	
INDOWN	Individual investor share ownership measured as the percentage of a firm's ownership structure comprised of individual investors. Coded as 1 if the firm is above the industry-year median individual ownership of the sample and 0 otherwise.
ANEXP	Financial analyst experience measured as the median number of prior quarters in which financial analysts have issued quarterly earnings forecasts for the focal firm. Coded as 1 if the firm is below the industry-year median analyst experience of the sample and 0 otherwise.
Panel C: Control variables	
LAGE	Natural logarithm of firm age measured as years since the firm's first appearance in the CRSP database.
LNBSEG	Complexity of business operations measured as the natural logarithm of the number of business segments in which the firm operates.
LNGSEG	Complexity of business operations measured as the natural logarithm of the number of geographic segments in which the firm operates.
LOSS	Indicator variable equal to 1 if firm earnings are less than zero and 0 otherwise.
EARN	Firm operating earnings equal to operating assets deflated by beginning total assets.
EARN_VOL	Earnings volatility measured as the standard deviation of the operating earnings during the prior five fiscal years.
BETA	Firm systematic risk estimated using monthly returns over a maximum of 36 months ending in July of year *t*.

Table A1 (*continued*)

Variable	Definition
SIZE	Firm size measured as the logarithm of market value of equity at the fiscal year end.
BM	Book-to-market ratio measured as firm book value in year t-1 divided by market value of equity at end of year t.
IVOL	Idiosyncratic risk volatility measured as the standard deviation of residuals from a market model regression estimated using daily returns over a one-year period ending in June of year t.
DE	Debt-to-equity ratio estimated as book value of long-term debt in year t-1 divided by market value of equity at end of year t.
IVOL	Idiosyncratic risk volatility measured as the standard deviation of residuals from a market model regression estimated using daily returns over a one-year period ending in June of year t.
DE	Debt-to-equity ratio estimated as book value of long-term debt in year t-1 divided by market value of equity at end of year t.
ALTZ	Firm risk of financial distress measured using Altman's Z-score from Altman (1968)'s discriminant model. The variable is coded as 2 if the score is less than 1.81, 1 if the score is between 1.81 and 3, and 0 if the score is greater than 3 (Lim and Tan, 2008).
ANFOL	Analyst following estimated as the number of analyst estimates included in the I/B/E/S database in year t.
IMPCC	Industry implied cost of capital, per Gebhardt et al. (2001).
AQMJ	Accruals quality measured, per the modified Jones model (Dechow et al., 1995).
LNNITEMS	Natural logarithm of the number of non-missing items in Compustat.
SI	Special items defined as the amount of special items scaled by book value of assets.
MA	Indicator variable equal to 1 if a firm appears in the SDC Platinum M&A database as an acquire in a year and 0 otherwise.
SEO	Indicator variable equal to 1 if a firm has a common equity offering in the secondary market as reported in the SDC Global New Issues database in a year and 0 otherwise.

Appendix B

Table B1
Covariate analysis.

Variable	Mean (Firms with low *BOG*)	N (Firms with low *BOG*)	Mean (Firms with high *BOG*)	N (Firms with high *BOG*)	Difference	*t*-statistic
Panel A: Mispricing-based propensity score matched sample						
LAGE	2.898	3,989	2.902	3,989	−0.004	−0.19
LNBSEG	1.577	3,989	1.577	3,989	0.000	0.00
LNGSEG	1.713	3,989	1.719	3,989	−0.006	−0.33
LOSS	0.219	3,989	0.224	3,989	−0.005	−0.51
EARN	0.109	3,989	0.106	3,989	0.003	1.13
EARN_VOL	0.065	3,989	0.061	3,989	0.004	0.82
BETA	1.152	3,989	1.150	3,989	0.002	0.13
SIZE	7.875	3,989	7.858	3,989	0.017	0.43
BM	0.463	3,989	0.468	3,989	−0.005	−0.53
IVOL	0.022	3,989	0.022	3,989	0.000	−0.64
DE	0.273	3,989	0.278	3,989	−0.005	−0.38
ALTZ	0.816	3,989	0.823	3,989	−0.007	−0.37
ANFOL	12.461	3,989	12.352	3,989	0.109	0.60
IMPCC	0.155	3,989	0.167	3,989	−0.012	−0.94
AQMJ	0.339	3,989	0.334	3,989	0.005	0.32
LNNITEMS	5.661	3,989	5.662	3,989	−0.001	−0.68
SI	−0.013	3,989	−0.014	3,989	0.001	0.26
MA	0.249	3,989	0.260	3,989	−0.011	−1.18
SEO	0.047	3,989	0.055	3,989	−0.008	−1.63
Panel B: Underpricing-based propensity score matched sample						
Variable	Mean (Firms with low *BOG*)	N (Firms with low *BOG*)	Mean (Firms with high *BOG*)	N (Firms with high *BOG*)	Difference	*t*-statistic
LAGE	2.931	2,178	2.941	2,178	−0.010	−0.39
LNBSEG	1.604	2,178	1.597	2,178	0.007	0.25
LNGSEG	1.817	2,178	1.825	2,178	−0.008	−0.29
LOSS	0.219	2,178	0.224	2,178	−0.005	−0.40
EARN	0.124	2,178	0.120	2,178	0.004	1.18
EARN_VOL	0.044	2,178	0.047	2,178	−0.004	−1.51
BETA	1.134	2,178	1.127	2,178	0.007	0.41
SIZE	7.907	2,178	7.894	2,178	0.013	0.24
BM	0.515	2,178	0.521	2,178	−0.006	−0.43
IVOL	0.022	2,178	0.022	2,178	0.000	−0.99
DE	0.348	2,178	0.349	2,178	−0.001	−0.06
ALTZ	0.834	2,178	0.828	2,178	0.007	0.25
ANFOL	12.791	2,178	12.859	2,178	−0.068	−0.28
IMPCC	0.063	2,178	0.062	2,178	0.001	0.20
AQMJ	0.313	2,178	0.299	2,178	0.014	0.64

Table B1 (*continued*)

Panel A: Mispricing-based propensity score matched sample						
Variable	Mean (Firms with low *BOG*)	N (Firms with low *BOG*)	Mean (Firms with high *BOG*)	N (Firms with high *BOG*)	Difference	*t*-statistic
LNNITEMS	5.656	2,178	5.656	2,178	0.000	0.19
SI	−0.018	2,178	−0.020	2,178	0.002	0.99
MA	0.243	2,178	0.257	2,178	−0.014	−1.05
SEO	0.016	2,178	0.018	2,178	−0.002	−0.47
Panel C: Overpricing-based propensity score matched sample						
Variable	Mean (Firms with low *BOG*)	N (Firms with low *BOG*)	Mean (Firms with high *BOG*)	N (Firms with high *BOG*)	Difference	*t*-statistic
LAGE	2.845	1,446	2.853	1,446	−0.007	−0.23
LNBSEG	1.552	1,446	1.537	1,446	0.015	0.51
LNGSEG	1.555	1,446	1.541	1,446	0.014	0.42
LOSS	0.230	1,446	0.243	1,446	−0.012	−0.79
EARN	0.081	1,446	0.079	1,446	0.002	0.34
EARN_VOL	0.100	1,446	0.083	1,446	0.017	1.41
BETA	1.170	1,446	1.158	1,446	0.012	0.55
SIZE	7.781	1,446	7.850	1,446	−0.069	−1.04
BM	0.402	1,446	0.391	1,446	0.011	0.89
IVOL	0.023	1,446	0.023	1,446	0.000	0.30
DE	0.211	1,446	0.203	1,446	0.007	0.64
ALTZ	0.813	1,446	0.820	1,446	−0.007	−0.21
ANFOL	11.719	1,446	12.080	1,446	−0.361	−1.14
IMPCC	0.293	1,446	0.326	1,446	−0.033	−1.01
AQMJ	0.402	1,446	0.414	1,446	−0.013	−0.39
LNNITEMS	5.667	1,446	5.668	1,446	0.000	−0.23
SI	−0.008	1,446	−0.009	1,446	0.001	0.30
MA	0.258	1,446	0.249	1,446	0.009	0.56
SEO	0.095	1,446	0.098	1,446	−0.002	−0.19

This table presents the covariate balance of Eq. (4) control variables between firms with high and low annual report readability (*BOG*) where the dependent variable in equity mispricing, underpricing, and overpricing, respectively. *, **, *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively. All variables are defined in Appendix A.

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