

# **It's Only Words?**

## **ESG Disclosure and Corporate Sustainability in Brazil**

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### **Abstract**

We investigate the effects of ESG disclosure on the corporate sustainability performance of listed firms in Brazil. Building on the concept of extensive and intensive margins, we differentiate between voluntary and mandatory ESG disclosure. First, we find that smaller firms and those with initially low ESG scores benefit significantly from voluntary ESG disclosure (extensive margin). Second, firms with initially high ESG scores benefit significantly from greater scale and scope in mandatory ESG disclosures (intensive margin), particularly in the environmental domain. Our study provides novel and differentiated evidence on the effects of ESG disclosure and offers implications for managers, investors, and policymakers.

Keywords: ESG reporting, sustainability reporting, textual analysis, emerging markets, Brazil

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## 1. Introduction

The increasing prominence of environmental, social, and governance (ESG) factors has reshaped corporate decision-making, investments, and regulatory frameworks (Kotsantonis et al., 2016; Amel-Zadeh and Serafeim, 2018; Ioannou and Serafeim, 2019; Krueger et al., 2020; Zhang et al., 2023). Investors, regulators, and other stakeholders now recognize ESG disclosure as a key mechanism for assessing corporate sustainability, risk management, and long-term financial performance. The COVID-19 pandemic accelerated this shift, reinforcing the role of sustainability in corporate resilience and capital allocation (Albuquerque et al., 2020). As a result, ESG reporting has evolved beyond a compliance exercise into a strategic tool influencing firm valuation, stakeholder perceptions, and access to capital.

Despite the growing attention to ESG disclosures, a fundamental question remains: how do different ESG disclosure strategies affect corporate sustainability outcomes? Firms disclose ESG information through voluntary and mandatory channels, but the impact of these disclosures may depend on firm characteristics, including size, initial ESG standing, disclosure quality, and the regulatory environment.

In this study, we examine how ESG disclosure affects corporate sustainability performance. We differentiate between the effects of voluntary and mandatory ESG disclosure, building on the theoretical concept of extensive and intensive margins.<sup>1</sup> In our context, the extensive margin refers to whether a firm chooses to engage in voluntary ESG reporting. The intensive margin refers to the reporting depth, quality, and complexity of those firms that engage in ESG reporting. This distinction is crucial for understanding the heterogeneous effects of ESG disclosure. On the one hand, firms that are smaller, less transparent and that show a weaker ESG performance may benefit most from engaging in voluntary ESG reporting (extensive

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<sup>1</sup> The theoretical concept of extensive and intensive margins was first introduced in research on international trade and later applied in labor and financial economics. It distinguishes between the participation decision (yes or no) and the decision of participants regarding scale and scope (how much and what quality).

margin). On the other hand, firms that are larger, more transparent, and that show stronger ESG performance may benefit the most from improving the scale and scope of their disclosures (intensive margin).

Hence, in this paper, we ask: *How are voluntary and mandatory ESG disclosure strategies associated with future corporate sustainability performance, and do these associations differ by firm size and initial ESG standing?*

To investigate our question, we focus on publicly listed firms in Brazil during the period from 2012 to 2022. Brazil is a large emerging economy, a member of the BRICS, and currently ranked 7th globally in terms of population and 8th in terms of GDP. Brazil has signed the Paris Agreement and is committed to reducing greenhouse gas emissions and building resilience to climate change. This topic has gained a lot of attention because of the increased tensions between ESG and opportunities for exploiting the vast natural resources. By hosting the COP 30 in 2025, the country further underscores its central role in the global climate agenda. Hence, the country provides a useful testing ground to investigate how ESG disclosures shape corporate sustainability performance.

Following signaling theory, we argue that under asymmetric information, good firms have incentives to engage in voluntary disclosure that is reliable and credible (Spence, 1973; Connelly et al., 2011). Greenwashing can be understood as a special case of signaling, where signalers are dishonest or signals lack reliability. Relatedly, Marquis, Toffel, and Zhou (2016) show that poor performers are less likely to engage in selective disclosure under scrutiny, which implies that voluntary sustainability reporting (SR) is more often associated with better firms. This framing connects our study with the broader literature on corporate disclosure strategies.

In addition, the Brazilian context provides an important setting to examine these dynamics. Brazil has been a pioneer in mandating ISSB-aligned sustainability reporting, becoming the first country to require mandatory IFSR S1 compliance for listed companies by January 1<sup>st</sup>,

2026<sup>2</sup>. At the same time, it still lags behind Europe in terms of the breadth and enforcement of environmental regulation. This dual institutional environment, characterized by both regulatory advances and relative enforcement weaknesses, amplifies the role of stakeholder scrutiny in determining the credibility of ESG disclosures. In such a setting, signaling and selective disclosure theories are particularly relevant: good firms may leverage voluntary sustainability reports to credibly differentiate themselves, while poor performers face greater risks if they attempt symbolic compliance or greenwashing.

In this study, we differentiate between two disclosure mechanisms: voluntary reporting and mandatory reporting. First, we investigate whether firms that voluntarily issue stand-alone sustainability reports experience improvements in their ESG performance. Drawing on signaling theory, we assess whether these reports reflect genuine ESG commitments or serve primarily as a reputation management tool. Our findings suggest that firms that are smaller and those with lower initial ESG standing benefit the most when they decide to engage in voluntary reporting, improving their sustainability performance through enhanced transparency (extensive margin). Second, we conduct a textual analysis of firms' annual regulatory filings, examining how ESG-related word frequency, readability, and tone influence ESG performance. We find that firms with stronger initial ESG standings derive greater benefits from the depth and quality of disclosures (intensive margin), particularly in the environmental domain. In contrast, the impact of mandatory disclosure on ESG-lagging firms is less pronounced, highlighting the limits of compliance-driven reporting.

Building on the theoretical concept of extensive and intensive margins, we provide a cohesive understanding of how ESG disclosure strategies influence corporate sustainability performance. We contribute to the growing ESG literature by demonstrating that firms at

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<sup>2</sup> IFRS S1 is the International Financial Reporting Standard issued by the International Sustainability Standards Board (ISSB) that establishes general sustainability-related disclosure requirements. In Brazil, mandatory compliance for all listed companies was established by Resolution CVM 193/2023, which requires adoption starting January 1, 2026, making Brazil the first country to mandate the standard.

different stages of ESG standing benefit from distinct reporting approaches. Moreover, our findings on ESG reporting help to explain other favorable effects beyond ESG scores, such as higher accounting quality, fewer ESG violations, better financial performance, and enhanced stock market performance and efficiency (Ioannou and Serafeim, 2019; Al-Shaer, 2020; Chen and Xie, 2022; Zhang et al., 2023; Krueger et al., 2024; Tsang et al., 2024). Our textual analysis of corporate ESG reporting in Brazil complements evidence from research on tone and readability of ESG reporting in other jurisdictions (Baier et al., 2020; Ignatov, 2023; Ferjancic et al., 2024; Li et al., 2024; Shimamura et al., 2025). From a practical perspective, our research provides valuable insights for managers, investors, and policymakers seeking to enhance ESG transparency and effectiveness.

The remainder of the paper is structured as follows. In Section 2, we summarize the related literature and derive a set of hypotheses. In Section 3, we describe the data and research methods. In Section 4, we present the main results on the effects of voluntary and mandatory ESG disclosure on corporate sustainability performance. Section 5 concludes.

## **2. Related literature and hypotheses**

Firms seek to be perceived as responsible corporate citizens, as this reputation can yield strategic advantages, including preferential investment opportunities (Sen et al., 2006), lower cost of capital, improved employee recruitment and retention (Turban and Greening, 1997), and favorable consumer behavior (Marin et al., 2009). The effects of voluntary and mandatory ESG disclosure on sustainability performance may differ, similar to the effects along the extensive and intensive margins in other contexts such as international trade, labor, or credit.

Voluntary ESG disclosure is the primary source of ESG information for retail investors in Brazil. A 2022 survey by the Brazilian Securities and Exchange Commission (*Comissão de Valores Mobiliários*, CVM) shows that 71% of investors rely on voluntary ESG disclosure in

Sustainability or Integrated Reports, compared to 32% who rely on mandatory ESG disclosure in Reference Forms (CVM, 2022). This finding underscores the importance of voluntary ESG disclosure for firms as it significantly shapes stakeholders' perceptions and decisions.

Following signaling theory (Spence, 1973; Connelly et al., 2011), we derive predictions about firms' ESG reporting and performance. Firms with strong ESG performance are more likely to issue voluntary reports because they can credibly communicate their ESG commitment at a lower cost, whereas firms with weak ESG performance face higher credibility risks and are less likely to disclose (Verrecchia, 1983; Li et al., 1997). Hence, we expect “good” firms to be more likely to issue sustainability reports as a way to credibly differentiate themselves from weaker peers. In contrast, in the case of greenwashing, firms with weaker ESG performance (“bad” firms) may disclose more ESG information to manipulate perceptions, as the perceived benefits of disclosure outweigh the risks (Clarkson et al., 2008; Patten, 2002; Lagasio, 2024). However, greenwashing is unlikely to persist when scrutiny is strong, as dishonest signals lose credibility over time. Consistent with this reasoning, Marquis, Toffel, and Zhou (2016) find that poor performers under scrutiny engage less in selective disclosure, suggesting that voluntary sustainability reports issuance should, on average, be associated with stronger ESG performance.

Moreover, the direction of causality between voluntary ESG disclosure and ESG performance is not necessarily obvious. Firms may disclose ESG information to signal pre-existing strong performance, or disclosure may provide valuable information to investors and, in turn, foster subsequent improvements in ESG performance. In this study, we do not distinguish between these mechanisms; instead, we focus on the overall effect of voluntary ESG disclosure on subsequent ESG outcomes. Accordingly, we hypothesize:<sup>3</sup>

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<sup>3</sup> In the empirical analysis, we estimate a Vector Autoregressive (VAR) model to examine which direction of causality is more likely to be supported by the data.

HYPOTHESIS H1: *Voluntary ESG disclosure has a positive effect on firms' future ESG performance.*

Furthermore, the effect of voluntary ESG disclosure on future ESG performance is likely heterogeneous across firm characteristics, particularly firm size and initial ESG standing. We treat these as conceptually distinct moderators linked to different mechanisms. First, firm size is a standard proxy for information asymmetry: smaller firms face higher information frictions and may benefit more from disclosure that reduces uncertainty for outside stakeholders (Jensen and Meckling, 1976; Myers and Majluf, 1984). Second, a firm's initial ESG standing captures a reputational catch-up mechanism: firms starting from lower ESG levels ("ESG-lagging") may rely more on disclosure to signal improvement and build up credibility.

Although these dimensions are conceptually different, they may be correlated (e.g., smaller firms may also be ESG-lagging). To address this, we state separate hypotheses for each factor but also examine their overlap by documenting the joint distribution of firm size and initial ESG standing, and estimating models that include both moderators and their interaction.

HYPOTHESIS H2: *Voluntary ESG disclosure is more effective in improving future ESG performance for smaller firms (H2a - Information-asymmetry channel) and in improving future ESG performance for firms with low initial ESG standing (ESG-lagging firms) (H2b - Reputational catch-up channel).*

Mandatory ESG disclosure for listed firms is similar to the intensive margin (how much and what quality?), corresponding to the scale and scope of reporting. In Brazil, the main channel for mandatory ESG disclosure for listed firms is the CVM Reference Form (equivalent to annual reports). According to decision-usefulness information theory, stakeholders value disclosures that are high-quality and relevant (Gray et al., 1995). Prior research suggests that ESG disclosures can enhance firm performance, reduce risk, and improve stock market

outcomes (Lins et al., 2017; Benlemlih et al., 2018; Albuquerque et al., 2020; Krueger et al., 2020; Zhang et al., 2023).

Textual analysis has provided insights into disclosure quality, as linguistic characteristics such as word frequency, readability, and tone may influence how stakeholders interpret ESG information (Baier et al., 2020; Ignatov, 2023; Ferjancic et al., 2024; Li et al., 2024; Shimamura et al., 2025). For example, Du and Yu (2021) found that clearer and more positive language in CSR reports positively affects future performance. In the Brazilian context, Miralles-Quiroz et al. (2018) examined the relevance of ESG disclosures across industries, finding that environmental disclosures play a greater role in non-sensitive industries, while social and governance aspects are more significant in sensitive sectors. However, no prior study has examined the relationship between ESG disclosures and subsequent ESG performance, analyzing mandatory CVM Reference Forms in Brazil. We hypothesize:

*HYPOTHESIS H3: Greater depth and higher linguistic quality of mandatory ESG disclosure are positively associated with firms' future ESG performance.*

While prior research highlights potential mechanisms, such as stakeholder responses to clearer disclosures (e.g., market discipline, reputational effects; Zheng, 2024; Krüger, 2015) or internal behavioral changes fostered by more structured reporting (e.g., managerial learning, organizational commitment; Argote, 2013; Meyer and Allen, 1991), our analysis does not attempt to disentangle these channels. Instead, following prior work on disclosure quality (e.g., Du and Yu, 2021; Baier et al., 2020), we treat linguistic features as observable proxies of disclosure depth and quality, focusing on their association with subsequent ESG outcomes.

Textual features such as word frequency, readability, and tone are not direct measures of ESG depth and quality, but they capture the extent to which firms communicate ESG priorities in ways that are interpretable and actionable for stakeholders. A higher frequency of ESG-related terminology is used as a proxy for disclosure depth, reflecting an organization's

emphasis and prioritization of ESG issues Readability, captured through average sentence length and the proportion of complex words, is taken to proxy both depth and quality; longer sentences and technical vocabulary may indicate substantive detail (depth), but if excessive, they can reduce accessibility (quality). Tone is interpreted primarily as an indicator of disclosure quality, shaping reputational perceptions and stakeholder trust. These linguistic characteristics matter because they affect how disclosures are received, processed, and acted upon by stakeholders, which in turn may shape incentives and subsequent ESG performance.

At the same time, we acknowledge that in the context of mandatory disclosures, symbolic or compliance-driven language may dilute the informativeness of textual features, which makes empirical testing essential to determine whether these proxies capture substantive or merely symbolic aspects of ESG disclosure. One limitation is that not all ESG disclosures carry the same weight. Our operationalization assumes equal impact across ESG-related language, but this simplification overlooks variation in materiality and the possibility of symbolic disclosure. Symbolic or ceremonial ESG language, statements that signal conformity with external expectations without substantive commitments, may serve reputational purposes without altering firm behavior (Meyer and Rowan, 1977; Marquis and Qian, 2014). While our empirical strategy captures the overall effect of disclosure on subsequent ESG performance, it cannot disentangle material from symbolic components.

By jointly analyzing voluntary and mandatory ESG disclosures, we explore how firms navigate their ESG communication strategies along the extensive and intensive margins. This theoretical concept offers a unified perspective on ESG communication strategies, linking insights from disclosure theory with empirical findings. By considering both the decision to voluntarily disclose and the depth and quality of mandatory disclosure, we provide a comprehensive analysis of how ESG communication affects corporate sustainability performance in Brazil.

### 3. Data and methodology

We investigate the impact of voluntary and mandatory ESG disclosure on corporate sustainability performance in the following ways. First, to study the impact of voluntary ESG disclosure along the extensive margin, we examine whether the issuance of stand-alone sustainability reports affects firms' future ESG scores. Second, to study the scale and scope of mandatory ESG disclosure at the intensive margin, we perform a textual analysis of the Reference Forms filed with the CVM by listed Brazilian firms.

#### 3.1 Data

Our sample consists of data from 131 publicly listed Brazilian firms during the period 2012-2022. We collect firms' ESG scores and financial variables, including profitability (ROA), firm size (log of total assets), leverage (debt-to-total assets), and sector (GICS)<sup>4</sup>, from the firms' Reference Forms (annual reports) on the CVM platform and the LSEG platform (formerly Refinitiv Eikon).<sup>5</sup> We gather information on voluntary issuance of sustainability reports by manually searching company websites from 2013 onwards. The raw dataset contains 1,441 firm-year observations. After considering missing values (573 cases, primarily missing ESG scores) and applying lead- or lag definitions of variables, our final sample comprises 738 firm-year observations from the period 2012–2022.

(Insert Table 1 about here)

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<sup>4</sup> The Global Industry Classification Standard (GICS) is a standardized system developed by MSCI and Standard & Poor's to categorize firms into sectors and industries based on their primary business activities. It is widely used in finance and accounting research for consistent sector-level comparisons.

<sup>5</sup> The LSEG (formerly Refinitiv) ESG scores are based on a subset of 186 industry-relevant indicators selected from over 870 ESG metrics, aggregated into ten categories and three pillars (E, S, G). Scores are benchmarked against industry and country peers, and the ESG Combined (ESGC) score incorporates 23 types of controversies with size-adjusted severity weights. While widely adopted, these scores rely on company self-reporting and face lower disclosure quality in emerging markets, such as Brazil. Importantly, Refinitiv was the only provider offering consistent ESG scores for Brazilian firms over our full sample period (2012-2022), whereas other databases became available only after 2016 and with substantially smaller coverage.

Panel A1 of Table 1 reports summary statistics of our main sample. The sustainability report issuance indicator *SR* shows a mean of 0.81, indicating widespread voluntary reporting among the firms in the sample. *ESG Scores* exhibit substantial variation, ranging from 1.07 to 92.21, highlighting the substantial disparities in sustainability performance. To mitigate outlier effects, we winsorize *ROA* and *Leverage*. We log-transformed *Size* because of its skewness. Moreover, we differentiate the summary statistics for firms that engage in voluntary ESG disclosure (Panel A2) and those that do not (Panel A3). The mean ESG score of firms that issue voluntary ESG reports is 57.88, while it is 32.96 for other firms. Unreported t-tests confirm that the difference between these mean ESG scores is statistically significant (p-val. < 0.001).

Furthermore, to study the depth and quality of mandatory ESG disclosure, we collect the firms' CVM Reference Forms. We adopt the ESG dictionary developed by Baier, Berninger, and Kiesel (2020), translate it into Portuguese, and expand it using AI-enhanced keyword search. We then create variables related to the ESG word frequency, linguistic tone (positive or negative), and readability (Fog Index), following Loughran and McDonald (2020).

Panel B of Table 1 reports summary statistics of the variables used in the textual analysis of mandatory ESG disclosure. The variable *ESG Word Freq* (mean = 31%), measured through the word frequency variables, exhibits relatively consistent patterns across the environmental, social, and governance dimensions, with slightly left-skewed distributions. The overall frequency of ESG terms, along with *Positive Tone*, suggests that firms generally maintain a balanced use of ESG-related language. However, the *PositiveTone\_Relative* variable, which captures the relative frequency of positive versus negative words, indicates a slight preference for positive language in corporate disclosures.

Further metrics, such as the total word count, average words per sentence, and the percentage of complex words, shed light on the complexity and length of firms' reports. On average, reports contain 167,252 words, with significant variability and a highly skewed

distribution, indicating that a few firms produce exceptionally lengthy documents. The average sentence length is 15.46 words, and 36.83% of the words are classified as complex, suggesting moderate linguistic complexity. Furthermore, our measure of readability (Fog Index) has a mean value of 20.91, suggesting that the reports are written at a level requiring at least some college education to be well understood.

While the Fog Index was originally developed for English texts (Gunning, 1952), its direct application to Portuguese-language disclosures presents linguistic and syntactic challenges. To mitigate this limitation, we decomposed the index into its components - average sentence length (ASL) and the proportion of complex words - and tested them separately (see Online Appendix OA3 for details). The results suggest that the significance initially attributed to the Fog Index is largely driven by ASL, while the complex-word component does not provide consistent explanatory power. This adjustment should be seen as an exploratory step to enhance the validity of readability measures in Portuguese corporate reports, rather than as a definitive solution, and results should be interpreted cautiously given the linguistic differences between English and Portuguese.

Furthermore, we report correlations between the ESG, financial, and textual variables in the Online Appendix Table OA1.1. The results show significantly positive correlations between the overall ESG score (t+1) and its components, indicating that improvements in one ESG dimension are closely linked to improvements in others. This finding aligns with the integrated nature of ESG assessments.

The correlations between ESG scores and the textual analysis variables are smaller and less consistently significant. Notably, the frequency of environmental terms (*Word\_Frequency\_E*) shows a positive correlation with the *ESG score* (t+1) (0.1475,  $p < 0.05$ ), suggesting that firms emphasizing environmental issues in their reports may experience improvements in ESG scores over time. In contrast, the word frequency variables related to social (*Word\_Frequency\_S*) and

governance (*Word\_Frequency\_G*) topics exhibit weaker and statistically insignificant correlations (0.0336 and 0.0429, respectively), implying that the focus on these areas may have a less direct influence on ESG scores. Additionally, all ESG-related terms are correlated with higher governance scores (0.1256,  $p < 0.05$ ). The overall frequency of ESG-related terms (*Word\_Frequency\_ESG*) has a weak positive correlation with the ESG score (t+1) (0.0518), but it is not statistically significant. These findings suggest that, while there is on average some association between ESG-related language in corporate reports and future ESG performance, these relationships are not strong and might hide heterogeneity across firms.

We do not assume that word frequency, readability, or tone, deterministically cause ESG improvements. Rather, we treat them as observable proxies of disclosure depth and quality, capturing the emphasis, framing, and accessibility of ESG information. Our empirical strategy tests whether these proxies are associated with subsequent ESG outcomes after controlling for firm fundamentals and unobserved heterogeneity. This approach allows us to evaluate whether linguistic dimensions of mandatory disclosures contain incremental information that stakeholders or regulators interpret as credible commitments to ESG practices.

Finally, since ESG disclosure practices are likely to vary systematically across industries, we also explore the variation by sector; detailed sector-by-sector statistics are provided in the Online Appendix OA5. These reveal meaningful heterogeneity relevant for both voluntary sustainability report (SR) issuance and the textual analysis of mandatory disclosures. For instance, firms in Communication Services exhibit both higher SR incidence and higher ESG scores, whereas Real Estate and Health Care firms consistently lag on both dimensions. Industrials stand out for their higher leverage ratios, while Financials and Consumer Staples show relatively strong environmental performance (Table OA5.1). In terms of textual metrics, sectoral differences are less pronounced, but Information Technology reports are somewhat more complex (higher Fog Index), while Financials, Consumer Staples, IT, and Real Estate

adopt a more positive tone (Table OA5.2 – Panel B). These descriptive findings underscore the importance of controlling for sector membership in the empirical models.

### *3.2 Assessment of Potential Selection Bias*

To address potential selection bias regarding missing ESG scores in our sample, we perform additional checks. First, we document that 198 of the 491 missing ESG scores ( $\approx 40\%$ ) are attributable to firms that went public only after 2016. This indicates that a sizable portion of the missingness is structural, reflecting limited historical backfill for recent IPOs, rather than firm-level disclosure choices.

Second, we examine missing values of ESG scores by year and sector. Coverage improves sharply over time, reaching near-completeness by 2021 (Pearson  $\chi^2(10)=361.04$ ,  $p<0.001$ ), consistent with the progressive expansion of provider coverage (Table OA2.1). Missing values also vary across sectors ( $\chi^2(10)=58.40$ ,  $p<0.001$ ): IT and Real Estate exhibit higher proportions of missing data, whereas Materials and Utilities are much more complete (Table OA2.2).

Third, we compare firms with and without ESG data on observable characteristics using two-sample t-tests (Table OA2.3). Firms without scores are, on average, smaller, less leveraged, and less likely to issue sustainability reports (SR), with no meaningful differences in profitability (ROA). These patterns are consistent with voluntary disclosure theory, which predicts that firms with greater information asymmetry or lower resources are less likely to disclose ESG information (Healy and Palepu, 2001; Kim, Taylor, and Verrecchia, 2021; Gray, Kouhy, and Lavers, 1995).

Fourth, a logit model (Table OA2.4) shows that SR issuance (1.252,  $p < 0.01$ ) and Size (1.055,  $p < 0.01$ ) are positively associated with ESG availability and serve as strong predictors of coverage; profitability and leverage are not statistically significant. Time effects are meaningful - earlier years (2014–2017) are less likely to have scores, and 2020 is more likely

- again consistent with expanding coverage. The Financial sector dummy is significantly negative relative to the omitted baseline (Communication Services).

Fifth, we estimate Heckman two-step selection models (using in the first-stage selection equation the same models used in the original models) (see Table OA2.5). Across specifications, the Inverse Mills ratio  $\lambda$  is statistically significant, indicating selection is not random; however, after controlling for the selection effect, our core results remain intact: SR is robustly and positively associated with future ESG scores, and Size remains a strong predictor. Notably, leverage (Debt-to-Total Assets\_w) is excluded from the outcome equation because it is neither significantly correlated with ESG performance (see Table OA1.1 - Panel A) nor shows a statistically significant coefficient in most specifications, either in the voluntary or the mandatory sustainability disclosure analyses.

To further probe robustness, we expanded the sample by adding 51 ESG scores from S&P and Bloomberg (47 usable in the regressions to match also available financial controls). Table AOA2.6 shows that the results are qualitatively unchanged and, in some cases, stronger: SR remains positive and highly significant ( $\approx 0.04$ – $0.10$ ), Size remains positive and significant ( $\approx 0.07$ – $0.09$ ), leverage remains weak or insignificant, and year effects are estimated with greater precision.

Overall, the evidence shows that a large part of the missing values is related to recent IPOs and early coverage gaps, and although selection into coverage is nonrandom, our corrected and expanded-sample results support the same conclusions. All details are provided in the Online Appendix OA2.

### *3.3 Assessment of the relation between Size and initial ESG standing*

To further clarify our empirical strategy, we distinguish firm subgroups along two separate dimensions. First, we classify firms as *small* or *large* based on whether their total assets fall

below or above the sample median. This split captures the role of information asymmetry: smaller firms typically face higher information frictions, making external disclosure more relevant for ESG evaluations. Second, we classify firms as *ESG-lagging* or *ESG-leading* according to whether their baseline ESG scores in 2013 were below or above the sample median. This classification captures a distinct mechanism of reputational catch-up: firms with initially weaker ESG performance may rely more on disclosure to improve their ESG standing.

While these two dimensions are conceptually distinct, they may be empirically correlated. To address this possibility, Table OA4.1 presents a 2×2 cross-tabulation of firm size and initial ESG standing. The results reveal that 68.8% of small firms are ESG laggards, whereas 67.8% of large firms are ESG leaders. A Pearson chi-squared test rejects independence between the two dimensions ( $\chi^2(1) = 98.79$ ,  $p < 0.001$ ). This evidence shows the expected overlap between small firms and ESG laggards, suggesting that the moderators in H2a and H2b are not fully independent. However, the cross-tabulation also shows meaningful variation across categories, with 15.6% of the sample classified as small-leading and 16.1% as large-lagging firms. This indicates that firm size and initial ESG standing are not redundant but provide partially distinct perspectives.

We then assess the relation between these categories and observable firm characteristics. A two-sample t-test of firm size across ESG groups (Table OA4.2) reveals that ESG-leading firms are on average significantly larger than lagging firms, with a mean difference of 1.23 log-points in total assets ( $p < 0.01$ ). Conversely, comparing ESG scores across size groups (Table OA4.3) shows that large firms exhibit substantially higher baseline ESG ratings than small firms, with a mean difference of 16.9 points ( $p < 0.01$ ). These results confirm that, while correlated, the two dimensions capture different aspects of firm heterogeneity.

Finally, we examine the joint effects of firm size and initial ESG standing in a regression framework (Table OA4.4). Model (1) includes only the categorical size-ESG groups and shows

that small-leading and large-leading firms perform significantly better than small-lagging firms. Model (2) adds continuous firm size and confirms that ESG-lagging versus leading still matters once size is controlled for, with higher explanatory power ( $R^2 = 0.289$ ). Model (3) tests an interaction between size and initial ESG standing, which is small and statistically insignificant, indicating that the two moderators operate largely independently.

Taken together, this analysis demonstrates that firm size and ESG baseline performance, although correlated and partially overlapping, provide complementary lenses to understand heterogeneity in ESG dynamics. The complete set of results, including the  $2 \times 2$  classification matrix, t-tests, and regression outputs, is presented in the Online Appendix OA4.

### 3.4 Methodology

To analyze the relationship between firms' voluntary and mandatory ESG disclosure and ESG performance, we proceed as follows.

First, we carry out a descriptive analysis of ESG scores of firms that voluntarily issue sustainability reports and those that do not. We then estimate a pooled Vector Autoregressive (VAR) model with two-way equations to explore the direction of causality, as shown in equations (1a) and (1b).<sup>6</sup> In this analysis, we take the issuance of stand-alone sustainability reports (*SR*) or the *ESG Score* of firm *i* at time  $t+1$  as dependent variable, respectively, and the contemporaneous values (time *t*) of both variables as explanatory variables. We also add a vector of time-varying key firm control variables *X*, including *ROA*, *Size*, *Leverage* and *Sector*. The pooled VAR model allows us to uncover the dominant cross-sectional patterns, while accounting for average firm-level heterogeneity.

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<sup>6</sup> Two comments are in order. First, we simplify the analysis by using a linear probability model, i.e., we estimate two OLS models rather than one OLS model and one model for binary dependent variables (logit or probit). Such specification makes the model equations consistent and facilitates the inclusion of firm fixed effects. Note that we obtain similar results when we use logit or probit models. Second, we do not estimate a VAR with firm-level times-series regressions (and therefore cannot perform Granger causality tests) because our dataset contains only 11 yearly observations per firm. We therefore estimate a pooled VAR model to examine the average effects.

$$SR_{i,t+1} = \beta_0 + \beta_1 ESG\ Score_{i,t} + \beta_2 SR_{i,t} + \beta_3 X_{i,t} + \varepsilon_{i,t} \quad (1a)$$

$$ESG\ Score_{i,t+1} = \beta_0 + \beta_1 SR_{i,t} + \beta_2 ESG\ Score_{i,t} + \beta_3 X_{i,t} + \varepsilon_{i,t} \quad (1b)$$

Second, to investigate the impact of mandatory ESG disclosures on future ESG scores along the intensive margin, we perform a textual analysis of the firms' CVM Reference Forms. The publication of these Reference Forms is mandatory, but the lengths and contents of the published information vary significantly across firms. We include ESG word frequency (*ESG Word Freq*), readability (*Readability*, measured by the Fog Index), and linguistic tone (*Tone*) as main explanatory variables and the vector  $X$  with firm controls, as shown in equation (2):<sup>7</sup>

$$ESG\ Score_{i,t+1} = \beta_0 + \beta_1 ESG\ Word\ Freq_{i,t} + \beta_2 Readability_{i,t} + \beta_3 Tone_{i,t} + \beta_4 X_{i,t} + \varepsilon_{i,t} \quad (2)$$

## 4. Results

### 4.1 Average effects of voluntary ESG disclosure

First, we perform t-tests to compare the mean ESG scores (total, environmental (E), social (S), and governance (G)) at time  $t+1$  for firms that voluntarily issue sustainability reports ( $SR = 1$ ) and those that do not ( $SR = 0$ ) at time  $t$ . We find firms issuing sustainability reports ( $SR = 1$ ) have significantly higher mean values for all ESG components. The overall ESG score is 0.58 for firms that issue voluntarily sustainability reports, compared to 0.33 for non-reporting firms, with a statistically significant difference (p-val.  $< 0.001$ ). The environmental score shows the largest difference (-0.36), with firms reporting having a mean score of 0.56 versus 0.20 for non-reporting firms (p-val.  $< 0.001$ ). Similarly, the social score shows a significant difference of -0.24, and the governance score has a smaller but still significant difference of 0.13. These

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<sup>7</sup> In additional analyses, we decompose the ESG Score in its constituents E Score, S Score and G Score and separately count the frequency of E, S or G words in the reference forms. We then re-estimate model (3) for the components of the ESG score as dependent variable as well as with the separate word frequency of E, S and G words, respectively.

results suggest that voluntary ESG disclosure is associated with higher future ESG scores and higher values for the sub-scores on E, S, and G.

We next examine the direction of causality between the issuance of sustainability reports (*SR*) and *ESG Scores*, estimating the pooled Vector Autoregressive (VAR) model, as shown in the equations (1a) and (1b). Table 2 reports the results.

(Insert Table 2 here)

We find that issuing sustainability reports (*SR*) in one period is significantly positively related to ESG scores in the next period. We do not find a significant effect of current ESG scores on future issuance of SR. Hence, these findings suggest that the dominant direction of causality goes from ESG disclosure to future ESG performance.<sup>8</sup> Based on this evidence, we estimate a set of regression models to assess the impact of voluntary ESG disclosure, measured by the issuance of *SR* at time *t*, on firms' *ESG Scores* at time *t*+1. Table 3 reports the results.

(Insert Table 3)

Table 3 shows a positive relationship, though the magnitude of the effect varies across different models. In the most basic model without controls (Model 1), the coefficient for SR is 0.0919, but it decreases to 0.0329 in more stringent models (Model 7) that control for financial variables and firm fixed effects.

The environmental score shows the most significant and consistent effect, with coefficients ranging from 0.138 in Model 1 to 0.0838 in Model 7. The social score shows a positive effect in the first models, which decreases when we add controls. The Governance score shows the smallest effect and is significant only in the basic model. Financial controls like ROA and Size

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<sup>8</sup> In preliminary analyses without firm fixed effects, we find two-way linkages in the pooled VAR model. However, the significant coefficient of the ESG score (*t*) in the regression with *SR* (*t*+1) as the dependent variable flips the sign and becomes insignificant when we add the firm fixed effects. In contrast, the significant coefficient of *SR* (*t*) in the regression with *ESG Score* (*t*+1) as the dependent variable remains significant even when we add the firm fixed effects.

are positively associated with ESG scores, suggesting that more profitable and larger firms tend to perform better. Leverage, however, does not significantly influence ESG scores.

These results indicate that the positive impact of voluntary disclosure is concentrated in the environmental (E) pillar. This finding is plausible in the Brazilian context, where issues such as deforestation, carbon emissions, and natural resource exploitation are at the forefront of regulatory scrutiny and public debate. Consequently, sustainability reports may place greater emphasis on environmental aspects, making them more salient for rating agencies and stakeholders (Lagasio, 2024).

In the next step, we estimate a dynamic panel data model that addresses potential concerns about endogeneity and serial correlation. In the Online Appendix Table OA1.2, we present the results of the Arellano-Bond estimation. The findings indicate that SR continues to have a significant positive effect on overall ESG scores (0.0288,  $p < 0.01$ ) and Environmental scores (0.0504,  $p < 0.01$ ) in the subsequent period, suggesting that sustainability reporting is particularly associated with improvements in the E pillar of ESG performance. For the social and governance scores, the effects of SR are positive but not statistically significant, indicating a less pronounced impact in these dimensions.

The diagnostic tests confirm the validity of the model specification. As expected in dynamic panel models, the AR(1) test indicates first-order autocorrelation in residuals, while the AR(2) test shows no evidence of second-order autocorrelation ( $p\text{-val.} > 0.474$ ), which supports the absence of misspecification. The Hansen and Sargan tests further indicate instrument validity, with no evidence of overidentifying restrictions. The Wald  $\chi^2$  statistics are highly significant across all models, confirming strong joint explanatory power. While conventional unit root tests are not reliable in short panels, the Arellano-Bond framework is appropriate for weak stationary processes, and the persistence of ESG scores is consistent with this assumption.

Finally, the previous analysis of voluntary ESG disclosure may be subject to selection bias. To address this concern, we employ Propensity Score Matching (PSM), controlling for firm size, sector, ROA, and leverage, which are key factors influencing both ESG performance and the likelihood of voluntary disclosure. Using data from 2016–2019, a sub-period with a balanced distribution of voluntary sustainability report issuers and non-issuers, we applied kernel matching, which minimizes the mean bias while retaining sample size. Balance diagnostics (Table OA1.3, and Figure OA1.1) show that standardized mean differences across covariates are substantially reduced after matching, with most variables falling below the conventional 0.25 threshold. This indicates reduced bias and improved comparability between treatment and control groups. Online Appendix Table OA1.3a presents the regression analysis on the matched sample, confirming a significantly positive relationship between SR issuance in  $t$  and ESG scores in  $t+1$ .

Overall, our findings are consistent with Hypothesis H1 and indicate that voluntary ESG disclosure has a positive effect on firms' future ESG performance, especially in the environmental domain and with smaller effects for the social and governance components.

#### *4.2 Heterogeneous effects of voluntary ESG disclosure*

To further explore the relationships, we differentiate the analysis by firm size, which is a proxy for asymmetric information (or firm transparency), and their initial ESG standing (ESG score below or above the 2013 sample median), which might influence the marginal impact of voluntary reporting.

Table 4 reports the results for the firm size split. We find that voluntary ESG disclosure significantly improves the ESG performance of smaller firms, especially in environmental and governance dimensions. The effect on the social component, though positive, is less consistent. These results highlight the importance of sustainability reporting in improving ESG practices

in smaller firms. For larger firms, the impact of sustainability reporting on ESG performance is positive and statistically significant only in the basic model, without controls. This finding is plausible as larger firms tend to disclose more information and be more transparent.

(Insert Table 4 here)

Furthermore, Table 5 reports the results by ESG-lagging firms. Interestingly, for firms with lower initial ESG standing, voluntary sustainability reporting significantly helps to improve future ESG scores, notably in the environmental domain. In contrast, for firms with higher initial ESG standing, the impact of reporting is weaker and not statistically significant.

(Insert Table 5 here)

In sum, the heterogeneous results above suggest that the positive impact of voluntary sustainability reporting on ESG scores is particularly strong for smaller firms and firms with lower initial ESG standings. These findings support Hypotheses H2a and H2b and confirm the ‘participation’ effects at the extensive margin documented in other economic contexts.

#### *4.3 Average effects of mandatory ESG disclosure*

We now turn to our textual analysis of the impact of mandatory ESG disclosure with CVM Reference Forms on firms’ ESG performance. Table 6 reports the results for the effects of various word frequency metrics related to ESG, readability (the Fog Index), and the linguistic tone (PositiveToneRelative1) on the *ESG Score* at time  $t+1$ , as earlier shown in equation (3).

(Insert Table 6 here)

The coefficients for the word frequency variables exhibit varying levels of magnitude, statistical significance, and direction of impact on ESG scores. For instance, *Word\_Frequency\_E* is statistically significant at the 10% level in the first model, suggesting a positive association with future ESG scores. However, this significance disappears in more

stringent models. Similarly, *Word\_Frequency\_G* shows a negative and statistically significant association with ESG scores in Model (2), but this effect is not consistent across the models.

The Fog Index, our measure of readability or textual complexity, demonstrates a positive and statistically significant effect on ESG scores across multiple models, particularly in Models (1) and (3). This suggests that more complex reports, as indicated by higher Fog Index values, are associated with higher future ESG scores, potentially indicating greater compliance with the three ESG pillars. However, additional robustness checks show that the observed effect of the Fog Index is primarily explained by average sentence length rather than by the proportion of complex words. Longer sentences are associated with higher ESG scores, whereas the complexity component of the index is not robust. These results are consistent with prior findings that readability effects are often driven by sentence length in empirical applications (Loughran & McDonald, 2014). They also highlight the need for further development of readability tools tailored to Portuguese (see Online Appendix OA3). On the other hand, the linguistic tone variable *PositiveToneRelative1* does not significantly affect the ESG scores in any of the models.

Financial controls such as ROA and Size are statistically significant in more stringent models, indicating their importance in explaining future ESG scores. The variations in significance and coefficients across models underscore the importance of considering different model specifications, such as the addition of firm fixed effects, year dummies, and sector dummies, which we add in various combinations across the seven models. The models also differ in their use of fixed effects, with some specifications controlling for firm-specific factors (e.g., Models 3 and 7), helping to account for unobserved heterogeneity.

Overall, the mandatory disclosure models yield moderately consistent results, but the findings are weaker and less stable across specifications compared with those of voluntary reporting. This pattern suggests that the effects of mandatory ESG communication are context-

dependent and less robust than expected. Hence, the findings should be interpreted with caution, as they do not allow unambiguous claims about the strength or direction of the effects.

Our textual analysis further indicates that while ESG word frequency, readability, and tone provide some insight into disclosure informativeness, their predictive power is limited and inconsistent. These proxies appear to reflect symbolic or compliance-driven elements more than substantive ESG practices. In addition, readability and tone metrics were developed primarily for English texts, making their application to Portuguese corporate filings exploratory. Taken together, these constraints imply that the results should be viewed as suggestive rather than conclusive.

In an additional analysis, we estimate a regression model in first differences, analyzing how changes in the ESG word frequencies, textual complexity (Fog Index), tone (Positive Tone), and financial variables affect future changes in ESG scores and their components (Environmental, Social, and Governance). This approach isolates within-firm variations to understand how changes in predictors influence ESG performance over time. We find that changes in frequency of E words from one year to another have the most notable impact, showing a strong, positive, and statistically significant effect on changes in firms' Environmental scores (coefficient: 2.593, p-val. < 0.01). Other findings indicate that changes in Social word frequency or Positive Tone have weaker or inconsistent effects on Social scores, with the latter shows a marginally significantly negative effect (coefficient: -0.367, p-val. < 0.1). For Governance scores, none of the predictors, including Governance word frequency and financial variables, display significant effects.

Furthermore, we estimate a dynamic panel data regression model to address concerns about endogeneity and serial correlation. Online Appendix Table OA1.4 presents the results of the Arellano-Bond estimation, which assesses the impact of ESG-related word frequency on firms'

future ESG performance. Four specifications examine the direct effects of overall ESG word frequency and its individual components on ESG scores in the subsequent period.

The findings indicate a highly significant positive effect of overall ESG word frequency on future ESG scores (coefficient = 0.629,  $p < 0.01$ ). This suggests that firms placing greater emphasis on ESG terms in their mandatory disclosures tend to improve subsequent ESG performance. Among the controls, return on assets (ROA) consistently shows a significant positive impact, while size and leverage display more limited effects. In the second and third specifications, environmental (Word\_Frequency\_E) and social (Word\_Frequency\_S) word frequencies are positive but not statistically significant. By contrast, governance-related word frequency (Word\_Frequency\_G) in the fourth specification exhibits a significant positive association with future ESG scores (coefficient = 0.617,  $p < 0.05$ ). This highlights governance communication as a key driver of ESG improvements. Finally, textual complexity (Fog Index) and tone (Positive Tone) do not display significant effects, suggesting that neither disclosure complexity nor linguistic framing materially influences ESG outcomes.

The diagnostic tests generally support the validity of the dynamic panel specification. As expected in dynamic models, the AR(1) test indicates first-order autocorrelation, while the AR(2) test confirms the absence of second-order autocorrelation ( $p$ -values  $\approx 0.21$ – $0.25$ ), ensuring the consistency of the estimates. The Hansen test results are broadly supportive of instrument validity, although the relatively low  $p$ -values in some specifications call for cautious interpretation. The Sargan test also does not reject the null of instrument validity, further strengthening the reliability of the results. The Wald  $\chi^2$  statistics are highly significant across all models, confirming strong joint explanatory power. This evidence suggests that the Arellano-Bond estimates are robust and appropriately specified.

Overall, the results underscore the importance of targeted communication strategies. Governance-focused disclosures emerge as particularly influential in improving ESG

performance, while environmentally or socially focused language may require more deliberate integration into firms' strategies to achieve significant impacts.

#### *4.4 Heterogeneous effects of mandatory ESG disclosure*

In order to gain insights into the heterogeneous effects of mandatory ESG disclosures in Reference Forms on future ESG performance, we again differentiate by firm size and initial ESG standing.

First, we differentiate by firm size. Table 7 presents the regression results for firms with total assets above the median ("large" firms).

(Insert Table 7 here)

Across different specifications, the combined ESG word frequency variable shows a positive and statistically significant effect in some models, specifically in Models (1) and (3). These findings suggest that large firms that emphasize ESG-related terms in their mandatory disclosures tend to see improvements in their future ESG ratings. However, this relationship is not consistent across all models, with the word frequency coefficient becoming statistically insignificant in other specifications, such as Models (2) and (4)-(7).

The *Fog Index* consistently shows no statistically significant relationship with ESG scores across all models, suggesting that the complexity of text, as captured by this readability measure, does not play a critical role in determining ESG performance for large firms. Similarly, the *Positive Tone* variable does not have a significant impact on ESG scores, reinforcing the notion that the tone of communication is not a key determinant of future ESG performance for these firms.

Additionally, separate regressions for Environmental (E), Social (S), and Governance (G) word frequencies do not show statistically significant effects on ESG scores for large firms,

indicating that the overall ESG communication may be more relevant than focusing on individual ESG dimensions for predicting future performance.

Second, we differentiate the analysis by initial ESG standing. Table 8 reports the results.

(Insert Table 8 here)

For ESG-leading firms (those with initial ESG scores above the 2013 median), the frequency of ESG-related words is positively associated with future ESG scores. Environmental terms consistently exhibit a statistically significant positive effect in most models, underscoring their importance in maintaining and improving ESG performance among ESG-leading firms. Social and governance terms initially show positive effects, but their significance diminishes when we add financial controls and fixed effects.

Neither the linguistic tone of the reports (*PositiveToneRelative1*) nor their readability (*FogIndex*) shows a significant impact on future ESG performance. These findings suggest that the contents matter more than tone or language complexity for these firms.

Overall, the results highlight that for firms with higher initial ESG standing, the frequency and focus of ESG-related content play a crucial role in driving future ESG performance, while other factors like readability and tone appear less relevant. For ESG-lagging firms, the overall frequency of ESG-related terms does not show consistent or significant effects on future ESG scores. However, the complexity of the text, as measured by the Fog Index, is positively related to future ESG Scores across all models. This suggests that for firms with initially low ESG scores, more detailed and nuanced reporting may be linked to better future performance.

In sum, the heterogeneous effects of mandatory ESG disclosure indicate that firm characteristics, such as size and initial ESG standing, as well as the complexity of ESG disclosures, have an impact on firms' future ESG performance. These findings suggest that, at the intensive margin, larger firms and particularly those with higher initial ESG scores tend to

benefit more from ESG disclosures, although the impact remains nuanced and contingent on multiple firm-specific factors.

Finally, we synthesize the main findings on the effects of voluntary and mandatory ESG disclosure in Table 9. We summarize the effects on overall and pillar-level ESG scores, distinguishing firms by firm size and initial ESG standing.

(Insert Table 9 here)

## 5. Conclusions

In this study, we investigate the impact of ESG information disclosure on corporate sustainability performance for listed firms in Brazil. Building on the concept of extensive and intensive margins, we differentiate between the effects of voluntary and mandatory ESG disclosure.

First, we show that voluntary ESG disclosure (extensive margin) positively influences firms' future ESG scores, particularly in the environmental domain, and for smaller and "ESG-lagging" firms. Second, using textual analysis of Reference Forms, we investigate the impact of mandatory ESG disclosures (intensive margin) on future ESG performance. We analyze the impact of ESG-related word frequency, language complexity, and linguistic tone. Firms with above-median initial ESG scores benefit from informative and focused ESG communication, particularly in the environmental dimension.

The results are driven by economic factors related to extensive and intensive margins. For smaller and ESG-lagging firms, initiating voluntary reporting (extensive margin) has a significant positive effect at the extensive margin, similar to financially constrained firms that gain access to credit or countries that start participating in international trade. For larger and, especially, ESG-leading firms, already actively participating in sustainability practices, the focus shifts to the depth and the quality of disclosures, with significant positive effect at the

intensive margin, similar to how financially stable firms strive for favorable credit terms. Additional analyses confirm that, while firm size and initial ESG standing are correlated, their partial overlap does not explain our main results.

The results highlight the need for tailored ESG reporting strategies based on firm-specific contexts, such as firm size and initial ESG standing. Policymakers and corporate managers can use these insights to design more effective and strategic ESG disclosure policies. Moreover, the findings underline the importance of aligning ESG communication with actual performance to reduce the risks of symbolic reporting.

The effect of voluntary disclosure is not evenly distributed across ESG pillars. The environmental domain appears to be the primary channel through which voluntary reporting influences ESG scores, while the effects on social and governance scores are smaller and more context-dependent. This pattern underscores the importance of considering pillar-level heterogeneity in interpreting the impact of sustainability reporting.

Our findings on the relationship between voluntary sustainability reporting and ESG scores are consistent with signaling theory. Good firms appear more likely to issue sustainability reports as credible signals, consistent with a separating equilibrium. Greenwashing is theoretically possible, but it represents a special case of signaling and is less consistent with our empirical evidence. This interpretation is fully consistent with Marquis, Toffel, and Zhou (2016), who find that poor performers are less prone to selective disclosure when there is scrutiny, making voluntary disclosure more likely for good firms.

Our study points to a clearer effect of voluntary disclosure on ESG performance compared to mandatory disclosure. The results on mandatory disclosure are inconsistent and unstable across analyses and should be treated as preliminary. One explanation for the latter lies in the use of textual complexity measures. The Fog Index was originally developed for English, and its application to Portuguese texts remains exploratory. We show that results are primarily

driven by average sentence length and not by the proportion of complex words. Another possible explanation is that the textual measures consider all ESG-related language as equivalent; they do not distinguish between material and symbolic disclosures.

Additionally, in mandatory reporting regimes, language often serves symbolic or compliance-driven purposes, limiting the extent to which word frequency, tone, or readability capture genuine ESG practices. While our results indicate that certain linguistic features have predictive value, these effects are contingent on firm characteristics. Hence, the differences between voluntary and mandatory ESG disclosure results may also reflect the interplay of signaling dynamics and institutional constraints. Future research could draw on materiality frameworks (e.g., SASB, IFRS S1) or apply linguistic techniques to distinguish symbolic from substantive ESG disclosure.

Overall, our paper advances our understanding of ESG disclosure strategies by documenting how voluntary and mandatory disclosures influence firms' future corporate sustainability performance in an emerging market context. It provides practical guidance for firms, investors, and policymakers seeking to shape and evaluate ESG practices and policies.

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**Table 1: Summary statistics**

This table presents summary statistics for the main variables analyzed in both voluntary and mandatory ESG disclosures. Panel A1 reports statistics for the full sample of voluntary ESG disclosure (non-missing values). Panel A2 presents statistics for firms that issued a Sustainability Report (SR = 1), while Panel A3 covers firms that did not (SR = 0). Panel B provides statistics for the complete sample of mandatory ESG disclosure, also considering non-missing values. The reported statistics include the mean, standard deviation, minimum, maximum, 5th percentile, median (50th percentile), and 95th percentile. ROA, Leverage (debt-to-total assets), FogIndex, and ESG Word Frequencies have been winsorized at the 2.5% and 97.5% percentiles. Total Assets are reported in BRL billion, and Size is the natural logarithm of Total Assets.

**Panel A1: Full sample used in the analysis of voluntary ESG disclosure**

Variable	Obs.	Mean	St. dev.	Min	p5	p50	p95	Max
SR	738	0.81	0.39	0.00	0.00	1.00	1.00	1.00
ESG score <sub>t+1</sub>	738	53.09	20.86	1.07	16.87	55.93	83.87	92.21
E score <sub>t+1</sub>	738	48.85	27.02	0.00	0.93	52.11	88.21	96.28
S score <sub>t+1</sub>	738	56.06	23.61	0.78	11.75	59.04	89.94	96.72
G score <sub>t+1</sub>	738	53.71	21.72	0.83	17.51	56.04	86.38	95.52
ROA	738	3.94	6.44	-13.84	-9.10	4.00	14.91	19.39
Total Assets	738	102.77	289.31	1.06	3.51	20.66	793.38	2,069.21
Size	738	23.89	1.45	20.78	21.98	23.75	27.40	28.36
Leverage	738	34.31	17.30	3.01	6.08	32.81	66.99	73.30

Panel A2: Firms that issued a Sustainability Report (SR = 1)

Variable	Obs.	Mean	St. dev.	Min	p5	p50	p95	Max
ESG score <sub>t+1</sub>	596	57.88	18.56	1.07	24.47	59.58	85.3	92.21
E score <sub>t+1</sub>	596	55.71	23.22	0	11.89	59.28	88.79	96.28
S score <sub>t+1</sub>	596	60.76	21.43	1.77	22.98	63.38	90.99	96.72
G score <sub>t+1</sub>	596	56.25	20.91	0.83	20.03	59.06	87.75	95.52
ROA	596	4.54	5.81	-13.84	-5.28	4.39	14.91	19.39
Total Assets	596	123.20	317.98	1.77	4.50	27.14	926.20	2069.21
Size	596	24.14	1.43	21.29	22.23	24.02	27.55	28.36
Leverage	596	34.80	17.29	3.01	6.27	33.01	67.17	73.30

Panel A3: Firms that did not issue a Sustainability Report (SR = 0)

Variable	Obs.	Mean	St. dev.	Min	p5	p50	p95	Max
ESG score <sub>t+1</sub>	142	32.96	17.78	5.23	6.74	28.75	65.25	79.81
E score <sub>t+1</sub>	142	20.06	22.53	0	0	10.60	66.17	81.44
S score <sub>t+1</sub>	142	36.35	22.12	0.78	2.63	33.34	75.92	83.74
G score <sub>t+1</sub>	142	43.05	21.87	6.69	13.04	40.33	79.18	92.18
ROA	142	1.45	8.17	-13.84	-13.84	1.80	14.80	19.39
Total Assets	142	17.00	40.67	1.06	1.63	8.26	59.56	453.05
Size	142	22.86	1.06	20.78	21.21	22.83	24.81	26.84
Leverage	142	32.27	17.23	3.01	3.65	31.93	64.12	73.30

Panel B: Sample used in the textual analysis of mandatory disclosure

Variable	Obs.	Mean	St. dev.	Min	p5	p50	p95	Max
ESG score <sub>t+1</sub>	795	51.60	21.02	1.07	14.69	53.62	82.66	92.21
E score <sub>t+1</sub>	795	47.48	26.97	0.00	0.00	50.56	87.48	96.28
S score <sub>t+1</sub>	795	54.86	24.01	0.66	9.30	58.08	88.93	96.86
G score <sub>t+1</sub>	795	52.05	22.22	0.83	15.20	53.90	84.75	95.52
ROA	795	0.04	0.06	-0.14	-0.08	0.04	0.15	0.19
Total Assets	795	102.00	285.00	1.06	3.54	20.40	793.00	2,070.00
Size	795	23.89	1.45	20.78	21.99	23.74	27.40	28.36
Leverage	795	0.34	0.17	0.03	0.06	0.33	0.66	0.73
Release	795	12.84	5.99	2.00	5.00	12.00	25.00	40.00
Total Words	795	167,252	63,189	56,626	91,177	154,048	280,414	469,961
Avg Sentence Length	795	15.46	2.52	9.66	11.56	15.53	20.14	26.05
% Complex Words	795	36.83	0.89	34.99	35.28	36.84	38.29	38.66
FogIndex	795	20.91	1.03	19.15	19.31	20.91	22.79	23.40
Word_Frequency_ESG	795	0.31	0.01	0.28	0.29	0.31	0.33	0.33
Word_Frequency_E	795	0.17	0.01	0.15	0.15	0.17	0.18	0.18
Word_Frequency_S	795	0.22	0.01	0.20	0.20	0.22	0.24	0.24
Word_Frequency_G	795	0.25	0.01	0.22	0.23	0.25	0.27	0.27
PositiveTone_Relative <sub>1</sub>	795	0.37	0.04	0.23	0.30	0.37	0.45	0.52

**Table 2: VAR model of voluntary ESG disclosure and ESG scores**

This table presents the results of a pooled Vector Autoregressive Regression analysis, examining the possible two-way relationships between the issuance of Sustainability Reports (SR) and ESG scores for the full sample of firms. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively.

Variable	(1) SR <sub>t+1</sub>	(2) ESG Score <sub>t+1</sub>
ESG Score <sub>t</sub>	-0.0448 (0.0972)	0.714*** (0.0280)
SR <sub>t</sub>	0.439*** (0.0340)	0.0334*** (0.00980)
Firm FE	Yes	Yes
Number of observations	738	738
R <sup>2</sup>	0.215	0.535

**Table 3: The effect of voluntary ESG disclosure on future ESG scores**

The rows in this table present the regression results on the impact of issuing Sustainability Reports (SR) in year t on the future ESG score, as well as on the E score, S score, and G score, respectively. Columns (1) to (7) represent different model specifications, incorporating various controls such as financial controls, time, industry, and firm fixed effects. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>ESG score<sub>t+1</sub></b>							
SR t	0.0919*** (0.0243)	0.0699*** (0.0230)	0.0449* (0.0237)	0.0504** (0.0210)	0.0476** (0.0211)	0.0397* (0.0214)	0.0329 (0.0219)
R <sup>2</sup>	0.222	0.114	0.150	0.323	0.365	0.183	0.202
<b>E score<sub>t+1</sub></b>							
SR t	0.138*** (0.0359)	0.132*** (0.0341)	0.0953** (0.0365)	0.0983*** (0.0315)	0.0948*** (0.0320)	0.0844** (0.0332)	0.0838** (0.0336)
R <sup>2</sup>	0.271	0.240	0.089	0.416	0.430	0.122	0.125
<b>S score<sub>t+1</sub></b>							
SR t	0.0810*** (0.0298)	0.0720** (0.0290)	0.0383 (0.0300)	0.0398 (0.0269)	0.0387 (0.0271)	0.0269 (0.0273)	0.0269 (0.0284)
R <sup>2</sup>	0.271	0.240	0.089	0.416	0.430	0.122	0.125
<b>G score<sub>t+1</sub></b>							
SR t	0.0710*** (0.0219)	0.0351 (0.0216)	0.0172 (0.0222)	0.0306 (0.0204)	0.0246 (0.0203)	0.0171 (0.0214)	0.00438 (0.0205)
R <sup>2</sup>	0.0575	0.0136	0.155	0.0558	0.105	0.147	0.191
Financial controls	No	No	No	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	No	No	No	Yes
Industry FE	No	No	No	No	Yes	No	No
Firm FE	No	No	Yes	No	No	Yes	Yes
Cluster (id)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	738	738	738	738	738	738	738

**Table 4: The effect of voluntary ESG disclosure on ESG scores for smaller firms**

This table presents the summary of regression results for smaller firms, defined as those with total assets below the median. The dependent variables are the ESG score and its components (E score, S score, G score) at time t+1. The key explanatory variable is the issuance of Sustainability Reports (SR) at time t. The table includes various model specifications that account for different combinations of financial controls, time fixed effects (Time FE), industry fixed effects (Industry FE), and firm fixed effects (Firm FE). Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>ESG score<sub>t+1</sub></b>							
SR t	0.106*** (0.0342)	0.103*** (0.0305)	0.0871** (0.0341)	0.0819*** (0.0278)	0.0831*** (0.0285)	0.0806*** (0.0291)	0.0767*** (0.0289)
R <sup>2</sup>	0.234	0.212	0.122	0.243	0.256	0.189	0.195
<b>E score<sub>t+1</sub></b>							
SR t	0.168*** (0.0478)	0.162*** (0.0422)	0.134*** (0.0488)	0.146*** (0.0403)	0.147*** (0.0420)	0.140*** (0.0442)	0.127*** (0.0439)
R <sup>2</sup>	0.317	0.296	0.158	0.355	0.313	0.177	0.191
<b>S score<sub>t+1</sub></b>							
SR t	0.0886** (0.0431)	0.0947** (0.0394)	0.0723 (0.0445)	0.0609* (0.0370)	0.0644* (0.0382)	0.0593 (0.0393)	0.0593 (0.0401)
R <sup>2</sup>	0.155	0.164	0.047	0.202	0.185	0.0977	0.101
<b>G score<sub>t+1</sub></b>							
SR t	0.0693*** (0.0241)	0.0667*** (0.0240)	0.0620** (0.0258)	0.0475*** (0.0174)	0.0476*** (0.0176)	0.0495*** (0.0171)	0.0513*** (0.0172)
R <sup>2</sup>	0.0599	0.0472	0.066	0.0187	0.141	0.158	0.167
Financial controls	No	No	No	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	No	No	No	Yes
Industry FE	No	No	No	No	Yes	No	No
Firm FE	No	No	Yes	No	No	Yes	Yes
Cluster (id)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	369	369	369	369	369	369	369

**Table 5: The effect of voluntary ESG disclosure on ESG scores for ESG-lagging firms**

This table presents the summary of regression results for firms lagging in ESG performance, defined as those with ESG scores below the median in 2013. The dependent variables are the ESG score and its components (E score, S score, G score) at time  $t+1$ . The primary explanatory variable is the issuance of Sustainability Reports (SR) at time  $t$ . The table includes seven different model specifications, varying by the inclusion of financial controls, time fixed effects (Time FE), industry fixed effects (Industry FE), and firm fixed effects (Firm FE). Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>ESG score <math>t+1</math></b>							
SR $t$	0.102*** (0.0280)	0.0906*** (0.0270)	0.0682** (0.0324)	0.0741*** (0.0269)	0.0712*** (0.0270)	0.0659** (0.0295)	0.0531* (0.0307)
R2	0.174	0.148	0.141	0.204	0.313	0.175	0.196
<b>E score <math>t+1</math></b>							
SR $t$	0.160*** (0.0424)	0.165*** (0.0395)	0.119** (0.0497)	0.130*** (0.0392)	0.129*** (0.0404)	0.116** (0.0451)	0.110** (0.0466)
R2	0.259	0.274	0.115	0.343	0.433	0.108	0.128
<b>S score <math>t+1</math></b>							
SR $t$	0.0959*** (0.0365)	0.0855** (0.0357)	0.0606 (0.0420)	0.0596* (0.0347)	0.0606* (0.0351)	0.0546 (0.0377)	0.0546 (0.0398)
R2	0.0956	0.0826	0.066	0.157	0.203	0.0989	0.108
<b>G score <math>t+1</math></b>							
SR $t$	0.0561** (0.0246)	0.0358 (0.0263)	0.0377 (0.0282)	0.0382 (0.0249)	0.0324 (0.0250)	0.0356 (0.0282)	0.0226 (0.0292)
R2	0.00552	1.09e-05	0.0889	2.10e-06	0.106	0.141	0.160
Financial controls	No	No	No	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	No	No	No	Yes
Industry FE	No	No	No	No	Yes	No	No
Firm FE	No	No	Yes	No	No	Yes	Yes
Cluster (id)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	373	373	373	373	373	373	373

**Table 6: Textual analysis of the effects of mandatory ESG disclosure on ESG scores**

This table summarizes regression analyses examining the direct effects of ESG word frequencies on ESG scores. Panel A presents the results for overall ESG word frequency, while Panel B shows the results for word frequencies related to Environmental (E), Social (S), and Governance (G) aspects. Various models include different combinations of financial controls, time fixed effects, industry fixed effects, and firm fixed effects. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively.

		Panel A: The effect of ESG words						
Variable		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		ESG score <sub>t+1</sub>						
	Word_Frequency_ESG	0.890 (0.719)	-0.777 (0.694)	0.919 (0.750)	0.111 (0.637)	0.0890 (0.651)	0.0378 (0.687)	-0.632 (0.693)
ESG Word Frequency	FogIndex	0.0227** (0.0101)	0.0178* (0.0101)	0.0274** (0.0108)	0.0157 (0.00962)	0.0152 (0.00992)	0.0162 (0.0108)	0.0159 (0.0108)
	PositiveToneRelative	-0.361 (0.269)	-0.308 (0.269)	-0.334 (0.289)	-0.212 (0.225)	-0.183 (0.232)	-0.211 (0.246)	-0.205 (0.259)
Financial Controls		No	No	No	Yes	Yes	Yes	Yes
Time FE		No	Yes	Yes	No	No	No	Yes
Industry FE		No	No	No	No	Yes	No	No
Firm FE		No	No	Yes	No	No	Yes	Yes
Cluster (id)		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations		795	795	795	795	795	795	795

Panel B: The effect of E, S, and G words

Variable		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		ESG score <sub>t+1</sub>						
E Word Frequency	Word_Frequency_E	2.180*	0.0318	1.978	0.691	0.609	0.506	-0.331
		(1.155)	(1.144)	(1.232)	(1.053)	(1.065)	(1.126)	(1.161)
	FogIndex	0.0212**	0.0139	0.0269**	0.0142	0.0138	0.0149	0.0138
		(0.0103)	(0.0102)	(0.0110)	(0.00975)	(0.0101)	(0.0108)	(0.0110)
	PositiveToneRelative	-0.328	-0.299	-0.310	-0.199	-0.172	-0.201	-0.202
		(0.265)	(0.270)	(0.285)	(0.223)	(0.231)	(0.246)	(0.259)
S Word Frequency	Word_Frequency_S	1.551	-0.442	1.718	0.240	0.189	0.200	-0.511
		(0.994)	(0.946)	(1.051)	(0.946)	(0.952)	(1.015)	(1.000)
	FogIndex	0.0201*	0.0160	0.0241**	0.0151	0.0148	0.0154	0.0151
		(0.0108)	(0.0109)	(0.0114)	(0.0105)	(0.0108)	(0.0116)	(0.0117)
	PositiveToneRelative	-0.325	-0.312	-0.296	-0.206	-0.178	-0.206	-0.210
		(0.261)	(0.266)	(0.280)	(0.218)	(0.226)	(0.240)	(0.255)
G Word Frequency	Word_Frequency_G	0.547	-1.331*	0.557	-0.172	-0.157	-0.207	-1.015
		(0.844)	(0.788)	(0.887)	(0.706)	(0.727)	(0.769)	(0.763)
	FogIndex	0.0262***	0.0183*	0.0310***	0.0172*	0.0165*	0.0173*	0.0161
		(0.00968)	(0.00980)	(0.0104)	(0.00916)	(0.00946)	(0.0103)	(0.0105)
	PositiveToneRelative	-0.371	-0.311	-0.344	-0.216	-0.188	-0.217	-0.213
		(0.268)	(0.267)	(0.288)	(0.223)	(0.230)	(0.244)	(0.258)
Financial Controls		No	No	No	Yes	Yes	Yes	Yes
Time FE		No	Yes	Yes	No	No	No	Yes
Industry FE		No	No	No	No	Yes	No	No
Firm FE		No	No	Yes	No	No	Yes	Yes
Cluster (id)		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations		795	795	795	795	795	795	795

**Table 7: Textual analysis of the effects of mandatory ESG disclosure on ESG scores for larger firms**

This table summarizes the regression analyses examining the direct effects of ESG-related word frequencies on ESG scores for larger firms (those above the median total assets). Panel A presents the results for the overall ESG word frequency, while Panel B shows the results for word frequencies related to Environmental (E), Social (S), and Governance (G) aspects. The regressions include varying combinations of financial controls, time fixed effects, industry fixed effects, and firm fixed effects across the models. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively.

		Panel A: The effect of ESG words						
Variable		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		ESG score <sub>t+1</sub>						
ESG Word Frequency	Word_Frequency_ESG	2.094*	-0.0208	2.093*	0.883	0.763	0.261	-0.203
		(1.123)	(0.851)	(1.238)	(1.003)	(1.013)	(1.063)	(0.930)
	FogIndex	0.00714	-0.00360	0.00977	0.00607	0.00345	0.00338	-0.00126
		(0.0153)	(0.0179)	(0.0181)	(0.0155)	(0.0164)	(0.0194)	(0.0206)
	PositiveToneRelative	-0.455	-0.328	-0.478	-0.296	-0.232	-0.226	-0.238
		(0.431)	(0.398)	(0.505)	(0.376)	(0.404)	(0.445)	(0.456)
Financial Controls		No	No	No	Yes	Yes	Yes	Yes
Time FE		No	Yes	Yes	No	No	No	Yes
Industry FE		No	No	No	No	Yes	No	No
Firm FE		No	No	Yes	No	No	Yes	Yes
Cluster (id)		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations		398	398	398	398	398	398	398

Panel B: The effect of E, S, and G words

Variable		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		ESG score <sub>t+1</sub>						
E Word Frequency	Word_Frequency_E	2.208 (1.570)	-1.115 (1.204)	2.130 (1.725)	-0.160 (1.347)	-0.394 (1.344)	-1.152 (1.417)	-2.037 (1.307)
	FogIndex	0.0142 (0.0150)	0.000138 (0.0173)	0.0172 (0.0177)	0.0143 (0.0149)	0.0116 (0.0159)	0.0109 (0.0185)	0.00494 (0.0197)
	PositiveToneRelative	-0.412 (0.421)	-0.286 (0.391)	-0.445 (0.500)	-0.238 (0.366)	-0.174 (0.393)	-0.151 (0.433)	-0.146 (0.446)
	Word_Frequency_S	1.531 (1.495)	-0.772 (1.177)	1.553 (1.680)	0.200 (1.362)	0.103 (1.381)	-0.477 (1.433)	-1.075 (1.317)
S Word Frequency	FogIndex	0.0150 (0.0160)	0.000337 (0.0197)	0.0177 (0.0189)	0.0121 (0.0168)	0.00899 (0.0178)	0.00857 (0.0208)	0.00328 (0.0223)
	PositiveToneRelative	-0.349 (0.409)	-0.318 (0.388)	-0.378 (0.486)	-0.247 (0.359)	-0.192 (0.387)	-0.199 (0.433)	-0.227 (0.449)
	Word_Frequency_G	1.328 (1.293)	-1.233 (1.044)	1.297 (1.427)	-0.162 (1.229)	-0.176 (1.236)	-0.808 (1.317)	-1.476 (1.131)
	FogIndex	0.0170 (0.0146)	0.00173 (0.0176)	0.0200 (0.0172)	0.0145 (0.0154)	0.0108 (0.0163)	0.0103 (0.0193)	0.00401 (0.0204)
G Word Frequency	PositiveToneRelative	-0.405 (0.426)	-0.256 (0.395)	-0.414 (0.496)	-0.235 (0.375)	-0.182 (0.399)	-0.166 (0.439)	-0.171 (0.451)
	Financial Controls	No	No	No	Yes	Yes	Yes	Yes
	Time FE	No	Yes	Yes	No	No	No	Yes
	Industry FE	No	No	No	No	Yes	No	No
Firm FE	No	No	Yes	No	No	Yes	Yes	
Cluster (id)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Number of observations	398	398	398	398	398	398	398	

**Table 8: Textual analysis of the effects of mandatory ESG disclosure on ESG scores for ESG-leading firms**

This table summarizes the regression analyses examining the direct effects of ESG-related word frequencies on ESG scores for "ESG-leading firms" (above the median initial ESG score). Panel A presents the results for the overall ESG word frequency, while Panel B shows the results for word frequencies related to Environmental (E), Social (S), and Governance (G) aspects. The regressions include varying combinations of financial controls, time fixed effects, industry fixed effects, and firm fixed effects across the models. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively.

		Panel A: The effect of ESG words						
Variable		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		ESG score <sub>t+1</sub>						
ESG Word Frequency	Word_Frequency_ESG_AI	1.693*** (0.557)	0.996* (0.572)	1.472** (0.601)	0.903* (0.539)	0.764 (0.549)	0.500 (0.610)	0.358 (0.580)
	FogIndex	-0.00337 (0.00757)	-0.00735 (0.00732)	0.00287 (0.00832)	-0.00197 (0.00691)	-0.00230 (0.00729)	-0.000142 (0.00753)	-0.00109 (0.00772)
	PositiveToneRelative	-0.184 (0.255)	-0.157 (0.250)	-0.187 (0.315)	-0.0992 (0.214)	-0.0905 (0.221)	-0.167 (0.252)	-0.151 (0.271)
	Financial Controls	No	No	No	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	No	No	No	Yes	
Industry FE	No	No	No	No	Yes	No	No	
Firm FE	No	No	Yes	No	No	Yes	Yes	
Cluster (id)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Number of observations		435	435	435	435	435	435	435

Panel B: The effect of E, S, and G words

Variable		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		ESG score <sub>t+1</sub>						
E Word Frequency	Word_Frequency_E	3.188*** (0.896)	2.157** (1.021)	2.844*** (0.986)	2.007** (0.890)	1.829** (0.887)	1.459 (0.988)	1.236 (1.052)
	FogIndex	-0.00251 (0.00783)	-0.00768 (0.00697)	0.00348 (0.00873)	-0.00268 (0.00712)	-0.00333 (0.00740)	-0.00145 (0.00767)	-0.00227 (0.00743)
	PositiveToneRelative	-0.128 (0.263)	-0.131 (0.251)	-0.157 (0.326)	-0.0762 (0.219)	-0.0812 (0.226)	-0.167 (0.257)	-0.153 (0.273)
	Word_Frequency_S	1.732** (0.766)	0.872 (0.851)	1.579* (0.837)	0.878 (0.768)	0.739 (0.780)	0.515 (0.856)	0.345 (0.866)
S Word Frequency	FogIndex	-0.000728 (0.00871)	-0.00595 (0.00802)	0.00445 (0.00963)	-0.000615 (0.00778)	-0.00127 (0.00812)	0.000150 (0.00837)	-0.000955 (0.00843)
	PositiveToneRelative	-0.111 (0.265)	-0.121 (0.249)	-0.126 (0.324)	-0.0609 (0.217)	-0.0594 (0.223)	-0.147 (0.252)	-0.139 (0.269)
	Word_Frequency_G	1.884*** (0.626)	1.128* (0.659)	1.592** (0.679)	1.020* (0.594)	0.860 (0.608)	0.531 (0.660)	0.385 (0.656)
G Word Frequency	FogIndex	-4.57e-05 (0.00709)	-0.00566 (0.00665)	0.00617 (0.00776)	-0.000340 (0.00636)	-0.00102 (0.00677)	0.000825 (0.00702)	-0.000437 (0.00710)
	PositiveToneRelative	-0.176 (0.256)	-0.153 (0.248)	-0.170 (0.318)	-0.0961 (0.212)	-0.0853 (0.219)	-0.162 (0.249)	-0.147 (0.268)
Financial Controls		No	No	No	Yes	Yes	Yes	Yes
Time FE		No	Yes	Yes	No	No	No	Yes
Industry FE		No	No	No	No	Yes	No	No
Firm FE		No	No	Yes	No	No	Yes	Yes
Cluster (id)		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations		435	435	435	435	435	435	435

**Table 9: Synthesis of main results by ESG pillar and firm subgroup**

This table reports the basic model results (without controls) from the Voluntary Sustainability Report analysis and the Textual ESG analysis of mandatory reporting, disaggregated by ESG pillar (Environmental, Social, Governance, Total) and by firm subgroup (size (small vs. large) and initial ESG standing (lagging vs. leading)). In the Voluntary Reporting analysis, the dependent variable is the ESG score (ESG, E, S, or G) at t+1, and the explanatory variable is SR issuance. In the Mandatory Reporting analysis, the dependent variable is the ESG score at t+1, and the explanatory variables are ESG word frequencies (ESG, E, S, or G). Coefficients with standard errors are reported in parentheses.

Analysis	Variable	Small Firms	Large Firms	ESG Lagging	ESG Leading
<b>Voluntary Reporting</b>		ESG score t+1			
	ESG score	0.106*** (0.0342)	0.0446* (0.0246)	0.102*** (0.0280)	0.0222 (0.0256)
		E score t+1			
	E score	0.168*** (0.0478)	0.0283 (0.0400)	0.160*** (0.0424)	0.0467 (0.0337)
		S score t+1			
	S score	0.0886** (0.0431)	0.0488* (0.0263)	0.0959*** (0.0365)	-0.00357 (0.0303)
		G score t+1			
	G score	0.0693*** (0.0241)	0.0794** (0.0381)	0.0561** (0.0246)	0.0215 (0.0430)
Analysis	Variable	Small Firms	Large Firms	ESG Lagging	ESG Leading
<b>Mandatory Reporting</b>		ESG score t+1			
	ESG Word Frequency	-0.111 (0.999)	2.094* (1.123)	-0.876 (0.888)	1.693*** (0.557)
	E Word Frequency	1.491 (1.894)	2.208 (1.570)	-0.883 (1.370)	3.188*** (0.896)
	S Word Frequency	1.120 (1.518)	1.531 (1.495)	-1.167 (1.200)	1.732** (0.766)
	G Word Frequency	-0.0243 (1.198)	-0.0243 (1.198)	-1.185 (1.028)	1.884*** (0.626)

## **Online Appendix**

### **It's Only Words?**

#### **ESG Disclosure and Corporate Sustainability in Brazil**

## Online Appendix OA1

**Table OA1.1: Correlations**

This table reports the correlations for the main variables analyzed in this study. Panel A presents the correlation matrix for the full sample of voluntary ESG disclosures. Panel B reports the correlation matrix for the variables used in the textual analysis. Statistical significance: \* $p < 0.05$ .

Panel A: Correlation matrix (full sample for analysis of voluntary ESG disclosure)

Variable	SR	ESG Score <sub>t+1</sub>	E score <sub>t+1</sub>	S score <sub>t+1</sub>	G score <sub>t+1</sub>	ROA	Size	Leverage
SR	1.00							
ESG score <sub>t+1</sub>	0.47*	1.00						
E score <sub>t+1</sub>	0.52*	0.86*	1.00					
S score <sub>t+1</sub>	0.40*	0.92*	0.77*	1.00				
G score <sub>t+1</sub>	0.23*	0.70*	0.38*	0.51*	1.00			
ROA	0.18*	0.08*	0.08*	0.09*	0.00	1.00		
Size	0.34*	0.50*	0.54*	0.50*	0.21*	-0.05	1.00	
Leverage	0.05	0.12*	0.13*	0.11*	0.10*	-0.38*	0.01	1.00

Panel B: Correlation matrix (full sample for textual analysis of mandatory ESG disclosure)

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) ESG score <sub>t+1</sub>	1.00													
(2) E score <sub>t+1</sub>	0.85*	1.00												
(3) S score <sub>t+1</sub>	0.92*	0.76*	1.00											
(4) G score <sub>t+1</sub>	0.70*	0.36*	0.50*	1.00										
(5) ROA	0.04	0.06	0.06	-0.03	1.00									
(6) Total Assets	0.34*	0.37*	0.35*	0.16*	-0.09*	1.00								
(7) Size	0.49*	0.56*	0.49*	0.18*	-0.07*	0.73*	1.00							
(8) Leverage	0.14*	0.12*	0.13*	0.12*	-0.37*	-0.01	0.01	1.00						
(9) FogIndex	0.01	-0.06	0.07	0.07*	0.08*	-0.16	-0.12*	-0.02	1.00					
(10) Word_Frequency_E	0.14*	0.01	0.15*	0.17*	0.09*	-0.01	0.03	0.00	0.54*	1.00				
(11) Word_Frequency_S	0.03	-0.08*	0.02	0.11*	0.07*	-0.04	-0.05	-0.02	0.63*	0.86*	1.00			
(12) Word_Frequency_G	0.04	-0.08*	0.04	0.11*	0.03	0.03	-0.01	-0.03	0.45*	0.81*	0.80*	1.00		
(13) Word_Frequency_ESG	0.05	-0.07*	0.04	0.12*	0.03	-0.02	-0.04	-0.03	0.57*	0.85*	0.91*	0.94*	1.00	
(14) PositiveToneRelative	-0.14*	-0.07*	-0.14*	-0.15*	0.03	0.01	-0.13*	-0.14*	-0.31*	-0.26*	-0.26*	-0.00	-0.12*	1.00

**Table OA1.2: Dynamic panel model of voluntary ESG disclosure**

This table presents the results of the Arellano-Bond Dynamic Panel Model analysis, investigating the effect of the issuance of Sustainability Reports (SR) and other financial variables on the future ESG scores and their components: Environmental (E score), Social (S score), and Governance (G score) at time  $t+1$ . The model accounts for the dynamic nature of ESG performance by including lagged values of the dependent variables (e.g., ESG score at time  $t$ ) to control for past performance. Standard diagnostic statistics, such as the p-values for the AR(1) and AR(2) tests, the Sargan test, and the Hansen test, are also provided to assess model validity. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively.

Variable	(1) ESG score $t+1$	(2) E score $t+1$	(3) S score $t+1$	(4) G score $t+1$
SR	0.0288*** (0.0112)	0.0504*** (0.0192)	0.0161 (0.0153)	0.0172 (0.0167)
ROA	0.0585 (0.0456)	0.0719 (0.0492)	0.0976 (0.0686)	0.129 (0.0883)
Size	0.000312 (0.00342)	0.00393 (0.00496)	0.00558 (0.00488)	0.00293 (0.00276)
Leverage	0.00184 (0.0166)	0.0326 (0.0217)	-0.00453 (0.0282)	0.0270 (0.0226)
ESG score	0.927*** (0.0498)			
E score		0.890*** (0.0464)		
S score			0.882*** (0.0531)	
G score				0.894*** (0.0631)
Number of observations	738	738	738	738
Wald chi2	61574	18188	48825	23536
p-value	0	0	0	0
AR(1) p-value	1.88e-08	2.11e-07	1.66e-06	6.84e-08
AR(2) p-value	0.474	0.662	0.752	0.618
Sargan p-value	0.177	0.191	0.202	0.746
Hansen p-value	0.299	0.274	0.313	0.284

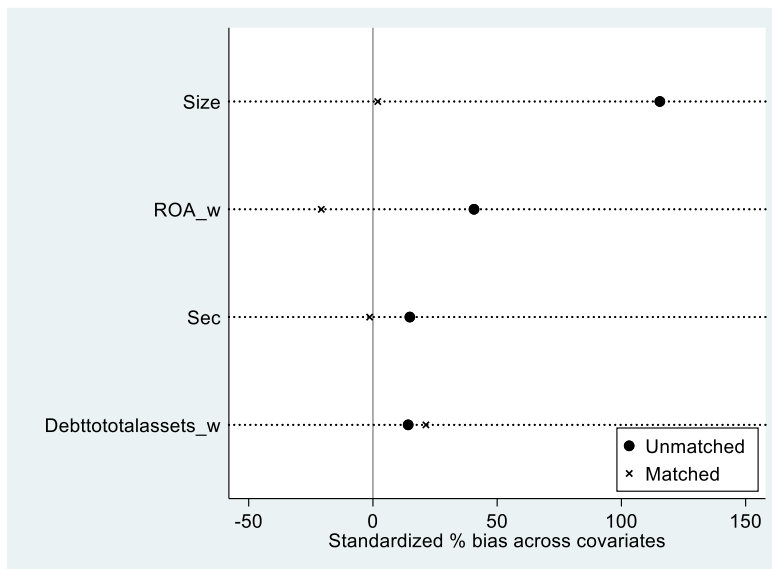
**Table OA1.3 – Balance Diagnostics Before and After Propensity Score Matching**

This table presents the mean bias and t-statistics for key variables before and after applying Propensity Score Matching (PSM).

Variable	Mean Bias Before Matching	Mean Bias After Matching	T-statistic Before	T-statistic After
Size	115.50%	1.90%	7.17	0.24
ROA_w	40.70%	-20.80%	3.29	-2.57
Debttotalassets_w	14.20%	21.30%	0.96	2.18
Sector	14.80%	-1.40%	0.98	-0.13

**Figure OA1.1 – Standardized Mean Differences Before and After Matching**

Figure A1 plots the standardized mean differences for each covariate before and after kernel matching. Most covariates fall below the conventional 0.25 threshold after matching, indicating good balance. Debt-to-total assets shows some residual imbalance, but overall comparability between treatment and control groups is improved.



**Table OA1.3a: The effects of voluntary ESG disclosure on ESG scores (PSM)**

This table presents the regression results of Propensity Score Matching (PSM) examining the impact of Sustainability Reporting (SR) on ESG performance (ESG score t+1) for the matched sample. Model (1) includes only SR, while Model (2) incorporates additional control variables such as Size, Sector, ROA, and Leverage. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively.

Variable	(1) ESG score t+1	(2) ESG score t+1
SR	0.240*** (0.0227)	0.231*** (0.0220)
Size		0.0358** (0.0142)
Sector		0.000372 (0.00363)
ROA		0.385 (0.253)
Leverage		0.353*** (0.0760)
Number of observations	232	232
R <sup>2</sup>	0.327	0.395

**Table OA1.4: Dynamic panel model of mandatory ESG disclosure**

This table presents the results of a dynamic panel model using the Arellano-Bond method. The dependent variable is the ESG score at time t+1, and the independent variables include word frequencies of ESG-related terms and their components (Environmental, Social, and Governance), as well as financial controls such as ROA, size, and leverage. The table also shows test statistics for autocorrelation (AR) and overidentification (Sargan and Hansen tests). Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively.

Variable	(1) ESG score t+1	(2) ESG score t+1	(3) ESG score t+1	(4) ESG score t+1
Word_Frequency_ESG	0.629*** (0.244)			
Word_Frequency_E		0.523 (0.448)		
Word_Frequency_S			0.461 (0.289)	
Word_Frequency_G				0.617** (0.306)
FogIndex	-0.00227 (0.00423)	0.000554 (0.00413)	-0.000576 (0.00395)	0.000268 (0.00426)
PositiveToneRelative	-0.0834 (0.0697)	-0.0482 (0.0678)	-0.0633 (0.0679)	-0.109 (0.0864)
ROA	0.177*** (0.0538)	0.144** (0.0558)	0.186*** (0.0630)	0.174*** (0.0555)
Size	0.00892* (0.00530)	0.00382 (0.00713)	0.00868 (0.00875)	0.0129 (0.00890)
Leverage	0.0316* (0.0178)	0.0202 (0.0199)	0.0308 (0.0235)	0.0408* (0.0243)
ESG score	0.858*** (0.0709)	0.924*** (0.0955)	0.860*** (0.120)	0.808*** (0.115)
Number of observations	795	795	795	795
Wald chi2	52045	55387	63737	27006
p-value	0	0	0	0
AR(1) p-value	1.62e-07	5.28e-07	1.69e-05	4.60e-06
AR(2) p-value	0.250	0.214	0.233	0.253
Sargan p-value	0.132	0.189	0.129	0.111
Hansen p-value	0.0378	0.0269	0.0973	0.0676

## **Online Appendix OA2: Analysis of Missing ESG Scores and Potential Selection Bias**

This appendix presents the diagnostic tests performed to examine the potential for selection bias arising from missing ESG scores in the Refinitiv dataset.

### 1. Missing values

We first examine whether missing values are linked to firms' listing history. Out of the 491 firm-year observations without ESG scores, 198 ( $\approx 40\%$ ) correspond to firms that went public only after 2016. Since Refinitiv does not provide retrospective coverage for pre-IPO periods, these missing values reflect structural coverage limitations rather than firm-specific nondisclosure.

#### 1.1 Missing values by year

Table OA2.1 cross-tabulates ESG score availability by year. Coverage improves sharply over time (Pearson  $\chi^2(10) = 361.04$ ,  $p < 0.001$ ). In 2012, over half the sample lacked an ESG score, whereas from 2021 onward, coverage became nearly universal (with 2022 reflecting ongoing forward coverage status in the provider database). This pattern is consistent with a progressive expansion of ESG reporting coverage in the Refinitiv database, rather than systematic firm-level selection.

**Table OA2.1 - ESG Scores by year**

Table OA2.1 presents the number and proportion of firms with and without ESG scores by year in our regression sample. The figures are reported in both absolute terms and as percentages by year and by the total sample.

Year		Yes <sup>1</sup>	No <sup>1</sup>	Total
2012	Number of obs.	66	65	131
	Year %	50.38	49.62	100
	Total %	7.44	11.73	9.09
2013	Number of obs.	74	57	131
	Year %	56.49	43.51	100
	Total %	8.34	10.29	9.09
2014	Number of obs.	75	56	131
	Year %	57.25	42.75	100
	Total %	8.46	10.11	9.09
2015	Number of obs.	76	55	131
	Year %	58.02	41.98	100
	Total %	8.57	9.93	9.09
2016	Number of obs.	77	54	131
	Year %	58.78	41.22	100
	Total %	8.68	9.75	9.09
2017	Number of obs.	80	51	131
	Year %	61.07	38.93	100
	Total %	9.02	9.21	9.09
2018	Number of obs.	88	43	131
	Year %	67.18	32.82	100
	Total %	9.92	7.76	9.09
2019	Number of obs.	105	26	131
	Year %	80.15	19.85	100
	Total %	11.84	4.69	9.09
2020	Number of obs.	115	16	131
	Year %	87.79	12.21	100
	Total %	12.97	2.89	9.09
2021	Number of obs.	131	0	131
	Year %	100	0	100
	Total %	14.77	0	9.09
2022 <sup>2</sup>	Number of obs.	0	131	131
	Year %	0	100	100
	Total %	0	14.77	9.09
Total	Number of obs.	887	554	1,441
	Full sample %	61.55	38.45	100
Pearson $\chi^2$ (10) = 361.0374			Pr = 0	

Note 1: “No” refers to missing ESG scores and “Yes” to non-missing ESG scores

Note 2: In 2022, 131 ESG scores are missing due to the one-year forward adjustment applied in the models.

## 1.2 Missing values by sector

Table OA2.2 shows the cross-tabulation by sector. Differences across industries are statistically significant (Pearson  $\chi^2(10) = 58.40$ ,  $p < 0.001$ ). Missingness is relatively higher in Information Technology and Real Estate, and lowest in Materials and Utilities. This heterogeneity suggests that part of the missingness may be linked to sectoral differences in coverage or disclosure practices.

Taken together, these descriptive patterns indicate that missing ESG scores are largely attributable to structural factors, namely, coverage expansion over time and uneven sectoral coverage, rather than firm-specific disclosure choices. This interpretation is reinforced by subsequent tests in this Online Appendix OA2 (Sections 2 and 3), which show that firm-level characteristics account for only part of the missingness.

**Table OA2.2 - ESG Scores by sector**

Table OA2.2 presents the number and proportion of firms with and without ESG scores by GICS sector in our regression sample. The figures are reported in both absolute terms and as percentages by sector and by the total sample.

Sector		Yes <sup>1</sup>	No <sup>1</sup>	Total
Communication Services	Number of obs.	32	23	55
	Sector %	58.18	41.82	100
	Total %	3.61	4.15	3.82
Consumer Discretionary	Number of obs.	154	143	297
	Sector %	51.85	48.15	100
	Total %	17.36	25.81	20.61
Consumer Staples	Number of obs.	105	49	154
	Sector %	68.18	31.82	100
	Total %	11.84	8.84	10.69
Energy	Number of obs.	46	31	77
	Sector %	59.74	40.26	100
	Total %	5.19	5.6	5.34
Financials	Number of obs.	112	64	176
	Sector %	63.64	36.36	100
	Total %	12.63	11.55	12.21
Health Care	Number of obs.	49	28	77
	Sector %	63.64	36.36	100
	Total %	5.52	5.05	5.34
Industrials	Number of obs.	102	85	187
	Sector %	54.55	45.45	100
	Total %	11.5	15.34	12.98
Information Technology	Number of obs.	12	21	33
	Sector %	36.36	63.64	100
	Total %	1.35	3.79	2.29
Materials	Number of obs.	103	29	132
	Sector %	78.03	21.97	100
	Total %	11.61	5.23	9.16
Real Estate	Number of obs.	27	28	55
	Sector %	49.09	50.91	100
	Total %	3.04	5.05	3.82
Utilities	Number of obs.	145	53	198
	Sector %	73.23	26.77	100
	Total %	16.35	9.57	13.74
Total	N	887	554	1,441
	Full sample %	61.55	38.45	100
		Pearson $\chi^2 (10) = 58.4004$		Pr = 0

Note: “No” refers to missing ESG scores and “Yes” to non-missing ESG scores

## 2. Differences in Firm Characteristics - Balance Tests (Missing vs. Non-missing)

We compare firm-level characteristics between observations with and without ESG scores using two-sample t-tests for sustainability report issuance (SR), firm size (log of total assets), profitability (ROA), and leverage (debt to total assets). The results are presented in Table OA2.3. Firms without ESG scores are less likely to issue a sustainability report, tend to be smaller, and exhibit lower leverage. Differences in profitability (ROA) are not statistically meaningful.

**Table OA2.3 – T-tests: firm characteristics with and without ESG scores**

This table reports mean comparisons (t-tests) between firms with available ESG scores and firms without ESG scores. Variables include firm size, return on assets (ROA), leverage (Debt-to-Total Assets), and the issuance of a Sustainability Report (SR). The table shows mean values for each group, the mean difference, the t-statistic, and significance levels.

**Notes:**

1. ESG Available = firms with ESG scores; ESG Missing = firms without ESG scores.
2. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10; “ns” = not significant.
3. Variables are measured as follows: Size = log of total assets; ROA = return on assets; Leverage = debt-to-total assets ratio.

Variable	ESG Available: Mean (N)	ESG Missing: Mean (N)	Mean Diff.	t-statistic	Significance
Sustainability Report (SR)	0.78 (821)	0.46 (444)	0.32	12.27	***
Size	23.78 (883)	22.67 (472)	1.1	12.62	***
ROA	0.044 (882)	0.048 (449)	-0.003	-0.77	ns
Leverage	0.339 (867)	0.318 (459)	0.021	2.06	**

Taken together, these findings suggest that missing ESG scores are concentrated among firms with characteristics typically associated with weaker disclosure incentives, smaller size, lower external financing needs, and lower propensity to engage in voluntary sustainability reporting. This pattern is consistent with the expectations of the voluntary disclosure literature.

### 3. Determinants of ESG Score Availability

We then estimated a logistic regression model to examine whether ESG score availability is systematically associated with firm characteristics, sector, or year (Table OA2.4). Sustainability reporting (SR) (1.252,  $p < 0.05$ ) and firm size (1.055,  $p < 0.05$ ) are the strongest positive predictors. ROA and leverage show no significant association. Year dummies confirm the expansion of coverage: earlier years are negatively and significantly related to availability, whereas 2020 is positively associated. Only one sector dummy loads significantly negatively. Overall, availability is best explained by reporting behavior, firm size, and temporal expansion.

Overall, these results reinforce the descriptive patterns documented in Sections 1 and 2: ESG score availability is largely explained by reporting practices and firm size, together with the progressive temporal expansion of the database, rather than by sector-specific factors.

**Table OA2.4 – Logistic regression: ESG score availability as the dependent variable**

This table reports the results of a logistic regression where the dependent variable is ESG score availability. Reported are coefficients and standard errors. Significance levels: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

ESG Score availability		
VARIABLES	Coefficient	Std. Error
SR	1.252***	0.379
Size	1.055***	0.265
ROA_w	-1.136	2.677
Leverage_w	-0.598	1.207
2.sector_id	-0.32	0.851
3.sector_id	-0.457	0.914
4.sector_id	0.102	1.651
5.sector_id	-1.948**	0.994
6.sector_id	0.147	1.364
7.sector_id	-0.638	0.828
8.sector_id	-0.113	1.503
9.sector_id	-0.039	1.169
10.sector_id	-0.699	1.028
11.sector_id	-0.899	0.954
2014.year	-0.282***	0.0782
2015.year	-0.420***	0.124
2016.year	-0.495***	0.139
2017.year	-0.506***	0.19
2018.year	-0.251	0.245
2019.year	0.536	0.334
2020.year	0.937**	0.396
2021o.year	-	-
2022o.year	-	-
Constant	-23.05***	6.168
Observations	935	

#### 4. Heckman Two-Step Selection Models

To evaluate potential non-random selection into ESG coverage, we estimate Heckman two-step models (Table OA2.5). For identification, leverage (Debt-to-Total Assets ratio) was excluded from the outcome equation, as it does not significantly correlate with ESG scores and shows a statistically significant coefficient in most specifications, either in the voluntary or the mandatory sustainability disclosure analyses. . The first-stage selection equation confirms that firm size strongly predicts ESG availability. In the second stage (outcome: ESG score and ESG score at t+1), sustainability reporting remains positive and highly significant. Importantly, the inverse Mills ratio ( $\lambda$ ) is significant (with both positive and negative signs across specifications), suggesting that selection is non-negligible. Nevertheless, the corrected outcome estimates of SR and firm size confirm the robustness of the main findings.

**Table OA2.5 – Heckman Two-Step Selection Models for ESG Scores**

This table presents Heckman two-step estimates of ESG scores at t+1. The selection equation (not reported) includes firm size, ROA, leverage, year, and industry dummies. Leverage is excluded from the outcome equation for identification. The inverse Mills ratio ( $\lambda$ ) is significant, indicating non-random selection, but the corrected estimates confirm that SR and firm size positively affect ESG scores. Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ESG score t+1							
SR	0.201*** (0.0227)	0.164*** (0.0250)	0.189*** (0.0224)	0.220*** (0.0209)	0.217*** (0.0227)	0.196*** (0.0211)	0.197*** (0.0231)
Size				0.0674*** (0.0053)	0.0653*** (0.0058)	0.0810*** (0.0067)	0.0803*** (0.0072)
ROA_w				0.125 (0.0980)	0.129 (0.0983)	0.197** (0.0988)	0.197** (0.0996)
$\lambda$ (Inverse Mills)	-0.111***	-0.215***	-0.0766**	0.0956***	0.0750*	0.108***	0.0989**
Constant	0.384*** (0.0253)	0.488*** (0.0360)	0.457*** (0.0406)	-1.296*** (0.1330)	-1.206*** (0.1520)	-1.552*** (0.1700)	-1.507*** (0.1870)
Financial controls	No	No	No	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes	No	Yes
Industry FE	No	No	Yes	No	No	Yes	Yes
Observations	1,065	1,065	1,065	1,065	1,065	1,065	1,065

## 5. Robustness Checks with Expanded Dataset

As a robustness check, we expand coverage by incorporating 51 additional ESG scores from S&P and Bloomberg, of which 47 are usable. This increases the sample from 738 to 785 firm-year observations (114 to 123 firms). The results remain consistent: sustainability reporting (SR) and firm size are positive and significant predictors of ESG scores, while leverage remains insignificant (Table OA2.6). Sectoral patterns are stable, and year effects are more precisely estimated, with consistently negative coefficients from 2014 onward. The expanded dataset, therefore, reinforces the core results while enhancing temporal precision. While the Refinitiv-only sample shows limited temporal variation, the expanded dataset displays stronger and more consistent negative year coefficients from 2014 onwards, suggesting that the inclusion of additional providers refines the time dynamics of ESG score normalization.

Overall, the expanded dataset not only confirms but also strengthens the core results: ESG scores are systematically higher for those issuing sustainability reports and for larger firms, with sectoral and temporal effects playing a secondary role.

**Table OA2.6 – Comparison of core regression results: Refinitiv-only vs. expanded dataset**

This table reports GLS regression results where the dependent variable is ESG score (t+1). Reported are coefficients with robust standard errors in parentheses. Significance levels: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

<b>Expanded dataset</b>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ESG score <sub>t+1</sub>							
SR t	0.102*** (0.0236)	0.0783*** (0.0219)	0.0488** (0.0225)	0.0588*** (0.0209)	0.0550*** (0.0208)	0.0462** (0.0211)	0.0381* (0.021)
R <sup>2</sup>	0.218	0.123	0.173	0.316	0.356	0.196	0.221
Number of observations	785	785	785	785	785	785	785
<b>Original Refinitiv-only dataset</b>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ESG score <sub>t+1</sub>							
SR t	0.0919*** (0.0243)	0.0699*** (0.0230)	0.0449* (0.0237)	0.0504** (0.0210)	0.0476** (0.0211)	0.0397* (0.0214)	0.0329 (0.0219)
R <sup>2</sup>	0.222	0.114	0.15	0.323	0.365	0.183	0.202
Number of observations	738	738	738	738	738	738	738
Financial controls	No	No	No	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	No	No	No	Yes
Industry FE	No	No	No	No	Yes	No	No
Firm FE	No	No	Yes	No	No	Yes	Yes
Cluster (id)	Yes	Yes	Yes	Yes	Yes	Yes	Yes

**Note:** As a robustness check, the sample expands by incorporating 51 additional ESG scores from S&P and Bloomberg, of which 47 are usable. This increases coverage from 738 to 785 firm-year observations (114 to 123 firms).

## 6. Summary

Across descriptive analysis, balance tests, logit models, Heckman selection corrections, and robustness checks with expanded data, we find that missing ESG scores are largely driven by structural factors, particularly IPO-related coverage gaps, temporal expansion, and sectoral differences, rather than systematic firm-level nondisclosure. After correcting for selection effects, our main findings remain robust.

## **Online Appendix OA3: Decomposition of the Fog Index**

The Fog Index (Gunning, 1952) is one of the most widely used readability metrics in financial and corporate disclosure research. Its direct application to Portuguese texts, however, is challenging due to differences in morphology and syntax. To address this limitation, we decomposed the index into its two underlying components: average sentence length (ASL), measured as the mean number of words per sentence, and the share of complex words. In line with the original English specification, complex words were initially defined as those containing two or more syllables, but we also tested alternative thresholds using words with more than three and more than four syllables.

We subsequently re-estimated our baseline models by including each component separately. The results show that the apparent significance of the Fog Index coefficients shown in Tables 7 and 8 is almost entirely driven by ASL. The complex-word component, in turn, does not display consistent explanatory power. The only exception occurs in initial models without controls, where words with more than four syllables are statistically significant; this effect, however, disappears once controls are included.

Tables OA3.1-3 report these results. They suggest that in the Brazilian context, sentence length may be a more valid proxy for readability than word complexity, consistent with prior evidence that sentence length is often the main driver of readability measures in financial texts (Loughran & McDonald, 2014).

These findings reinforce that textual complexity research in Portuguese is still at an early stage and requires deeper methodological development and validation (Leal et al., 2024; Finatto, 2011). Accordingly, we treat this analysis as exploratory and caution against overgeneralization.

**Table OA3.1 – Textual complexity (>2 syllables) in mandatory ESG disclosure and ESG scores**

This table reports GLS regressions of ESG scores (t+1) on textual complexity. Complexity is measured by average sentence length (ASL) and the share of complex words with more than 2 syllables. Panel A presents results for the overall ESG word frequency, while Panel B shows results for word frequencies related to Environmental (E), Social (S), and Governance (G) aspects. Coefficients with robust standard errors clustered at the firm level are reported in parentheses. Significance levels: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

		Panel A: The effect of ESG words						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Analysis		ESG score <sub>t+1</sub>						
ESG Word Frequency	Word_Frequency_ESG_AI_w	0.825 (0.679)	-0.761 (0.671)	0.883 (0.705)	0.131 (0.607)	0.11 (0.619)	0.0835 (0.651)	-0.56 (0.66)
	Complex2syll	0.54 (0.78)	0.182 (0.751)	0.639 (0.844)	0.301 (0.723)	0.247 (0.737)	0.234 (0.774)	0.124 (0.769)
	Average Sentence Length	0.00941** (0.00394)	0.00742* (0.00392)	0.0109** (0.00428)	0.00584* (0.0034)	0.00574 (0.00352)	0.00594 (0.00392)	0.00592 (0.00407)
	PositiveToneRelative1	-0.348 (0.265)	-0.309 (0.269)	-0.326 (0.283)	-0.215 (0.228)	-0.188 (0.235)	-0.221 (0.25)	-0.218 (0.263)
	Financial controls	No	No	No	Yes	Yes	Yes	Yes
	Time FE	No	Yes	Yes	No	No	No	Yes
	Industry FE	No	No	No	No	Yes	No	No
	Firm FE	No	No	Yes	No	No	Yes	Yes
	Cluster (id)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Observations	795	795	795	795	795	795	795
	Number of firms	114	114	114	114	114	114	114

Panel B: The effect of E, S, and G words

E Word Frequency	Word_Frequency_E_AI_w	2.015*	-0.0652	1.855	0.674	0.594	0.525	-0.32
		(1.142)	(1.142)	(1.214)	(1.028)	(1.037)	(1.093)	(1.136)
	Complex2syll	0.495	0.121	0.625	0.267	0.218	0.207	0.0884
		(0.795)	(0.749)	(0.856)	(0.737)	(0.751)	(0.785)	(0.767)
	Average Sentence Length	0.00887**	0.00635	0.0107**	0.00538	0.00532	0.00557	0.00542
	(0.00404)	(0.00402)	(0.00442)	(0.00349)	(0.00362)	(0.00401)	(0.00419)	
	PositiveToneRelative1	-0.319	-0.298	-0.306	-0.202	-0.177	-0.211	-0.213
		(0.26)	(0.268)	(0.279)	(0.225)	(0.233)	(0.248)	(0.262)
S Word Frequency	Word_Frequency_S_AI_w	1.386	-0.527	1.585	0.231	0.183	0.232	-0.474
		(0.962)	(0.923)	(1.014)	(0.911)	(0.916)	(0.972)	(0.959)
	Complex2syll	0.468	0.171	0.553	0.288	0.238	0.216	0.119
		(0.793)	(0.758)	(0.859)	(0.739)	(0.753)	(0.79)	(0.779)
	Average Sentence Length	0.00863**	0.00707*	0.00986**	0.0057	0.00565	0.00572	0.0058
	(0.00418)	(0.00416)	(0.00453)	(0.00369)	(0.0038)	(0.00419)	(0.00434)	
	PositiveToneRelative1	-0.317	-0.313	-0.293	-0.21	-0.184	-0.215	-0.222
		(0.256)	(0.264)	(0.274)	(0.222)	(0.229)	(0.244)	(0.258)
G Word Frequency	Word_Frequency_G_AI_w	0.518	-1.27	0.56	-0.134	-0.119	-0.142	-0.916
		(0.799)	(0.779)	(0.842)	(0.680)	(0.703)	(0.748)	(0.760)
	Complex2syll	0.574	0.274	0.672	0.341	0.282	0.271	0.204
		(0.793)	(0.761)	(0.867)	(0.729)	(0.746)	(0.787)	(0.784)
	Average Sentence Length	0.0105***	0.00738*	0.0120***	0.00631*	0.00614*	0.00628	0.00587
	(0.00382)	(0.00380)	(0.00417)	(0.00327)	(0.00339)	(0.00381)	(0.00400)	
	PositiveToneRelative1	-0.36	-0.31	-0.339	-0.22	-0.193	-0.226	-0.223
		(0.266)	(0.268)	(0.284)	(0.228)	(0.234)	(0.249)	(0.262)
	Financial controls	No	No	No	Yes	Yes	Yes	Yes
	Time FE	No	Yes	Yes	No	No	No	Yes
	Industry FE	No	No	No	No	Yes	No	No
	Firm FE	No	No	Yes	No	No	Yes	Yes
	Cluster (id)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Observations	795	795	795	795	795	795	795
	Number of firms	114	114	114	114	114	114	114

**Table OA3.2 – Textual complexity (>3 syllables) in mandatory ESG disclosure and ESG scores**

This table reports GLS regressions of ESG scores (t+1) on textual complexity. Complexity is measured by average sentence length (ASL) and the share of complex words with more than 3 syllables. Panel A presents results for the overall ESG word frequency, while Panel B shows results for word frequencies related to Environmental (E), Social (S), and Governance (G) aspects. Coefficients with robust standard errors clustered at the firm level are reported in parentheses. Significance levels: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Panel A: The effect of ESG words**

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Analysis		ESG score t+1						
ESG Word Frequency	Word_Frequency_ESG_AI_w	0.729 (0.655)	-0.762 (0.664)	0.773 (0.684)	0.106 (0.614)	0.0757 (0.628)	0.0433 (0.668)	-0.569 (0.657)
	Complex3syll	1.221 (0.987)	0.246 (0.909)	1.39 (1.078)	0.47 (0.914)	0.517 (0.925)	0.538 (0.989)	0.31 (1.027)
	Average Sentence Length	0.00921** (0.00396)	0.00739* (0.00392)	0.0106** (0.00430)	0.00578* (0.00339)	0.00568 (0.00351)	0.00587 (0.00391)	0.00589 (0.00407)
	PositiveToneRelative1	-0.442* (0.265)	-0.331 (0.259)	-0.431 (0.285)	-0.256 (0.211)	-0.229 (0.218)	-0.261 (0.232)	-0.241 (0.242)
	Financial controls	No	No	No	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	No	No	No	Yes	
Industry FE	No	No	No	No	Yes	No	No	
Firm FE	No	No	Yes	No	No	Yes	Yes	
Cluster (id)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations		795	795	795	795	795	795	795
Number of firms		114	114	114	114	114	114	114

Panel B: The effect of E, S, and G words

E Word Frequency	Word_Frequency_E_AI_w	1.894*	-0.0617	1.704	0.652	0.555	0.477	-0.33
		(1.110)	(1.119)	(1.186)	(1.033)	(1.045)	(1.114)	(1.123)
	Complex3syll	1.158	0.146	1.377	0.405	0.456	0.475	0.252
		(1.013)	(0.926)	(1.090)	(0.931)	(0.943)	(1.000)	(1.032)
	Average Sentence Length	0.00862**	0.00634	0.0104**	0.0053	0.00525	0.00549	0.00539
	(0.00406)	(0.00402)	(0.00443)	(0.00347)	(0.00359)	(0.00400)	(0.00419)	
	PositiveToneRelative1	-0.408	-0.312	-0.41	-0.238	-0.213	-0.247	-0.231
		(0.265)	(0.259)	(0.284)	(0.212)	(0.219)	(0.234)	(0.242)
S Word Frequency	Word_Frequency_S_AI_w	1.296	-0.51	1.481	0.222	0.16	0.2	-0.471
		(0.930)	(0.894)	(0.980)	(0.905)	(0.910)	(0.972)	(0.931)
	Complex3syll	1.203	0.183	1.347	0.461	0.512	0.513	0.266
		(0.982)	(0.929)	(1.063)	(0.907)	(0.919)	(0.977)	(1.033)
	Average Sentence Length	0.00838**	0.00702*	0.00956**	0.0056	0.00555	0.00563	0.00576
	(0.00420)	(0.00416)	(0.00454)	(0.00367)	(0.00378)	(0.00417)	(0.00433)	
	PositiveToneRelative1	-0.408	-0.33	-0.391	-0.249	-0.224	-0.253	-0.242
		(0.257)	(0.254)	(0.276)	(0.206)	(0.213)	(0.227)	(0.237)
G Word Frequency	Word_Frequency_G_AI_w	0.377	-1.270*	0.397	-0.175	-0.172	-0.207	-0.931
		(0.773)	(0.766)	(0.819)	(0.696)	(0.719)	(0.775)	(0.753)
	Complex3syll	1.348	0.382	1.535	0.567	0.602	0.632	0.426
		(0.990)	(0.889)	(1.090)	(0.929)	(0.943)	(1.016)	(1.032)
	Average Sentence Length	0.0103***	0.00734*	0.0117***	0.00622*	0.00605*	0.00618	0.00583
	(0.00383)	(0.00380)	(0.00419)	(0.00325)	(0.00337)	(0.00380)	(0.00399)	
	PositiveToneRelative1	-0.464*	-0.344	-0.454	-0.269	-0.241	-0.274	-0.256
		(0.265)	(0.258)	(0.285)	(0.211)	(0.217)	(0.231)	(0.242)
	Financial controls	No	No	No	Yes	Yes	Yes	Yes
	Time FE	No	Yes	Yes	No	No	No	Yes
	Industry FE	No	No	No	No	Yes	No	No
	Firm FE	No	No	Yes	No	No	Yes	Yes
	Cluster (id)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Observations	795	795	795	795	795	795	795
	Number of firms	114	114	114	114	114	114	114

**Table OA3.3 – Textual complexity (>4 syllables) in mandatory ESG disclosure and ESG scores**

This table reports GLS regressions of ESG scores (t+1) on textual complexity. Complexity is measured by average sentence length (ASL) and the share of complex words with more than 4 syllables. Panel A presents results for the overall ESG word frequency, while Panel B shows results for word frequencies related to Environmental (E), Social (S), and Governance (G) aspects. Coefficients with robust standard errors clustered at the firm level are reported in parentheses. Significance levels: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

		Panel A: The effect of ESG words						
Analysis		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		ESG score t+1						
ESG Word Frequency	Word_Frequency_ESG_AI_w	0.785 (0.641)	-0.737 (0.650)	0.824 (0.656)	0.12 (0.597)	0.0956 (0.607)	0.0752 (0.635)	-0.538 (0.642)
	Complex4syll	2.867 (1.849)	0.887 (1.799)	3.760* (2.057)	1.425 (1.638)	1.593 (1.685)	1.44 (1.831)	0.948 (1.898)
	Average Sentence Length	0.0103*** (0.00385)	0.00773* (0.00396)	0.0120*** (0.00414)	0.00630* (0.00340)	0.00632* (0.00353)	0.00648 (0.00395)	0.0063 (0.00416)
	PositiveToneRelative1	-0.454* (0.267)	-0.344 (0.268)	-0.457 (0.287)	-0.27 (0.221)	-0.245 (0.228)	-0.272 (0.243)	-0.251 (0.253)
	Financial controls	No	No	No	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	No	No	No	Yes	
Industry FE	No	No	No	No	Yes	No	No	
Firm FE	No	No	Yes	No	No	Yes	Yes	
Cluster (id)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations		795	795	795	795	795	795	795
Number of firms		114	114	114	114	114	114	114

Panel B: The effect of E, S, and G words

E Word Frequency	Word_Frequency_E_AI_w	1.953*	-0.0393	1.757	0.658	0.563	0.508	-0.298
		(1.089)	(1.100)	(1.147)	(0.996)	(1.002)	(1.054)	(1.094)
	Complex4syll	2.79	0.936	3.732*	1.381	1.55	1.407	0.987
		(1.879)	(1.763)	(2.102)	(1.639)	(1.690)	(1.833)	(1.864)
	Average Sentence Length	0.00971**	0.0067	0.0118***	0.00581*	0.00588	0.00609	0.00582
	(0.00399)	(0.00408)	(0.00431)	(0.00351)	(0.00365)	(0.00406)	(0.00429)	
	PositiveToneRelative1	-0.421	-0.331	-0.436	-0.255	-0.232	-0.26	-0.246
		(0.266)	(0.266)	(0.285)	(0.220)	(0.227)	(0.243)	(0.253)
S Word Frequency	Word_Frequency_S_AI_w	1.344	-0.491	1.514	0.23	0.178	0.231	-0.443
		(0.936)	(0.887)	(0.982)	(0.894)	(0.897)	(0.945)	(0.920)
	Complex4syll	2.829	0.932	3.695*	1.417	1.59	1.428	0.976
		(1.853)	(1.782)	(2.054)	(1.638)	(1.686)	(1.826)	(1.882)
	Average Sentence Length	0.00947**	0.00738*	0.0110**	0.00613*	0.0062	0.00624	0.00617
	(0.00411)	(0.00420)	(0.00440)	(0.00369)	(0.00381)	(0.00422)	(0.00443)	
	PositiveToneRelative1	-0.419	-0.347	-0.418	-0.264	-0.241	-0.265	-0.254
		(0.260)	(0.262)	(0.279)	(0.215)	(0.223)	(0.238)	(0.248)
G Word Frequency	Word_Frequency_G_AI_w	0.473	-1.229*	0.489	-0.144	-0.138	-0.153	-0.883
		(0.742)	(0.731)	(0.767)	(0.659)	(0.676)	(0.713)	(0.708)
	Complex4syll	2.941	0.941	3.847*	1.484	1.641	1.488	1.003
		(1.876)	(1.790)	(2.091)	(1.658)	(1.700)	(1.846)	(1.890)
	Average Sentence Length	0.0114***	0.00772**	0.0132***	0.00678**	0.00672**	0.00683*	0.00628
	(0.00373)	(0.00386)	(0.00404)	(0.00327)	(0.00340)	(0.00384)	(0.00410)	
	PositiveToneRelative1	-0.470*	-0.35	-0.474	-0.279	-0.254	-0.281	-0.261
		(0.269)	(0.267)	(0.288)	(0.220)	(0.227)	(0.242)	(0.253)
	Financial controls	No	No	No	Yes	Yes	Yes	Yes
	Time FE	No	Yes	Yes	No	No	No	Yes
	Industry FE	No	No	No	No	Yes	No	No
	Firm FE	No	No	Yes	No	No	Yes	Yes
	Cluster (id)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Observations	795	795	795	795	795	795	795
	Number of firms	114	114	114	114	114	114	114

## **Online Appendix OA4: Subsample Analyses: Size × Initial ESG Standing**

This appendix provides supplementary analyses to clarify the relationship between firm size and initial ESG standing and addresses the potential concern that the two dimensions may suffer from conceptual overlap. Firms are classified as small, if their total assets fall below the sample median, and as large otherwise. Similarly, firms are classified as ESG-lagging if their ESG score in 2013 falls below the sample median and as ESG-leading if it exceeds the median.

We present descriptive cross-tabulations, mean comparison tests, and regression results to disentangle these categories. These analyses support the distinction between the moderating effects proposed in Hypotheses H2a (size) and H2b (initial ESG standing), while also acknowledging their empirical correlation. As discussed in Section 3.3, while the two categories are correlated, they capture distinct mechanisms - information asymmetry for small firms and reputational catch-up for ESG-lagging firms.

### **1. Cross-tabulation of firm size and baseline ESG performance**

We first examine the joint distribution of firm size and ESG standing. Firms are classified as small or large based on whether their total assets fall below or above the sample median. Similarly, they are classified as lagging or leading depending on whether their baseline ESG scores in 2013 fall below or above the sample median.

Table OA4.1 reports the joint distribution of firms by size (Small vs. Large, based on median total assets) and baseline ESG standing (Lagging vs. Leading, based on median 2013 ESG scores). The Pearson  $\chi^2$  test of independence indicates that the two classifications are significantly associated ( $\chi^2(1) = 98.79, p < 0.01$ ). While overlap exists (34.4% of the sample are small–lagging firms), the non-trivial shares of small–leading (15.6%) and big–lagging (16.1%) firms confirm that the two dimensions are not redundant.

**Table OA4.1: Joint distribution of firms by size and ESG standing**

This table shows the cross-classification of firms by size (Small vs. Large) and baseline ESG standing (Lagging vs. Leading).

Size	Initial ESG Standing		Total
	Lagging	Leading	
<b>Small (N)</b>	254	115	369
Size %	68.83	31.17	100
Total %	34.42	15.58	50
<b>Large (N)</b>	119	250	369
Size %	32.25	67.75	100
Total %	16.12	33.88	50
<b>Total</b>	373	365	738
	Pearson $\chi^2$ (10) = 98.7921	Pr = 0	

## 2. T-test of firm size across ESG performance groups

We next test whether ESG-lagging and ESG-leading firms differ in their size. A two-sample t-test shows that leading firms are significantly larger than lagging firms, with a mean difference of 1.23 log-points in total assets ( $t = -12.72$ ,  $p < 0.01$ ). This confirms that initial ESG standing is associated with firm size but does not imply equivalence.

Table OA4.2 presents a two-sample t-test comparing firm size (log of total assets) between lagging and leading firms. Leading firms are on average 1.23 log-points larger than lagging firms ( $t = -12.72$ ,  $p < 0.01$ ). This indicates that firms with stronger initial ESG standing tend to be significantly larger.

**Table OA4.2: Firm size comparison between lagging and leading firms**

This table reports a two-sample t-test of firm size (log of total assets) between lagging and leading firms.

					95% Conf. Interval	
<b>ESG Standing</b>	<b>Obs.</b>	<b>Mean</b>	<b>Std. Err.</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
Lagging	373	23.280	0.057	1.107	23.168	23.393
Leading	365	24.514	0.079	1.503	24.360	24.669
Combined	738	23.891	0.054	1.455	23.786	23.996
Difference		-1.234	0.097		-1.425	-1.044
T-statistic*		-12.717				

\*p<.001

### 3. T-test of ESG performance across size groups

We then compare baseline ESG scores between small and large firms. Large firms exhibit substantially higher ESG ratings (mean = 59.9) compared to small firms (mean = 43.0), with a difference of 16.9 points ( $t = -11.71$ ,  $p < 0.01$ ). This again demonstrates that size correlates with initial ESG standing, but each variable retains its own explanatory power.

Table OA4.3 reports a two-sample t-test of baseline ESG scores between small and big firms. Large firms display significantly higher ESG ratings (mean = 59.9) compared to small firms (mean = 43.0), with a mean difference of 16.9 points ( $t = -11.71$ ,  $p < 0.01$ ). This demonstrates that firm size is positively associated with initial ESG standing.

**Table OA4.3: Baseline ESG scores by firm size**

This table reports a two-sample t-test of baseline (2013 median) ESG scores between small and large firms.

					95% Conf. Interval	
<b>Size</b>	<b>Obs.</b>	<b>Mean</b>	<b>Std. Err.</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
Small	369	43.028	1.083	20.798	40.899	45.157
Large	369	59.889	0.949	18.239	58.022	61.756
Combined	738	51.459	0.784	21.290	49.920	52.997
Difference		-16.861	1.440		-19.688	-14.034
T-statistic*		-11.708				

\*p<.001

#### **4. Regression of ESG scores on size and ESG standing (alternative specifications)**

Finally, we assess the joint role of firm size and ESG baseline standing using a regression framework. Normalized ESG scores are regressed on categorical variables combining both dimensions, with small-lagging firms as the reference group.

Table OA4.4 presents OLS regressions of normalized ESG scores on firm size and ESG baseline standing. Model (1) includes categorical variables for firm groups defined by size - ESG combinations (small – lagging firms as reference). Model (2) adds firm size (log of total assets) as a continuous covariate to disentangle the role of information asymmetry from initial ESG standing. Model (3) includes an interaction between size and ESG standing to test whether the effects of the two moderators overlap. Robust standard errors are reported in parentheses. Controls include return on assets and leverage. Results indicate that both firm size and initial ESG standing contribute independently to ESG performance. The interaction is statistically insignificant, suggesting that the two moderators capture distinct rather than overlapping mechanisms.

Taken together, these results indicate that while larger firms are more likely to be ESG leaders, size and ESG-lagging capture related but distinct dimensions, supporting the distinction made in Hypotheses 2a and 2b.

**Table OA4.4: OLS regressions of ESG scores on firm size and initial ESG standing**

This table presents OLS regressions of ESG scores t+1 on firm size and initial ESG standing. Model (1) includes group dummies (small – lagging as reference). Model (2) adds firm size (log of total assets) as a continuous covariate. Model (3) includes an interaction between size (Small or Large) and ESG standing (Lagging or Leading). Robust standard errors are in parentheses; controls are return on assets and leverage.

Notes: Group 1 (reference) = Small and Lagging firms. Group 2 = Small and Leading firms. Group 3 = Large and Lagging firms. Group 4 = Large and Leading firms. Column (3) shows interaction terms between firm size and initial ESG standing.

	(1)	(2)	(3)
ESG score t+1			
Group 2: Small and Leading	0.149*** (0.0254)	0.126*** (0.0235)	
Group 3: Large and Lagging	0.0581* (0.0312)	-0.00547 (0.0309)	
Group 4: Large and Leading	0.164*** (0.0267)	0.0814*** (0.0267)	
Large			0.0581* (0.0312)
Leading			0.149*** (0.0254)
Small × Lagging			0
			0
Small × Leading			0
			0
Large × Lagging			0
			0
Large × Leading			-0.0426 (0.0334)
ROA_w	0.160** (0.0788)	0.129* (0.0759)	0.160** (0.0788)
Leverage_w	0.0646 (0.0651)	0.0659 (0.0600)	0.0646 (0.0651)
Size		0.0830*** (0.0174)	
Constant	0.414*** (0.0279)	-1.525*** (0.4160)	0.414*** (0.0279)
Observations	738	738	738
R-squared	0.199	0.289	0.199
Number of id	114	114	114

## **Online Appendix OA5: Sectoral Summary Statistics**

Tables OA5.1 and OA5.2 report sector-level descriptive statistics for the two datasets used in our analysis.

### **1. Summary Statistics of Voluntary Sustainability Report (SR) Issuance and Financial Variables by Sector**

Table OA5.1 presents sector-level averages of Sustainability Report (SR) issuance, ESG scores, and financial variables (ROA, Total Assets, and Leverage) for Brazilian listed firms from 2012–2022. Communication Services firms exhibit the highest SR incidence and ESG scores, while Real Estate and Health Care firms are at the lower end. Industrials show higher leverage ratios, reflecting sector-specific financial structures.

### **2. Textual Analysis Metrics of Mandatory ESG Disclosures by Sector**

Table OA5.2 reports sector-level averages of textual measures derived from mandatory ESG disclosures. Sectoral variation is modest: Communication Services and Financials have higher ESG scores, Real Estate and Health Care remain lower, Information Technology reports are slightly more complex (higher Fog Index), and Consumer Staples and Financials adopt a more positive tone. Word frequency measures display modest variation, with Information Technology emphasizing ESG terms slightly more.

Overall, these descriptive patterns confirm that ESG disclosure and performance differ systematically across industries, underscoring the importance of controlling for sector effects in the empirical analysis.

**Table OA5.1 - Summary Statistics by Sector - Voluntary Disclosure**

This table reports the means of the main variables used in the empirical estimations across the eleven GICS sectors of Brazilian publicly held companies from 2012–2022, using data from Refinitiv Eikon. SR (Sustainability Report) equals 1 if the firm issued a report that year, and 0 otherwise. Total Assets are reported in BRL billion.

	Sector	N	SR	ESG score <sub>t+1</sub>	E score <sub>t+1</sub>	S score <sub>t+1</sub>	G score <sub>t+1</sub>	ROA <sub>w</sub>	Total Assets	Leverage <sub>w</sub>
1	Communication Services	27	1.00	66.72	62.27	69.57	64.42	2.05	70.71	27.15
2	Consumer Discretionary	124	0.67	42.72	35.67	43.70	50.08	1.73	10.80	30.99
3	Consumer Staples	91	0.97	56.86	57.71	55.85	56.76	5.24	40.93	36.03
4	Energy	37	0.65	49.79	38.06	55.19	57.37	4.75	225.25	34.58
5	Financials	89	0.83	60.58	57.63	67.28	54.63	4.34	531.98	24.17
6	Health Care	36	0.61	37.89	33.43	37.24	42.25	6.70	9.58	28.25
7	Industrials	85	0.78	54.40	48.24	59.13	54.56	2.54	18.14	48.69
8	Information Technology	9	0.78	61.33	19.67	54.25	79.93	7.86	3.62	21.35
9	Materials	91	0.87	56.45	56.15	58.36	55.15	3.16	73.23	38.86
10	Real Estate	22	0.55	33.25	29.53	35.87	33.95	3.61	8.92	29.50
11	Utilities	127	0.90	57.18	54.48	63.07	54.31	5.57	34.73	35.47
	Total Sample means	738	0.81	53.09	48.85	56.06	53.71	3.67	102.77	34.31

**Table OA5.2- Summary Statistics by Sector - Mandatory Disclosure**

This table summarizes key variables by sector, divided into two panels. Panel A shows the means for ESG scores and financial control variables, with ROA and Leverage winsorized at the 2.5% and 97.5% cutoffs. Panel B presents means for textual variables, including Release, Total Words, and Fog Index, along with Word Frequencies; only the Fog Index and Word Frequencies are winsorized. Overall sample means are provided in the final row of each panel.

**Panel A: ESG scores and financial control variables – means by sector**

	Sector	N	ESG score <sub>t+1</sub>	E score <sub>t+1</sub>	S score <sub>t+1</sub>	G score <sub>t+1</sub>	ROA <sub>w</sub>	Total Assets	Size	Leverage <sub>w</sub>
1	Communication Services	30	64.87	62.95	68.84	58.39	0.02	69.40	24.87	0.27
2	Consumer Discretionary	128	41.77	34.78	42.59	48.91	0.02	10.90	22.81	0.31
3	Consumer Staples	98	54.25	55.54	53.35	53.53	0.05	39.60	23.88	0.36
4	Energy	40	48.38	36.34	53.67	56.61	0.05	226.00	24.16	0.34
5	Financials	98	58.25	56.94	64.46	53.21	0.04	517.00	25.85	0.24
6	Health Care	38	34.17	30.29	33.11	39.20	0.06	9.52	22.67	0.28
7	Industrials	91	53.61	46.29	59.09	54.19	0.03	17.60	23.32	0.48
8	Information Technology	10	55.98	11.85	47.21	76.78	0.09	3.40	21.78	0.21
9	Materials	101	54.88	54.69	56.87	53.78	0.03	71.50	24.43	0.38
10	Real Estate	23	31.72	27.56	34.59	32.58	0.04	8.78	22.85	0.30
11	Utilities	138	56.21	52.85	63.44	52.71	0.06	34.30	23.86	0.35
	Total Sample means	795	51.60	47.48	54.86	52.05	0.04	102.00	23.89	0.34

**Panel B: Textual variables – means by sector**

	Sector	N	Release	Total Words	Avg. WrdsSent	Complex Wrds	FogIndex	w	WF E	AI w	WF S	AI w	WF G	AI w	WF ESG	AI w	Pos. Tone Rel1
1	Communication Services	30	12.63	188,566	16.26	36.70	21.12		0.17		0.23		0.25		0.32		0.36
2	Consumer Discretionary	128	12.66	154,455	16.00	36.75	21.11		0.16		0.22		0.25		0.31		0.38
3	Consumer Staples	98	12.03	155,379	15.44	36.61	20.84		0.17		0.22		0.25		0.31		0.39
4	Energy	40	13.55	171,962	15.33	37.12	20.99		0.17		0.23		0.25		0.32		0.35
5	Financials	98	15.81	172,834	14.18	36.78	20.39		0.17		0.22		0.25		0.31		0.40
6	Health Care	38	12.50	174,781	16.23	37.16	21.36		0.17		0.23		0.25		0.32		0.36
7	Industrials	91	12.37	160,495	15.08	36.91	20.80		0.17		0.22		0.25		0.31		0.38
8	Information Technology	10	14.10	120,674	16.25	37.56	21.52		0.18		0.24		0.27		0.33		0.39
9	Materials	101	12.24	165,341	14.01	36.78	20.32		0.16		0.21		0.24		0.30		0.35
10	Real Estate	23	9.43	156,468	15.99	36.53	21.01		0.16		0.22		0.25		0.31		0.39
11	Utilities	138	12.64	186,543	16.70	36.93	21.41		0.17		0.22		0.25		0.31		0.34
	Total Sample means	795	12.84	167,252	15.46	36.83	20.91		0.17		0.22		0.25		0.31		0.37