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Research article

# The independent and moderating role of choice of non-financial reporting format on forecast accuracy and ESG disclosure☆

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ABSTRACT

Over the last two decades, the non-financial disclosure requirement has become a major concern for companies, consumers, governments, and policymakers. While compelling evidence has accumulated over time on the positive effect that moving away from disclosing non-financial information within mandatory financial statements, conflicting findings have emerged on the relative merits that choice of non-financial reporting format, in particular between sustainability and integrated reporting, can have on analysts' forecast accuracy. In addition, recent evidence from a non-voluntary setting has suggested that such choice could influence the effect of ESG disclosure and consequently reduce information asymmetry. Aiming to shed some light on these propositions within a voluntary setting, we conducted an empirical study focusing on a representative sample of listed European companies. We retrieved and analysed the last ten years (2012–2021) of publicly available financial information about the top 600 companies listed in the Eurostoxx. Our findings indicate that both a sustainability and an integrated report are significantly associated with improved forecast accuracy, relative to an annual report. We also find that ESG disclosure is significantly moderated by such choice. The environmental pillar score was found to strongly and positively affect forecast error, independently from other controls including the social and governance pillars. For companies opting to disclose non-financial information within an annual report, alternative forms of communication will therefore become critical to ensure that financial analysts, and ultimately investors, are informed about the company's sustainability-related activities and plans. Future research should be directed at examining the magnitude and direction of these effects among small and medium-size listed companies and in other decision-making settings to test the generalisability of these findings.

## 1. Introduction

Traditional financial reporting has been recognized as not being fully suitable to accommodate the increasing financial and non-financial information needs and expectations from multiple stakeholders, with doubts about its usefulness raised from scholars and practitioners (Lev and Gu, 2016). Suggestions about the adoption of alternative forms of reporting formats capable of efficiently accommodating environmental, social and governance-related information, namely sustainability report (SR) and integrated report (IR) have therefore been put forward.

Sustainability reporting standards typically focus on addressing non-financial disclosure only, being separate reports from those required under financial reporting regulations (Global Reporting Initiative, 2021). Such feature of SR has been criticised by some scholars in that they would fail to integrate financial and non-financial information, and therefore drivers of value creation, hence limiting investors and analysts' ability to adequately interpret the financial implications of the latter. Consequently, IR was introduced to address this limitation

☆ In addition, research has suggested that, under an assumption that ESG disclosure can affect forecast accuracy and consequently future financial disclosure, a shift in reporting format can influence stakeholders' understanding of the firm and its future, and therefore ESG disclosure and consequently reduce information asymmetry (Bernardi and Stark, 2018). While providing an important contribution to the non-financial reporting literature, those findings might not be readily generalised to different study settings due to limitations acknowledged by the authors. Bernardi and Stark (2018) focused their investigation on the South African context where a mandatory IR regime has been in place since 2010. The final sample consisted of 41 firms with 5 years of consecutive observations from more than a decade years ago, limiting the external validity of the results accordingly. However, that study provides a research opportunity to examine whether choice of non-financial reporting format can affect the a priori assumed positive association between ESG disclosure and forecast accuracy in voluntary settings.

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(International Integrated Reporting Council [IIRC], 2013) by linking material quantitative and qualitative information from sustainability and intangibles reports, as well as financial statements, within a concise and self-contained document. Supporters of IR argue that, by adopting a multi-capital perspective, IR offers a more comprehensive understanding of an organization's value creation process (Stubbs and Higgins, 2018) and ultimately lead to improved decision-making and more efficient allocation of funds. However, the debate on the relative merits and usefulness of the two alternative reporting forms is still open, especially after the implementation of the European Non-financial Directive which requires large companies in Europe to produce annual corporate reports including information on their social, environment, human rights and anti-corruption policies, risks and disclosure (European Union, 2014).

From a theoretical standpoint, the release of non-financial information would reduce information asymmetry, and therefore influence investor judgement and behaviour, by providing better quality and relevant information, which would in turn positively impact financial analysts' ability to predict future earnings accurately (Verrecchia, 1983, 2001). A currently limited number of empirical studies have examined the effect that either SR (Dhaliwal et al., 2011, Dhaliwal et al., 2012, Matsumura et al., 2014, Muslu et al., 2019; Schiemann and Sakhel, 2019; Plumlee et al., 2015) or IR (Bernardi and Stark, 2018; Caglio et al., 2020; Flores et al., 2019; Kim et al., 2017; Rossignoli et al., 2022; Wahl et al., 2020; Zhou et al., 2017) individually have on forecast accuracy – measured as forecast error or dispersion – relative to annual reporting.

Another stream of research for which a growing body of evidence currently exists has focussed on how ESG scores attributed by rating agencies, such as Bloomberg – which are partly based on what is disclosed by a given company regarding non-financial information – affect forecast accuracy (Bernardi and Stark, 2018; Dhaliwal et al., 2012; Muslu et al., 2019; Schiemann and Sakhel, 2019). Conflicting results have emerged however and to date no definitive conclusions can be drawn on relative merits of SR or IR in improving forecast accuracy.

Against this backdrop, the aim of this study was therefore to shed some light on the influence that choice of non-financial reporting format can have on forecast accuracy and its moderating role on ESG disclosure. To this end, we analyse a sample of the top 600 companies listed in the Eurostoxx for the period 2012–2021 and estimate levels of forecast accuracy – measured both in terms of forecast accuracy and forecast dispersion – associated with publication of an annual report (AR), a SR and an IR. Furthermore, we examine if ESG disclosure is moderated by choice of non-financial reporting format. Our results show that both the two latter forms of reporting are associated with improved forecast accuracy, relative to AR, and that this choice can independently influence the effect that ESG disclosure has on forecast accuracy. Our study contributes to the literature review in different ways. Firstly, it is the first study that investigates whether any of the two main forms of non-financial reporting, SR and IR, is superior in supporting financial analysts predict future disclosure accurately, compared to AR. Secondly, we examine the role of reporting choice on the effect that ESG disclosure has on forecast accuracy. The remainder of this manuscript is organised as follows: section 2 provides a literature review on the association between SR, IR and forecast accuracy and posit two hypotheses. Section 3 describes the research design and methodology followed to test our hypotheses. Section 4 presents the empirical results. Section 5 provides a discussion of the study findings, placing them in the relevant policy context and scientific literature, concluding with some final remarks.

### 1.1. Literature review and hypothesis development

#### 1.1.1. Non-financial reporting format and forecast accuracy

The voluntary disclosure theory proposes that sharing private information with investors can improve the effectiveness of resource allocation, decreasing information asymmetry (Healy and Palepu, 2001). The extant literature proposes theoretically (Diamond and Verrecchia, 1991; Lambert et al., 2007) and finds empirically that analysts can estimate earnings more accurately if they have better-quality information, via voluntary disclosure (Lang and Lundholm, 1996, Hope et al., 2016). In this context, financial analysts are intermediaries between firms and investors who gather, process and analyse financial information. When analysts' predictions are more accurate, investors can more effectively allocate their capital, which has beneficial effects on the capital market. The usefulness of voluntary disclosure to financial analysts can be assessed by examining the relationships between choice of reporting framework and the precision of financial analysts' forecasts.

Within the broader context of corporate social responsibility (CSR), a large body of empirical studies have examined the impact of that non-financial disclosure, has on information asymmetry, measured either as forecast errors or forecast dispersion. Plumlee et al. (2015) and Matsumura et al. (2014) investigated disclosures relating to the specific activities, i.e., environmental activities, while Dhaliwal et al. (2011, 2012) analysed the impact of standalone CSR reports, which include SR, report on all CSR activities. Dhaliwal et al. (2011) found that firms initiating CSR reports have a lower cost of equity capital and smaller analyst forecast errors, when the disclosures could be supported by superior CSR activities. Similarly, Dhaliwal et al. (2012), who analysed a sample of firms from 31 countries, found that the impact of the issuance of a standalone SR on information asymmetry was stronger in more stakeholder-oriented countries. More recently, Schiemann and Sakhel (2019) who focused their investigation on climate-related physical risk reporting, observed a decrease in information asymmetry for companies that disclosed more (or more serious) physical risks in high carbon-emitting sectors. Muslu et al. (2019) developed a scoring system based on the quality of ESG-related disclosure in CSR standalone reports via textual analysis. This analysis examined the effects of different levels of ESG disclosure on information asymmetry, providing evidence for more substantial content leading to lower forecast error. Overall, therefore, the findings of this part of literature indicated that choice of standalone CSR reporting, including SR was positively associated with forecast accuracy, compared to non-standalone forms of non-financial disclosure reporting.

By contrast, the results of empirical studies focusing on choice of IR vs any other form of reporting and forecast accuracy indicate a positive association favouring IR in mandatory settings. Zhou et al. (2017) analysed a sample of companies listed on the Johannesburg Stock Exchange during the period 2009–2012 and found that companies publishing IR in accordance with the IIR Framework (International Integrated Reporting Council, 2021) had significantly lower forecast errors. Comparable results were found by Bernardi and Stark (2018) who investigated the effect of choice of IR on analyst forecast error, concentrating on the transition to the new reporting system in South Africa. These authors also provided evidence for the level of ESG disclosure, in particular environmental disclosure, being associated with improved forecast accuracy, after the introduction of the mandatory IR regime. Caglio et al. (2020) analysing a sample companies listed in the Johannesburg Stock Exchange during the period 2011–2016, found that the assured IR decreased forecast dispersion significantly.

Studies instead based in voluntary settings have showed somewhat mixed results. Kim et al. (2017), examined 156 IR adopters from 18 countries in 2014 and 2015 and showed that adoption of IR decreased forecast dispersion. Flores et al. (2019) compared continental European and North American IR adopters with non-adopters and found a positive effect of voluntary IR publication on forecast errors. This effect was stronger in America, which the authors attributed to a stronger shareholder orientation. Contrary to these results, however, Wahl et al. (2020) found no significant association between adoption of the IR and forecast errors, whereas Rossignoli et al. (2022) confirmed that a voluntary release of IR increases forecast accuracy, but they also indicated that this association depends on the institutional characteristics of country. Only the study of Permatasari and Narsa (2022) specifically compared SR vs IR and found that SR had a higher value-relevance to investors than IR. This review of the literature showed that, except for

the latter study, SR and IR have not been directly compared to one another in terms their influence on forecast accuracy. Given the current evidence base, we posit that SR and IR both improve forecast accuracy, relative to AR and test their relative effectiveness. Hence, we hypothesize:

**H1**. Choice for a SR or a IR reporting format increases forecast accuracy relative to an AR.

#### *1.1.2. ESG disclosure, non-financial reporting format and forecast accuracy*

Theoretical and empirical evidence supports the argument that there is a positive association between level of ESG disclosure, measured as ESG disclosure score and forecast accuracy. In their meta-analyses, Orlitzky et al. (2003) and Margolis and Walsh (2003) showed that CSR activities enhance brand reputation (Brown and Dacin, 1997; Lev et al., 2010), attract and motivate employees (Waddock and Graves, 1997; Roberts and Dowling, 2002; Edmans, 2011); improve relationship with regulators and customers (Cheng et al., 2011; Goss and Roberts, 2011) and mitigate regulatory and operational risk (Starks, 2009). In line with these findings, Cho et al. (2013) examined whether ESG disclosure measured as from KLD STAT (KLD Research and Analytics, 2022) has a beneficial impact on information asymmetry and found evidence for a positive association. More recently, Rossignoli et al. (2022) found that the level of governance-related disclosure is negatively associated with forecast errors, while social domain is not consistently associated with forecast accuracy. A study by Bernardi and Stark (2018) investigated whether a change to a IR format had any efficacy on the negative association between ESG disclosure and information asymmetry. These authors found that the introduction of a IR mandatory non-financial reporting regime in South Africa improved forecast accuracy, with this effect being mediated by an improvement in ESG disclosure. In particular, they found level of environment-related disclosure being more strongly and positively associated with forecast accuracy, compared to the social and governance domains.

However, the study by Bernardi and Stark (2018) was conducted in a mandatory setting and analysed a relatively small number of companies (n = 41) from observations from 2018 to 2012. As acknowledged by their authors, the limited number of company-years observations considered and the setting in which that research was conducted limited the generalisability of those findings. In particular, no previous research study has assessed the effect that choice of non-financial reporting format can have in a voluntary setting, such as that of the European market, and directly compared the relative merits of SR, IR and AR in their ability to influence the presumed positive association between ESG disclosure and forecast accuracy. Based on our review of the literature, we therefore formulate the following hypothesis:

**H2**. Choice of non-financial reporting format moderates the positive association between ESG disclosure and forecast accuracy.

## 2. Materials and methods

### *2.1. Sample and data collection*

To investigate the company's choice of reporting framework (annual report, sustainability report and integrated report), we focused on the sample of public companies currently listed in the Eurostoxx 600 for the last decade of available data at the time of writing, that is 2012–2021. The initial sample was therefore composed by 6600 company-year observations. Appendix I breaks down the initial sample by country, industry and respective number of companies and company-years observations. In line with the previous literature review (Kim et al., 2017; Melloni et al., 2017; Kiliç and Kuzey, 2018; Flores et al., 2019; Girella et al., 2019; Rossignoli et al., 2022), we assigned the companies to the IR category based on whether they employed the reporting framework proposed by the International IR Council (IIRC, 2013). With regards to SR, we conducted a manual search by reviewing the organisations' official websites. We extracted company-level financial statement and market data from the Refinitiv Eikon database (Eikon, 2022)

### *2.2. Variables*

Information asymmetry, as proxied by forecast accuracy, was the outcome under study, which was measured as forecast error (FE, the primary dependent variable) and forecast dispersion (FD). Following the approach used by Dhaliwal et al. (2012), Zhou et al. (2017), FEs were computed as the absolute difference between the company's actual earnings and the analysts' typical earnings forecasts for the year, as follows:

$$\mathrm{FE}_{i,t} = \frac{\left| EPS_{i,t} - \ Forecast\ EPS_{i,t} \right|}{P_{i,t}}$$

where *EPSi*.t are the realized earnings per share for company *i*, in year *t*, *Forecast EPS*$_{i.t,j}$ is the median EPS consensus forecast for a company *i* for year *t*, and $P_{i,t}$ is the mean stock price for company i, in year t. Forecast dispersion was calculated as the standard deviation of the FEs for the last five years. The key explanatory variable was reporting choice, a nominal variable which was is equal to 0, 1 or 2, depending on whether the company released an annual report, SR or an IR, respectively. The ESG disclosure was measured by ESG score, a ratio scale variable which was treated as continuous. The ESG score is a weighted average of the three index constituents or pillars, that is environmental, social and governance. Based on a total of ten subcategories which are aimed to reflect the company's ESG disclosure, commitment and effectiveness based on publicly reported information, within Refinitiv Eikon the three pillars are each assigned a score ranging between 0 (worst) and 100 (best) that are then approximately weighted as follows: environmental 0.44, social 0.31 and 0.25 (Eikon, 2022). The three pillar scores were each separately considered for sensitivity analysis.

Based on the extant literature on the determinants of analysts' forecast accuracy (e.g., Duru and Reeb, 2002; Lang and Lundholm, 1996; Lehavy and Li, 2009) we identified the following set of contextual and financial control variables which may impact the investigated associations. In terms of the former group, financial year, the company's main industry and country of domain. Financial control domains were (Refinitiv code):

- *size*, measured by the firm's market value of equity (MV), based on studies documenting that analysts' errors are smaller for larger firms (e.g., Lang and Lundholm, 1996; Lehavy *et al.*, 2011);
- *beta*, a measure of stock volatility of returns relative to the reference market (BETA), which is likely to be negatively associated with forecast accuracy (Takamatsu and Lopes Fávero, 2019);*market-to--book value*, to control for the firm's growth prospects (MVBV). The variable is computed as the firm's market value of equity divided by its book value. Evidence shows that abnormally high growth prospects can decrease forecast accuracy (Ayres et al., 2017). Also, it can be the case that high-growth firms tend to attract a larger analyst following, prompting greater demand for private information about these companies and, thereby, improved forecast accuracy (Lang and Lundholm, 1996; Barth. et al., 2001);
- *leverage* may also affect analysts' accuracy since it can induce higher levels of earnings volatility by increasing a firm's financial risk (Parkash. et al., 1995). Leverage was measured using the ratio between total debt and total capital (LEV 1).
- *profitability,* measured in terms of absolute difference between current and previous financial year, scaled by total assets, as it can be expected that abnormal earnings may be associated with less accurate analysts' forecasts (e.g., Lang and Lundholm, 1996; Duru and Reeb, 2002); whether the company reported a negative profit (loss); and return of assets.

In addition, as supplementary analysis we tested for the inclusion of *analyst coverage* (Number of Analysts) and *earnings volatility* (Earning Volatility) in the statistical models, which are intrinsic to the measurement of forecast accuracy, and therefore endogenous. Analyst coverage was measured as the number of analysts issuing a forecast for the firm at the beginning of the year of forecasts. Previous research found that higher firm's following increases the accuracy of earnings forecasts (Lang and Lundholm, 1996; Hong and Kacperczyk, 2010). Earnings volatility is likely to be associated with lower analysts' accuracy (e.g., Lang and Lundholm, 1996), as given the effect of more imprecise EPS predictions. The standard deviation of return on assets (ROA) computed over the five years prior to the EPS forecast was used to measure earnings volatility. Finally, we also tested whether the choice of using the Global Reporting Initiative format – a prominent SR standard – had any moderating effect on the investigated associations. ESG disclosure was proxied by the ESG disclosure score, following the approach used by Bernardi and Stark (2018).

### 2.3. Empirical strategy

Two sets of linear regression models (ordinary least square) were estimated based on the respective hypotheses. In our first set of models, we assessed the relationship between choice of reporting framework and forecast accuracy:

$$Forecast\ accuracy_{it} = \beta_0 + \beta_1\ Reporting_{it} + \beta_2\ Contextual\ controls_{it} + Financial\ controls_{it} + \varepsilon_{it} \quad (1)$$

In the second set of models, we tested for the moderating role of reporting choice on the association between the ESG disclosure and forecast accuracy, using the following equation:

$$\text{Forecast accuracy}_{it} = \beta_0 + \beta_1 \text{Reporting}_{it} + \beta_2\ \text{ESG}_{it} + \beta_3\ \text{Reporting}_{it} * \text{ESG}_{it} + \beta_4\ \text{Contextual controls}_{it} + \beta_5\ \text{Financial controls}_{it} + \varepsilon_{it} \quad (2)$$

### 2.4. Statistical analysis

Summary statistics were used to describe trends in choice of reporting framework and ESG score over time. Pearson's pairwise correlations were computed for each of the identified variables. A forward stepwise approach for model specification was employed, with three regression models being built progressively. Specification 1 included only the key independent variables of interest (i.e., reporting choice and ESG score), as appropriate. Specification 2 included specification 1 variables and contextual controls, that is financial year, industry and country. Finally, model specification was further augmented with the inclusion of financial controls (specification 3). Among this set of controls, selection between alternative measures of domain was based on significance level and effect magnitude, in priority order. Interaction terms were used to evaluate the presence of effect modification. Wald tests were performed to assess between-category differences. Significance level was set at $p < 0.05$. All analyses were performed using STATA 16 software (StataCorp, 2019).

## 3. Results

### 3.1. Descriptive statistics

Pearson's pairwise correlations in **Appendix II** indicated that forecast accuracy, measured as FE and FD, would improve with a choice of non-financial reporting format alternative to an AR, a higher ESG score and number of analysts evaluating the company's disclosure. None of the remaining control variables were significantly correlated with the dependent variables, indicating that companies included in the sample were not significantly different from one another in the way those dimensions could affect information asymmetry. Fig. 1 illustrates the trend in choice of non-financial reporting format by the Eurostoxx 600 listed companies over time. This chart shows a marked proportional decrease in the release of an AR, relative to either a SR or an IR, starting at a 32.8% of all companies and steadily decreasing at an average annual 3.2% to reach a 4.2% in 2021, that is reducing to a 12.8% of the original 2012 value.

In parallel with this effect, relatively steady upward trends in both the overall ESG and its three pillar scores characterised the studied time period (Fig. 2). Starting at a 61.1%, a substantial 13.7% improvement in the medial score was observed in 2021, with comparable effects estimated for the environmental, social and governance pillars. Furthermore, the ESG score distributions showed a marked shift toward the right-hand side of the x-axis, indicating that over time comparatively fewer companies reported low scores, as indicated by a first decile score standing at 27.8% in 2012 to shift to more than double that value (57.6%) after eight years.

### 3.2. Regression results

Table 1 shows that choice of either sustainability or IR is consistently associated with improved forecast accuracy (smaller forecast error), compared to AR, after controlling for contextual and financial factors. While the country of domain appeared to significantly affect forecast accuracy when contextual factors only where considered, this was no longer the case after including financial covariates.

The other control variables did not make any significant difference in adjusting for any of the effects observed between the key explanatory variable and forecast error. **Appendix III** shows the distribution of the company-year observations by model specification. Similar results were estimated when FD was considered the dependent variable (**Appendix IV**).

Table 2 shows that the company's ESG score significantly moderates the effect that choice of reporting framework has on forecast accuracy. **Appendix V** shows the distribution of the company-year observations by model specification. In particular, a company with a median ESG score (66.6), both sustainability and IR are associated with smaller forecast error, compared to those who chose to publish an annual report. This meant that for companies publishing an annual report, the ESG score showed to have a significantly larger role in terms improved forecast accuracy, compared to other forms of reporting. Similar to what was found in Table 1, while not being statistically significant, there seemed to be a difference in effect magnitude between integrating reporting and SR, whereby the companies adopting the latter appeared

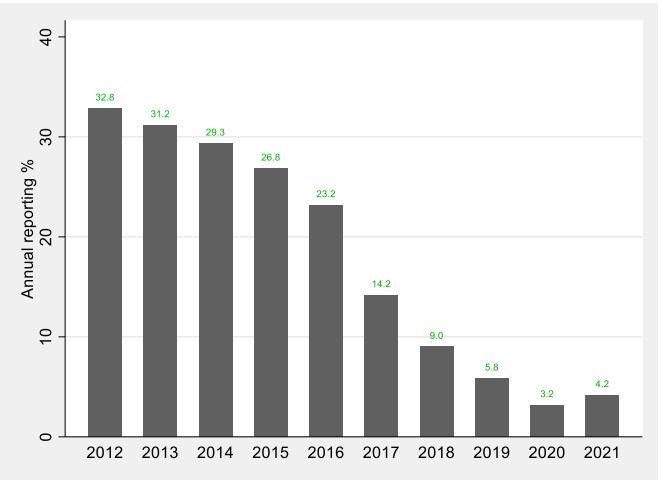


**Fig. 1.** EURO STOXX 600 Annual reporting % over time.

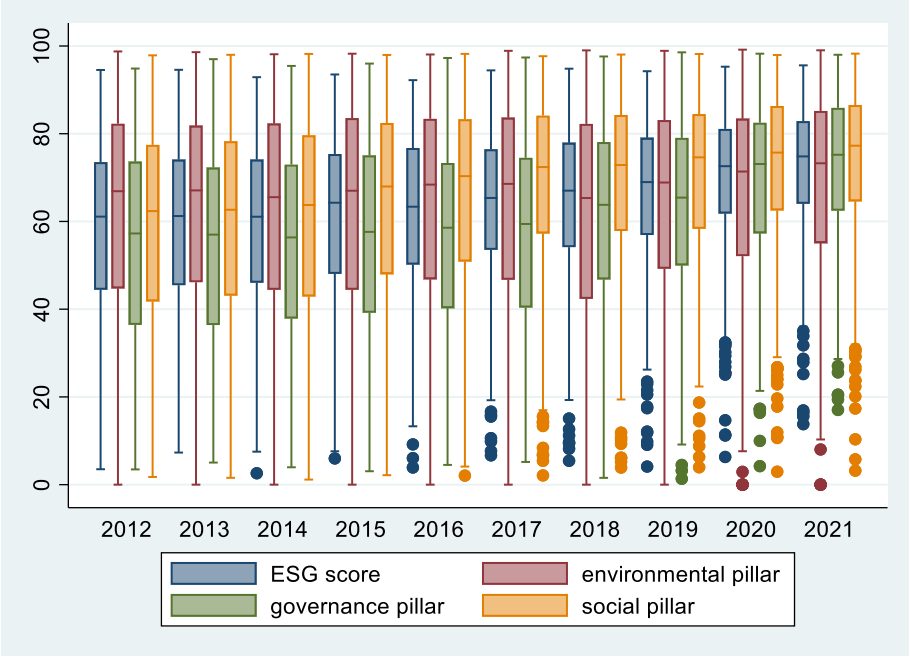


**Fig. 2.** EURO STOXX 600 ESG scores over time.

to be slightly more sensitive to the ESG score, in comparative terms. As with Table 1, the other control variables did not make any significant difference in adjusting for any of the effects observed between the key explanatory variables and forecast error.

Sensitivity analyses indicated that these results were overall robust to variations to the ESG pillar score considered with choice of non-financial reporting format alternative to an AR playing a moderating role in reducing information asymmetry. Score (**Appendix VI**). Further testing revealed that the governance pillar score (−0.157, p = 0.022), and in particular the environmental score (−0.209, p = 0.006) positively and independently affected forecast accuracy when measured as FE, but not as FD (**Table A, Appendix VI**). When analysing FD as the dependent variable, comparable estimates were generated, with the exception that both the environmental and social showed to be associated with a larger moderating effect than the governance pillar (**Appendix VII**).

Supplementary analysis showed that use of the GRI framework made no difference to forecast accuracy in univariate analysis., but had a small significant effect (mean 7.316, standard error 3.482) on forecast error, negatively impacting accuracy. This analysis confirmed the results reported above regarding the effect of reporting choice and the moderating role of ESG scores and showed that, in line with our prior expectation, earnings variability was negatively associated with forecast error. Furthermore, this analysis revealed that analyst coverage, measured as the number of analysts following a company, is a significant independent predictor of forecast error (mean −0.513, standard error 0.222), with a greater number of analysts comparatively benefiting more companies opting for an annual report (**Appendix VIII**).

## 4. Discussion and conclusions

This study aimed to shed some light on whether non-financial disclosure reporting – either in the form of a SR or an IR - decreases information asymmetry between company and financial analysts relative to AR. Furthermore, we examined the moderating role of ESG scores on those relationships. We found strong evidence for rejecting the null hypothesis of there not being any difference between non-financial reporting formats, whereby the release of either a SR or an IR was significantly associated with improved forecast accuracy. We found no evidence for a systematic differential effect between the two forms of non-financial disclosure report, although we observed a non-significant difference in the magnitude of effects in favour of IR. These findings were robust and consistent across statistical tests and analyses, starting from pairwise correlations to multivariable regression models controlling for several contextual and financial factors. We conducted sensitivity analyses by testing this hypothesis using two alternative proxy measures of information asymmetry, namely, forecast error and forecast dispersion.

Within a relatively limited body of studies, while these findings align with part of the existing literature (Higgins and Walker, 2012; Flower, 2015; Rowbottom and Locke, 2016; Lai et al., 2017, 2018), they also stand in opposition to what was recently found within the study by Permatasari and Narsa (2022). These authors examined which of the two types of non-financial disclosure reports – sustainability or IR – were more valued by capital market investors and relevant for their decision making. Value-relevance of this reporting choice was evaluated based on whether it could explain stock prices, stock returns or firm value, under the assumption that the information provided by the report will be used to inform investors' investment decisions. They found, in line with previous studies (Klerk and Villiers, 2012; Cardamone et al., 2012) that SR would provide better value-relevance than IR, suggesting that the market would attach higher value to companies dealing and separately reporting on ethical, economic, environmental, and social issues. Nonetheless, Permatasari and Narsa (2022) also found that IR was moderating the value relevance of accounting information in explaining market value. However, that analysis focused on a limited sample of early IR adopters , as acknowledged by the authors, reducing the generalisability of those findings accordingly.

We found that a choice for either SR or IR, relative to AR, favourably moderates the positive association between ESG score and forecast accuracy. Similar to what was found for hypothesis one, we did not find any evidence for any systematic differential effect between the two alternative forms of non-financial disclosure reporting. We tested this hypothesis not only by using the two measures of forecast accuracy, but also individually considering the three ESG environmental, social and governance pillar scores. Overall, we found that the environmental pillar score had an independent and strong effect on forecast accuracy, after controlling for relevant covariates and the social and governance pillar scores. To the best of our knowledge, this is the first study

**Table 1**
Hypothesis 1 regression models – forecast error.

| VARIABLES | specification 1 | specification 2 | specification 3 |
|---|---|---|---|
| 1. Sustainability | −12.176*** | −13.465*** | −9.637** |
| | (3.745) | (4.086) | (4.050) |
| 2. Integrated | −14.212*** | −15.687*** | −11.575** |
| | (5.025) | (5.419) | (5.401) |
| industry | | −0.027 | 0.028 |
| | | (0.388) | (0.375) |
| country | | 0.328* | 0.262 |
| | | (0.188) | (0.181) |
| 2013.year | | −1.347 | −1.471 |
| | | (5.774) | (5.617) |
| 2014.year | | −1.635 | −7.558 |
| | | (5.756) | (5.600) |
| 2015.year | | −7.012 | −7.658 |
| | | (5.736) | (5.556) |
| 2016.year | | −6.784 | −7.635 |
| | | (5.681) | (5.497) |
| 2017.year | | −5.924 | −7.322 |
| | | (5.658) | (5.494) |
| 2018.year | | −5.519 | −6.817 |
| | | (5.646) | (5.490) |
| 2019.year | | −0.928 | −2.100 |
| | | (5.636) | (5.454) |
| 2020.year | | −0.546 | −1.258 |
| | | (5.632) | (5.441) |
| 2021.year | | −2.943 | −4.199 |
| | | (5.593) | (5.394) |
| beta | | | −0.536 |
| | | | (2.772) |
| earnchange | | | −0.013 |
| | | | (0.146) |
| levone | | | <0.001 |
| | | | (0.004) |
| loss | | | −4.243 |
| | | | (4.143) |
| mvbv | | | −0.031 |
| | | | (0.071) |
| mv | | | <-0.001 |
| | | | (0.000) |
| roa | | | 0.077 |
| | | | (0.122) |
| Constant | 14.230*** | 14.184** | 13.071* |
| | (3.504) | (6.396) | (6.748) |
| Company-year observations | 5295 | 4998 | 4771 |
| R-squared | 0.002 | 0.004 | 0.003 |

Standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

**Table 2**
Hypothesis 2 regression models – forecast error.

| VARIABLES | specification 1 | specification 2 | specification 3 |
|---|---|---|---|
| 1. Sustainability | −94.099*** | −103.956*** | −80.975*** |
| | (12.510) | (13.521) | (13.236) |
| 2. Integrated | −105.103*** | −116.583*** | −93.868*** |
| | (24.659) | (25.788) | (24.548) |
| esg | −2.351*** | −2.571*** | −2.147*** |
| | (0.306) | (0.327) | (0.322) |
| 1. Sustainability#c.esg | 2.213*** | 2.416*** | 1.973*** |
| | (0.318) | (0.340) | (0.336) |
| 2. Integrated#c.esg | 2.351*** | 2.574*** | 2.136*** |
| | (0.418) | (0.440) | (0.427) |
| industry | | −0.077 | 0.004 |
| | | (0.413) | (0.400) |
| country | | 0.308 | 0.246 |
| | | (0.201) | (0.194) |
| 2013.year | | −0.972 | −1.380 |
| | | (6.353) | (6.225) |
| 2014.year | | −1.555 | −8.563 |
| | | (6.311) | (6.176) |
| 2015.year | | −7.182 | −8.523 |
| | | (6.268) | (6.104) |
| 2016.year | | −5.927 | −7.369 |
| | | (6.211) | (6.038) |
| 2017.year | | −4.863 | −6.914 |
| | | (6.114) | (5.967) |
| 2018.year | | −4.799 | −6.549 |
| | | (6.035) | (5.892) |
| 2019.year | | −0.708 | −2.120 |
| | | (6.021) | (5.861) |
| 2020.year | | 0.404 | −0.567 |
| | | (6.037) | (5.874) |
| 2021.year | | −0.971 | −2.657 |
| | | (6.087) | (5.904) |
| beta | | | −0.994 |
| | | | (2.980) |
| earnchange | | | −0.030 |
| | | | (0.151) |
| levone | | | −0.000 |
| | | | (0.004) |
| loss | | | −3.842 |
| | | | (4.464) |
| mvbv | | | −0.022 |
| | | | (0.077) |
| mv | | | 0.000 |
| | | | (0.000) |
| roa | | | 0.034 |
| | | | (0.138) |
| Constant | 105.111*** | 114.758*** | 96.299*** |
| | (11.113) | (13.246) | (13.319) |
| Company-year observations | 4940 | 4659 | 4444 |
| R-squared | 0.018 | 0.021 | 0.016 |

Standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

examining the moderating role choice on non-financial format in voluntary settings, which provides a basis for comparison for future studies on this topic.

The presented findings have potential implications for reporting framework choice and communication. We found that there is no significant difference between the two forms of non-financial disclosure reporting in affecting forecast accuracy. While such choice could influence other relevant decision-making dimensions, our findings indicate that there is no need for company managers to switch to any of the two reporting forms if improved forecast accuracy is the goal to pursue. This however is not intended to undermine the current efforts and role by standard-setters such as the IIRC (2021), the European Commission (2022) and the International Accounting Standard Board (2021) in trying to harmonise reporting standard across countries and improve reporting transparency, which can ultimately benefit forecast accuracy and therefore savings allocation. Nonetheless, our findings do support the current trend in opting out of disclosing non-financial information within mandatory financial statements, which aligns with the policy direction and position by the European Commission within the new CSRD issued in December 2022. Moreover, if a company intends to opt for AR, its ESG score will play a significant role in improving forecast accuracy. Therefore, for these companies, alternative forms of communications (e.g., analyst meetings and press conferences) regarding the company's sustainability-related activities and plans will play a disproportionally more important role on affecting the elements considered within the ESG scores.

### 4.1. Strengths and limitations

To the best of our knowledge, this is the first study comparing the three alternative options for disclosing non-financial reporting directly against one another. We analysed a sample of data from the top 600 listed companies in Europe considering the last ten years of available information. Compared with previous studies, our sample was significantly larger and representative of large European companies, increasing the reliability of our findings within such context accordingly. We also conducted a series of sensitivity analyses to test base case assumptions. However, we did limit the identification of IR to the framework proposed by IIRC and to European companies only. As a result, our findings may not be generalised to other decision-making

settings such as South Africa where listed companies are required to submit an IR on a comply or explain basis (Integrated Report Committee of South Africa IRCSA, 2011). Moreover, the companies analysed in this study were a selective sample of large, mostly public companies who routinely interact with capital markets and have a non-negligible stake in ensuring non-financial information quality. In addition, the coefficient of determination of the regression models was low. In terms of R-squared, a low value indicates that the independent variables explained only a limited proportion of the variation in forecast accuracy, and therefore other unidentified factors will have played a major role in contributing to the variance. One plausible explanation for the low value if the marked increase of forecast accuracy derived from the COVID-19 pandemic which increased forecast uncertainty across most economic domains and markets in Europe and beyond. We expect the results of the presented analysis to be different in a sample of small to medium-size or not listed companies, such as those that will be impacted by the upcoming CSRD. Nonetheless, this limitation is shared with previous studies on this topic which analysed the adoption of IR (Kim et al., 2017; Melloni et al., 2017; Kiliç and Kuzey, 2018; Flores et al., 2019; Girella et al., 2019; Rossignoli et al., 2022).

Secondly, we did not control our results for the quality of the information disclosed in the corporate reports, but only for reporting format choice. This would have required a qualitative assessment of 6600 reports which was beyond the scope of our study. Future qualitative-level studies such as those conducted by Zúñiga et al. (2020) and Leukhardt et al. (2022) could address this limitation by for instance conducting an analysis on a subsample of European companies and examine the differences between the quality of information disclosed in the alternative forms of non-financial reporting format. Further, while we did control for country of domain in our analysis, which may have captured part of the country-related heterogeneity in reporting customs and norms, unlike previous studies such as that by Rossignoli et al. (2022) and by Berg et al. (2022), we did not take into account the heterogeneity in institutional characteristics and settings and other ESG ratings, limiting our analysis as a result.

We sourced the financial statement data from the Refinitiv Eikon dataset, which has been widely used by researchers in the area, increasing the probability of study replication. This to some degree constrained the extent of statistical analysis to the dimensions and variables present within such dataset. However, we also retrieved information on reporting choice within other datasets and on the identified companies' websites, enabling us to pursue our research objectives. On the other hand, the methods used by rating agencies to calculate a company's ESG score differ markedly between providers, both in terms of pillar relative weights and their components. Therefore, the presented results might not be reproducible if an alternative ESG score provider was to be used Schiemann and Tietmeyer (2022). Future mapping studies should investigate the level of score overlap between different providers and how they affect forecast accuracy.

### 4.2. Concluding remarks

A company choice of adopting a non-financial disclosure framework, either it be a SR or an IR format, makes a significantly positive difference in the level of forecast accuracy by analysts, and therefore reduced information asymmetry, relative to an AR. Such choice also moderates the positive effect that ESG disclosure has on forecast accuracy. For companies opting for the use of AR, alternative forms of communication will become critical to ensure that financial analysts, and ultimately investors, are as adequately informed about the company's sustainability-related activities and plans.

## Credit author statement

Paola Rossi: Conceptualization, Methodology, Investigation, Resources, Data Curation, Writing - Original Draft, Writing - Review & Editing, Visualization, Project administration. Paolo Candio: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing - Original Draft, Writing - Review & Editing, Visualization, Project administration.

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## Declaration of competing interest

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

## Data availability

Data will be made available upon request.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvman.2023.118891.

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