The Non-Financial Spillovers of Financial Information Processing Costs: Evidence from the U.S. XBRL Mandate

Marco Errico* Mohammed Zakriya†

January 15, 2023

Abstract

We study the impact of market participants' financial information processing costs on firms' environmental, social, and governance (ESG) engagement. By leveraging the eXtensible Business Reporting Language (XBRL) mandate in the U.S. as an exogenous shock to financial information processing cost, we document a significant increase in firms' ESG performance after the XBRL adoption. Further analyses reveal that the mandate affected Governance Score the most (consistent with XBRL being beneficial to institutional investors that care more about governance mechanisms) and the magnitude of its effect wanes over time. Our results are robust to multiple falsification tests and alternative identification strategies. We argue that when market participants' constraints associated with processing financial information are relaxed, they allocate more time to process non-financial (ESG) disclosures, especially in financially opaque firms. Upon facing this increased attention, firms' managers respond by improving ESG engagements. Consistent with this view, we find that the XBRL mandate´s positive effects are concentrated in firms that are either well-monitored, opaque, or have risk-taking managers.

Keywords: ESG, XBRL, disclosure, reporting regulation, information processing costs
JEL classifications: G32, G34, L21, M14, Q56

*ESADE Business School, Universitat Ramon Llull. Email: marco.errico@esade.edu.
†IESEG School of Management, Univ. Lille, CNRS, UMR 9221 - LEM. Email: m.zakriya@ieseg.fr.

1 Introduction

Information processing costs impede market participants from acquiring and integrating information available in public disclosures (Grossman and Stiglitz, 1980; Verrecchia, 1982; Merton et al., 1987). Market participants and investors, hence, "rationally weigh the benefits of obtaining firm information against the costs of processing that information" (Blankespoor, 2019). As a result, how market participants' respond to disclosure is influenced by the cost associated with its processing. This, in turn, also impacts firms' disclosure incentives when they have benefits associated with disclosing information. Several studies have shown capital market effects that benefit market participants when there is a reduction in financial information processing costs (Blankespoor et al., 2014; Liu et al., 2014; Kim et al., 2019; Blankespoor, 2019). However, little is known as to whether these benefits spill over to firms' non-financial information. In this paper, we investigate how a reduction in market participant's financial information processing costs affects firm's incentives to improve their non-financial Environmental, Social, and Governance (ESG) performance and engage in better Corporate Social Responsibility (CSR) disclosure.

The adoption of mandatory eXtensible Business Reporting Language (XBRL) provides us with an ideal setting that exogenously affects information processing costs. We hypothesize that a mandatory switch to XBRL format benefits market participants in processing financial information faster, allowing them to dedicate more time to scrutinize non-financial ESG information. By facing this increase in attention, firms improve their ESG policies. Using the XBRL mandate for our experimental setup has several advantages. First, firms that adopt XBRL filing format—no matter voluntarily or in response to the mandate—continue to do so without switching back to non-XBRL format. This ensures that XBRL and non-XBRL filing firms are mutually exclusive and can be clearly identified consistently without any possible empirical miscategorization.

Second, the relatively short period of three years for the market-wide implementation of the XBRL mandate and also the presence of voluntary adopters, allow us to perform multiple falsification tests to assess the validity of our results. Third, since XBRL mandate has been introduced in three different phases, it permits to gather more detailed insights into the evolution of its impact on ESG over time as well as exploiting the staggered adoption empirically to design alternative identification strategies. Fourth, in our empirical setting, firms are highly unlikely to self-select into the treatment group (i.e., of mandated XBRL filers) or actively engage in avoiding the XBRL adoption because they have no choice but to follow the U.S. Securities and Exchange Commission (SEC) mandate. Essentially, the self-selectors are weeded out and isolated in our sample in the form of voluntary adopters. Thus, we are also able to largely avoid any firm-specific sources of endogeneity. In particular, the presence of voluntary adopters allow us to analyze whether the effect is due to firm's behavior (i.e. voluntary adopters), the regulation itself (i.e. mandatory adopters), or both. Lastly, for a financial disclosure regulation to effectively impact non-financial behaviour of firm, market participants should be well-informed about the regulation change while the firms are not given enough time to understand and anticipate its potential impact and react to it. This was clearly the case with XBRL mandate as it was officially announced only in the year of its first phase of implementation.

Using an initial sample of over 28,500 ESG Scores provided by Thomson Reuters Refinitiv/ASSET4 for U.S. firms from 2002 to 2020 (with a coverage of more than 3,200 firms), we study the change in their ESG performance when their 10-K reports are mandated to be filed using the newer, standardized, and machine-readable XBRL format. Refinitiv/ASSET4 ESG data has been frequently used in recent literature studying antecedents and outcomes of CSR or ESG (e.g., Liang and Renneboog, 2017; Dyck et al., 2019; Christensen, 2022). We employ a staggered difference-in-differences (DiD) approach to show that firms mandated by SEC to adopt XBRL filing experience

a significant increase in their ESG Scores relative to their pre-XBRL years. To emphasize the economic significance of our finding, the average increase in ESG performance is approximately 5% relative to pre-XBRL period. Our results are robust after controlling for time-variant and invariant firm characteristic, to partially account for the staggered year-wise adoption of XBRL mandate by implementing fixed effects as well as accounting for heterogeneity in the treatment effects of the staggered phase-wise XBRL adoption (Sun and Abraham, 2021; Callaway and Sant'Anna, 2021; Goodman-Bacon, 2021; Baker et al., 2022). Next, on examining the effect of XBRL mandate on the Environmental, Social, and Governance Pillar Scores separately, we find that the increment in their respective magnitudes is highest for the Governance Score and lowest for the Environmental Score. There are two possible explanations for these heterogeneities among ESG Scores. Firstly, this could be explained by the difficulties accompanying assessment of environmental parameters for the firms, their managers, and investors (Ittner and Larcker, 2001; Dumitrescu and Zakriya, 2021). Secondly, XBRL has been show to be beneficial mostly to sophisticated institutional investors who have the requisite resources and capabilities (Blankespoor et al., 2014). These investors are known to have first-order interests in influencing firms' policies related to corporate governance mechanisms (Bushee et al., 2014).

One underlying assumption in our main DiD identification is that firms react to the increased scrutiny from market participants on ESG disclosures after the XBRL mandate by improving their ESG engagement. To rule out that our results are not merely reflecting changes in market participants expectations toward ESG issues, we examine ESG Controversies Score that quantifies the gravity of "news stories about, among other issues, environmental incidents, or scandals about product-harm responsibility" that firms do not have direct control over (Caglio et al., 2020). We find that there is no statistically significant effect of XBRL mandate on ESG Controversies Score, providing some indicative evidence that the impact of information processing

cost is directed only toward ESG actions and not necessarily on ESG perceptions. Another central assumption in our DiD specification is that the impact of XBRL mandate on ESG Scores is consistent across all the three phases of its implementation. However, given that size is an important determinant of CSR engagement (Drempetic et al., 2020) and the three XBRL implementation phases were demarcated around a factor closely related to size, i.e., firms' public float, we expect considerable heterogeneity in how the shock to information processing cost affects firms' ESG Scores in each of the three XBRL mandates. Indeed, we document a monotonically decreasing effect of XBRL reporting on ESG Score and two of its three pillars—Social and Environmental Scores—over time. Zhou (2020) shows a similar decline in magnitude of the effect of XBRL adoption on firms' timeliness of 10-K filings.

We conduct several tests examining the internal validity of our main results and ruling out potential sources of endogeneity. We start with a placebo XBRL implementation beginning in 2014 instead of actual XBRL mandate of 2009 and assigning placebo treatments using the same three market float-based criteria to identify phase-wise placebo adoptions. We also repeat placebo test by focusing on pre-XBRL implementation period. We don't find any effect on ESG Score or its three Pillar Scores for these placebo treatments. These tests allay any concerns about structured implementation of the mandate or similar confounding factors driving our results, while also affirming that there are parallel trends in the absence of treatment. Next, we investigate whether our findings are indeed driven by the regulation change and does not merely reflect changes due to firms' XBRL adoption action. Using a sample of "voluntary" firms that start filing their financial disclosures in XBRL format before the mandate, we do not find any evidence of changes in ESG Scores. This is consistent with XBRL literature that shows that market participants benefited from XBRL adoption only after its mass acceptance and implementation that follows the

mandatory adoptions (Dong et al., 2016).[1]

Finally, we tackle concerns about non-random assignment of XBRL treatment and related endogeneity arising from the phase-wise implementation cutoffs. Given that the phase-wise XBRL adoption relies on firms' market float, which is closely related to firm size, one potential concern is that bigger firms have more resources to allocate to ESG engagement and are also more prone to ESG risks (Krüger, 2015; Drempetic et al., 2020; Ting, 2021). This would imply that the impact of XBRL mandate is concentrated mainly in the first treatment phase. This is indeed true in our setting as seen from the magnitude of coefficients for different XBRL adoption phases. Thus, studying different-sized firms all together, whose XBRL treatment assignment is endogenous to size, could result in biased DiD estimates. We address this concern by exploiting fiscal year-end variations for similar-sized firms that affects their XBRL adoption and studying the differential impact on their ESG performance cross-sectionally. This approach allows the identification of a similar control group that differs just because of differences in fiscal year-end variation between treated and control groups. Our results from this cleaner identification again corroborates our main findings. Since this alternative identification captures within-year cross-sectional variations, it also alleviates any concerns about other concurrent events driving our results.[2]

The principal means through which SEC's XBRL mandate reduces information processing costs is by enabling market participants and investors to employ advanced data analytic tools by quickly processing the machine-readable XBRL filings. Thus, we hypothesize that with easier and quicker access to financial information after XBRL adoption, firms' investors can potentially devote more time to seek and understand non-financial ESG information. In response to this increased attention, firms would

[1]However, this result has to be interpreted with caution as there are only a few voluntary XBRL adopters in our sample, which severely constrains the statistical power of our findings.

[2]For instance, we use Thomson Reuters Asset4 data to measure ESG performance and the year when Thomson Reuters acquired Asset4 (2009) coincides with the XBRL implementation. The identification using fiscal year-end variations ensures that such confounding events are controlled for.

have improved their ESG engagements. To understand the underlying channels accompanying increased investor scrutiny, we examine the variations in the treatment effect from XBRL mandate cross-sectionally by median-based partitioning of our sample firms using proxies for external monitoring, firm opacity, and managerial risk aversion, and then examining how it moderates the XBRL treatment. Increased investor attention would have effectively translated into better ESG performance more so in firms that are well-monitored because their financial statements are already under higher scrutiny. Moreover, the effect of XBRL adoption can be expected to be higher for opaque firms because they would be more susceptible to increased scrutiny when the more accessible and standardized information disclosures in XBRL format are employed. And, lastly, increased investor attention would require firms to react quickly with improved ESG policies, which would have been easier for firms with a higher propensity of managerial risk-taking. We run empirical tests on these propositions and find supportive evidence that all these three aspects positively moderate the impact of mandated XBRL adoption on ESG performance.

Being a key "voice" mechanism for investors, investor voting behavior during shareholder meetings can partly reflect their involvement in monitoring and/or activism campaigns (Brochet et al., 2021; Bermejo et al., 2022; Lesmeister et al., 2022). Despite the differences in the voting support for ESG proposals between ESG-motivated and conventional investors (Dikolli et al., 2022), we expect that when there is an increased ESG scrutiny in the markets (following XBRL implementation), there is a higher support for ESG-related proposals among shareholders (Chen et al., 2020). Our empirical tests show that this is indeed the case. Essentially, following the XBRL adoption, we find that there is a marginal increase in investor support for ESG proposals, but not for non-ESG routine proposals. This trend is largely restricted to management-sponsored proposals. These proposals target the governance aspects of the firm, for which institutional investors have higher preferences (Bushee et al., 2014).

This result is consistent with XBRL mandate having a stronger effect on Governance Score given that it's been beneficial mostly to institutional investors.

Our main contribution to the existing literature is to show that financial disclosure regulations can have important implications for firms' non-financial policies. This effect is relatively understudied as research has largely focused on such regulations' effects on financial markets and its intermediaries (Griffin, 2003; Bhattacharya et al., 2018; Drake et al., 2020), or firm-specific characteristics such as their financial information environment (Dong et al., 2016; Gao and Huang, 2020). Specifically, we contribute to and extend the literature on information processing costs (see Blankespoor et al., 2020 for a detailed review) by showing its economically significant impact on non-financial ESG performance. Moreover, by focusing on the XBRL mandate, we contribute to the literature that investigates the effect of new technologies on disclosure dissemination (Miller and Skinner, 2015). To this end, we also tangentially contribute to the literature studying the ESG and sustainability effects of mandatory CSR reporting regulations (Christensen et al., 2021; Fiechter et al., 2022), as we show that financial disclosure mandates can also have ESG consequences by relaxing constraints associated with processing financial information. Given the current debate around a non- financial disclosure mandate, our study is informative. Our results on differential impacts of XBRL adoption on the three ESG Pillar Scores address the literature highlighting measurement issues with ESG data due to its multidimensionality (Khan et al., 2016; Kotsantonis and Serafeim, 2019; Serafeim and Yoon, 2022). Moreover, our paper is also relevant to the broader literature on CSR and ESG. Many papers have studied financial accounting antecedents and outcomes of CSR (Moser and Martin, 2012; Watson et al., 2015; Gillan et al., 2021). While much of this literature debates CSR's effect on firm valuation (Lys et al., 2015; Ferrell et al., 2016; Lins et al., 2017; Bartov et al., 2021), some studies have focused on its implications for cost of capital (Dhaliwal et al., 2011; El Ghoul et al., 2011), firm risk (Dumitrescu and Zakriya, 2021), bankruptcy (Maso

et al., 2020; Dumitrescu et al., 2020), and taxes (Lanis and Richardson, 2012; Hoi et al., 2013). By looking at financial information processing costs, we focus on an unexplored determinant of CSR and find that financial disclosure regulations can potentially have beneficial spillover effects on CSR performance.

The rest of this paper is organized as follows: Section 2 provides institutional background on the XBRL mandate in the U.S. and develops our hypotheses. Next, Section 3 describes our data, sample, and research methodology. In Section 4, we present all our main results of causal estimations including robustness checks, falsification tests, and alternative identification. Section 5 provides insights on the underlying mechanisms that can potentially explain our main results, and Section 6 concludes.

2 Institutional Background and Literature

2.1 Overview of XBRL Mandate and its Impact

In April 2009, the SEC mandated all public companies subject to filing requirements in the United States to provide XBRL versions of their quarterly and annual financial reports in addition to the standard text or html filings. The mandate has been introduced over three phase-in periods (2009 for firms with a public common equity float over $5 billion; 2010 for firms with a public float over $700 million; 2011 for all remaining companies). The SEC argues that XBRL helps market participants to capture and process information more quickly and at less cost (SEC, 2009). With XBRL, less time, money, and effort are needed to acquire financial information by market participants to make decisions. This is because XBRL facilitates comparison of data across time and across firms, hence, reducing market participants' costs of acquiring information.

Several studies have studied the capital market consequences of XBRL mandate in

the U.S. Blankespoor et al. (2014) showed that the XBRL increases information asymmetry between less-sophisticated investors and more-sophisticated investors around 10-k filings for the first-phase of adopters. Meanwhile, Dong et al. (2016) focused on all three phases of mandatory adoption in the U.S. and find that XBRL reporting facilitates the incorporation of firm-specific information into stock prices and lowers firms' stock return synchronicity. Similarly, Kim et al. (2019) and Blankespoor (2019) demonstrate the impact of XBRL adoption on accounting quality and disclosure choices, respectively. While earnings management or absolute discretionary accruals decrease following XBRL adoption, firms tend to increase their quantitative footnotes disclosure upon implementation of the same.

Blankespoor et al. (2020) provides a detailed review of how the shock to market participants' information processing costs from XBRL implementation not only influences firms' choices, but also impacts equity markets indirectly through institutional investors. For instance, Bhattacharya et al. (2018) show that information access improves for the smaller institutional investors following XBRL mandate, hence "leveling the playing field between large and small institutions." Consequently, Kim et al. (2019) document evidence that breadth of ownership increases in firms after the adoption of XBRL, and that the effect is stronger for firms with higher information processing costs. Aside from institutional investors, the XBRL-related shock to information processing costs, also benefits tax authorities. Chen et al. (2021) find evidence that XBRL adoption decreases tax avoidance by small cap firms and that the XBRL mandate reduces the cost of Internal Revenue Service (IRS) monitoring.

2.2 CSR and ESG: Current Literature

Several managerial and firm characteristics including governance structures have been shown to be important in shaping firms' CSR and ESG outlook (Moser and

Martin, 2012; Gillan et al., 2021; Christensen et al., 2021). One such firm-specific determinant of firms' CSR strategy is firm size (Drempetic et al., 2020). Larger firms have more resources to direct toward CSR investments, can potentially communicate them more efficiently, and may be more incentivized to engage in CSR practices (Wickert et al., 2016; Ting, 2021). Banker et al. (2022), meanwhile, show that CSR activities are reflective of corporate strategy. Moreover, past studies have shown the importance of unobservable and observable managerial traits for CSR (Davidson et al., 2019), including their personal and demographic attributes (Di Giuli and Kostovetsky, 2014; Borghesi et al., 2014; Cronqvist and Yu, 2017; Hegde and Mishra, 2019).

Along with these intra-firm aspects, outside pressure from investors, industry peers, or other stakeholders are also critical for firms CSR behavior (Khan et al., 2016; Dyck et al., 2019). While much of this pressure can be attributed to institutional investors and their ESG preferences (Chen et al., 2020; Kim et al., 2019), the role of other stakeholders—regulators (Dai et al., 2018), competitors (Dupire and M'Zali, 2018), media (El Ghoul et al., 2019), and customers (Dai et al., 2021)—influence firm CSR attitude.

Notwithstanding these antecedents of CSR, several of its outcomes have also been studied in the past, with a large focus on its impact on firm value and performance (Watson et al., 2015; Gillan et al., 2021). For instance, Lys et al. (2015) and Bartov et al. (2021) show the positive and negative impacts of socially responsible and irresponsible behaviors, respectively, on firm valuation. Moreover, CSR has been shown to influence firms' cost of capital and risk (Dhaliwal et al., 2011; Dumitrescu and Zakriya, 2021), information asymmetry and transparency (Kim et al., 2012; Cho et al., 2013), tax policies (Lanis and Richardson, 2012; Hoi et al., 2013), and innovation capacity (Cook et al., 2019).

2.3 XBRL Mandate and ESG Performance: Predictions

The brief literature review presented above with regards to the XBRL mandate and the CSR/ESG performance motivate our examination of the impact of information processing costs on firms' ESG profiles. In particular, XBRL filings are meant to reduce information acquisition and processing costs as they benefit market participants when the availability financial data in company filings are reported in a standardized form. Grossman and Stiglitz (1980) show that the reduction in the cost of information increases the number of informed investors and improves the market efficiency. However, alongside benefiting financial markets through easier information access that is more disciplined and of a better quality (Dong et al., 2016; Kim et al., 2019), it also affects market participants ability to assimilate and process financial information quickly (Bhattacharya et al., 2018; Blankespoor et al., 2020). Given that market participants do not have unlimited information processing capacity (Hirshleifer and Teoh, 2003), easy access to information helps optimize the time allocated to extracting useful information and learning from it (Peng, 2005). As a result, market participants—and especially, sophisticated ones—would have actively sought alternative sources of information (including the non-financial ESG information) to maintain their informational advantage (Kalay, 2015). Furthermore, following the 2008 global financial crisis, we know that market participants attention to non-financial (i.e., ESG) information has considerably increased (Dumitrescu and Zakriya, 2022) in general. Taken together, this implies that following XBRL mandate, standardization of financial reports in XBRL format would have allowed firms' investors to be able to devote more time to better process and understand non-financial ESG information. Hence, we expect firms to have reacted by improving their ESG policies. Accordingly, we state our main hypothesis as follows:

Hypothesis 1:

XBRL mandate leads to improvements in firms' ESG performance.

In recent years, one frequently presented critique of ESG performance measures is that they are over-expansive in terms of scope (Khan et al., 2016; Christensen et al., 2021), especially because they capture firms' engagement with multiple stakeholder groups who have their own competing interests (Dumitrescu and Zakriya, 2021). Hence, balancing between different stakeholders' needs may not always be easy for firms and their managers. Particularly, if we focus on three broad categories covered under ESG performance, i.e., environmental, social, and governance characteristics taken separately, we can expect considerable heterogeneity with respect to how they are addressed by firms. Moreover, market participants also need not be equally receptive to each of these three ESG dimensions. For instance, while environmental superstars (exemplary green firms) or environmental laggards (notoriously toxic firms) are easily identifiable (Fernando et al., 2017), its not easy for investors to assess the environmental performance of an average firm. In sharp contrast, "market participants [and investors have already] learned to appreciate the differences between well-governed firms and poorly governed firms" after early 2000s (Bebchuk et al., 2013). Finally, the benefits of XBRL have been mostly captured by institutional investors (Blankespoor et al., 2014), who have specific preferences for certain governance mechanisms (Bushee et al., 2014). In light of these arguments, if indeed investor attention to ESG information is impacted by mandated XBRL adoption, we can expect a greater impact on governance performance than on environmental performance. Therefore, we propose the following hypothesis:

Hypothesis 2:

The effects of mandated XBRL adoption on firms' ESG performance are not homogeneous across its environmental, social, and governance pillars.

Finally, we investigate whether firms targeted by each of the three phases of XBRL

mandate react in the same manner to increased investor scrutiny following XBRL adoption. On the one hand, Zhou (2020) show a declining relevance of XBRL mandate for firms' 10-K filing timeliness from phase 1 to phase 3 of the SEC's mandate. On the other hand, aided by learning gains over the three phases, Dong et al. (2016) show an increasing relevance of XBRL adoption for the amount of information impounded in stock prices. These opposing forces of delayed informational efficiency and improved market learning should ideally dictate how XBRL mandate effects ESG performance over the three phases. However, when the focus is on ESG information, Drempetic et al. (2020) state "larger companies are under more pressure to disclose more information in order to gain legitimacy." Furthermore, the benefits arising from XBRL adoption itself could be size size-depended—i.e, "benefits may be greater for large companies than for small companies" (Yoon et al., 2011). Given that size—as reflected by public float in SEC's mandate—forms the basis for the three phases of XBRL mandate, thus, we predict a large variation in the way XBRL mandate impacts ESG performance from phase 1 to phase 3. Correspondingly, based on these arguments, we hypothesize:

Hypothesis 3:

The effects of XBRL mandate on firms' ESG performance declines progressively over the three phases of XBRL implementation.

3 Data and methodology

3.1 Data Sources and Sample Selection

To construct our sample, we obtained the ESG data of all U.S. firms available in the Thomson Reuters Refinitiv/ASSET4 database. Beginning 2002, ASSET4 started compiling CSR data from publicly available sources for Russell 1000 firms. The universe of companies covered by Refinitiv/ASSET4 has steadily increased over the years. Next, we

collect XBRL filings from EDGAR (Electronic Data Gathering, Analysis, and Retrieval System) database of Interactive Data Filings and monthly Really Simple Syndication (RSS) feeds. These include voluntary XBRL filings starting 2005 and the mandatory XBRL adopters after 2009. For each XBRL filing, we obtain its form type, reporting period, and firm identity. Since ESG data is available on annual basis, we focus only on annual 10-K filings. Thus, for each of our Refinitiv/ASSET4 sample observation, we are able to track 10-K filing dates for every instance that these filings were made in the XBRL format. Although our full sample period spans 2002 to 2020, the three phases of mandated XBRL adoption are implemented between 2009 and 2012.

After merging the Refinitiv/ASSET4 and filings data, our sample comprises over 28,500 firm-year observations for over 3,250 firms. For these sample firms, we then obtain their annual financial fundamentals from Compustat, stock price data from the Center for Research in Security Prices (CRSP), CEO data are obtained from the Execucomp database, analyst coverage from the Institutional Brokers' Estimate System (IBES), and institutional ownership and blockholding data from Thomson Reuters 13-F filings. Lastly, shareholder voting data is obtained from Institutional Shareholder Services (ISS) Voting Analytics, which reports voting activity and results for a large sample of U.S. firms. We include voting data for all the proposals (both management- and shareholder-sponsored) that were submitted for consideration in shareholder meetings of our sample firms between 2003 and 2020. In total, we have voting data for 474,109 proposals, with majority of them (97.7%) being management-sponsored. ISS tracks shareholders' voting data (voted for, against, or abstained) on each proposal that was raised during a shareholder meeting. Additional important proposal-related variables include the meeting date, meeting type, proposal number, type or sponsor (management or shareholder), and management recommendation.

Table 1 summarizes the number of firms in our sample over the years. While the sample coverage increases from 2002 to 2020 considerably, during the XBRL

implementation years (i.e., 2009 to 2012) it remains relatively stable.

3.2 Summary Statistics

Our primary measures of firms' ESG performance are the ESG Score, Governance Pillar Score, Social Pillar Score, and Environmental Pillar Score provided each year on the scale of 0 to 100. The Environmental Pillar reflects assessment on three broad categories involving resource use, emissions, and innovation; the Social Pillar Score encompasses workforce, human rights, community, and product responsibility issues; whereas the Governance Pillar evaluates on three verticals, i.e., management, shareholders, and CSR strategy. These ten categories within the three Pillars are aggregated together into an ESG Score that measures the firms' overall ESG performance. Along with these measures, Refinitiv/ASSET4 also provides ESG Controversies Score and ESG Combined Score. The ESG Controversies Score is assessed using a set of 23 ESG controversy topics and identifying if the firms encountered any ESG scandals on these topics as reported in the media, whereas the ESG Combined Score simply combines the ESG Score and ESG Controversies Score. All our main variables including ESG performance measures and XBRL adoption indicators are defined in Appendix Table A.1.

Table 2 provides descriptive statistics for all the main variables included in our analyses. The mean (standard deviation) value for ESG Score is 40.871 (20.026). Among the three ESG sub-scores, Governance Score has the highest mean, whereas the Environmental Score has the lowest. In our sample, the mean (s.d.) return on asset is 2.5% (5.5%) and the rate of sale's growth is 12.5% (50.5%). We also present the summary statistics for partitioning variables. For instance, in our sample firms are covered, on average, by 10.67 analysts, the mean ratio of number of shares held by institutional investors to the total number of shares is 69,3%, and the mean number of

blockholders in the sample firms is 2.58.

3.3 Research Design and Empirical Specification

To test Hypotheses 1 and 2, we assess the average effect of mandated XBRL adoption on ESG performance measures by estimating the following regression:

$$Y_{i,t} = \beta_0 + \beta_1 XBRL_{mandate} + \sum_{j=1}^{K} Controls_{i,t-1}, + FirmFE + YearFE + \epsilon \quad (1)$$

Where $Y_{i,t}$, denotes any of the ESG performance measures for firm i in year t. Our main variable of interest is $XBRL_{mandate}$ that equals to 1 for years when firms adopt XBRL following SEC mandate, and 0 otherwise. We also control for firm-specific characteristics ($Controls$), for idiosyncratic firm factors using firm fixed effects ($FirmFE$), and for time-specific variations by including year fixed effects ($YearFE$). To account for any transitory shocks that are correlated across time for a given firm, we employ firm-clustered standard errors.

Following prior literature (Di Giuli and Kostovetsky, 2014; Davidson et al., 2019; Dyck et al., 2019), we control for firm's size (*Size*), leverage (*Leverage*), market to book ratio (MTB), return on asset (ROA), firm's age (*Age*), average monthly returns (*Avg. Returns*), the level of cash (*Cash*), the level of dividends (*Dividend*), capital expenditures ($CAPEX$) and sales growth (*Sales Growth*).

Next, to test Hypothesis 3, we assess the average effect of each of the three phases of XBRL mandate on ESG performance measures using the following specification:

$$\begin{aligned} Y_{i,t} =& \beta_0 + \beta_{1a} XBRL\_1_{mandate} + \beta_{1b} XBRL\_2_{mandate} + \beta_{1c} XBRL\_3_{mandate} \\ &+ \sum_{j=1}^{K} Controls_{i,t-1} + FirmFE + YearFE + \epsilon \end{aligned} \quad (2)$$

In this regression, we merely replace the variable $XBRL_{mandate}$ in Equation (1) with a

set of indicators ($XBRL\_1_{mandate}$, $XBRL\_2_{mandate}$, and $XBRL\_3_{mandate}$) that are representative of years when firms report using XBRL format after either of the three phases of SEC mandate is implemented. All the other variables are as defined as in Equation (1).

4 Main Results: Information Processing Costs and ESG Performance

4.1 Average Treatment Effect

In Figure 1, we provide graphical evidence of XBRL adoption increasing ESG performance sharply after the mandate. This effect is distinctly visible across all four performance measures. In Table 3, the main results of the effect of XBRL adoption on all ESG performance measures (i.e. ESG Score, Governance Score, Social Score, and Environmental Score) are reported using the empirical specification in Equation (1). In each model, we control for year and firm fixed effects and use a difference-in-differences (DiD) approach for SEC's staggered XBRL adoption program. The coefficient on $XBRL_{mandate}$ captures the average effect of mandated XBRL adoption within each of the firms. Results show that the coefficients on $XBRL_{mandate}$ are positive and significant at 1% level across all ESG dimensions, supporting Hypothesis 1 that mandated XBRL adoption positively affects ESG performance. In terms of economic significance, the introduction of XBRL improves the ESG Score by almost 1.93 points (column 1), which translates to approximately 5% increase in an average firms ESG performance relative to pre-regulation period. The effect of XBRL adoption is strongest for the Governance Score and weakest for the Environmental Score. This finding supports our Hypothesis 2 given that we find heterogeneous effects of XBRL mandate across ESG performance measures.

For control variables, our results are in line with prior studies. Large firms tend to have a higher ESG score. Indeed the coefficient on *Size* is positive across all ESG dimensions. Similarly, there is a statistically significant positive coefficient for market to book ratio (MTB) and sales growth (*Sales Growth*) consistently.

Recent advances in econometrics literature highlight potential issues encountered in using two-way fixed effect (TWFE) structures with heterogeneous treatment effects that vary over time and across groups (Callaway and Sant'Anna, 2021; Goodman-Bacon, 2021; Sun and Abraham, 2021; Baker et al., 2022). We implement alternative TWFE estimations that account for the staggered nature of the XBRL over the three phases using the Sun and Abraham's (2021) and Callaway and Sant'Anna's (2021) estimators. Table A.2 reports the average treatment effects from these two estimations. Our main estimates remain economically and statistically significant.[3] In the discussion of the economic magnitudes for the XBRL's effect on ESG performance measures, we focus on the results reported in Table 3 given that they provide most conservative estimates.

Next, we consider an alternative estimation that includes industry fixed effects instead of firm fixed effects. The results are reported in table A.3, which remain qualitatively similar to the main results seen in Table 3. Finally, in Table A.4 we analyzed the impact of mandated XBRL adoption on ESG Controversies Score that captures external issues outside the control of firms such as any controversial environmental scandal or governance-related lawsuits that disrupted firms' ESG reputations. The coefficient on $XBRL_{mandate}$ is not significant whether we use firm fixed effects (column 1) or industry fixed effects (column 3). Thus, the results in Table A.4 corroborate our argument that firm react to increased scrutiny on ESG disclosures and we are not capturing general changes in expectation from market participants over ESG trends.

[3]We report the analysis using not-yet-treated firms as the control group. Unlike Table 3, in both these alternative estimations used in Table A.2, we restrict our sample to one year after the last cohort is treated (i.e., 2012) to ensure implementation of a strict TWFE DiD design that requires at least one year before XBRL adoption (i.e., at least one untreated period).

4.2 The Effect of Different Phases of XBRL Mandate

In our main DiD analysis, we assume that the impact of XBRL mandate on firms' ESG performance does not change during the three phases of its implementation. Hence, we employ a single indicator $XBRL_{mandate}$ representing the DiD term across all three phases. Nevertheless, given that size is an important determinant of CSR engagement (Drempetic et al., 2020; Ting, 2021) and the three XBRL implementation phases were designed around a size threshold (i.e. firms' public float), we plausibly expect heterogeneity in the XBRL implementation groups. Thus, by using Equation (2), we disaggregate $XBRL_{mandate}$ of Equation (1) based on the three phases of XBRL mandate implementation and regress ESG Score, Governance Score, Social Score, and Environmental Score on the three post adoption indicators (i.e., $XBRL\_1_{mandate}$, $XBRL\_2_{mandate}$, and $XBRL\_3_{mandate}$).

In Table 4, we present the results showing the impact of XBRL mandate on ESG performance across the three phases of its implementation. Consistent with our main findings, there is a positive and statistically significant coefficient on $XBRL\_1_{mandate}$ for each of the ESG Score, Governance Score, and Social score. The coefficient is significant at the 1% level or better. In terms of economic significance, the effect of first phase XBRL adoption on ESG score is approximately 7.5% relative to pre-regulation level. Governance Score and Social Score experienced the strongest improvement, by approximately 10.1% and 10.2% respectively. For $XBRL\_2_{mandate}$ and $XBRL\_3_{mandate}$, results are less consistent. For ESG score, the magnitude of the effect for $XBRL\_2_{mandate}$ and $XBRL\_3_{mandate}$ monotonically decrease. This finding supports our Hypothesis 3 that predicted the effect of XBRL mandate to decline over the three phases of SEC's implementation. This can be potentially explained by firms' declining proclivity to engage in ESG activities throughout the different phases of XBRL mandate. This could be due to lack of investor attention towards smaller firms, and

hence lesser market scrutiny. Alternatively, this could also be due to management's reduced expectation of market scrutiny or even the expectation of potential postponement or revocation of the mandate for smaller firms (Blankespoor, 2019). For Governance Score, the magnitude of the effect is the strongest. Each adoption group responded to the increase of monitoring by improving Governance Score between almost 4.9 points ($XBRL\_1_{mandate}$) and 4.3 points ($XBRL\_2_{mandate}$). For both Social and Environmental scores there is a monotonic decrease in magnitude of the coefficient: while the statistical significance for the coefficient of Social Score vanishes after the first year of adoption, the coefficients for Environmental Score are statistically insignificant. This potentially points out to the difficulties faced when adjudicating environmental engagement of firms by the market participants and investors (Ittner and Larcker, 2001; Dumitrescu and Zakriya, 2021), and is consistent with the low magnitude for overall effect of XBRL mandate on Environmental Score reported in Table 3. On the whole, the results in Table 4 confirm our prediction of monotonically decreasing effect of XBRL mandate across the three implementation phases of XBRL mandate.

4.3 Internal Validity

To provide further evidence that the increase in CSR engagement is related to the adoption of XBRL, we implement three additional tests that strengthen our internal validity: placebo analyses, evidence from non-mandatory XBRL reporting, and variation in fiscal year-end.

4.3.1 Evidence from Placebo Treatments

Here, we present the results from placebo treatment and falsification tests that alleviate any concerns of our main results being driven by any confounding extraneous factors or due to random differences between the XBRL mandated and non-mandated

firms. Specifically, we assign "placebo" treatments a) in the period when all firms were already treated to see if there is differential effect despite no exogenous XBRL mandate in this period, and b) in the pre-treatment period by restricting the sample up to 2009 to verify the parallel trend assumption and show that in absence of the treatment, we do not find any different effects on ESG performance. Ideally, the coefficients from the regressions estimating the effect of these placebo XBRL treatments should be not statistically significant.

In Table 5, we report the results from the first placebo test. In this placebo analysis, we assign a fictitious XBRL mandate beginning in 2014 instead of actual XBRL mandate of 2009, with the treatment firms designated using the same market float thresholds as the actual mandate. We then regress ESG Score, Governance Score, Social Score and Environmental Score on $PlaceboXBRL_{mandate}$. In each model, the coefficient of interest is statistically insignificant.

Next, we assign placebo treatment during the pre-treatment years to test the parallel trend assumption. In this case, we restrict our sample up to 2009, and assign placebo XBRL mandate beginning in 2005, once again using market float criteria of the actual XBRL mandate. We then replicate the results of Table 5 for the pre-treatment years. As shown in Appendix Table A.5, the coefficients for $PlaceboXBRL_{mandate}$ re-affirm the validity of our main results because they are statistically insignificant for the ESG Score and its three Pillar Scores.

4.3.2 Evidence from Non-Mandatory XBRL Reporting

To ensure that the observed effects on ESG performance is driven by a reduction in financial information-processing cost specifically due to the SEC's XBRL mandate, we additionally studied the impact of XBRL filings under the voluntary adoption program. The XBRL adoption in the U.S. started as a voluntary program in 2005 before being mandated by SEC in 2009. Voluntarily adopting firms were not exposed to the same set

of stringent requirements associated with XBRL filings under the mandatory program. Given the lack of clear guidelines for the XBRL adoption during this non-mandated period and the untimely and possibly unreliable adoption by firms filings in XBRL format under the voluntary program (SEC, 2005; Dong et al., 2016), their impact on information processing costs would have been lower and would have, therefore, drawn little reaction from investors. Therefore, we predict a weaker or no effect of XBRL adoption on ESG performance under the voluntary program. Moreover, by disentangling voluntary and mandatory adopters, we can assess whether the change in ESG performance is mainly due to firms' XBRL adoption decision (voluntary adopters), or change in regulation (mandatory adopters), or both.

We identify all the voluntary adopters—including those firms adopting XBRL before June 15, 2009 as well as those that essentially fell under Phase 2 or Phase 3 of the mandate still decided to adopt XBRL in advance—and study whether XBRL adoption by these firms had an impact on their ESG Score, Governance Score, Social Score, and Environmental Score. In Table 6, the main variable of interest is the indicator $XBRL_{no-mandate}$, which equals to 1 for those firms that voluntarily adopted XBRL during the period 2005-2010. We find that the effect of voluntary XBRL adoption is not statistically significant across all ESG performance measures. Thus, this result corroborates our argument that the effect on ESG performance shown in our main results are caused by change in the disclosure regulation rather than the firms action of XBRL adoption itself.

4.3.3 Evidence from Fiscal Year-End Variations

In our main analysis, we have applied an identification strategy that relies on the DiD approach to test how XBRL mandate affects ESG performance measures. Nevertheless, to the extent that our treatment sample is not randomly assigned, endogeneity concerns may arise if treated and control firms are not perfectly comparable. Indeed, XBRL mandate,

as a treatment, is based on size-specific thresholds (i.e., public float), which prior studies shows to be correlated with ESG engagement (Krüger, 2015; Drempetic et al., 2020; Ting, 2021). Hence, to address this concern, we exploit our experimental setting by focusing on the regulation's implementation schedule that allow us to exploit variations in fiscal year-ends (FYEs) of the same sized firms. Indeed, our main identification strategy relies using fiscal year-ends because all the three phases of XBRL implementation is specifically applicable to firms of a certain size (in terms of public float) whose FYE lies between June 15 of a given year to June 14 of the following year. Thus, for instance, in the second phase of XBRL mandate, a mid-sized firm (i.e., with a public float between $700 million and $5 billion) would only be mandated to submit their 10-K filing in XBRL format if they had their FYE after June 15, 2010. For similar-sized firms with FYE June 14, 2010 or earlier in that year, the XBRL mandate would be applicable alongside phase 3, or in the following year.

Thus, we exploit this FYE variation of Phase 2 XBRL mandated firms and study the cross-sectional effect on their ESG performance in the years 2010 and 2011. Essentially, our identification strategy is aimed at isolating the difference in the ESG performance of mandated XBRL Phase 2 firms with those of similar size who had a delayed XBRL mandate only because their FYE was before June 15, 2010, and not after.[4] Table 7 shows the results for this cross-sectional estimation. The indicator $XBRL\_2_{mandate}(FYE_{var})$ takes the value 1 to represent treated firms, i.e., phase 2 firms in 2010 who were mandated to report in XBRL format because their FYE was after June, 15, whereas the control group comprises of phase 2 eligible firms (based on market float) that are not mandate in the applicable year due to their FYE being before June 15. Our results from this alternative identification corroborates our main result as we find a statistically significant impact on the ESG Score for XBRL mandated firms.

[4]We replicate and re-estimate the same identification strategy for Phase 1 eligible firms (i.e., with market float $\geq$ $5 billion) and find our results supported. However, with only a small number of firms comprising the control group in this case, the identification has very low statistical power.

Of the three Pillar Scores, only Governance Score has statistically significant coefficient for $XBRL\_2_{mandate}(FYE_{var})$. This is not surprising given that we conduct this test using Phase 2 firms, and as documented by Table 4, the effect of XBRL mandate for Phase 2 firms is mainly driven through the Governance Score.

5 Examining the Effectiveness of XBRL Mandate on ESG Performance

5.1 Cross-Sectional Analyses

In our main results, we document an average increase in ESG performance measures following the XBRL mandate. This is consistent with our prediction that a reduction in financial information processing costs provides market participants more incentives to scrutinize non-financial information. However, we expect that the effect of XBRL adoption on ESG performance varies cross-sectionally conditional on certain firm and firm-related market characteristics. In particular, we focus on external monitoring, firm opacity, and managerial risk-aversion.

We expect market participants—and more specifically, investors—to be more attentive to non-financial ESG information in those firms that are well-monitored. Given that XBRL adoption benefits sophisticated investors more as they can leverage their greater resources better than less sophisticated investors (Blankespoor et al., 2014), using proxies for high monitoring by sophisticated investors, we expect the benefit of a reduction of information processing costs to be greater for firms with higher monitoring. XBRL adoption can affect the amount of disclosures made by firms (Blankespoor, 2019) and hence opaque firms are more likely to benefit from a reduction in information processing costs Dong et al. (2016). This is because, by definition, opaque firms are generally less transparent about their financial information (Hutton

et al., 2009). Accordingly, we predict that the effect of XBRL mandate on ESG performance will be higher for opaque firms. Lastly, managers have an important role to play in shaping firms' ESG policies (Davidson et al., 2019). Firms with risk-taking CEOs that have more freedom to change and adapt corporate policies when faced with increased investor scrutiny would be more likely to react quickly with improvements in ESG policies. Thus, we expect XBRL mandate to be more influential to ESG performance for firms with low managerial risk aversion.

5.1.1 External Monitoring

To test our prediction regarding external monitoring, we use three proxies: number of analysts covering a firm ($Analysts$), percentage of shares held by institutional investors (IOP) and the number of institutional investors that hold more than 5% of firm's shares ($Blockholders$), and partition firms into groups based on their medians each year. We then regress ESG Score, Governance Score, Social Score, and Environmental Score on the interaction between $XBRL_{mandate}$ and an indicator representing high external monitoring (i.e., $High_{Analysts}$, $High_{IOP}$, or $High_{Blockholders}$). The results are shown in Table 8.

For all three external monitoring proxies, we find that firms with high level of external monitoring exhibit a stronger improvements across ESG Score, Governance Score, and Social Score when XBRL mandate is applied to them. These improvements are statistically significant at 1% level. We document little or no evidence for the moderating effect of external monitoring on Environmental Score. This is consistent with results reported in Tables 3 and 4, which they show little or nor effect for for environmental score. This results is also consistent with potential challenges faced by market participants when assessing firms' environmental performance (Ittner and Larcker, 2001; Dumitrescu and Zakriya, 2021).

5.1.2 Firm Opacity

We measure firm opacity using two measures obtained from discretionary accrual models—i.e., Dechow and Dichev (2002) model modified by McNichols (2002) ($AbsDDM$) and modified Jones (1991) model ($AbsMJM$). Additionally, following Hutton et al. (2009), we build a third proxy for opacity ($Opaque$) by taking the three-year moving average of $AbsMJM$ to "capture the multi-year effects of earnings management."— For each of these firm opacity proxy, we then partition our sample firms into two groups around their medians each year. We then regress ESG Score, Governance Score, Social Score, and Environmental Score on the interaction term combining $XBRL_{mandate}$ and an indicator representing high opacity (i.e., $High_{AbsDDM}$, $High_{AbsMJM}$, or $High_{Opaque}$). The results are reported in Table 9.

We document that high opacity firms have a significantly higher positive effect of XBRL adoption on ESG Score and two of its three pillars—i.e., Governance Score and Environmental Score—across all the three opacity proxies. The effect is strongest when we use $Opaque$ as proxies of firm opacity in Panel C. Despite unconditional effect of $XBRL_{mandate}$ on Social Score being significant, we observe that there is no significant moderation effect of opacity for Social Score across all the three proxies. This potentially points to the increasing prominence of social issues for firms irrespective of their financial transparency.

5.1.3 Managerial Risk Aversion

For managerial risk-taking and risk aversion propensity, we implement three proxies consistent with literature: an indicator equals to 1 in case the CEO has a dual role in the firm, i.e., they also serves as chairman in the board of director ($CEODuality$), the number of years years since the CEO has been appointed ($CEOTenure$) and a gender indicator which is equal to 1 in case the CEO is female ($FemaleCEO$) (Faccio et al., 2016;

Ferris et al., 2019). The continuous variable $CEOTenure$ is transformed into high/low tenure indicator using median values each year. We then study the moderation effect of managerial risk-taking by regressing ESG performance measures on the interaction between $XBRL_{mandate}$ and each of the managerial risk aversion proxies. The results are summarized in Table 10.

Due to the limited availability of CEO-level data for our sample companies, we lose a significant number of observations when the moderating effect of managerial risk-taking proxies is assessed. In Table 10, we find significant effects (at 10% or better) for ESG Score and Governance Score across all three proxies. The concentration of power and risk-taking in the firms is best represented using $CEODuality$ (Panel A), as documented by the coefficient of interaction term which is statistically significant across all ESG performance measures. The magnitude of coefficients is highest when we proxy for managerial risk-aversion using CEO's gender (Panel C).

5.2 XBRL Mandate and Investor Voting Behavior

Shareholder voting is arguably the most direct form of investor monitoring and engagement activity (Lesmeister et al., 2022), while also representing investor activism to some degree (Brochet et al., 2021). If indeed investor pressure—due to increased attention to non-financial information—is the driver of improved ESG performance following the SEC mandated XBRL adoption by firms, it is plausible to assume an impact on their shareholder voting activity. We explore this channel by implementing voting data covered by ISS Voting Analytics which includes both management- and shareholder-sponsored proposals. In our analysis, we focus on both as they reflect two different facets of voting behavior: while the voting response on the first set of proposals captures shareholder engagement and support for managers' initiatives, the voting pattern for second set of proposals is indicative of how well the shareholders react to their fellow shareholders' activism.

Accordingly, we examine whether there are any underlying changes in shareholder voting behavior due to the XBRL mandate. In its essence, the empirical tests performed in this section are aimed at assessing whether the investor attention and pressure that drives ESG performance is visible when they are casting their votes on ESG-related proposals. To do so, we study the shareholder *support* that each of the proposals receive using an estimation similar to our baseline model in Equation (1). In these estimations we also additionally control for proposal and meeting characteristics such as the proposals' management recommendation (voting "For" or "not"), proposal sponsor (management or shareholder) and meeting type (annual general meeting, extraordinary general meeting, special meeting, etc.). Specifically, to examine voting behavior with respect to ESG-related proposals, we identify the proposals that are specifically pertinent to governance (antitakeover-, director-, board-, compensation-, or other governance-related proposals), social (human rights, gender equality, discrimination, charitable activities, etc.), and environmental (environmental policy changes, emissions, climate change, safety, recycling, etc.). To ascertain that we capture variation in shareholder *support* only specific to ESG proposals and not to other proposals, we also identify a set of "routine" proposals that target non-ESG business or operational routines such as dividend approvals, company name changes, auditor ratification, etc.[5]

Table 11 reports the results of the proposal-level regressions for shareholder *support* (i.e., the proportion of "For" votes cast) on our main variable of interest $XBRL_{mandate}$. Our estimations are aimed at capturing the difference in shareholders' voting *support* for ESG proposals after XBRL mandate. In Panel A, the effect of XBRL mandate on voting support for different proposals raised during shareholder meetings is reported for all ESG proposals (column 1), and these proposals segregated by their sponsors (columns 2 and 3). We find that the coefficients on $XBRL_{mandate}$ is positive and statistically significant (at 1% level) for ESG proposals mainly when they are

[5]A full list of proposal identifiers from ISS (i.e., *ISSItemOnAgendaID*) classified into different categories according to their available descriptions can be made available on request.

sponsored by the management. This is consistent with the importance of managers' role for the effectiveness of XBRL adoption seen in the previous section. More importantly, the coefficient of $XBRL_{mandate}$ is statistically insignificant for non-ESG routine proposals showing the influence of the XBRL adoption conveys the voting behavior mainly for ESG-related proposals. In Panel B, we separately analyze the environmental, social, and governance specific proposals. The effect of XBRL adoption is found to be statistically significant for the governance-related proposals (at 1% level), with the support for these proposals improving by approximately 0.6% after a firm adopts XBRL reporting. These results are consistent with existing literature that shows XBRL being beneficial to institutional investors (Blankespoor et al., 2014), some of which tend to show greater "governance-sensitivity" (Bushee et al., 2014).

Despite these results largely supporting the role of investors and their attention to ESG proposals in improving ESG performance after the SEC mandated XBRL adoption, they have to be interpreted with caution. Firstly, when the focus is toward ESG proposals, only a minuscule proportion of social and environmental proposals are voted for in shareholder meetings. In other words, there is an over-representation of governance proposals. Second, multiple other factors such as proxy voting advisors, meeting venues, and meeting contentiousness can affect shareholder voting behavior (Li and Yermack, 2016; Malenko and Shen, 2016; Brochet et al., 2021). Since we do not observe and thus control for these factors, our results are merely indicative and do not necessarily reflect causality.

6 Conclusions

Financial information processing costs require market participants and investors to commit ample resources and time in assimilating and processing financial information, hence leaving them with very little resources that can be employed for understanding non-

financial information. In this paper, we provide insights on this phenomena by examining the impact of financial information processing cost on firms' ESG performance.

The impact of regulations targeting information processing costs on financial markets and corporate financial decisions have been widely debated and discussed (Healy and Palepu, 2001; Leuz and Wysocki, 2016; Roychowdhury et al., 2019). Over the past decade, numerous studies have shown the effect of such regulations on several market- and firm-level financial characteristics including information asymmetry (Griffin, 2003; Blankespoor et al., 2014; Bhattacharya et al., 2018), market efficiency (Dong et al., 2016; Gao and Huang, 2020), earnings quality (Kim et al., 2019), institutional ownership (Kim et al., 2019), and corporate tax behavior (Chen et al., 2021). However, much remains to be understood about the possible spillover effects of financial information processing costs-reducing regulations on non-financial behavior of the firms such as their ESG performance and CSR disclosures. ESG information disclosure and communication is becoming increasingly important for both the firms and their investors. From firms perspective, recent COVID-19 crisis has re-established the need for firms to engage in good ESG practices due to its risk mitigation properties (Albuquerque et al., 2020; Ding et al., 2021; Dumitrescu and Zakriya, 2021). For investors, their attention to firms' ESG engagements alongside their financial performance is becoming increasingly important in managing their investment portfolios (Amel-Zadeh and Serafeim, 2018; Krueger et al., 2020). Thus, it is important to understand how and why information processing costs may impact firms' ESG policies.

We employ a quasi-natural experiment exploiting the U.S. SEC mandate requiring firms to submit their quarterly and annual financial reports in XBRL format. By making financial data standardized and machine readable, XBRL filings were aimed at reducing information processing costs of market participants and investors. Our results show that following XBRL mandate, the XBRL adopting firms have significantly higher ESG performance. Subsequent analyses reveal that the XBRL mandate affected

governance performance the most, followed by the social and environmental performance, respectively. Moreover, the magnitude of impact of XBRL adoption on ESG performance declines over the three phases of XBRL implementation by SEC. Our results survive a battery of robustness checks, falsification tests, and alternative identification strategies.

Further supplementary analyses help us provide insights on how investor pressure could have potentially driven the improvements in firms' ESG performance when they benefit from a reduction in processing financial information. Essentially, firms that have high external monitoring should be prone to higher investors' and analysts' scrutiny of both financial and non-financial (or, ESG) information. Moreover, opaque firms can be expected to suddenly face more investor scrutiny on their ESG policies when standardized reporting under XBRL format reduces their information processing costs. Lastly, to effectively respond to investor pressure, firms must be able to quickly react, which would ideally be easier in firms that have risk-taking managers. Indeed, we find evidence supporting these mechanisms as the positive impact of XBRL mandate on ESG performance is seen to be concentrated in well-monitored and financially opaque firms that have managers with low risk aversion. We finally investigate voting behavior as potential mechanism that lead to improvements in ESG performance. Our findings imply an increasing support for ESG-related proposals among investors in XBRL mandated firms. However, this change in support is mainly seen for management-sponsored proposals that are specifically aimed at improving firms' governance characteristics.

By showing the spillover effects of a financial reporting mandate, our study also has implications for the current debate around the need for a non-financial reporting mandate and whether it could be effective (Christensen, 2022) . To this end, we provide evidence that by relaxing the constraints associated with processing financial information processing capacity, market participants' attention to non-financial disclosures increases

and lead to postive firms' externalities.

Appendix A. Supplementary Results

Table A.1: Variable definitions

Table A.2: Alternative Estimation (Using Staggered Difference-in-Differences Estimators)

Table A.3: Alternative Estimation (Using Industry FEs Instead of Firm FEs)

Table A.4: Alternative Estimation (Using Other ESG Performance Measures)

Table A.5: Pre-Treatment Placebo Test for XBRL Reporting and ESG Performance

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Figure 1: ESG Performance Measures over Event Time

The figures below show the estimated coefficients of regressing ESG Score, Social Score, Governance Score, and Environmental Score on XBRL adoption following SEC mandate (i.e., the event) with year and firm fixed effects. Standard errors are estimated by clustering at the firm level. We omit the indicator for year t-1, which serves as benchmark. Vertical bands represent 95% confidence interval for the point estimate each year relative to the treatment period.

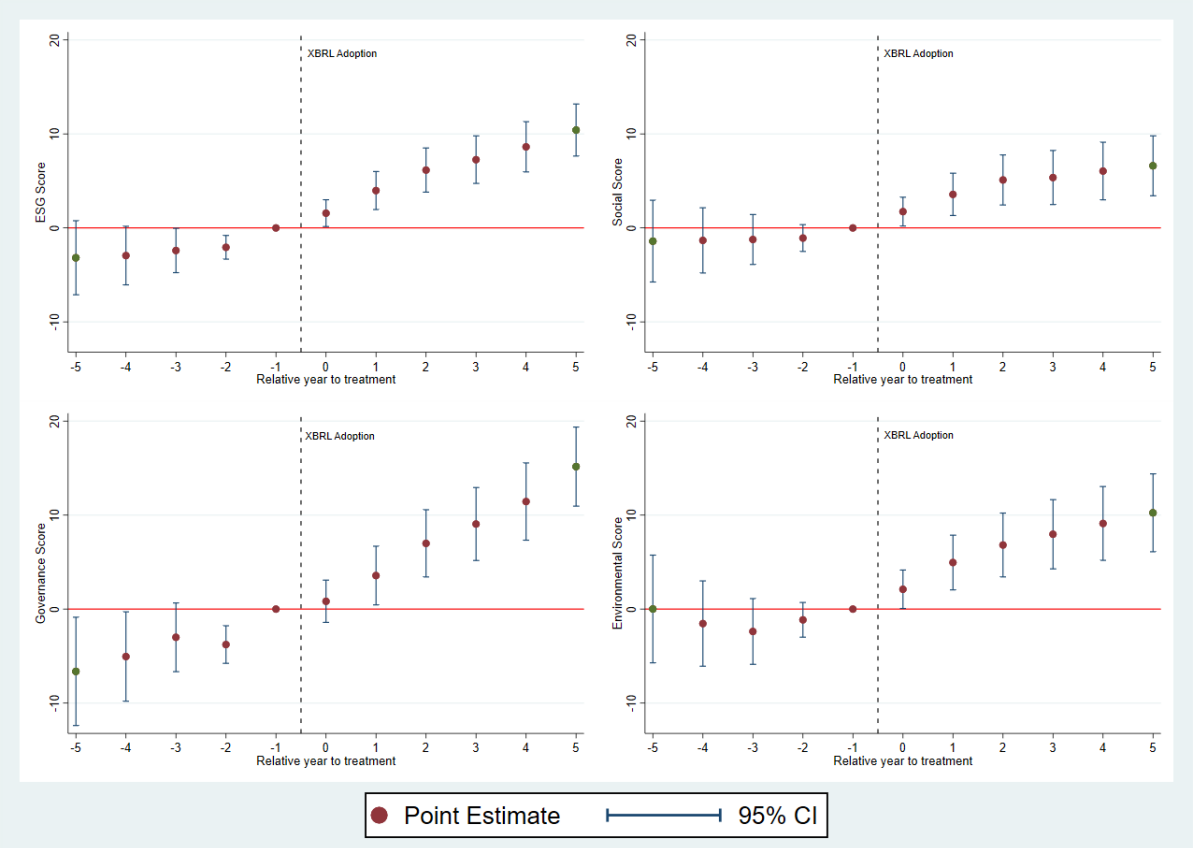

Table 1: XBRL Mandate and Refinitiv ESG Sample Distribution

This table shows the distribution of number of firms in the Refinitiv ESG sample over the years and how they are affected by the XBRL mandate across its three implementation phases. In this distribution, voluntary adopters are included within Non-XBRL$_{Mandated}$ group because they adopted XBRL even before they were mandated by SEC to do so.

Year	Non-XBRL$_{Mandated}$	XBRL$_{Mandated}$	Total	XBRL Implementation
2002	527	0	527	
2003	522	0	522	
2004	734	0	734	
2005	851	0	851	
2006	853	0	853	
2007	850	0	850	
2008	1,041	0	1,041	
2009	877	291	1,168	Phase 1
2010	477	756	1,233	Phase 2
2011	384	853	1,237	
2012	18	1,215	1,233	Phase 3
2013	0	1,234	1,234	
2014	0	1,228	1,228	
2015	0	1,873	1,873	
2016	0	2,563	2,563	
2017	0	2,928	2,928	
2018	0	2,910	2,910	
2019	0	2,819	2,819	
2020	0	2,747	2,747	
Total	7,134 (25%)	21,417 (75%)	28,551 (100%)	

Table 2: Descriptive Statistics

Panel A presents summary statistics of main variables used in the empirical analyses. Panel B presents summary statistics of partitioning variables used in the empirical analyses. The sample consists of mandatory adopters for the period 2009–2012. The variables are as defined in appendix A.1 and variables are winsorized at 1% and 99%.

	N	Mean	SD	p25	Median	p75
Panel A. Main Variables						
Dependent Variables						
ESG Score	28,551	40.871	20.026	25.263	37.114	54.791
Governance Score	28,551	50.177	22.708	32.053	51.139	68.347
Environmental Score	28,551	27.384	28.444	0.000	18.727	49.335
Social Score	28,551	42.455	21.836	25.582	38.665	57.526
Control Variables						
Size	27,781	8.508	1.879	7.378	8.453	9.639
Leverage	27,763	0.605	0.267	0.440	0.600	0.771
MTB	27,315	2.694	4.688	0.972	1.625	3.007
ROA	25,191	0.025	0.055	0.012	0.028	0.043
Age	27,967	5.237	0.924	4.700	5.403	5.938
Avg. Returns	27,974	0.012	0.038	-0.005	0.012	0.028
Cash	28,551	0.090	0.133	0.004	0.044	0.121
Dividend	26,862	0.012	0.028	0.000	0.004	0.015
CAPEX	26,869	0.028	0.037	0.004	0.016	0.036
Sales Growth	27,120	0.001	0.005	-0.001	0.001	0.002
Panel B. Partitioning Variables						
External Monitoring						
Analysts	23,618	10.673	8.107	4.000	9.000	16.000
Institutional Ownership	24,999	0.696	0.388	0.557	0.776	0.902
Blockholders	25,005	2.583	1.793	1.000	3.000	4.000
Firm Opacity						
AbsDDM	26,919	0.080	0.109	0.028	0.054	0.096
AbsMJM	27,669	0.122	0.180	0.022	0.065	0.164
Opaque	25,900	0.391	0.544	0.107	0.256	0.506
Managerial Risk-Taking						
CEO Duality	18,350	0.498	0.500	0.000	0.000	1.000
CEO Tenure	18,222	7.184	7.147	2.000	5.000	10.000
Female CEO	18,350	0.039	0.193	0.000	0.000	0.000

Table 3: Mandatory XBRL Reporting and ESG Performance

This table provides results of regressing ESG Score, Governance Score, Social Score, and Environmental Score on $XBRL_{mandate}$ and firm-specific control variables using the specification shown in Equation (1). $XBRL_{mandate}$ is an indicator that takes value 1 for firms filing their financial statements in XBRL format when mandated by SEC and zero otherwise. It encompasses the implementation of all the three XBRL phases. Coefficients are provided with t-statistics in parentheses below. All models have firm-clustered, robust standard errors. Variable definitions are provided in Appendix Table A.1.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable	ESG Score (1)	Governance Score (2)	Social Score (3)	Environmental Score (4)
$\boldsymbol{XBRL_{mandate}}$	**1.9227*** (3.79)**	**2.6566*** (3.28)**	**1.9949*** (2.82)**	**1.4615*** (2.58)**
$Size_{t-1}$	2.5108*** (7.00)	2.1116*** (3.95)	3.6617*** (6.20)	2.3648*** (5.44)
$Leverage_{t-1}$	-0.9444 (-1.07)	-0.8576 (-0.68)	0.3457 (0.27)	-0.2796 (-0.28)
MTB_{t-1}	0.0001*** (3.13)	0.0004*** (7.59)	-0.0002*** (-14.51)	-0.0001*** (-5.11)
ROA_{t-1}	5.2666** (2.12)	8.2060* (1.90)	4.5831 (1.20)	3.7528 (1.10)
Age_{t-1}	1.4937*** (3.32)	3.3842*** (5.06)	0.8027 (1.15)	0.7658 (1.46)
$Avg.Returns_{t-1}$	2.0110 (1.13)	1.4264 (0.44)	-2.3837 (-0.95)	5.1402** (2.36)
$Cash_{t-1}$	-1.8883 (-1.30)	-2.7891 (-1.32)	-0.1441 (-0.07)	0.1324 (0.08)
$Dividend_{t-1}$	4.4708 (1.01)	-3.2533 (-0.52)	12.6436* (1.75)	5.8699 (1.35)
$CAPEX_{t-1}$	-5.5266 (-1.25)	-7.7672 (-1.13)	-14.2638** (-2.11)	-3.2449 (-0.64)
$SalesGrowth_{t-1}$	0.0026*** (6.78)	0.0012** (2.00)	0.0020*** (4.25)	0.0042*** (10.36)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of observations	22,647	22,647	22,647	22,647
Adj. R^2	0.492	0.120	0.436	0.426
Number of Firms	3,261	3,261	3,261	3,261

Table 4: The Three Phases of Mandatory XBRL Reporting and ESG Performance

This table provides results of regressing ESG Score, Governance Score, Social Score, and Environmental Score number on the three different phases of XBRL mandate using the model specification shown in Equation (2). $XBRL\_1_{mandate}$, $XBRL\_2_{mandate}$, or $XBRL\_3_{mandate}$ are indicators that take value 1 for firms that are subject to the first, second, and third phase of the SEC mandate, respectively, and 0 otherwise. Coefficients are provided with t-statistics in parentheses below. All models have firm-clustered, robust standard errors. Variables are as defined in Appendix Table A.1.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

Dependent Variable	ESG Score	Governance Score	Social Score	Environmental Score
	(1)	(2)	(3)	(4)
$\boldsymbol{XBRL\_1_{mandate}}$	**2.7197*** **	**4.8910*** **	**4.0455*** **	**0.3277**
	(2.96)	**(3.67)**	**(2.60)**	**(0.29)**
$\boldsymbol{XBRL\_2_{mandate}}$	**1.5402***	**4.3312*** **	**0.4613**	**0.2528**
	(1.89)	**(3.32)**	**(0.34)**	**(0.26)**
$\boldsymbol{XBRL\_3_{mandate}}$	**1.1851**	**4.5553****	**-0.1279**	**-0.6802**
	(0.74)	(2.15)	(-0.06)	(-0.32)
$Size_{t-1}$	2.4904***	2.1236***	3.5926***	2.3500***
	(6.99)	(3.99)	(6.10)	(5.43)
$Leverage_{t-1}$	-0.9346	-0.8682	0.4046	-0.2807
	(-1.07)	(-0.69)	(0.32)	(-0.28)
MTB_{t-1}	0.0001***	0.0004***	-0.0002***	-0.0001***
	(2.98)	(7.47)	(-12.01)	(-4.42)
ROA_{t-1}	4.8420**	6.8848	4.3891	3.8448
	(1.97)	(1.61)	(1.17)	(1.13)
Age_{t-1}	1.6177***	3.5910***	0.9915	0.7911
	(3.56)	(5.31)	(1.42)	(1.50)
$Avg.Returns_{t-1}$	1.7076	0.9940	-2.5801	4.8292**
	(0.96)	(0.31)	(-1.03)	(2.21)
$Cash_{t-1}$	-1.7540	-2.6376	0.1314	0.1817
	(-1.22)	(-1.24)	(0.06)	(0.11)
$Dividend_{t-1}$	3.8246	-4.2819	11.7176*	5.6515
	(0.89)	(-0.69)	(1.66)	(1.31)
$CAPEX_{t-1}$	-6.2838	-9.2523	-15.1688**	-3.3476
	(-1.43)	(-1.36)	(-2.25)	(-0.66)
$SalesGrowth_{t-1}$	0.0026***	0.0014**	0.0016***	0.0043***
	(6.14)	(2.18)	(2.97)	(9.41)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	22,647	22,647	22,647	22,647
Adj. R^2	0.492	0.122	0.438	0.426
Number of Firms	3,261	3,261	3,261	3,261

Table 5: Placebo Test for XBRL Reporting and ESG Performance

This table presents results for a placebo analysis that examines the effect of XBRL mandate on the ESG Score, Governance Score, Social Score, and Environmental Score when $PlaceboXBRL_{mandate}$ is employed in place of actual $XBRL_{mandate}$ in Equation (1). To do so, we assign placebo XBRL implementation from 2014 to 2017 instead of actual XBRL implementation from 2009 to 2012. Coefficients are provided with t-statistics in parentheses below. All models have firm-clustered, robust standard errors. Variables are as defined in Appendix Table A.1.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable	ESG Score (1)	Governance Score (2)	Social Score (3)	Environmental Score (4)
$\boldsymbol{PlaceboXBRL_{mandate}}$	**0.5508**	**0.5388**	**1.0983**	**0.2550**
	(1.14)	**(0.63)**	**(1.54)**	**(0.47)**
$Size_{t-1}$	2.4907***	2.0864***	3.6346***	2.3515***
	(6.95)	(3.91)	(6.15)	(5.41)
$Leverage_{t-1}$	-0.9860	-0.9139	0.2997	-0.3103
	(-1.12)	(-0.73)	(0.23)	(-0.31)
MTB_{t-1}	0.0001***	0.0004***	-0.0002***	-0.0001***
	(3.13)	(7.58)	(-14.56)	(-5.09)
ROA_{t-1}	5.3488**	8.3547*	4.5854	3.8411
	(2.16)	(1.94)	(1.20)	(1.12)
Age_{t-1}	1.5083***	3.4034***	0.8199	0.7762
	(3.34)	(5.06)	(1.18)	(1.48)
$Avg.Returns_{t-1}$	1.5794	0.8498	-2.8783	4.8266**
	(0.89)	(0.26)	(-1.15)	(2.21)
$Cash_{t-1}$	-1.9209	-2.8332	-0.1800	0.1083
	(-1.32)	(-1.35)	(-0.09)	(0.06)
$Dividend_{t-1}$	4.2992	-3.4844	12.4516*	5.7439
	(0.98)	(-0.55)	(1.72)	(1.33)
$CAPEX_{t-1}$	-5.8646	-8.2054	-14.6828**	-3.4806
	(-1.33)	(-1.20)	(-2.17)	(-0.69)
$SalesGrowth_{t-1}$	0.0026***	0.0012**	0.0020***	0.0043***
	(6.80)	(2.01)	(4.28)	(10.37)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	22,647	22,647	22,647	22,647
Adj. R^2	0.492	0.120	0.437	0.427
Number of Firms	3,261	3,261	3,261	3,261

Table 6: Voluntary XBRL Reporting and ESG Performance

This table shows the effect of voluntary XBRL adoption on ESG Score, Governance Score, Social Score, and Environmental Score. The sample consists of voluntary adopters for the period 2005–2010. Unlike $XBRL_{mandate}$ that captures firms implementing XBRL following SEC mandate, $XBRL_{no-mandate}$ represents firms who voluntarily adopt XBRL even before they are mandated by SEC. Coefficients are provided with t-statistics in parentheses below. All models have firm-clustered, robust standard errors. Variables are as defined in Appendix Table A.1.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable	ESG Score (1)	Governance Score (2)	Social Score (3)	Environmental Score (4)
$\boldsymbol{XBRL_{no-mandate}}$	**-1.1680**	**0.9031**	**1.7521**	**-4.1910**
	(-0.53)	**(0.25)**	**(0.55)**	**(-1.57)**
$Size_{t-1}$	-1.0074	-1.0862	1.1282	-1.5988*
	(-1.21)	(-1.01)	(0.84)	(-1.67)
$Leverage_{t-1}$	-1.1079	-3.8868	2.6515	-0.9017
	(-0.46)	(-1.25)	(0.77)	(-0.33)
MTB_{t-1}	-0.0017**	-0.0071***	0.0023**	0.0003
	(-2.32)	(-6.21)	(2.06)	(0.35)
ROA_{t-1}	12.6428	6.9223	20.0628	13.5982
	(1.23)	(0.46)	(1.33)	(1.14)
$Age_{t-1}1$	0.2865	0.6985	-0.6846	1.4412
	(0.30)	(0.59)	(-0.46)	(1.23)
$Avg.Returns_{t-1}$	6.3365	9.5433	4.0686	5.6375
	(1.62)	(1.35)	(0.74)	(1.29)
$Cash_{t-1}$	-11.0270***	-14.8155***	-2.3446	-7.3164*
	(-3.07)	(-3.39)	(-0.40)	(-1.82)
$Dividend_{t-1}$	-0.5588	2.5146	-7.2190	-0.8690
	(-0.07)	(0.22)	(-0.46)	(-0.11)
$CAPEX_{t-1}$	-16.6619*	-14.9606	-16.3973	-20.0355*
	(-1.66)	(-1.03)	(-1.08)	(-1.73)
$SalesGrowth_{t-1}$	0.0051***	0.0024***	0.0055***	0.0069***
	(17.96)	(6.05)	(13.64)	(20.50)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	5,629	5,629	5,629	5,629
Adj. R^2	0.411	0.0425	0.428	0.365
Number of Firms	1,126	1,126	1,126	1,126

Table 7: Mandatory XBRL Reporting and ESG Performance (Alternative Identification Using Variations in Fiscal Year-End)

This table presents the cross-sectional regression results for mandatory XBRL adoption on ESG Score, Governance Score, Social Score, and Environmental Score using an alternative identification strategy. Specifically, we exploit the variation of fiscal year-ends (FYEs) for XBRL phase 2 firms for the sample period 2010–2011. The main DiD variable $XBRL\_2_{mandate}(FYE_{var})$ represents treatment group denoted by 1 for firms who are mandated by SEC to adopt XBRL in phase 2—i.e., firms with public float between $700 million and $5 billion, and FYE between 15 June 2010 and 14 June 2011. Similar sized firms in terms of public float, but with FYE before 15 july 2010, thus, form the control group denoted by 0. Coefficients are provided with t-statistics in parentheses below. Unlike the main identification strategy in Table 3 that includes firm fixed effects, in these estimations we include industry fixed effects so that the cross-sectional variations are captured by the DiD term. All models have firm-clustered, robust standard errors. Variables are as defined in Appendix Table A.1.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable	ESG Score (1)	Governance Score (2)	Social Score (3)	Environmental Score (4)
$\boldsymbol{XBRL\_2_{mandate}(FYE_{var})}$	**2.7622****	**7.6232*****	**-0.2542**	**0.9437**
	(1.98)	**(3.19)**	**(-0.12)**	**(0.56)**
$Size_{t-1}$	6.9046***	2.6681***	11.6117***	7.4914***
	(9.88)	(2.76)	(12.99)	(9.60)
$Leverage_{t-1}$	1.1287	1.1685	1.0094	-0.3233
	(0.49)	(0.38)	(0.33)	(-0.12)
MTB_{t-1}	0.0136	0.0177	-0.0230	0.0261
	(0.36)	(0.30)	(-0.67)	(0.74)
ROA_{t-1}	16.2717	-13.1430	6.0939	51.3273**
	(0.78)	(-0.47)	(0.24)	(2.19)
Age_{t-1}	1.4264**	2.7601***	-0.1762	1.8757***
	(2.19)	(2.80)	(-0.21)	(2.58)
$Avg.Returns_{t-1}$	-21.0186*	-24.2258	-31.6154**	-16.1763
	(-1.80)	(-1.30)	(-2.14)	(-1.24)
$Cash_{t-1}$	15.8953***	16.4260**	17.9608***	11.7586*
	(3.21)	(2.18)	(2.75)	(1.90)
$Dividend_{t-1}$	13.9282	26.4388	26.1781	12.2562
	(0.44)	(0.82)	(0.69)	(0.31)
$CAPEX_{t-1}$	-25.7530	-41.5741	6.7781	-10.9269
	(-1.26)	(-1.31)	(0.23)	(-0.45)
$SalesGrowth_{t-1}$	-0.0240	-2.2957***	0.2598	1.9539***
	(-0.04)	(-2.78)	(0.35)	(2.83)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	913	913	913	913
Adj. R^2	0.293	0.169	0.361	0.226

Table 8: The Moderating Effect of External Monitoring

This table shows the effect of XBRL adoption on ESG Score, Governance Score, Social Score, and Environmental Score conditional on external monitoring. In Panel A, we proxy for external monitoring using analyst coverage with $HIGH_{Analysts}$ representing firms with the value of *Analysts* greater than annual median value. In Panels B and C, we proxy for external monitoring using institutional ownership and blockholding, respectively. $HIGH_{IOP}$ ($HIGH_{Blockholder}$) is an indicator equal to 1 for those firms with the value of institutional ownership *IOP* (*Blockholder*) greater than its annual median value. The t-statistics for firm-clustered, robust standard errors are shown in parentheses below the coefficients. For definitions of *Analysts*, *IOP* (i.e. institutional ownership), and *Blockholder*, see Appendix Table A.1. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

Panel A: Proxied using High/Low Analysts Coverage				
Dependent Variable	ESG Score	Governance Score	Social Score	Environmental Score
	(1)	(2)	(3)	(4)
$XBRL_{mandate}$	0.7285	0.7849	0.3958	0.7061
	(1.59)	(1.03)	(0.58)	(1.28)
$HIGH_{Analysts}$	-0.1383	0.0367	-1.8649***	0.1353
	(-0.42)	(0.07)	(-3.88)	(0.35)
$\boldsymbol{XBRL_{mandate} * HIGH_{Analysts}}$	**1.5908*** **	**2.4924*** **	**2.6740*** **	**0.7904***
	(4.44)	**(4.19)**	**(5.05)**	**(1.84)**
Control Variables	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	19,340	19,340	19,340	19,340
Adj. R^2	0.407	0.030	0.337	0.327
Panel B: Proxied using High/Low Institutional Ownership (IOP)				
Dependent Variable	ESG Score	Governance Score	Social Score	Environmental Score
	(1)	(2)	(3)	(4)
$XBRL_{mandate}$	0.5327	-0.1585	0.7121	0.7543
	(1.20)	(-0.21)	(1.09)	(1.42)
$HIGH_{IOP}$	-1.4109***	-2.8274***	-3.2887***	0.1657
	(-3.96)	(-4.77)	(-6.29)	(0.39)
$\boldsymbol{XBRL_{mandate} * HIGH_{IOP}}$	**1.6980*** **	**4.6021*** **	**1.6641*** **	**0.0468**
	(4.92)	**(8.00)**	**(3.28)**	**(0.11)**
Control Variables	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	20,345	20,345	20,345	20,345
Adj. R^2	0.399	0.037	0.331	0.319
Panel C: Proxied using High/Low Blockholders Presence				
Dependent Variable	ESG Score	Governance Score	Social Score	Environmental Score
	(1)	(2)	(3)	(4)
$XBRL_{mandate}$	0.7021	0.9289	0.6500	0.7409
	(1.56)	(1.24)	(0.98)	(1.37)
$HIGH_{Blockholders}$	-0.7713**	-0.9868*	-1.8248***	-0.0104
	(-2.44)	(-1.87)	(-3.93)	(-0.03)
$\boldsymbol{XBRL_{mandate} * HIGH_{Blockholders}}$	**1.2722*** **	**2.3980*** **	**1.4440*** **	**0.0394**
	(3.67)	**(4.15)**	**(2.84)**	**(0.10)**
Control Variables	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	20,349	20,349	20,349	20,349
Adj. R^2	0.399	0.039	0.330	0.319

Table 9: The Moderating Effect of Firm Opacity

In this table, we present the effects of XBRL adoption on the four ESG performance measures (i.e., ESG Score, Governance Score, Social Score, and Environmental Score) conditional on financial reporting opacity. The sample consists of XBRL adopters during the period 2009–2012 as mandated by U.S. SEC. In Panel A, $HIGH_{AbsDDM}$ is and indicator equal to 1 for those firms with the value of $AbsDDM$ are higher than its annual median value. In Panel B, $HIGH_{AbsMJM}$ is an indicator equal to 1 for those firms with the value of $AbsMJM$ higher than its annual median value. In Panel C, we divide high opacity firm using $HIGH_{Opaque}$, which represents firms with value of *Opaque* greater than its annual median value. We show t-statistics in parentheses below the coefficients for firm-clustered, robust standard errors. $AbsDDM$, $AbsMJM$, and *Opaque* are firm opacity proxies as defined in Appendix Table A.1. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Proxied using High/Low AbsDDM				
Dependent Variable	ESG Score	Governance Score	Social Score	Environmental Score
	(1)	(2)	(3)	(4)
$XBRL_{mandate}$	1.5769***	2.2747***	1.9195***	0.7405
	(3.80)	(3.29)	(3.16)	(1.49)
$HIGH_{AbsDDM}$	-0.3949	-0.8139*	0.1182	-0.7848**
	(-1.39)	(-1.72)	(0.28)	(-2.31)
$\boldsymbol{XBRL_{mandate} * HIGH_{AbsDDM}}$	**0.5324***	**1.1927****	**-0.2566**	**0.9842*****
	(1.67)	**(2.25)**	**(-0.55)**	**(2.59)**
Control Variables	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	21,773	21,773	21,773	21,773
Adj. R^2	0.401	0.019	0.334	0.325
Panel B: Proxied using High/Low AbsMJM				
Dependent Variable	ESG Score	Governance Score	Social Score	Environmental Score
	(1)	(2)	(3)	(4)
$XBRL_{mandate}$	1.3146***	2.2415***	1.7319***	0.2860
	(3.21)	(3.29)	(2.88)	(0.58)
$HIGH_{AbsMJM}$	-0.7230***	-0.5914	-0.1240	-1.3380***
	(-2.71)	(-1.33)	(-0.32)	(-4.20)
$\boldsymbol{XBRL_{mandate} * HIGH_{AbsMJM}}$	**1.1140*****	**0.8962***	**0.4792**	**2.0547*****
	(3.75)	**(1.81)**	**(1.10)**	**(5.79)**
Control Variables	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	22,035	22,035	22,035	22,035
Adj. R^2	0.402	0.032	0.333	0.329
Panel C: Proxied using High/Low Opaque				
Dependent Variable	ESG Score	Governance Score	Social Score	Environmental Score
	(1)	(2)	(3)	(4)
$XBRL_{mandate}$	0.7343*	0.9885	1.7155***	-0.1061
	(1.78)	(1.43)	(2.83)	(-0.21)
$HIGH_{Opaque}$	-1.6412***	-2.3031***	-0.2049	-1.8717***
	(-5.52)	(-4.61)	(-0.47)	(-5.25)
$\boldsymbol{XBRL_{mandate} * HIGH_{Opaque}}$	**1.8225*****	**2.6142*****	**0.1649**	**2.5405*****
	(5.64)	**(4.82)**	**(0.35)**	**(6.56)**
Control Variables	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	21,207	21,207	21,207	21,207
Adj. R^2	0.366	0.019	0.292	0.284

Table 10: The Moderating Effect of Managerial Risk-Taking

This table shows the results for the effect of XBRL adoption on ESG Score, Governance Score, Social Score, and Environmental Score conditional on managerial risk aversion. In Panel A, *CEODuality* equals 1 for the firm-year observations when CEO also serves as the chairman of its board of directors. In Panel B, *CEOTenure* measure the number of years since the current CEO was appointed. In Panel C, *FemaleCEO* is and indicator equal to 1 when the CEO is female. We show t-statistics in parentheses below the coefficients using firm-clustered, robust standard errors. *CEODuality*, *CEOTenure* and *FemaleCEO* are defined in Appendix Table A.1.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

Panel A: Proxied using CEO Duality				
Dependent Variable	ESG Score	Governance Score	Social Score	Environmental Score
	(1)	(2)	(3)	(4)
$XBRL_{mandate}$	1.5683***	3.0057***	1.2702*	1.0452*
	(3.02)	(3.49)	(1.65)	(1.70)
CEO Duality	-2.3232***	-3.3141***	-3.0893***	-1.0013**
	(-6.75)	(-5.80)	(-6.04)	(-2.45)
$\boldsymbol{XBRL_{mandate} * CEO\ Duality}$	**2.0093*** **	**2.4526*** **	**2.5865*** **	**1.0022** **
	(5.27)	**(3.88)**	**(4.57)**	**(2.21)**
Control Variables	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	15,949	15,949	15,949	15,949
Adj. R^2	0.513	0.138	0.458	0.444
Panel B: Proxied using CEO Tenure				
Dependent Variable	ESG Score	Governance Score	Social Score	Environmental Score
	(1)	(2)	(3)	(4)
$XBRL_{mandate}$	2.5392***	3.5528***	2.6487***	1.8780***
	(4.98)	(4.21)	(3.50)	(3.11)
CEO Tenure	-0.2946	-1.4052***	-0.3440	0.5136
	(-0.95)	(-2.74)	(-0.75)	(1.39)
$\boldsymbol{XBRL_{mandate} * CEO\ Tenure}$	**0.6199***	**2.0558*** **	**0.4264**	**-0.3396**
	(1.71)	**(3.42)**	**(0.79)**	**(-0.79)**
Control Variables	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	15,842	15,842	15,842	15,842
Adj. R^2	0.512	0.137	0.458	0.444
Panel C: Proxied using CEO Gender				
Dependent Variable	ESG Score	Governance Score	Social Score	Environmental Score
	(1)	(2)	(3)	(4)
$XBRL_{mandate}$	2.8998***	4.6581***	2.7999***	1.7688***
	(6.20)	(6.01)	(4.03)	(3.19)
Female CEO	5.1649***	6.4299***	-1.0504	5.3127***
	(4.21)	(3.16)	(-0.58)	(3.65)
$\boldsymbol{XBRL_{mandate} * Female\ CEO}$	**-3.0885** **	**-4.0931***	**2.8662**	**-3.9275*** **
	(-2.43)	**(-1.95)**	**(1.52)**	**(-2.61)**
Control Variables	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	15,949	15,949	15,949	15,949
Adj. R^2	0.512	0.137	0.457	0.444

Table 11: Mandatory XBRL Reporting and Shareholder Voting Behavior

This table summarizes the results for the effect of XBRL adoption on the level of support obtained (in terms of the proportion of shareholders' "for" votes cast) for the management- and shareholder-sponsored proposals during the shareholder meetings. In Panel A, we classify the ESG proposals based on the type of sponsor: Management (column 2) and Shareholder (column 3) and also show the results using routine (non-ESG) proposals (column 4). In Panel B, ESG proposals are classified into environmental, social, and governance proposals based on their ISS classification codes and description. All regressions include firm-level controls used in the main analyses presented in Table 3. In addition, proposal-and meeting-level controls include management recommendation ("For" or not) and meeting type (annual general meeting, extraordinary general meeting, special meeting, etc.).
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

Panel A: Classified by Proposal Sponsors

	ESG Proposals			Routine Proposals
	Both	Management	Shareholder	Both
	(1)	(2)	(3)	(4)
$\boldsymbol{XBRL_{mandate}}$	**0.5722*** (6.77)**	**0.4471*** (5.70)**	**-3.0786** (-2.07)**	**0.0186 (0.12)**
Proposal/Meeting Controls	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	301,682	294,671	6,676	48,696
Adj. R^2	0.549	0.202	0.571	0.738

Panel B: Classified by Proposal Types

	All ESG	Governance	Social	Environmental
	(1)	(2)	(3)	(4)
$\boldsymbol{XBRL_{mandate}}$	**0.5722*** (6.77)**	**0.5774*** (6.99)**	**1.3875 (0.88)**	**-2.6264 (-1.15)**
Proposal/Meeting Controls	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	301,682	298,871	1,657	879
Adj. R^2	0.549	0.393	0.656	0.531

Table A.1: Variable definitions

Variables	*Description*
Main Dependentent Variables:	
ESG Score	Measurement of the firm's ESG performance based on public data collected by Refinitv. It combines the three different pillars, i.e., environmental, social, and governance pillar scores.
Governance Score	The Governance Pillar Score is a sub-score of ESG Score that only captures the firms' corporate governance characteristics related to shareholders rights, takeover defences, managerial compensation, board structure, etc.
Environmental Score	The Environmental Pillar Score shows firms assesment on environmental aspects such as emission, biodiversity, waste management, energy use, water use, product innovation etc.
Social Score	The Social Pillar Score shows evaluation of the firms for social characteristics including community engagement, human rights, data privacy, product quality, workers safety & health, diversity & inclusion, etc.
Other Dependentent Variables:	
ESG Management proposals	Number of proposal related to ESG issues and sponsored by the management in the annual meeting
ESG Shareholder proposals	Number of proposal related to ESG issues and sponsored by shareholders in the annual meeting
Routine proposals	Number of ESG routine proposal sponsored by either the management or shareholder in the annual meeting
ESG Controversy Score	Refinitiv assess firms on 23 ESG controversy topics and assigns them the ESG controversies. Any controversial scandal related to these ESG topics results in a degradation of the Controversy Score.
ESG Combined Score	This combines the ESG score with the ESG controversy Score to provide a "a comprehensive evaluation" of the firms sustainability commitment and conduct.
Control Variables:	
Size	The natural logarithm of total assets.
Leverage	The ratio of the sum of short-term debt and long-term debt to total assets.
MTB	The natural logarithm of ratio of market value to book value
ROA	The ratio of operating income before depreciation to total assets
Age	The natural logarithm of age of firm based on the months listed on Compustat
Avg. Returns	Average monthly returns over last 12 months
Cash	Ratio of cash balances over total assets.
Dividend	Ratio of cash dividends over total assets.
CAPEX	The log transformed ratio of capital expenditures over total assets.
Sales Growth	The difference between total sales and last year's total sales divided by last year's total sales.
Partitioning Variables:	
Institutional Ownership	The ratio of the number of shares owned by all 13f institutional investors to the total number of shares. Quarterly owendership annualized by taking average in a calendar year.
# Blockholders	The average number of blockholders who have investment positions in the firm in a given year. Blockholders are defined as institutional investors with more than 5% ownership of the firm.
# Analysts	Average number of investment analysts covering a firm. Annual measure is computed using the average number of earnings estimates available for the firm in each quarter.
SD residual	Following Dechow and Dichev (2002), for each firm, it is the standard deviation over past five year (t-4 to t) of the error term obtained from regressing total current accruals on the cash flow from operations and its lead and lag values.
Discretionary Accruals	Absolute value of discretionary acruals using modified Jones (1991) model.
Opaque	Following Hutton et al. (2009), it is the sum total of absolute discretionary accruals over past 3 years to take a multi-year perspective to account for any inconsistencies in firms' earnings management policies.
CEO Duality	An indicator showing whether the firm's CEO also serves as the chairman of its board of directors in a given year.
CEO Tenure	Number of years since the CEO took the position.

Table A.2: Alternative Estimation (Using Staggered Difference-in-Differences Estimators)

The table reports two alternative difference-in-difference specifications using the Callaway and Sant'Anna (2021) and the Sun and Abraham (2021) estimators that account for heterogeneities in treatment effects. Coefficients are provided with t-statistics in parentheses below. All models have firm-clustered, robust standard errors. Variables are as defined in Appendix A.1.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Callaway and Sant'Anna's (2021) Estimation

Dependant Variable	ESG Score	Governance Score	Social Score	Environmental Score
	(1)	(2)	(3)	(4)
$\boldsymbol{XBRL_{mandate}}$	**2.2289*** **	**4.1489*** **	**1.7017**	**0.8226**
	(3.92)	**(3.70)**	**(2.71)**	**(1.06)**
Control Variables	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	6,561	6,561	6,561	6,561
Number of Firms	1,055	1,055	1,055	1,055

Panel B: Sun and Abraham's (2021) Estimation

Dependant Variable	ESG Score	Governance Score	Social Score	Environmental Score
	(1)	(2)	(3)	(4)
$\boldsymbol{XBRL_{mandate}}$	**4.7176*** **	**5.3342**	**3.2742** **	**3.6986***
	(3.86)	**(1.44)**	**(2.83)**	**(1.86)**
Control Variables	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	6,561	6,561	6,561	6,561
Number of Firms	1,055	1,055	1,055	1,055

Table A.3: Alternative Estimation (Using Industry Fixed Effects Instead of Firm Fixed Effects)

This table replicates the results the results in Table 3 by regressing ESG Score, Governance Score, Social Score, and Environmental Score on $XBRL_{mandate}$ and control variables. However, we replace firm fixed effects in Equation (1) by industry fixed effects. Similar to Table 3, $XBRL_{mandate}$ is an indicator that takes value 1 for firms filing their financial statements in XBRL format when mandated by the SEC regulation and zero otherwise. All the three XBRL implementation phases are included within $XBRL_{mandate}$. Coefficients are provided with t-statistics in parentheses below. All models have firm-clustered, robust standard errors. Variables are as defined in Appendix A.1.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable	ESG Score (1)	Governance Score (2)	Social Score (3)	Environmental Score (4)
$\boldsymbol{XBRL_{mandate}}$	**1.6988***	**1.2416**	**2.2304***	**1.9002****
	(1.88)	**(1.07)**	**(1.83)**	**(1.96)**
$Size_{t-1}$	7.5814***	4.4019***	10.8662***	8.0950***
	(47.38)	(21.40)	(48.44)	(46.03)
$Leverage_{t-1}$	-1.3573	-1.2392	-1.7543	-0.8499
	(-1.56)	(-1.13)	(-1.49)	(-0.86)
MTB_{t-1}	0.0001***	0.0003***	0.0001***	-0.0001
	(2.76)	(12.86)	(3.01)	(-0.85)
ROA_{t-1}	2.2263	7.7994	-7.9461	-0.2968
	(0.49)	(1.45)	(-1.58)	(-0.07)
Age_{t-1}	2.2097***	3.6754***	2.2377***	1.0641***
	(8.10)	(10.20)	(6.11)	(3.49)
$Avg.Returns_{t-1}$	5.0744*	-3.3702	4.4456	13.0475***
	(1.83)	(-0.83)	(1.20)	(4.00)
$Cash_{t-1}$	11.5134***	1.1055	16.8354***	16.9468***
	(6.36)	(0.48)	(6.89)	(8.09)
$Dividend_{t-1}$	58.8531***	33.8454***	81.6513***	62.8326***
	(4.73)	(2.90)	(4.74)	(4.76)
$CAPEX_{t-1}$	-2.3222	5.1133	7.0883	-3.3822
	(-0.31)	(0.55)	(0.72)	(-0.41)
$SalesGrowth_{t-1}$	0.0022***	-0.0011	0.0009	0.0046***
	(2.65)	(-1.06)	(0.67)	(5.39)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	22,495	22,495	22,495	22,495
Adj. R^2	0.469	0.195	0.512	0.418

Table A.4: Alternative Estimation (Using Other ESG Performance Measures)

This table provides results of regressing Controversy Score and ESG Combined Score on the variable $XBRL_{mandate}$ as well as control variables. $XBRL_{mandate}$ is an indicator that takes value 1 for firms filing their financial statements in XBRL format when mandated by the regulation and zero otherwise. It encompasses the implementation of all the three XBRL phases. Coefficients are provided with t-statistics in parentheses below. All models have firm-clustered, robust standard errors. Variables are as defined in Appendix A.1. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

Dependent Variable	Controversy Score (1)	ESG Combined Score (2)	Controversy Score (3)	ESG Combined Score (4)
$\boldsymbol{XBRL_{mandate}}$	**-0.8318**	**1.3976*** **	**-0.7224**	**1.4075**
	(-0.72)	**(2.64)**	**(-0.50)**	**(1.60)**
$Size_{t-1}$	-3.7398***	1.7074***	-6.1400***	5.8091***
	(-5.54)	(4.49)	(-19.28)	(32.51)
$Leverage_{t-1}$	-1.1389	-1.2572	0.1495	-0.9841
	(-0.68)	(-1.30)	(0.15)	(-1.17)
MTB_{t-1}	0.0000	0.0001***	-0.0000	0.0001**
	(0.67)	(4.22)	(-0.09)	(2.04)
ROA_{t-1}	13.9515**	6.7339***	11.6680***	6.3699
	(2.46)	(2.62)	(2.81)	(1.30)
Age_{t-1}	-2.3584***	1.2015***	-0.3557	1.9572***
	(-3.33)	(2.58)	(-1.18)	(7.52)
$Avg.Returns_{t-1}$	4.9740	3.1870	4.5123	5.6426**
	(0.97)	(1.64)	(0.87)	(2.01)
$Cash_{t-1}$	3.6775	-0.7574	-14.3514***	7.8472***
	(1.37)	(-0.50)	(-6.63)	(4.50)
$Dividend_{t-1}$	-1.5100	3.2956	-11.1055	49.4256***
	(-0.20)	(0.80)	(-1.32)	(4.38)
$CAPEX_{t-1}$	11.8427	-5.1507	9.8122	-2.3796
	(1.45)	(-1.12)	(1.20)	(-0.34)
$SalesGrowth_{t-1}$	0.0011	0.0032***	0.0022**	0.0018**
	(0.97)	(5.73)	(2.24)	(2.29)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm/Industry Effects	Firm	Firm	Industry	Industry
Number of Observations	22,647	22,647	22,495	22,495
Adj. R^2	0.043	0.388	0.203	0.366
Number of Firms	3,260	3,261	3,261	3,261

Table A.5: Pre-Treatment Placebo Test for XBRL Reporting and ESG Performance

This table replicates the results from Table 5 to test for the parallel trend assumption on ESG measures before the XBRL mandate. We assign a placebo treatment starting 2005 instead of actual XBRL implementation in 2009, using similar market float criteria. In this test, we include only the pre-treatment years in our sample, i.e., 2002 to 2009. Coefficients are provided with t-statistics in parentheses below. All models have firm-clustered, robust standard errors. Variables are as defined in Appendix Table A.1. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable	ESG Score (1)	Governance Score (2)	Social Score (3)	Environmental Score (4)
$\boldsymbol{PlaceboXBRL_{mandate}}$	**-0.5146**	**-1.1976**	**-2.2605**	**0.3308**
	(-0.27)	**(-0.43)**	**(-0.95)**	**-0.13**
$Size_{t-1}$	-1.1656	-1.1089	0.6843	-1.6573
	(-1.30)	(-0.90)	(0.49)	(-1.61)
$Leverage_{t-1}$	-1.2718	-3.945	2.8628	-1.4819
	(-0.50)	(-1.07)	(0.82)	(-0.51)
MTB_{t-1}	-0.0021***	-0.0072***	0.0016	-0.0001
	(-2.67)	(-5.76)	(1.35)	(-0.11)
ROA_{t-1}	9.8235	-3.724	16.1791	14.0065
	-0.89	(-0.22)	(0.99)	(1.00)
Age_{t-1}	0.78	1.3077	-0.3086	1.818
	(0.76)	(1.02)	(-0.19)	(1.46)
$Avg.Returns_{t-1}$	16.5769***	19.1736**	12.0845	16.7936**
	(2.77)	(2.07)	(1.38)	(2.37)
$Cash_{t-1}$	-13.5361***	-18.0852***	-2.7202	-9.9671**
	(-3.10)	(-3.47)	(-0.39)	(-2.02)
$Dividend_{t-1}$	-1.6458	3.1554	-9.2526	-3.6586
	(-0.21)	(0.25)	(-0.53)	(-0.46)
$CAPEX_{t-1}$	-15.9671	-13.0004	-18.5196	-21.4629
	(-1.38)	(-0.77)	(-1.07)	(-1.62)
$SalesGrowth_{t-1}$	0.0061***	0.0022***	0.0056***	0.0071***
	(18.87)	(9.90)	(12.87)	(19.52)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Number of Observations	4,662	4,662	4,662	4,662
Adj. R^2	0.381	0.0387	0.388	0.339
Number of Firms	1,056	1,056	1,056	1,056