MANDATORY ESG REPORTING AND CORPORATE PERFORMANCE

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Abstract

We examine the effects of mandatory ESG reporting on firms' corporate performance. Using variation from Sweden's size-based ESG reporting regulation, which requires medium private firms to start reporting ESG information from 2017 onward, we document that mandatory ESG reporting improves firms' corporate performance. This finding is consistent with two non-mutually exclusive mechanisms: (1) disclosing ESG information enlarges the opportunity set of mandated firms to enter larger supply chains, and (2) capital providers incorporate ESG information in their debt pricing decisions. In addition, we document the ESG disclosure dynamics of private firms in both a voluntary and a mandatory regime. Our results withstand several robustness tests and an alternative research design. Collectively, our findings provide insights into the consequences of mandatory ESG reporting at the firm level.

Keywords: *private firms, mandatory ESG reporting, disclosure regulation, difference-in-differences design.*
JEL Codes: *K22, G38, M14, M41, M48.*

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1   Introduction

"I have asked SEC staff to develop a mandatory climate risk disclosure rule proposal for the Commission's consideration by the end of the year. [...] Generally, I believe it's with mandatory disclosures that investors can benefit from that consistency and comparability. When disclosures remain voluntary, it can lead to a wide range of inconsistent disclosures."

— SEC Chairman Gary Gensler, July 28 2021

The debate on whether ESG reporting should be mandatory is ongoing and of growing importance for regulators[1]. The key question is whether mandatory ESG reporting can improve corporate responsiveness on sustainability and social issues without being detrimental to corporate performance. Understanding this trade-off is key for regulators to be able to tackle the global environmental and social issues that we face today. In this paper, we examine the corporate performance effects of mandatory environmental, social and governance (ESG) reporting at the firm level.

Despite the abundant research on the effects of ESG disclosures (Christensen et al. [2021]), we lack a clear understanding of the consequences that mandatory ESG disclosure has on firms' corporate performance. The lack of understanding stems from mixed conclusions on the effects of ESG reporting at the firm level. On the one hand, it is fairly clear that increased ESG reporting pushes firms to invest in more ESG-related projects (Fiechter et al. [2022]) and that ESG investments are beneficial for stakeholders (Christensen et al. [2017]; Chen et al. [2018]; Darendeli et al. [2022]; Fiechter et al. [2022]). On the other hand, the effects ESG reporting on firm financial performance and value are less clear. Several studies find negative effects on labor productivity and profitability from mandated non-financial disclosures (Christensen et al. [2017]; Chen et al. [2018]). However, several other studies find positive associations with firm market value and Tobin's Q (Plumlee et al. [2015]; Ioannou and Serafeim [2019]). At the same time, others find no impact of ESG

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[1]One example is the European Union, which is preparing to adopt the European Sustainability Reporting Standards (ESRS) under the umbrella of the Corporate Sustainability Reporting Directive (CSRD) by June 2023. This set of reporting sustainability standards also focuses on environmental, governance and social information similar to the already adopted European Union Directive 2014/95 on non-financial reporting. However, the ESRS is complemented with sector- and SMEs-specific standards. The ESRS focuses on three main elements: information on the entire value chain, accounting for the double materiality concept, and the inclusion of the due diligence concept. For more information, please visit https://www.efrag.org/lab6. Another example is the Securities and Exchange Commission's proposal for a mandatory climate risk disclosure in the United States.

reporting on firm value (Cho et al. [2015]) or observe differing market reactions to the adoption of mandatory ESG reporting depending on firms' ex ante level of ESG performance and disclosure (Grewal et al. [2018]). We believe that the mixed results in the literature arise from selection issues in voluntary settings and the potentially confounding effects of alternative institutional settings.

In this paper, we study the corporate performance effects of the adoption of the EU mandatory ESG reporting directive for private Swedish firms. Our focus on the private Swedish firm setting provides two main benefits that we believe can help overcome the empirical challenges of prior research. First, by focusing on a single country setting, we are better able to control for confounding factors. In addition, it allows us to exploit specific institutional features and avoid some of the limitations of international studies (for example, see Fiechter et al. [2022][2]). Second, examining the Swedish setting allows us to study the reaction of and the effect for smaller private firms. Such analysis is lacking in the literature due to data unavailability. We believe that these special institutional characteristics are interesting enough to compensate for the problem of external validity, which is inherent to institutional-dependent research designs. Limitations aside, our focus on private Swedish firms is useful to assess how ESG disclosures can affect firm performance and to discover which institutional characteristics influence the effect on firms.

Theoretically, mandatory financial reporting can affect firms' corporate performance in different ways. The literature predicts the effect on the outcome of a cost-benefit analysis (Leuz and Wysocki [2016]; Minnis and Shroff [2017]). In the case of private firms, the costs and benefits of reporting arise mainly from the users of the information disclosed. While transacting stakeholders (e.g., capital providers, suppliers and customers) create benefits through improved financing conditions, non-transacting stakeholders (e.g., competitors and general interest parties) can impose proprietary costs for the disclosing firm.

Continuing with this theoretical framework, the effect of mandating firms to report ESG information on corporate performance ex ante is not clear. On the one

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[2]Fiechter et al. [2022] investigate the real effects of the EU Directive ESG reporting mandate for 576 EU firms. While their study provides very insightful evidence on how firms react to an ESG reporting mandate, their international sample restricts their inferences on the specific mechanisms responsible for such effect.

hand, mandated firms can access superior supply chains by lowering the disclosure costs and ESG-related reputational risks of corporate customers and becoming a better supplier-customer match in terms of ESG (Dai et al. [2021]; Darendeli et al. [2022]). In addition, a mandate for ESG information creates demand for such information and increases its value. This fact, together with the increased comparability of information, reduces processing costs for capital providers such as banks and suppliers, and incentivizes them to take ESG information into account when making decisions. In this case, mandated firms could benefit from improved financing conditions (Leuz and Schrand [2009]; Minnis and Shroff [2017]). On the other hand, although the mandate would reduce the costs of producing the information by generating a larger market for such information, firms must still bear the direct costs of disclosing ESG information. Moreover, disclosing more information can create additional proprietary costs for firms (Dedman and Lennox [2009]; Bernard [2016]; Bernard et al. [2018]; Gassen and Muhn [2018]). This situation can be aggravated in the case of ESG information because it is more closely linked to the firm's core operations and activities (Christensen et al. [2021]). The potential costs and benefits of mandatory ESG disclosures make it difficult to hypothesize the direction of the effect. Ultimately, it is an empirical question whether firms derive a positive or negative effect on corporate performance from an ESG reporting mandate.

Our paper tests the effect of mandatory ESG reporting on corporate performance for private Swedish firms. Sweden's adoption of the European Union Directive 2014/95 on non-financial reporting provides a suitable setting. While the EU Directive targeted a restricted group of large and listed firms, Sweden's adoption of the Directive targeted a broader set of firms (Årsredovisningslag (1995:1554)). First, the ESG reporting mandate is independent of the firm's listing status, and second, the size thresholds at which firms become subjected to the mandate are substantially lower than in the EU Directive. In Sweden, mandatory ESG reporting applies to firms that, for the last two consecutive financial years, have met two of the following three criteria: (a) on average, they have more than 250 employees; (b) they report total assets exceeding SEK 175 million ($\approx$ USD 21 million); or (c) they report net sales larger than SEK 350 million ($\approx$ USD 42 million).[3] In contrast, the

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[3]This requirement is expressed in Årsredovisningslag (1995:1554), Chapter 6 Section 10.

size criterion in the original EU directive requires that companies have at least 500 employees, which is double the Swedish employee threshold. The mandatory ESG reporting amendment of the Swedish Årsredovisningslag (1995:1554) was passed on December 1, 2016, but it was implemented for the first time for the financial year that began immediately after December 31, 2016. This amendment requires firms meeting the criteria to issue an ESG report (on an integrated or standalone basis) covering all the material ESG aspects necessary to understand firms' business operations.

We exploit variation present in this setting to estimate the impact of mandating ESG reporting on corporate performance. Namely, we compare firms that meet the requirements under the Årsredovisningslag (1995:1554) ESG reporting amendment (2016:947), and firms that do not meet the requirements, conditional on controlling for the determinant factors of treatment status. First, we adopt a multivariate regression discontinuity design (Reardon and Robinson [2012]; Breuer et al. [2018]) and then expand this design by exploiting the timing of the amendment's adoption, employing a difference-in-differences design. In our main analysis, we use a time-invariant treatment, i.e., we base our assignment to the treatment and the control group by using a firm's size figures from the 2016 fiscal year only. We adopt this approach for the following two reasons: (1) basing our treatment and control group assignment on one year allows us to use a more flexible specification, forcing us to only control for the factors that determine assignment in 2016 and; (2) the time-invariant nature of the assignment rule leads to the individual treatment variable to be fully absorbed by the firm fixed effects. Otherwise, with a time varying treatment, variation remains even with the presence of the firm fixed effects in the assignment rule, which might be correlated with unobservable time-varying covariates that could generate bias in our results.[4] (For more details on the design, the sampling process

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The full text of the law can be found here: https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/arsredovisningslag-19951554_sfs-1995-1554 [Accessed 12/09/2021].

[4]Alternatively, we provide an array of robustness checks including a time-varying treatment, a two-year assignment rule based on the years 2015 and 2016 and an instrumented one-year 2016 based rule with a quasi-assignment of firms to the treatment and control groups based on the size thresholds applied to the year 2013 (before the announcement of the Swedish rule). We apply this last decision rule only to our regression discontinuity design for the 2017-2020 period provided in the Online Appendix OA.3 and Table OA.3. This last variation of the assignment rule (using the treatment in 2013 as a predictor for treatment based in 2016) provides additional evidence of an

and data characteristics, please refer to Sections 4, 5.1 and 5.2 respectively).

We find ESG reporting mandates lead to superior corporate performance, as shown by an increased level of return on assets. Our RDD-DiD estimates suggest that mandating firms to disclose an ESG report increases their return on assets by 1.2% relative to not-subjected firms. This effect is economically moderate, representing 8% of the sample average. In other words, this increase translates into approximately 120 thousand SEK ($\approx$ 14.4 thousand USD), on average, in terms of EBITDA. Alternatively, we provide evidence on the impact on return on assets calculated using firms' net income. We find that an increase in return on assets (based on net income) of also approximately 1.2%, which represents 20% of the sample mean. This effect translates into an increase of approximately 120 thousand SEK ($\approx$ 14.4 thousand USD), on average, in terms of net income. Taken together, the return on assets results indicate that ESG reporting mandates improve the corporate performance of the firms forced to disclose.

Given that we find a positive effect on corporate performance from the ESG reporting mandate, we propose and test two non-mutually channels through which an ESG reporting mandate potentially affects corporate performance: the *supply chain* channel and the *financing* channel. The rationale behind the *supply chain* channel is that large corporate customers are also required to disclose ESG information annually after 2017. This requirement creates a preference for corporate customers to contract with suppliers with ESG information readily available (Dai et al. [2021]; Darendeli et al. [2022]). ESG transparent suppliers decrease the cost of producing ESG information for the corporate customer, and the latter is able to partially transfer reputational risks from disclosure to the suppliers. We test the *supply chain* channel by comparing: (1) firms in business-to-business (B2B) industries versus firms in business-to-consumer (B2C) industries, (2) firms following a differentiation strategy versus firms pursuing cost leadership, and (3) firms in highly competitive versus slightly competitive environments. Firms in B2B industries are more likely to be part of a supply chain as a supplier, firms following a differentiation

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effect, even if there is size management to avoid being subjected to the mandate. This additional evidence occurs in addition to our visual inspection of the individual-size data distributions and of our threshold manipulation tests (McCrary [2008]). We thank the anonymous reviewer for this suggestion, and we provide these robustness checks on the alternatives to our main assignment rule in Table OA.2.

strategy have more incentives to adopt an ESG profile sooner than firms following a cost leadership strategy, and firms in more competitive environments can benefit more from ESG reporting as a tool to gain more market share. Overall, we find that these firms are more likely to issue an ESG report after the mandate becomes effective. We find mixed evidence that the effect of mandatory ESG reporting on corporate performance is concentrated in these sets of firms. More specifically, we do not find significant evidence of a differential impact of the ESG reporting mandate on firms in a B2B/B2C industry, whereas we find significant evidence of a differential impact on firms pursuing a differentiation strategy and firms that face higher product market competition. The rationale behind the *financing* channel is that the ESG reporting mandate reduces the costs of processing the information, and it creates demand for such information. This situation incentivizes stakeholders, such as capital providers, to incorporate ESG information into their decisions (e.g., debt pricing and lending decisions), ultimately allowing mandated firms to enjoy improved financing conditions. To test this channel we examine the effect of mandatory ESG reporting on interest rates and pledged assets. We find that the ESG reporting mandate decreases interest rates and pledged assets for the mandated firms.

We also study the disclosure dynamics after the mandate becomes effective. We hypothesize that in a voluntary regime, only high quality firms above a certain size-capacity threshold will disclose ESG information. However, in a mandatory regime, disclosure dynamics are contingent on the level of non-compliance costs. If non-compliance costs are low, higher-quality medium-sized firms would continue to disclose, while lower-quality medium-sized firms would postpone disclosure until the demand for ESG information grows. If non-compliance costs are high, all medium-sized firms would disclose once the mandate becomes effective. We find that only 4.91% (0.41%) of medium (small) firms disclose in the voluntary regime, while 45.34% (1.08%) of medium (small) firms disclose in the mandatory regime[5]. These findings suggest that non-compliance costs in our setting are moderate and that full disclosure equilibrium is expected in the medium to long run (similarly to

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[5]These figures stem from analysis in a matched sample. For detailed information on the matched sample, please refer to Section 5.1.2.

disclosure dynamics in Bourveau et al. [2020]).

Last, we conduct several sensitivity analyses to ensure the robustness of our results. First, we examine whether firms anticipate the passage of the ESG reporting mandate. We do not find differences between the treatment and control groups before adoption of the ESG reporting mandate in 2017. Next, we conduct an array of sensitivity tests regarding our research design choices. Additionally, we replicate our main findings using different matched samples and alternative measures of corporate performance. Finally, we implement a regression discontinuity design where we exploit cross-sectional variation in the assignment rule. Our results withstand the different robustness analyses and collectively show that our main result is robust.

Our paper contributes to the literature in various ways. First, we document the effect of mandatory ESG reporting on firm performance. Prior research reports mixed results on the effect of ESG-related reporting on firm value or performance. Previous results vary in the direction of the effect from negative effects with respect to profitability (Chen et al. [2018]; Fiechter et al. [2022]), labor productivity (Christensen et al. [2017]) and market reaction (Grewal et al. [2018]) to positive associations with respect to firm value (Plumlee et al. [2015]) and Tobin's Q (Ioannou and Serafeim [2019]) to no impact with respect to firm value (Cho et al. [2015]). Using the variation in ESG reporting resulting from the size criteria used in the Swedish setting, we are able to isolate the effect of ESG information disclosure on firm performance. Additionally, we complement studies examining the role of ESG information throughout the supply chain. Prior research finds that corporate customers care about the ESG transparency of their suppliers, which affects the matching between suppliers and customers (Dai et al. [2021]; Darendeli et al. [2022]). We add to this literature by documenting that firms in B2B industries are more likely to report ESG information than firms in B2C industries.

Second, our paper contributes to the literature on the consequences of mandatory reporting for private firms. The literature suggests that such regulations can level the playing field among stakeholders and reduce duplicative efforts (Leuz and Wysocki [2016]; Minnis and Shroff [2017]; Breuer et al. [2018]). However, they can also create negative externalities and impose costs such as decreased information from

the loss of revealed preferences, diminished benefits from relationship approaches, and intensified proprietary costs (Minnis and Shroff [2017]; Breuer et al. [2018]; Dedman and Lennox [2009]; Bernard [2016]; Bernard et al. [2018]; Gassen and Muhn [2018]). Our paper suggests that mandatory reporting reduces the costs of processing information for stakeholders and that the regulation incentivizes stakeholders to incorporate such information into their decision making process.

Third, our paper relates to the literature studying changes in disclosure dynamics in different informational settings (Gassen and Muhn [2018]; Breuer et al. [2020]; Bourveau et al. [2020]). Bourveau et al. [2020] study disclosure dynamics in the 1890s streetcar industry with the introduction of a new quarterly newspaper supplement that disseminates earnings information to dispersed investors. This setting allows them to study the unravelling prediction. Their findings show that, contrary to the unravelling prediction, a fraction of firms do not disclose in the short run, but nearly full disclosure equilibrium is achieved in the medium to long run. They explain this prediction failure as a deviation from rational expectations. Our results complement the findings of Bourveau et al. [2020], suggesting that in a mandatory setting where disclosure is costly and non-compliance costs are low (i.e., weaker enforcement), full disclosure equilibrium is not achieved in the short run. Instead, only a fraction of firms will disclose initially, and a full disclosure equilibrium is expected in the medium to long run.

Last, our paper informs regulators about the costs and benefits that current and future ESG reporting mandates impose on firms. Our findings underscore the importance of considering institutional features when developing policies and regulations. Specific characteristics in the institutional setting (e.g., cultural reception, level of enforcement, type of firms subject to the regulation, etc.) can alter the cost-benefit scheme for firms, which in turn can result in disparate impacts on firms. This effect is especially relevant for settings such as the European Union, where regulations must be adopted by State Members whose institutional features show considerable heterogeneity (e.g., Fiechter et al. [2022]).

2 Conceptual underpinnings

Private firms generally face lower reporting requirements than public firms. They enjoy more discretion in their disclosure decisions, which can be expected to follow a cost-benefit analysis considering the users of the information to be disclosed[6].

However, users can also vary with the type of disclosure. More specifically, ESG disclosures can include a broader set of users than financial disclosures, and oftentimes, the relevance of the information is firm- or industry-specific (Christensen et al. [2021]). For example, stakeholders of firms in the chemical industry are more likely to benefit from environmental information than stakeholders of a consulting firm. Therefore, the cost-benefit analysis for ESG disclosures for private firms might diverge from that for traditional financial disclosures.

2.1 Cost-benefit analysis of voluntary disclosure

Consider first the benefits of voluntary financial disclosure. Capital providers, such as banks, need financial information for debt pricing and lending decisions. By disclosing financial information to capital providers, firms can reduce agency and processing costs in corporate transactions and obtain improved financing conditions (Verrecchia [1983]; Diamond and Verrecchia [1991]; Verrecchia [2001]). Suppliers' use of financial information follows the same logic. Being transparent serves as a signal for the firm's type and risk profile, which can influence the cost of operations when transacting with suppliers.

The benefits of disclosing ESG information are partly similar to those mentioned above, but they present some nuances. ESG information can be useful for lenders and suppliers as a signaling mechanism for a low-risk or high-trust profile since ESG reporting creates a reputational commitment for the firm (Kim et al. [2014]; She

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[6]The main users of financial information have been categorized in the literature as either transacting stakeholders or non-transacting stakeholders (Dedman and Lennox [2009]; Minnis [2011]; Breuer et al. [2018]; Gassen and Muhn [2018]). Transacting stakeholders are primarily capital providers, customers and suppliers, while non-transacting stakeholders include competitors and general interest parties. These different stakeholders can impose benefits and costs for the disclosing firm. For example, while disclosures might induce capital providers to offer better financing conditions, the use of these disclosures by competitors can impose proprietary costs on the firm.

[2021]). In addition, ESG reporting can be used as a differentiation strategy by firms. Firms can broaden their set of customers and strengthen their relationship with current customers by exploiting ESG reporting as a differentiation strategy. For example, a firm disclosing that its processes are environmentally-friendly allows its customers to exploit this information in their products.

Nevertheless, we also need to consider the costs of disclosure. First, private firms face the direct costs of disclosure. Frequently, direct costs are overlooked in the literature, which tends to focus on larger and public firms. However, for medium and small private firms, direct costs are often not trivial. This fact is particularly true in the context of voluntary ESG reporting. Absent regulation or standards, producing an ESG report is very costly for firms, and most likely, they will need to externalize this activity, which disincentivizes small firms from disclosing.

Second, disclosing information can impose proprietary costs on the reporting firm. Regarding financial information, Gassen and Muhn [2018] provide evidence of firms' concerns about proprietary costs when disclosing financial information. They study German firms' choices to be financially transparent or opaque using a field experiment. Their findings indicate that firms are less willing to disclose information when they take non-transacting stakeholders into account. Gassen and Muhn's [2018] findings are consistent with those of Dedman and Lennox [2009]. Dedman and Lennox [2009] survey managers from private U.K. firms to identify managers' perception of the current competitive state. Based on information from 1,010 responding firms, the findings suggest that managers are more likely to withhold information if they perceive the competitive environment as strong. In a similar vein, Bernard [2016] studies the German setting and finds that financially constrained private firms avoided financial disclosure requirements to reduce predation risk until the cost of non-compliance was sufficiently high. In the European setting, Bernard et al. [2018] present evidence that private European firms are willing to manage their size to avoid mandatory disclosure and audit requirements based on size thresholds. Bernard et al.'s [2018] further suggest that proprietary costs are a main driver of size management strategies for private European firms.

Prior research has also contributed to our understanding of proprietary costs

for aggregated versus detailed disclosures. Proprietary costs are most relevant for detailed disclosures and, in this case, specifically for private firms, while aggregated disclosures impose lower proprietary costs on the disclosing firm (Leuz et al. [2008]; Bens et al. [2011]). Disclosing ESG information can impose material proprietary costs on the disclosing firm because such information is directly linked to the firm's main operations and activities (Christensen et al. [2021]). However, in the setting that we study, which comprises ESG disclosure by smaller private firms, it is less likely that proprietary costs are the most relevant ones. It is reasonable to assume that in a voluntary setting where regulation and standards are missing, the cost of producing the information in the first place is likely to be the most relevant cost. This assumption leaves proprietary costs as a residual cost, which will be incurred by only the subset of firms with the capacity to adopt a differentiation strategy through ESG disclosure.

The third important cost of disclosure, which is especially relevant to ESG disclosure, is reputational costs from *choosing to disclose*. In the case of reporting ESG information, firms establish a reputational commitment that creates a risk through an ex post shaming effect (Christensen [2022]). The company H.B. Fuller is a clear example of this phenomenon. H.B. Fuller is an American adhesive manufacturer that claimed to be a highly socially responsible corporation. The company was exalted for its careful management of toxic waste, attentiveness to nature preserves and philanthropic donations. However, H.B. was the center of the scandal regarding glue-sniffing in the 1990s in Latin America[7] [8]. Glue-sniffing became predominant among destitute Latin American children to allay hunger. Although the children consumed glue from different manufacturers, H.B. Fuller was the corporation that received all the criticism, and its Resistol glue product became the main focus of the controversy. The conflict developed to the point where H.B. Fuller was forced to discontinue its operations in Latin America. Meanwhile, the remaining manufacturers–who did not portray themselves as being socially responsible–received only limited criticism. Thus, companies presenting an image of themselves as socially responsible businesses as a way to stand out from competitors are subject to greater reputational

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[7] (2004, June 25). The Burdens of Responsibility. *The Economist.* Link [Accessed 12/05/2022]
[8] Jackson, K. T. Building Reputational Capital: Strategies for Integrity and Fair Play that Improve the Bottom Line. 1st ed. Oxford University Press, 2004

damages, especially when ESG incidents lead to controversies.

2.2 Market-wide effects and cost-benefit analysis from mandated disclosures

A mandatory setting would alter firms' disclosure behaviors. In the setting we study, medium firms (i.e., treatment group) are mandated to disclose ESG information from the 2017 fiscal year onward. A shift toward mandating firms to disclose ESG information creates a market for such information. Increased demand for ESG information simultaneously decreases the fixed cost of disclosure and levels the playing field by reducing information asymmetries. In addition, a disclosure mandate such as the one we study increases comparability and standardizes information, ultimately reducing processing costs. Hence, in the mandatory setting, disclosing information becomes more cost effective than in the voluntary setting. In the voluntary setting, there is no standard disclosure mechanism and, consequently, disclosing information is subject to material fixed costs for the disclosing party. Moreover, the use of such information is subject to significant processing costs. However, under the mandatory setting, regulation becomes the disclosure mechanism, and both the fixed costs of disclosure as well as the processing costs are mitigated by creating a market for such information. Lower production costs reduce the fixed costs of disclosure, while increased information comparability alleviates processing costs.

Mandated firms can benefit from disclosing ESG information by accessing superior supply chains. Corporate customers, especially larger customers, that are required to disclose ESG information will prefer suppliers with accessible ESG information and may even exert pressure for suppliers to be transparent in terms of ESG through assortative matching (Dai et al. [2021]; Darendeli et al. [2022]). Corporate customers have several incentives to contract with ESG disclosing suppliers after the mandate came into effect. First, for corporate customers, who are also required to disclose ESG information, the cost of producing ESG information is lower when contracting with transparent suppliers. For example, if corporate customers must now disclose their products' environmental footprint, it will be less costly to estimate the figure if suppliers across the supply chain have this information avail-

able. Second, contracting with transparent suppliers alleviates reputational risks and the ex post shaming effect for corporate customers. For instance, if a customer discloses that they are subject to high standards of working conditions, and there is a scandal concerning one of their suppliers abusing their employees working conditions, the corporate customer will bear the reputational effects for contracting with the supplier. However, had the supplier disclosed that they are subject to the supply chain's working condition standards, the corporate customer would have been able to transfer the reputational damage to the corresponding supplier. Accordingly, firms mandated to disclose ESG information can benefit from opportunities to enter superior supply chains.

In terms of financing, a mandate for ESG disclosure can benefit firms by mitigating costs for stakeholders. In a mandatory regime, increased comparability through information standardization reduces information processing costs for capital providers (e.g., banks) and levels the playing field, which can lead to improved financing conditions (Verrecchia [2001]; Leuz and Wysocki [2016]; Minnis and Shroff [2017]). In addition, the mandate itself induces demand for ESG information and assigns value to such information. Thus, banks are incentivized to incorporate ESG information for debt pricing and lending decisions.

Focusing on firm-specific costs from mandatory ESG disclosure, firms are also subject to differences from the voluntary setting. First, the direct costs of producing an ESG report decrease, even if the report is not produced in-house. The mandate lowers the production costs by creating a market and inducing demand for ESG information. Despite the decreased direct costs of disclosure, disclosing firms still incur proprietary costs and reputational risks in the mandatory setting. In this case, the argument follows the same logic as in the voluntary setting.

2.3   Corporate performance and the ESG reporting mandate

Given that a disclosure mandate can alter the cost-benefit scheme, we expect firms' corporate performance to be impacted.

On the one hand, if the firm-specific benefits from the ESG disclosure mandate outweigh the firm-specific costs, we expect firms' corporate performance to be pos-

itively affected by the regulation. In this case, the positive effect on performance would operate through two potential main mechanisms[9]: the *supply chain* channel and the *financing* channel. First, mandated firms can experience improved corporate performance from the supply chain effect. After the mandate is implemented, firms required to disclose ESG information have more opportunities to access superior supply chains. Corporate customers required to disclose ESG information will prefer transparent suppliers (Darendeli et al. [2022]). Ex post regulation, the pool of suppliers meeting the criteria to enter a supply chain–where the corporate customer is required to report on ESG–will be narrowed by the requirement to possess available ESG information. This situation will increase mandated firms' probability to enter such supply chains. Entering a larger supply chain can have substantial positive effects on firms in terms of demand, which is expected to positively affect performance. Second, mandated firms can also experience improved corporate performance due to the financing effect. The mandate reduces information processing costs for stakeholders (Minnis and Shroff [2017]), especially capital providers such as banks. Furthermore, the mandate creates demand for ESG information and assigns a value to such information. Accordingly, banks have incentives to incorporate ESG information into debt pricing and lending decisions. Therefore, disclosing firms can benefit from improved financing conditions[10].

On the other hand, if the firm-specific costs from the ESG disclosure mandate outweigh the firm-specific benefits, we expect firms' corporate performance to be negatively affected by the regulation. In this case, we expect corporate customers to not care about ESG information, making ESG reporting an indistinctive trait for suppliers. In a similar vein, we expect regulation to have null effects on market incentives for consuming ESG information[11].

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[9]We are aware that there are other stakeholders that are potential users of ESG disclosures, namely, employees. We acknowledge that an ESG reporting mandate can also affect firms' corporate performance by impacting employee dynamics. We discuss a credible commitment channel through employees in Appendix OA.1 in the Online Appendix.

[10]Prior literature is scarce on the effects of ESG reporting on debt conditions. However, several studies document a negative association between CSR performance and loan spreads, and a positive association with access to finance (Goss and Roberts [2011]; Chava [2014]; Cheng et al. [2014]; Kim et al. [2014]; Cheng et al. [2017]; Kleimeier and Viehs [2018]). We argue that mandatory ESG reporting helps lenders compare firms while incurring in lower information processing costs and reduce information asymmetries (Christensen et al. [2021]).

[11]In addition, firms' corporate performance could be negatively affected in the short run if investments in ESG take too long to materialize. For example, Chen et al. [2018] find a negative effect

2.4 Comparison of disclosure dynamics in the voluntary versus the mandatory setting

The earlier discussion gives an overview of the main costs and benefits of private firms' disclosure decisions and how the cost-benefit analysis changes when a subset of firms is required to disclose. However, so far, we have stayed silent on how a reporting mandate alters the disclosure dynamics of firms. In this section, we discuss which types of firms would choose to disclose in a voluntary regime and how these disclosure dynamics change in the mandatory regime.

Considering ESG disclosures, we can elaborate which set of firms would derive a net benefit from voluntarily disclosing ESG information. We distinguish between small and medium private firms[12]. Moreover, firms can be (1) high quality or (2) low quality. Figure 1 illustrates the type of players and their strategies in a voluntary setting, where only medium firms are mandated to disclose. Firms know their type, but the remaining participants are aware only of the distribution of firm types. Being a higher type allows firms to widen their set of opportunities (i.e., improved financing conditions with banks and suppliers, new customers, etc.).

In a voluntary setting, high-quality firms have incentives to disclose ESG information as a signaling mechanism that allows them to access a larger set of opportunities. Meanwhile, low-quality firms would not find it profitable to imitate high quality firms' disclosure strategy due to the direct costs and reputational commitment. Notably, most likely, there will be a size-capacity constraint. That is, for firms to benefit from ESG disclosure, they need to have a minimum capacity to face the fixed costs of disclosure. However, in the setting we study, this capacity constraint need not be at the small/medium threshold. Hence, high-quality firms above the size-capacity constraint would voluntarily disclose ESG information, while low-quality firms would choose not to disclose due to high imitation costs.

Hence, in the voluntary setting, due to the absence of a disclosure mechanism and the high cost of disclosure, there is not a full disclosure equilibrium. This

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on financial performance from CSR spending for the three years following a CSR reporting mandate. Similarly, Christensen et al. [2017] observe an average negative effect in labor productivity for the first years after the introduction of mandatory mine-safety disclosures.

[12] *Medium* firms refer to the treatment group in our empirical analyses.

result contrasts with that of Bourveau et al. [2020], who find that a full disclosure equilibrium is achieved in the medium to long run. However, Bourveau et al. [2020] assume disclosures are costless, whereas in our (voluntary) setting, firms must incur in high (fixed) costs to disclose, and there is no credible disclosure mechanism. Assuming a continuum of firm types, only the highest quality firms would reveal their type through disclosures, while lower quality firms' best response would still be to be assigned to the average quality type because of the fixed costs of disclosure.

Nevertheless, under the mandatory setting, the regulation acts as a disclosure mechanism[13], and the costs of disclosure decrease. In a mandatory setting where non-compliance costs are high (due to strong enforcement), mandated firms would achieve a full disclosure equilibrium[14] in the short run as illustrated in the shaded area of Figure 1. High-quality small firms will only disclose in the mandatory setting if they can still obtain a net benefit. Conversely, in a mandatory setting where non-compliance costs are low (because of weak enforcement), the shift in the disclosure equilibrium would be more similar to that in Bourveau et al. [2020], where a full disclosure equilibrium is achieved only in the medium to long run. Right after the mandate becomes effective, only higher quality firms would start disclosing. As the number of disclosing firms increases, processing costs are further reduced and more information is demanded by the different stakeholders. Hence, eventually, lower quality firms' best response becomes to disclose the information until full disclosure equilibrium is achieved.

Ultimately, given the potential market-wide and firm-specific costs and benefits of an ESG disclosure mandate, it remains an empirical question whether firms' corporate performance will be positively or negatively affected.

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[13]For example, the disclosure mechanism in Bourveau et al. [2020] is the quarterly supplement in the *Commercial & Financial Chronicle* newspaper.

[14]Here, full disclosure equilibrium is implied for the subset of medium firms.

3 Institutional background

The European Union's attention to ESG concerns materialized in 2014, when the European Parliament passed the Directive 2014/95 on non-financial reporting[15]. The EU Directive targets large public interest entities for requirements on ESG-related topics periodic disclosures. More specifically, the EU directive requires large listed firms on European Union exchanges or firms with a significant fraction of their operations in the EU, those with more than 500 employees, or those designated as "public-interest entities" because of their size, activities or number of employees, to prepare annual ESG reports. The mandate became effective in the 2017 fiscal year.

The annual ESG reports must include information on several dimensions: environmental, social and employee matters, respect for human rights, anti-corruption and diversity on the board of directors. Related to these ESG dimensions, firms must state their business model, policies and procedures in place to address the different ESG matters and the outcomes of such policies, risks associated with the different dimensions and the ways in which the firm is managing these risks, and the key performance indicators most relevant to the firm.

Despite the European Union's narrow scope for the Directive, when Sweden incorporated the Directive in its annual accounts[16], it modified the size criterion to include a larger set of firms. Mandatory ESG reporting in Sweden applies to firms that, for the last two financial years, have met two of the following three criteria: (a) on average, they have more than 250 employees; (b) they report total assets exceeding SEK 175 million ($\approx$ USD 21 million); or (c) they report net sales larger than SEK 350 million ($\approx$ USD 42 million). These criteria are independent of firms' listing status. Accordingly, approximately half of the private-sector workforce is affected by the regulation[17]. Moreover, subsidiaries covered in their entirety by the ESG report of the group (i.e., all subsidiaries are included in the group ESG

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[15]For more information please see https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014L0095 [Accessed 12/09/2021]

[16]For more information please see Årsredovisningslag (1995:1554), Chapter 6 Section 10 https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/arsredovisningslag-19951554_sfs-1995-1554 [Accessed 12/09/2021]

[17]The Swedish Agency for Growth Policy Analysis (2018). From voluntary to mandatory sustainability reporting. Ref: 2018/070.

report) are exempt from preparing an ESG report and need only to disclose the corresponding parent's identifying information.

The regulator's aim with the EU Directive was to increase transparency as well as comparability in ESG disclosures across European firms and to reinforce their relevance. However, enforcement mechanisms to achieve this goal have been lacking so far. At the European level, compliance enforcement is delegated to the member states, and there are no further requirements for firms to audit their ESG reports.

4   Research design

Sweden's adoption of the EU directive leads to variation in firms' ESG disclosure resulting from the multithreshold size criteria associated with the mandatory disclosure requirements (see Section 3) and in the timing of the adoption, i.e., the 2017 fiscal year. This variation should lead to discontinuous ESG disclosures for similar firms around the thresholds. This setting allows us to implement a variant of the regression discontinuity design where treatment is assigned based on multiple assignment variables and, at the same time, extend this setting to use the variation in the timing of the adoption with a difference-in-differences approach. In our case, the multiple variables are assets, sales and the average number of employees. Our decision rule is similar to Reardon and Robinson [2012] and Breuer et al. [2018], although we calculate it based solely on the year 2016 to obtain a time invariant treatment:

$$Treatment_{i,2016} = \begin{cases} 1 & if \ min\left\{ \sum_{n=1}^{3} \sum_{n \neq m} Size_{i,2016}^{n} Size_{i,2016}^{m} \right\} > 0 \\ 0 & if \ min\left\{ \sum_{n=1}^{3} \sum_{n \neq m} Size_{i,2016}^{n} Size_{i,2016}^{m} \right\} = 0 \end{cases} \tag{1}$$

where $Size_{i,2016}^{1}$ is an indicator equal to one if the $Total\_Assets_{i,2016}$ ($Dimension_{i,2016}^{TA}$) of firm i exceeds the total assets threshold in 2016 (T_{2016}^{TA}), $Size_{i,2016}^{2}$ is an indicator equal to one if the $Sales_{i,t}$ ($Dimension_{i,2016}^{Sale}$) of firm i exceeds the sales threshold in 2016 (T_{2016}^{Sale}) and $Size_{i,2016}^{3}$ is an indicator equal to one if the number $Avg\_Employees_{i,2016}$ ($Dimension_{i,2016}^{EMP}$) of firm i exceeds the employee threshold in

2016 (T_{2016}^{EMP}). $Treatment_{i,2016}$ is a discontinuous function of the three criteria that classifies firms based on whether they are required to disclose ESG information for the 2016 fiscal year. In our assignment rule, firms are subject to treatment if they have surpassed two of the three thresholds (total assets, sales or average number of employees) for the 2016 fiscal year.[18]

We estimate the following specification, which is akin to a parametric regression discontinuity and difference-in-differences design (RDD-DiD):

$$ROA_{i,t} = \beta Mandatory\_ESG\_Reporting_{i,t} + \psi f(Dimension_{i,t})$$
$$+ \kappa f(Dimension_{i,t}) \times Post\_Treatment_t + \lambda Controls \qquad (2)$$
$$+ \gamma Controls \times Post\_Treatment_t + \mu_i + \delta_j \times \eta_t + \varepsilon_{i,t}$$

where $ROA_{i,t}$ is a measure of corporate performance of firm i in year t, $Mandatory\_ESG\_Reporting_{i,t}$ is the interaction of $Treatment_{i,2016}$ and $Post\_Treatment_t$, where $Treatment_{i,2016}$ is our decision rule and $Post\_Treatment_t$ is equal to 1 if the year is 2017 or later, and $f(Dimension_{i,t})$ is a control function similar to that of Breuer et al. [2018]:

$$\psi f(Dimension_{i,t}) = \sum_{n=1}^{3} \psi_n Size_{i,t}^n + \sum_{n=1}^{3} \psi_{3+n} h(Dimension_{i,t}^n)$$
$$+ \sum_{n=1}^{3} \psi_{6+n} Size_{i,t}^n \times h(Dimension_{i,t}^n)$$

where $h(Dimension_{i,t}^n)$ is the natural logarithm of $Dimension_{i,t}^n$ over T_t^n. $Controls$ is a vector including firm-level variables such as leverage, liquidity, tangibility and firm age, plus growth variables for total assets, sales and the number of employees. We also allow $\psi f(Dimension_{i,t})$ and our control vector to differ between the pre-treatment and post-treatment period by interacting them by $Post\_Treatment_t$. μ_i are firm fixed effects and $\delta_j \times \eta_t$ are industry-year fixed effects.[19] We cluster standard

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[18]We provide alternative assignment rules in our robustness tests, which are available in the Online Appendix. Table OA.2 of the Online Appendix reports how our main analyses change with different assignment rules (definitions of the treatment group). For instance, we use a time-varying treatment. Our main results remain consistent in all instances.

[19]Table OA.2 of the Online Appendix reports how our main analyses respond to different fixed effects structures, e.g., firm and year, firm and year-location, firm and year-location-industry, firm and year-group status. Our main results remain consistent in all instances.

errors at the firm level.[20]

Studies that implement regression discontinuity designs mostly restrict their sample to observations close to the bandwidth. However, since in our setting, there are three thresholds for the different dimensions (before and after adoption of the treatment), we follow prior literature in choosing the full sample to carry out the analyses (Reardon and Robinson [2012]; Breuer et al. [2018]).

To identify the effect of mandatory ESG disclosure, we need to ensure that no other regulations or shocks exist that could confound our results. To the best of our knowledge, we are aware of none. We strengthen this assumption by using the variation in the timing of the adoption. The ESG reporting mandate came into effect on December 1, 2016, and was applied for the first time for the financial year beginning immediately after December 31, 2016, i.e., 2017, in Sweden (transitional provision 2016:947 in the Årsredovisningslag (1995:1554)), making it less likely that another law with similar thresholds drives our results.

An additional requirement is that firms do not manipulate their average number of employees, sales and/or total assets in a way that would allow them to self-select into or out of treatment under the Swedish reporting law. There exists evidence of firms managing their size to avoid regulations with multiple thresholds. For instance, Bernard et al. [2018] study size management by European firms to avoid mandatory audits. They find that at least 8% of firms close to the mandatory income disclosure threshold manage their size downward, sacrificing approximately 6% of their assets to avoid such disclosure. Similarly, these authors find that approximately 4% of firms manage their size downward to avoid external audits. Thus, it could also be that, in the context of mandatory ESG disclosure, if firms estimate the costs of such disclosure to be sufficiently high, the costs of managing their size downward are lower than those of disclosure. In such a scenario, firms may sacrifice some of their assets, sales or number of employees to avoid meeting the criteria for the mandate. However, we are confident that private Swedish firms are not self-selecting out of the treatment group for two reasons: (1) we assume that the costs associated with

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[20]Table OA.2 of the Online Appendix reports how our main analyses react to different clustering structures, e.g., industry clustering, double clustering by firm and year, location. Our main results remain consistent in all instances.

ESG disclosure are smaller than those of opening the firm's financial statements to auditors (the law stipulates neither how the disclosure should be made nor whether its contents should be assured); and (2) we inspect the individual distributions of the size variables (during the full period and the pre-treatment and post-treatment periods) that are used to determine treatment selection. Based on density tests (McCrary [2008]) around these thresholds, we find no evidence of size manipulation (neither during the full period nor during the pre-treatment and post-treatment periods). We discuss this evidence in Section 6.1.

Finally, we test the assumption that the treatment and control group have parallel trends. This DiD assumption requires that treatment firms would have evolved as control firms in the post-treatment period absent of treatment. We use the leads and lags model to test this assumption. We find evidence in favor of fulfillment of the parallel trends assumption in Figure 8 and discuss the evidence in Section 7.1.

5   Data

5.1   Sampling process

5.1.1   Main sampling process

We collect data for Swedish private firms from the Serrano database[21] and its related products. Serrano collects organization-level data from the Swedish Companies Registration Office (Bolagsverket), Statistics Sweden (SCB) and Bisnodes group register. We use financial statement data from Bokslut (within Serrano), ranging from 1998 until 2020.[22] We also use organizational-level data such as the legal form of the organization, the active status of the firm, industry membership and group-level information. Additionally, we obtain information on firms' listing status from

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[21]WEIDENMAN, PER. The Serrano Database for Analysis and Register-Based Statistics. *Swedish House of Finance Research Data Center.* https://www.hhs.se/en/houseoffinance/data-center/ [Accessed 09/07/2022]

[22]We also find evidence of the effect of ESG reporting mandates on corporate performance for a balanced sample of firms. We balance the sample by imposing that firms need to report financial statement data three years before and after the adoption of the Swedish mandate. We apply this requirement to mitigate concerns with a long time series before adoption.

Nordic Compass[23] and complement it with Bureau van Dijk's Orbis.

We begin by restricting our sample to limited liability firms (Aktiebolag or AB) for the 1998 to 2020 period. We proceed to drop firms owned by public administration and those that are inactive.[24] We continue to drop firms in the finance and insurance sectors as their reporting scheme and calculation of corporate performance differs from those of other corporations. Later, we merge the remainder dataset with financial statement data for privately held firms from Bokslut. We do so after identifying and eliminating publicly quoted firms from Bokslut using the listing status from Nordic Compass and Orbis. Finally, we drop micro firms (those with less than 10 employees on average over our sample period), Swedish subsidiaries (which are not subject to the disclosure requirements)[25] and restrict the final sample to those observations with available data (non-missing) for our main corporate performance analyses. The final sample consists of close to 150,000 firms that yield over 1.1 million firm-year observations for the period 1999-2020.[26] These numbers change in different specifications due to singletons within fixed effects groupings and due to further data restrictions for analyses other than our main ones.

Additionally, to mitigate concerns of a long time series in the pre-treatment period (1998-2016), e.g., firms appearing only in the pre-treatment period and disappearing after adoption of the treatment, we provide an alternative sampling restriction. We perform a balancing process that requires all firms in our sample to appear in the sample at least 3 years before and after adoption. We provide the results of this reduced sample alongside our remaining analyses.

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[23]Nordic Compass, Swedish House of Finance's ESG Database. *Swedish House of Finance Research Data Center.* https://www.hhs.se/en/houseoffinance/data-center/ [Accessed 09/07/2022]

[24]Serrano defines active limited liability firms as those with either more than: 10 thousand SEK of net sales, other operating income, financial income, financial expenses, dividend amount; or more than 500 thousand SEK in total assets.

[25]We include in our analyses independent entities, parent companies and foreign subsidiaries, as all of these company types are subject to the reporting mandate. In our Online Appendix, Table OA.2 reports our main results under different fixed effects structures, and given potential concerns about the group type (independent firm, parent company or foreign subsidiary) influencing the results, we use year-group type fixed effects to make comparisons within the same year for the same group type company.

[26]The loss of data for 1998 is due to the use of opening balances and averages in calculating some of the variables used in the analyses.

5.1.2 Sampling process for disclosure analyses

In our analysis of firms' compliance with the ESG reporting mandate, we employ a different sampling process to obtain our sub-sample. We begin by keeping all firms that meet our main assignment rule to the treatment group in the year 2016, which results in 840 firms subjected to the ESG reporting mandate. We randomly select 250 firms from the 840 mandated firms. We then hand collect data from 2013 to 2020 from companies' websites and the Swedish company registry for these treated firms. We are able to obtain such data for only 240 treated firms for the 2013-2020 period. We match these treated firms in the cross-section of 2016 to firms in the control group using their propensity score with a 1:1 nearest neighbor algorithm.[27] This step results in a total of 1,463 (1,451) treated (control) firm-year observations.

5.2 Descriptive Statistics

We use two measures for corporate performance (based on operating performance): $ROA\_(EBITDA)_{i,t}$ is operating income (*rorresul*) plus depreciation and amortization (*avskriv*) over the opening balance of total assets (*tillgsu*), and $ROA\_(NI)_{i,t}$ is net income (*resar*) over the opening balance of total assets (*tillgsu*). We use other outcomes to inspect the mechanisms that could drive our result. These are: $Interest\_Rate_{i,t}$ is the external interest rate, i.e., the interest paid on short-term and long-term loans to credit institutions (*rtekoext*) over the opening balance of short-term and long-term loans (*kskkrin + lskkrin*); $Pledged\_Assets_{i,t}$ is the sum of pledged assets, i.e., a company's property used as security in conjunction with a loan arrangement, usually a bank loan, over the value of total assets (*tillgsu*). We gather data on total assets, sales and the average number of employees to calculate whether a given firm is subjected to the ESG reporting mandate for 2016 and to construct the control function for our RDD-DiD. In particular, $Total\_Assets_{i,t}$ is total asset size measured in thousands of SEK (*tillgsu/1,000*), $Sales_{i,t}$ is sales volume measured in thousands of SEK (*ntoms/1,000*), and $Employees_{i,t}$ *(Average)* is the average number of employees (*antanst*) during a year. We further control for

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[27]Please refer to Section OA.2 in the Online Appendix for more details of the propensity score matching procedure that we use in our paper.

the growth in these three size variables: $Sales\_Growth_{i,t}$ is the yearly firm growth rate of sales ($ntoms$), $Assets\_Growth_{i,t}$ is the yearly firm growth rate of total assets ($tillgsu$), and $Employee\_Growth_{i,t}$ is the yearly firm growth rate of the number of employees ($antanst$). We take this measure to account for the fact that growing firms might be driving our results. Finally, we include firm-level controls such as leverage, liquidity, tangibility and firm age. Notably, $Debt\text{-}to\text{-}Equity_{i,t}$ is short-term and long-term loans ($kskkrin + lskkrin$) over the book value of equity ($eksu$), $Cash\text{-}to\text{-}Assets_{i,t}$ is cash and cash equivalents ($kabasu + kplacsu$) over total assets ($tillgsu$), $Tangibility_{i,t}$ is tangible fixed assets ($matanlsu$) over total assets ($tillgsu$), and $Firm\_Age_{it}$ is the number of years since the company registered with the Swedish Companies Registration Office.

Table (2) offers detailed descriptive statistics for our main sample. A private firm in Sweden has an average ROA based on EBITDA of 15% and an average ROA based on a net income of approximately 6%. These firms grow on average 5% in terms of sales, 8% in terms of total assets, and 2% in terms of employees. On average, these firms report total assets of 10 million SEK, sales of 14.9 million SEK and 16 employees on average. Additionally, these firms pay, on average, 7% on their loans and have pledged assets as collateral representing 56% of their total assets (for firms that use at least some private debt as a financing instrument). Firms in the sample exhibit a leverage ratio (measured as the debt-to-equity ratio) of 0.68, on average, with cash and cash equivalents averaging 27% of the firms' total assets. These firms also have tangible fixed assets of approximately 20% of total assets, and they are 16.21 years old on average. They also report on average a 7% interest rate emanating from their bank loans and pledged assets worth 56% of their total assets (for firms with bank debt as part of their financial structure).

All continuous variables are winsorized at the top and bottom 5% levels to minimize the influence of extreme observations. This approach is consistent with the higher levels of winsorization used to address even more extreme outliers that are common in studies using private firm data (Minnis [2011]; Bernard et al. [2018]; Gao et al. [2013]). Additionally, following Minnis [2011], we censor the distribution of firms' interest rate at the 10% level.[28]

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[28]In tests reported in Table OA.2 in the Online Appendix, we report how our main result

6 Results

6.1 Firm size distribution

We start our empirical analyses by providing descriptive evidence on the size distribution of our sample. Figures 2 to 4 show separate histograms for the three size dimensions: number average of employees, total assets, and sales, respectively. Each figure plots three separate histograms using the full period (Panel A), the pre-treatment period (Panel B) and the post-treatment period (Panel C).

The distributions for the number of average employees (Figure 2) show a downward trend in all three periods. The density change at the threshold is minimal except for the post-treatment period. The density change at the threshold in the post-treatment period is sharper; however, observations are crowded above the cut-off, not below it, which alleviates concerns regarding threshold manipulation to avoid the ESG reporting mandate. This sharp contrast from one bin to another in the distribution is not characteristic of firms around the threshold; rather, we observe these variations across the whole distribution.

The distribution of total assets (Figure 3) and sales (Figure 4) show a similar downward trend to that of the number of average employees. For these two cases, we do not observe sharp changes of the density around the threshold, which is especially true when comparing densities around the threshold in the pre-treatment period versus the post-treatment period.

To further mitigate concerns that firms manipulate their size to intentionally stay below the threshold and avoid the ESG reporting mandate, we perform the density test proposed by McCrary [2008]. Figures 5 to 7 show the histograms, estimated densities and 95% confidence intervals for the three size dimensions: number average of employees, total assets, and sales. Similar to the histograms, each figure plots three separate histograms using the full period (Panel A), the pre-treatment period (Panel B) and the post-treatment period (Panel C). The absolute values of the t-statistic for the McCrary's [2008] density test when we use the full period

responds to different ways of winsorizing the data, i.e., winsorizing at the industry level, year level, and year-industry level and winsorizing twice (the raw data variables and the final variables).

sample are 0.42, 0.04 and 0.7 for the number of average employees, total assets and sales, respectively. When we restrict the sample to the pre-treatment period (post-treatment period), the absolute values of the t-statistic are 0.14 (1.08), 0.04 (0.13) and 0.5 (0.68) for the number of average employees, total assets and sales, respectively. These values indicate that all three distributions are smooth around the threshold, alleviating concerns regarding manipulation of the forcing variables.

This descriptive evidence suggests one of the following scenarios: either any costs generated by the ESG reporting mandate are not exceedingly relevant for the mandated firms and the benefits compensate for them, the costs of non-compliance for mandated firms are not high, or both. In any case, the graphical evidence for the setting we study is opposite to the that reported in Bernard et al. [2018], where European private firms do find it profitable to manage their size downwards to elude financial reporting and auditing mandates.

6.2   Firm size and disclosure dynamics

Next, we examine firms' disclosure dynamics before and after the ESG reporting mandate comes into effect. Following from Section 2.4, due to the fixed costs of disclosure and thus the high imitation costs, we expect only higher quality firms above the size-capacity constraint to disclose ESG information in the voluntary regime. However, in the mandatory regime where medium firms are required to disclose, we make different predictions depending on the level of non-compliance costs. When non-compliance costs are high, higher quality medium firms continue to disclose, and lower quality medium firms start disclosing since not complying with the mandate becomes costlier for them than incurring the fixed costs of disclosure. In the second case, where non-compliance costs are lower, we expect that higher quality medium firms will continue to disclose, but that lower quality medium firms start disclosing at a later time, once the number of disclosing firms increases and the demand for ESG information grows.

Table 3 shows the percentage of control and treatment firms disclosing in the voluntary and mandatory regime for a matched sample described in Section 5.1.2. In the voluntary regime, 0.41% of small firms disclosed ESG information, whereas

4.91% of medium firms disclosed such information. These figures suggest two possibilities: (1) the size-capacity constraint is below the small/medium threshold but close to it; and (2) the fixed costs of disclosure are high. In the mandatory regime, only 1.08% of small firms disclose, representing an increase of 0.67 percentage points. However, the fraction of medium firms disclosing increases from 4.91% to 45.34%, representing a positive change of 40.43 percentage points. These figures provide several insights. First, high-quality small firms can still obtain a benefit from reporting ESG information in the mandatory regime. Second, the figures indicate that non-compliance costs are moderate in the mandatory regime. Third, in untabulated tests, we observe that from the 45.34% of disclosing medium firms in the mandatory regime, most firms start disclosing in 2017 (i.e., when the ESG reporting mandate becomes effective). However, a few firms start disclosing in later years. This finding is consistent with a full disclosure equilibrium being achieved in the medium to long run as in Bourveau et al. [2020].

In sum, this descriptive evidence is insightful for understanding disclosure dynamics in an ESG setting. The figures are consistent with ESG disclosure having a fixed cost and a mandatory regime where enforcement is weaker. These results may be of use to regulators trying to maximize the returns from ESG disclosure mandates.

6.3 Effect of mandatory ESG reporting on corporate performance

Our main analysis investigates the impact of the ESG reporting mandate on corporate performance. We capture corporate performance with two measures of operating performance: $ROA\_(EBITDA)_{it}$ and $ROA\_(NI)_{it}$. The first measure does not account for differences in terms of depreciation and amortization policies or the impact of the financial results and corporate taxes. The second measure, on the other hand, does take these items into account.

Table 4 reports the estimation results for firms' operating performance. Columns (1), (2) and (3) report the results of our main specification using $ROA\_(EBITDA)_{it}$ as the outcome variable. In Column (1)'s specification, we do not include firm

controls, except for size growth variables and the contemporaneous control function that determines the assignment rule. We run the analysis on the full sample. In Columns (2) and (3), we include firm level control and their interactions with the $Post\_Treatment_t$ variable. The difference between the specifications in Columns (2) and (3) is the sample that the estimation uses. Column (2) uses our full sample to run the estimation, whereas Column (3) reports our main results for a reduced balanced sample of firms that appear in the sample at least 3 years before and after the adoption of the treatment. Columns (4), (5) and (6) follow the same structure as before, with the exception of designating $ROA\_(NI)_{it}$ as the outcome.

We find a positive significant relation between mandated private Swedish firms and operating performance after the ESG reporting mandate becomes effective. Mandated firms, on average, present an increase in $ROA\_(EBITDA)_{it}$ that ranges from 1.2% (t-statistic=1.76) to 1.6% (t-statistic=2.05). The magnitude of the coefficient for $ROA\_(EBITDA)_{it}$ represents an increase of SEK 120,000-SEK 160,000 ($\approx$USD 14,400-USD 19,200) in the EBITDA. Analogously, mandated firms, on average, present an increase in $ROA\_(NI)_{it}$ that ranges from 1.2% (t-statistic=2.21) to 1.6% (t-statistic=3.05). The magnitude of the coefficient for $ROA\_(NI)_{it}$ represents an increase of SEK 120,000-SEK 160,000 ($\approx$USD 14,400-USD 19,200) in terms of net income. This figure is an approximation of the true economic impact as we employ firm and year-industry fixed effects.

Overall, these results suggest that mandated private Swedish firms benefit from disclosing ESG information. The results would be in line with firm-specific benefits from the ESG disclosure mandate outweighing the firm-specific costs. In contrast to our results, prior research examining the consequences of mandated non-financial disclosure found negative effects in financial performance (ROA) and in labor productivity (Christensen et al. [2017]; Chen et al. [2018]; Fiechter et al. [2022]). However, there are several differences between their institutional settings and ours. First, the scope of the earlier studies focuses on listed and larger firms. The information environment surrounding listed firms is more rigid due to additional disclosure regulations and is more responsive to public scrutiny and investors' reactions. Listed firms are also subject to a distinct set of economic incentives. These differences conceive a substantially different scheme for the firm-specific costs and benefits of an

ESG (or non-financial) reporting mandate for listed firms (Leuz and Schrand [2009]; Minnis and Shroff [2017]; Christensen et al. [2021]). Second, large listed firms have lower growth opportunities, for example, to access superior supply chains, since they most likely already belong to one of them. Third, information production and implementation costs (i.e., direct costs) for an ESG report are less relevant for larger firms since they have more resources. However, political costs (Grewal et al. [2018]) and reputational risks (ex post shaming effect) are exacerbated for listed firms due to higher public scrutiny and being subject to market monitoring. Fourth, the nature and scope of the disclosures diverge from ours[29]. For example, Christensen et al. [2017] study the mandated inclusion of mine safety records in financial reports and find that mine-safety disclosures directly affect firms' workforce.

Given these differences, it is reasonable to find disparate consequences from an ESG reporting mandate in the setting we study. To understand how mandatory ESG reporting could affect firms' corporate performance positively, in the following two sections, we examine the treatment effect with respect to two (non-mutually exclusive) channels: the supply chain channel and the financing channel.

6.3.1 The supply chain channel

We start by investigating a potential supply chain channel through which an ESG reporting mandate affects corporate performance. According to a supply chain channel, once the ESG reporting mandate becomes effective, mandated firms will enlarge their set of opportunities in relation to the supply chain. Corporate customers required to disclose ESG information will prefer transparent suppliers (Dai et al. [2021]; Darendeli et al. [2022]) since their transparency reduces disclosure costs for customers and partially shifts the reputational risks across the supply chain. For example, corporate customers with ESG information readily available from their suppliers must produce less information (e.g., they do not need to rely on estimations for the environmental footprint of products). Moreover, given an ESG-related scandal involving one of the suppliers, corporate customers can shield their reputation by pointing to misleading disclosures by the suppliers. After the ESG reporting

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[29]With the exception of Fiechter et al. [2022], who examine the European Union Directive 2014/95.

mandate comes into effect, we expect mandated firms to have a higher likelihood of accessing superior supply chains and the entry into these supply chains to result in a higher demand that positively affects firms' financial performance.

To test the supply chain channel, we examine the disclosure dynamics of mandated firms in the mandatory regime, as well as the effect of mandatory ESG reporting on corporate performance, in several cross-sectional analyses. First, we differentiate firms in a B2B industry versus firms in a B2C industry[30] ($B2B_j$). B2B firms are more likely to be part of a supply chain as suppliers. Therefore, B2B firms should experience a larger effect on performance from an ESG reporting mandate than B2C firms, according to a supply chain channel. Second, we compare firms following a differentiation strategy with firms implementing a cost leadership strategy. Firms under a differentiation strategy have more incentives to adopt an ESG profile sooner than firms under a cost leadership strategy. A firm with ESG information available (i.e., stronger ESG profile) becomes more attractive to large corporate customers. Last, we compare firms in a highly competitive environment to firms in a low competition environment. Firms that operate in more competitive environments might benefit from disclosing ESG information more than firms mandated to disclose in less competitive environments. For instance, firms in highly competitive environments might benefit from disclosing ESG information, which might allow them to increase their market share compared to firms in highly concentrated markets where no additional share is gained from the disclosure of ESG information. Reporting ESG information would be a competition tool for these firms in highly competitive markets where concentration is low.

Table 5 reports univariate analyses for mandated firms' reporting behavior in the post-treatment period, comparing firms in B2B industries and firms in B2C industries (Panel A), firms following a differentiation strategy and firms seeking cost leadership (Panel B), and firms in high competition environments versus firms in low competition environments (Panel C). We explore the differences for firms in the treatment group from which we are able to obtain compliance data. The results in Panel A show that firms in B2C industries have a statistically significant

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[30]We follow Lev et al. [2010, pg.188] and translate four-digit SIC codes into Swedish SNI 2007 codes to classify industries into B2B and B2C industries.

(t-statistic=-3.09) lower likelihood to prepare an ESG report after the mandate comes into effect than firms in B2B industries. The results in Panel B show that firms pursuing cost leadership are less likely to prepare an ESG report after 2016 compared to firms following a differentiation strategy, although the difference is statistically insignificant (t-statistic=-1.18)[31]. Finally, the results in Panel C show that firms operating in a low competition environment have a statistically significant (t-statistic=-3.29) lower likelihood of preparing ESG reports after 2016 than firms in highly competitive environments.

Table 6 reports the estimation results for a triple difference-in-differences analysis of our RDD-DiD design, comparing, in Panel A, firms that belong to a B2B industry with firms in B2C industries; in Panel B, firms following a differentiation strategy and firms following a low cost strategy; and in Panel C, firms in highly competitive environments and firms in more concentrated markets. Panels A, B, and C in Table 6 all follow the same structure as our main analysis of corporate performance in Table 4. There are two differences: (1) in Table 6, we use an extra interaction term (sometimes more terms)[32] that captures the differential impact of mandated ESG reporting on corporate performance for the different firms mentioned above in the paragraph; and (2) in Panel A, our fixed effects structure is firm and year (not firm and year-industry), which allows us to exploit the differences between B2B and B2C industries.

The results in Panel A suggest that there is no systematic difference in a multivariate setting between B2B and B2C firms with respect to their effect of mandatory ESG reporting on corporate performance. This finding holds true for all specifications, except for Column (1), where we observe a statistically significant positive difference between B2B and B2C. In the univariate analysis of Table 5, we observe a statistically significant positive difference in the propensity to comply with the mandate between B2B and B2C firms. There could be myriad reasons why the

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[31]The reason that the number of observations in this univariate analysis is lower than in Panels A and C is the exclusion of firms following neither a differentiation strategy nor a cost leadership strategy.

[32]When we compare firms following a differentiation strategy with firms following a low cost strategy, we include a third category of firms that are not following either of the aforementioned strategies. We do so to not reduce the sample size and to keep comparing firms that follow a differentiation strategy with low cost firms as a base.

univariate statistically significant positive difference does not carry over to our multivariate analysis of corporate performance. For instance, the potentially reduced variation in the $B2B_j$ after partialling out the firm fixed effects might be one reason. Another reason could be the potential measurement error in generating the variable itself. On the other hand, Panels B and C consistently show that firms that follow a differentiation strategy or that are competing in markets with low concentration report a larger impact of mandatory ESG reporting on corporate performance than firms that follow a low cost strategy or that compete in highly concentrated markets. All of the coefficients are positive and statistically significant at reasonable significance levels.

Overall, these results are indicative of a supply chain channel where corporate customers care about the ESG transparency of their suppliers and act accordingly. The results are also consistent with Darendeli et al.'s [2022] findings that corporate customers adjust their supplier portfolio according to suppliers' CSR practices. The supply chain channel is also consistent with prior literature examining the effects of mandatory non-financial disclosure on the performance of large listed firms (Christensen et al. [2017]; Chen et al. [2018]; Fiechter et al. [2022]). Research examining listed firms on average finds a negative effect of mandated non-financial reporting on financial performance (Chen et al. [2018]; Fiechter et al. [2022]) and labor productivity (Christensen et al. [2017]). These findings are compatible with ours. Medium private firms in our sample have opportunities to grow and increase their capacity to enter larger supply chains. However, large listed firms most likely are already part of a large supply chain; hence, ESG reporting cannot help them further enlarge their set of opportunities. This situation reduces the benefits of ESG reporting for large listed firms. These results are insightful for understanding the variation in findings in the literature.

6.3.2 The financing channel

We continue to study a non-mutually exclusive financing channel through which an ESG reporting mandate potentially impacts firms' corporate performance. Mandating firms to disclose ESG information diminishes the costs of processing the informa-

tion by creating demand for it. Additionally, the mandate incentivizes stakeholders such as capital providers to incorporate ESG information in their decisions. For example, once the ESG reporting mandate is enforced, banks will be more likely to consider ESG information in their debt pricing and lending decisions. Consequently, this set of firms is able to operate more cheaply. According to a financing channel, once the mandate is effective, we expect mandated firms to enjoy improved financing conditions.

To test the financing channel, we examine the effect of mandatory ESG reporting on two variables that capture a dimension of firms' financing conditions. First, we analyze the effect on interest rates, which we calculate for firms with available information on their private debt. Additionally, we exclude firms with no debt. The interest rate allows us to study variations in the cost of debt financing for mandated firms. Second, we analyze pledged assets, which enables us to study whether banks perceive firms' risk differently after the ESG reporting mandate is enforced. Firms reporting ESG information should experience a decrease in their cost of debt as well as in pledged assets.

Table 7 reports the estimation results for the impact of mandatory ESG reporting on firms' $Interest\_Rate_{i,t}$ and $Pledged\_Assets_{i,t}$. We closely follow the structure of Table 4, except for outcomes that are now in Columns (1) to (3) $Interest\_Rate_{i,t}$ and in Columns (4) to (6) $Pledged\_Assets_{i,t}$. Sample sizes differ due to the availability of loan data and the use of debt as a financing instrument for firms.

We find a negative relation between mandated private Swedish firms and the interest rate as well as pledged assets after the ESG reporting mandate comes into effect. On average, mandated firms exhibit a decrease in $Interest\_Rate\_i, t$ that ranges approximately from -0.4% (t-statistic=-2.36) to -0.5% (t-statistic=-2.49). Analogously, mandated firms exhibit a decrease in $Pledged\_Assets_{i,t}$ that ranges from 10.5% (t-statistic=-4.44) to 12.3% (t-statistic=-4.51).

In sum, these results are consistent with a financing channel where banks start assigning a value to ESG information and incorporate it in their debt pricing decisions, resulting in improved financing conditions for the disclosing firms.

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7 Robustness

7.1 The parallel trends assumption

To alleviate concerns that firms anticipate the passage of the ESG reporting mandate and that there are no statistically significant differences between the treatment and control groups before the adoption of the ESG reporting mandate in 2017, we replace $Mandatory\_ESG\_Reporting_{i,t}$ in Equation (2) with separate indicators variables for each year and an indicator aggregating all years before 2012. The year 2016 (t) is used as the benchmark. This analysis helps us to detect trends before the ESG reporting mandate came into effect. Figure 8 plots the corporate performance effects in event time for $ROA\_(EBITDA)_{i,t}$ (Panel A) and $ROA\_(NI)_{i,t}$ (Panel B) of the parallel trends analysis, together with a 95% confidence interval. We do not observe significant pre-trends for $ROA\_(EBITDA)_{i,t}$ or $ROA\_(NI)_{i,t}$. The effect of mandatory ESG reporting on corporate performance is not immediate. In $t+1$, the effect is positive but not statistically significant, and it becomes significant from $t+2$ onward[33]. For the years $t+1$ to $t+3$, the trend of the effect is increasing. This finding is concordant with a reporting mandate as ours, where the effect is expected to take time to materialize and to reach its maximum. In $t+4$ (2020 fiscal year), we observe a decreased effect. This result is consistent with the negative effects of SARS-CoV-2 on firms' performance. Overall, the analysis does not suggest any significant differences between treated and control firms in the pre-treatment period, but they suggest a positive shift in corporate performance after the mandate is enforced.

7.2 Robustness tests

In this section, we document the robustness of our findings according to a series of sensitivity tests. The results for the robustness tests in Sections 7.2.1 to 7.2.4 are summarized in Table OA.2 in the Online Appendix. The robustness tests in Table OA.2 use Equation (2) in Table 4, Columns (2) and (5), as the base specifi-

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[33]The $t+2$ coefficient for $ROA\_(NI)_{i,t}$ is statistically significant at the 10% significance level (p-value=5.6%).

cation.

7.2.1 Sensitivity to research design choices

We start by considering alternative ways to winsorize our results. In the main analyses, we winsorize our variables after we define our main sample (for more details, please see our sample selection process) at the top and bottom 5% to alleviate the impact of influential observations. We start our robustness tests with a double winsorization, i.e., by winsorizing both the raw data used in variable constructions and later the final variables as we define our main sample. We adopt this approach to further mitigate the influence of extreme observations. Additionally, we winsorize our data at the year level, then at the industry level and, last, at the year-industry level. All winsorizations are performed for the continuous variables at the top and bottom 5%. We winsorize within year, industry and the combination of the two as alternative ways of defining extreme observations. Table OA.2 Robustness (1) shows that our estimates retain the same magnitude and statistical significance regardless of the winsorization alternative.

We continue our robustness tests by considering alternative clustering structures for the standard errors of our main results. In our main analyses, we allow the standard errors to present serial correlation, i.e., we allow the standard errors to have a non-negative correlation within the same firm from one year to the next. Alternatively, we cluster the standard errors by: (1) firm and year (to account for both serial correlation and cross-correlation among firms), (2) year (to allow cross-correlation), (3) industry (to allow correlation within industries) and (4) location (to allow geographical correlation). The results in Table OA.2 Robustness (2) show that our estimates remain mostly the same in magnitude and statistical significance. We mention magnitude, as clustering by location restricts our sample by a few hundred observations, which is why we see a change in one of the coefficients. Otherwise, the coefficients remain the same, as expected.

Next, we consider the fixed effects structures in our main analyses, firm and year-industry fixed effects. These fixed effects structures allow us to account for observable and unobservable time invariant differences within a given firm and time

variant and invariant factors within a given industry in a given year. We probe our fixed effects (FEs) structure in the following manner: (1) firm and year FEs, (2) firm and location-year fixed FEs, (3) firm and location-industry-year FEs, and (4) firm and group status-year FEs. In the first fixed effect structure, we control only for factors that show no variation within firm and within year. With the location-year FEs, we control for factors that affect all firms in a given geographical region in a given year. On the other hand, we use one of our most demanding FEs structure and make comparisons not only within a firm but also for a firm in a given year that is in the same geographical location and belongs to the same industry. Finally, we compare firms with other firms from the same category of group type in the same year, i.e., we compare independent firms with independent firms, parent companies with parent companies, etc. Table OA.2 Robustness (3) shows that our estimates remain similar in magnitude and statistical significance.

7.2.2 Sensitivity to the treatment and control assignment rule

In our main analyses, we use an assignment rule based on the Swedish amendment to Årsredovisningslag (1995:1554), Chapter 6 Section 10. We follow a time invariant adaptation of this rule for the year 2016 and for only one period (as in Equation (1)). We provide robustness checks for this assignment rule by testing time varying (dynamic) treatments based on two consecutive periods and one period, and finally another based on 2016 for two consecutive periods. We find consistent results in terms of corporate performance in Table OA.2 Robustness (4). We also probe the flexibility of our control function by taking into account the lagged size determinants. We perform this step in Table OA.2 Robustness (5) for the assignment rules that incorporate two period data into the decision to be assigned to the treatment or control group. We follow our main specification without allowing the control function to differ before and after adopting the amendment in 2016. We find consistent (albeit weaker) results in terms of corporate performance. We also use alternative functional forms in our robustness checks. We probe our main functional form by introducing the firm size determinants in our main specification in a polynomial form (we use second, third, fourth and fifth order polynomials), without interacting them with a post treatment indicator. We also probe the control functional form, allow-

ing it to interact with our variable $Mandatory\_ESG\_Reporting_{i,t}$ and by creating 25 equally spaced linear splines and 50 equally spaced bins in our size variables. Nearly all of these alternative functional forms provide robust and consistent results in Table OA.2 Robustness (6).

7.2.3 Matched sample analyses

We re-run our main analysis on four different matched subsamples based on our firm level controls and industry membership. First, we match treated firms using a propensity score algorithm. We match the data using observations from the last pre-treatment period, i.e., 2016. We also use the following options: no replacement, descending order, logit and one-to-one matching, giving us 840 treated firms that are matched with 840 control firms in 2016. After populating the remaining matched sample, we obtain 21,039 matched firm-year observations. Alternatively, we use a one-to-ten matching procedure, with the options of common support, a caliper of 0.05 and logit. Thus, we match 833 treated firms with 6,078 (some control firms can act as controls for multiple treated firms). Additionally, we employ a coarsened exact matching procedure with an automatic coarsening algorithm for the firm-level controls and exact matching for industry membership. Finally, we use the entropy balancing method to weight the observations in our main specification using the weights from a balancing algorithm with a tolerance of 0.05 and using only the first moments of the distributions.

Table OA.2 Robustness (7) shows that the matched sample evidence is consistent with our main results in that the coefficients are positive and statistically significant at sensible levels.

7.2.4 Alternative measures of corporate performance

Last, we examine the effect of $Mandatory\_ESG\_Reporting_{i,t}$ on two additional dependent variables: return on equity ($ROE_{i,t}$) and total factor productivity ($Total\_Factor\_Prod_{i,t}$). In Table OA.2 Robustness (8) we find that, once the mandate is enforced, treated firms exhibit an increase of 1.9% (t-statistic: 2.48) in their return on equity and an increase of 8.9% (t-statistic: 5.01) in their total factor productivity.

These findings strengthen our conclusion that mandatory ESG reporting leads to higher performance levels in corporations.

7.2.5 Alternative research design: regression discontinuity

Alternatively, we implement a regression discontinuity design where we exploit cross-sectional variation in the assignment rule proposed by the Swedish amendment to Årsredovisningslag (1995:1554), Chapter 6 Section 10. In this setting, we focus on the years 2017 to 2020, when the law is already implemented. A more thorough explanation of the implementation of this design can be found in Appendix OA.3 in the Online Appendix. Our main results are robust to this setting. We do find that the magnitude of the effects of mandatory ESG reporting on corporate performance seem to be larger in the RDD design. This finding could indicate potential omitted variable bias in this setting, as we do not employ firm fixed effects. We also provide a series of robustness tests for this alternate research design, which can be found in Table OA.3 in the Online Appendix. In these robustness checks, which include polynomials and alternative functional control functions, the magnitude of the coefficients is more similar to our main results under the RDD-DiD research design.

8 Conclusion

In this paper, we investigate the corporate performance effects of mandatory ESG reporting for firms. We exploit variation from Sweden's size-based ESG reporting regulation. Sweden requires medium firms to start reporting ESG information from 2017 onward, regardless of the listing status. This requirement allows us to estimate the effect of mandatory ESG reporting for private firms.

We find that mandatory ESG reporting improves corporate performance for the subset of mandated firms. This finding is robust to an array of different specifications and robustness tests, thus alleviating concerns that our results are driven by alternative variations. Moreover, our findings enhance our understanding of the disclosure dynamics for private firms in a voluntary and mandatory regime, and they

emphasize the consequences of the setting details such as the disclosure costs and the level of non-compliance costs.

These findings are consistent with our two proposed explanations: a supply chain channel and a financing channel. First, the descriptive evidence that firms in B2B industries, firms following a differentiation strategy and firms operating in more competitive environments are more likely to issue an ESG report, together with the result that the main effect is concentrated for firms following a differentiation strategy and firms in more competitive environments, is consistent with a supply chain channel where (1) disclosing ESG information increases opportunities for mandated firms to enter larger supply chains, and (2) corporate customers care about ESG information and make decisions accordingly. Second, the result that mandated firms have lower interest rates and pledged assets once the ESG reporting mandate becomes effective is consistent with a financing channel where mandating the disclosure of ESG information reduces the costs of processing information and increases the demand for such information, incentivizing capital providers to incorporate ESG information into their debt pricing decisions.

Our paper contributes to the literature in several ways. First, we contribute to the literature on (mandatory) non-financial reporting by documenting the effect of mandatory ESG reporting on corporate performance for private firms, which so far has mixed conclusions. Second, our findings are suggestive of mandatory reporting reducing the costs of processing information for stakeholders and indicate stakeholders are incentivized to use the information when making decisions, contributing to the literature on the consequences of mandatory reporting for private firms. Third, our paper contributes to the literature studying firms' disclosure dynamics under different informational settings by documenting private firms' reactions to ESG disclosures in a voluntary and mandatory regime. Last, our paper informs regulators of the costs and benefits of mandatory ESG disclosures for firms. Our results emphasize the importance of institutional details for the consequences of such mandates and caution regulators about expectations regarding the effects of ESG disclosure mandates for different types of firms. Hence, when requiring firms to disclose ESG information, regulators should bear in mind that while disclosures can be cost-effective for certain types of firms and in certain institutional settings,

this need not be the case for others, where firms can incur substantial costs.

Our findings are subject to one main caveat: the interpretation of our results is bound to the institutional setting of our study, and we cannot guarantee that our findings would hold in other settings (external validity). However, we can affirm the important role of such institutional details in the cost-effectiveness of ESG reporting mandates. We leave it to future research to investigate the cost-effectiveness of different policies on the different settings.

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A   Figures

Figure 1. Caption
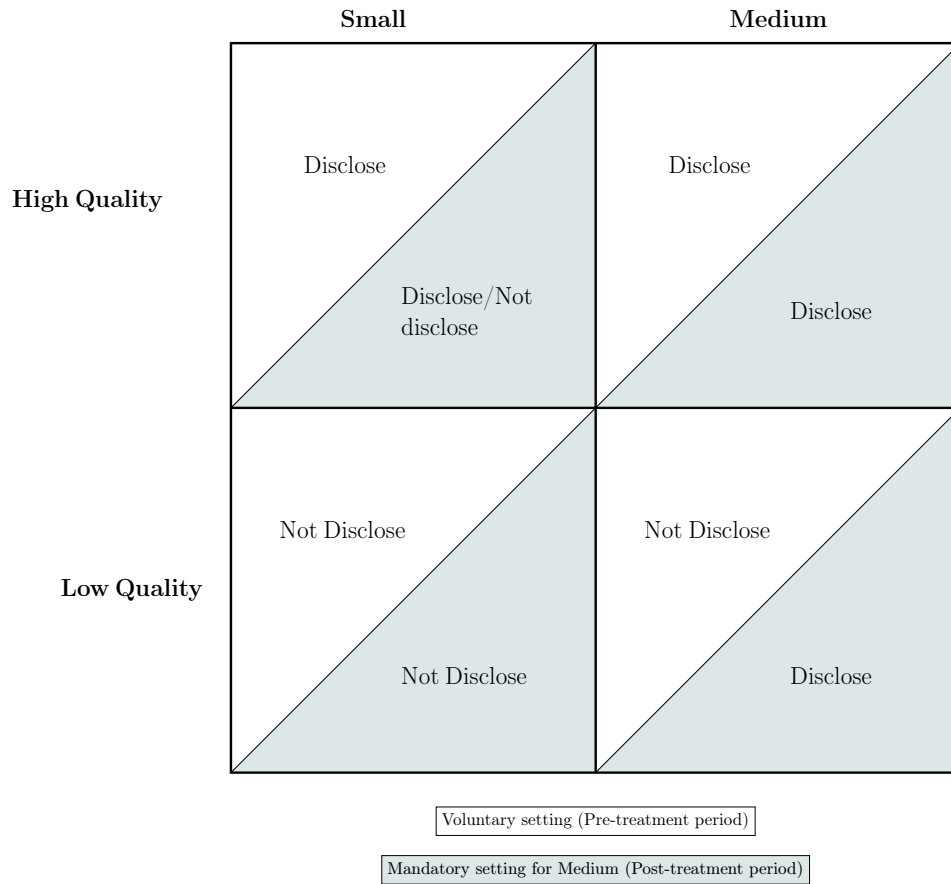
This figure represents the disclosure dynamics in both, a voluntary and a mandatory regime according to the assumptions in Section 2.4. We distinguish between *small* and *medium firms* that simultaneously can be *high-quality* or *low-quality* firms. Blank areas correspond to the voluntary setting (or the pre-treatment period in our empirical analyses), and shaded areas correspond to the mandatory setting (or post-treatment period in our empirical analyses). The mandatory setting applies only to *medium* firms.

Figure 2. Distribution of the number of average employees around the 250 threshold

Panel A. Full period.

Panel B. Pre-treatment period.

Panel C. Post-treatment period.

Density of Average Employees
Post–treatment period (2017–2020)
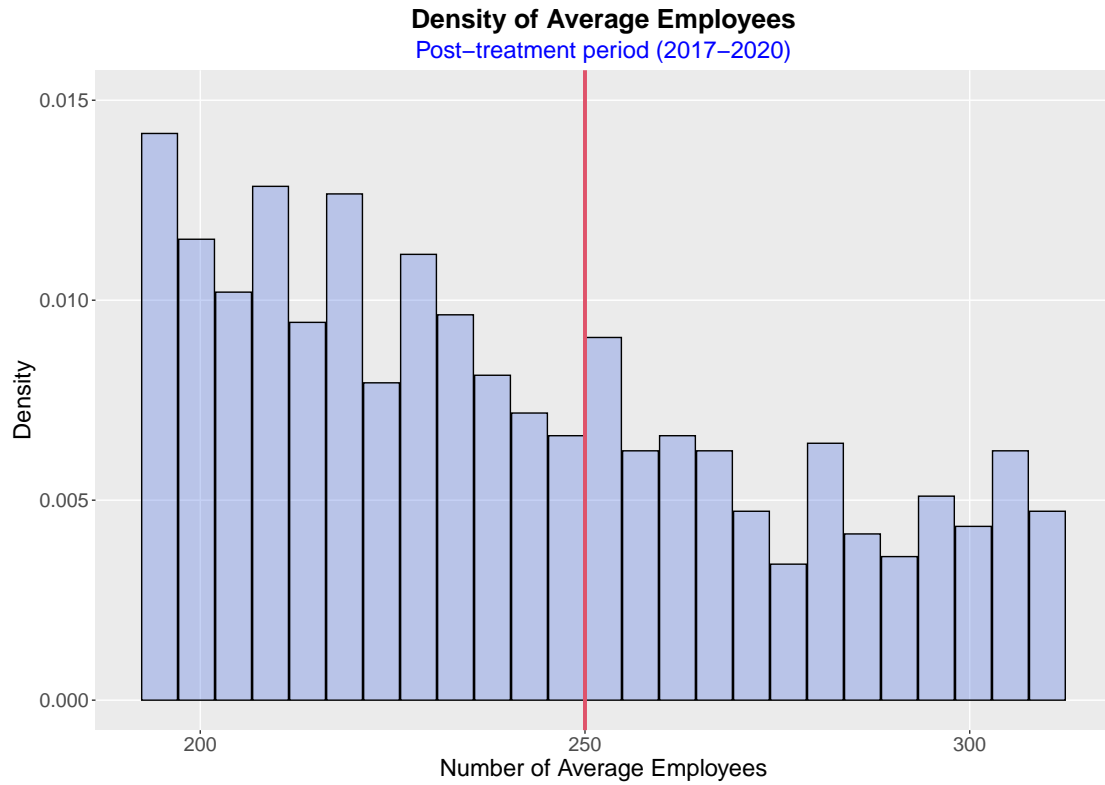
This figure shows the empirical densities of average employees around the 250 threshold. Panel A depicts the distribution for the full sample period from 1999 to 2020. Panel B depicts the distribution for the pre-treatment sample period from 1999 to 2016. Panel C depicts the distribution for the post-treatment sample period from 2017 to 2020.

Figure 3. Distribution of total assets (in millions of SEK) around the 175 million SEK threshold

Panel A. Full period.
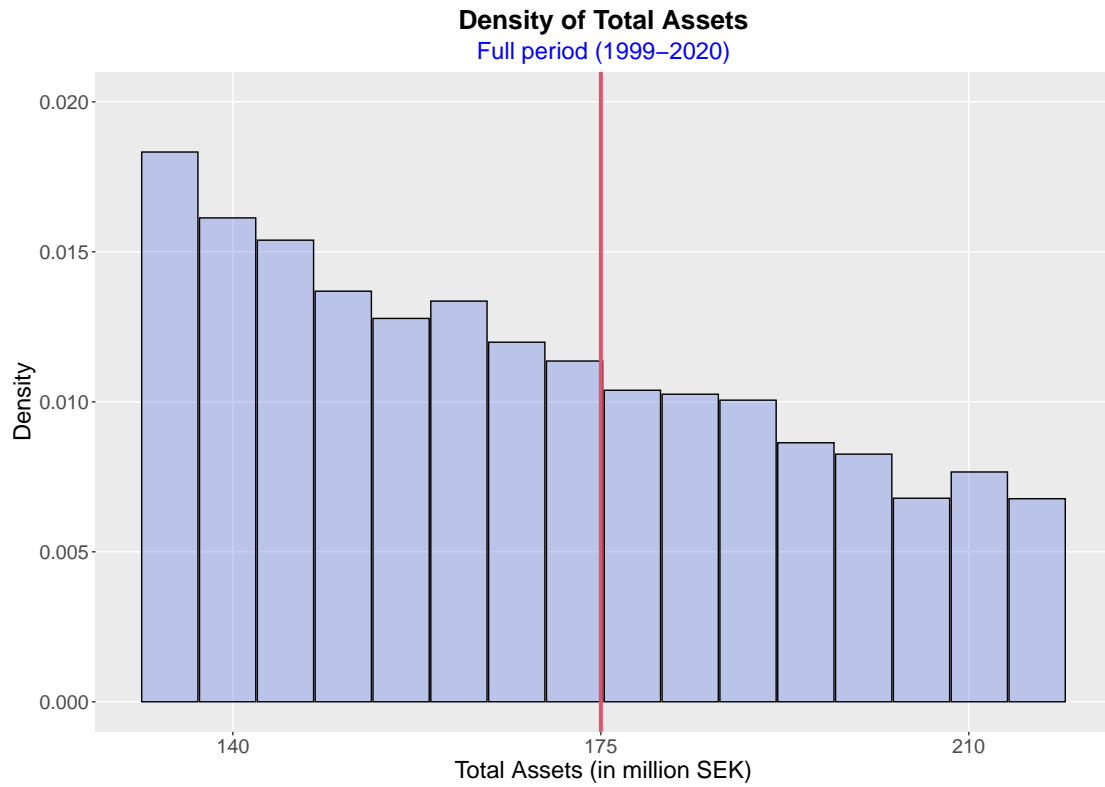
Panel B. Pre-treatment period.
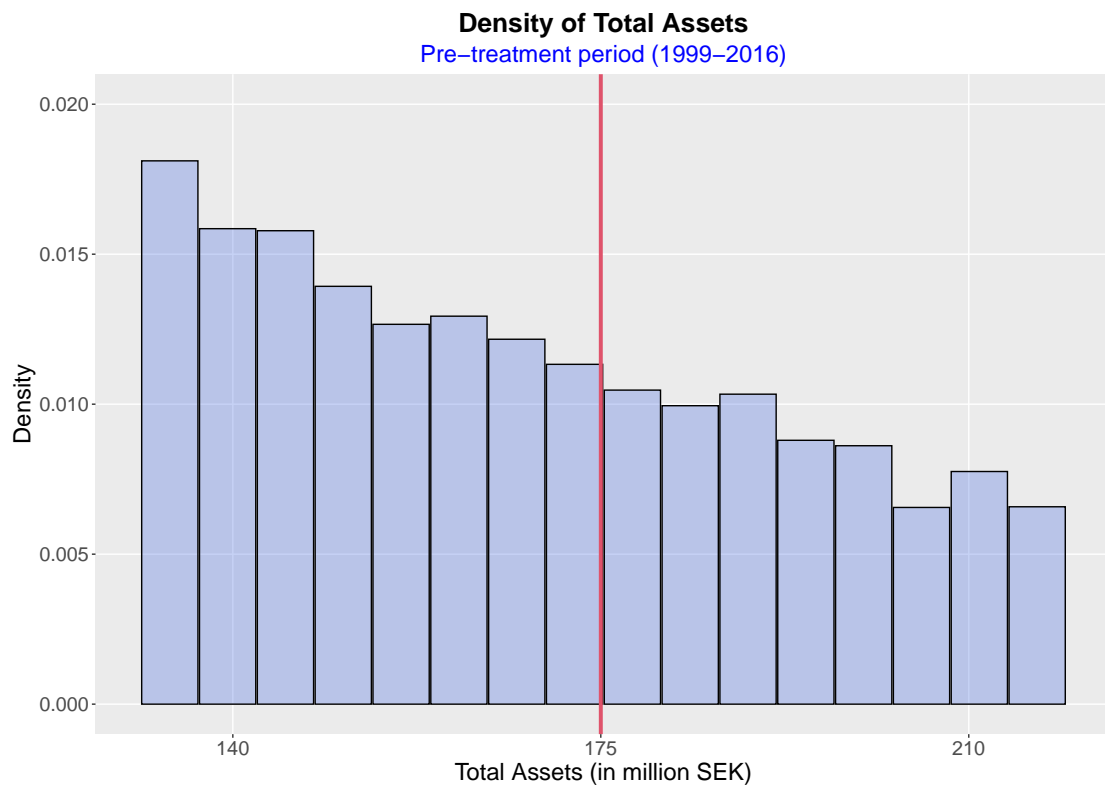
Panel C. Post-treatment period.
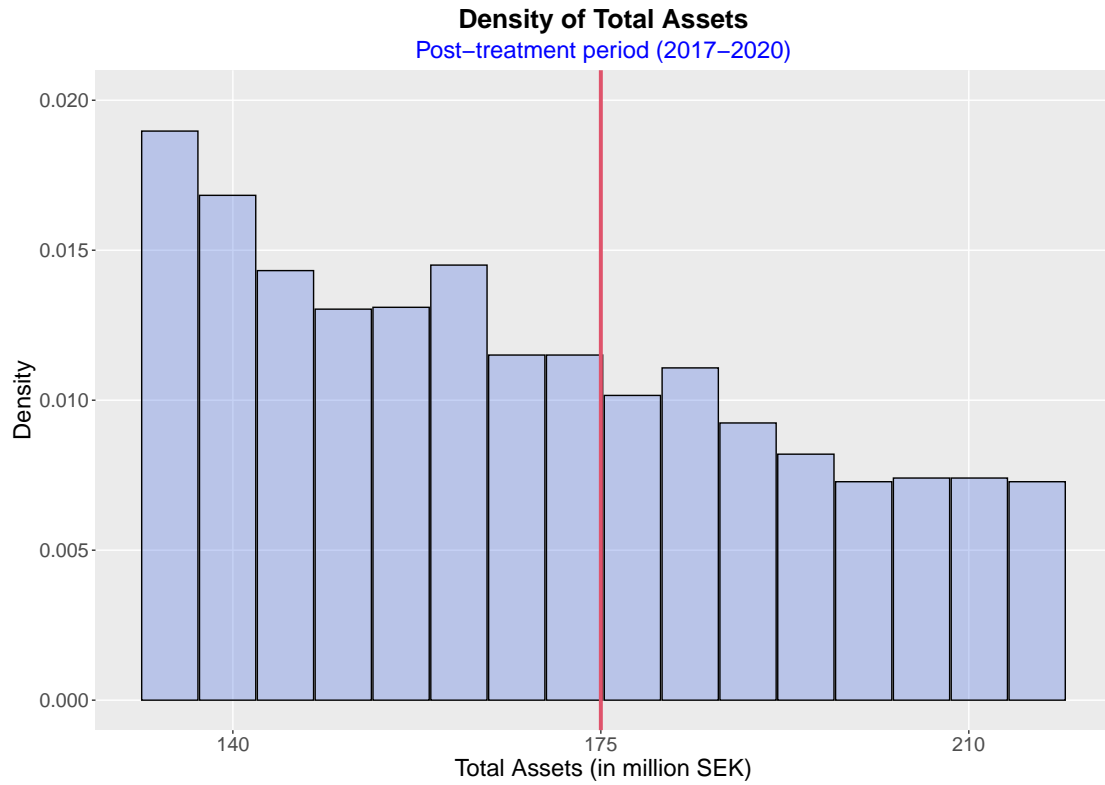
This figure shows the empirical densities of total assets (in million of SEK) around the 175 threshold. Panel A depicts the distribution for the full sample period from 1999 to 2020. Panel B depicts the distribution for the pre-treatment sample period from 1999 to 2016. Panel C depicts the distribution for the post-treatment sample period from 2017 to 2020.

Figure 4. Distribution of sales (in millions of SEK) around the 350 million SEK threshold

Panel A. Full period.

Panel B. Pre-treatment period.

Panel C. Post-treatment period.

Density of Sales
Post–treatment period (2017–2020)
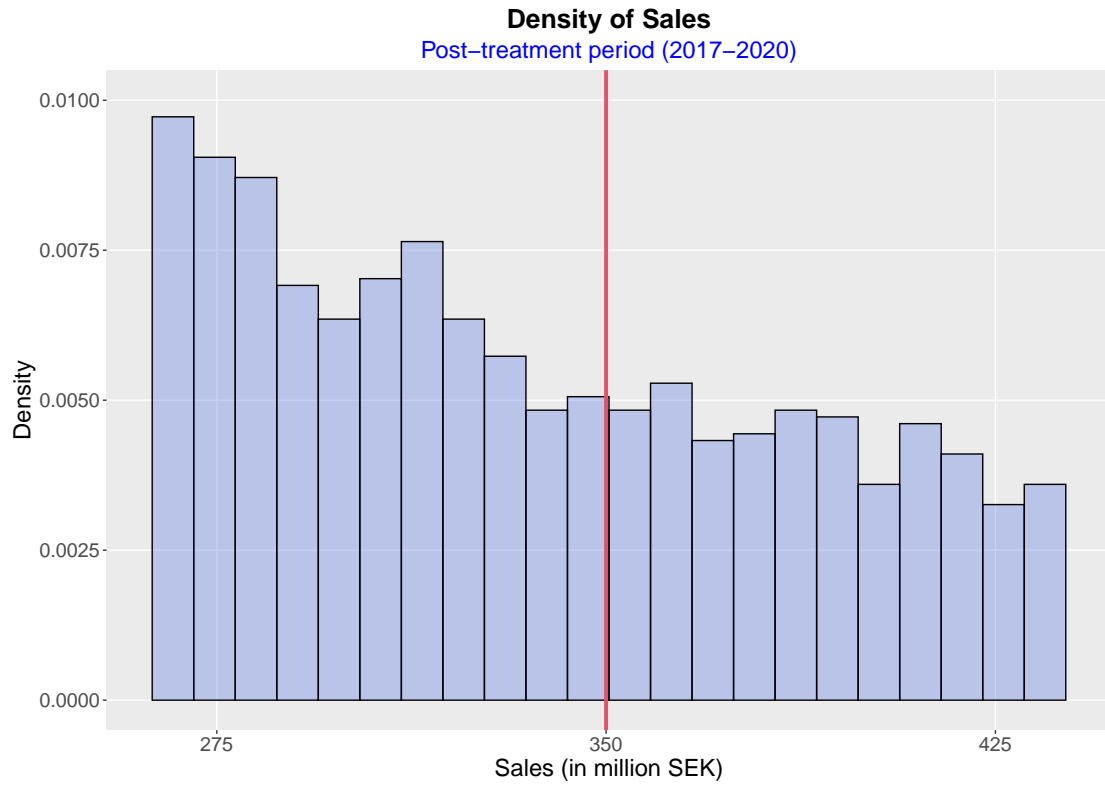
This figure shows the empirical densities of sales (in millions of SEK) around the 350 threshold. Panel A depicts the distribution for the full sample period from 1999 to 2020. Panel B depicts the distribution for the pre-treatment sample period from 1999 to 2016. Panel C depicts the distribution for the post-treatment sample period from 2017 to 2020.

Figure 5. Density tests: Number of average employees.

Panel A. Full period.

Panel B. Pre-treatment period.

Panel C. Post-treatment period.

Density of Average Employees
Post–treatment period (2017–2020)
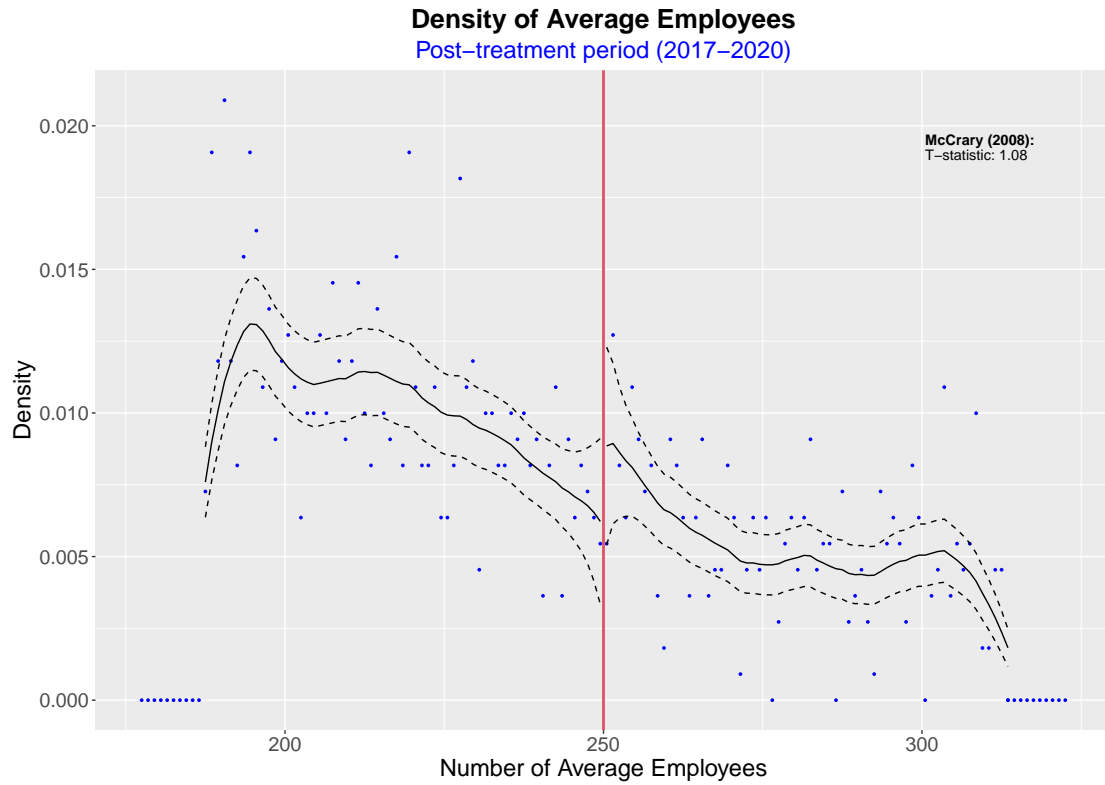
This figure shows the histogram, estimated densities and 95% confidence intervals of the number of average employees around the 250 threshold. The absolute values of the McCrary [2008] test statistic are included in all three figures. Panel A uses the full sample period from 1999 to 2020. Panel B uses the pre-treatment sample period from 1999 to 2016. Panel C uses the post-treatment sample period from 2017 to 2020.

Figure 6. Density tests: Total assets.

Panel A. Full period.
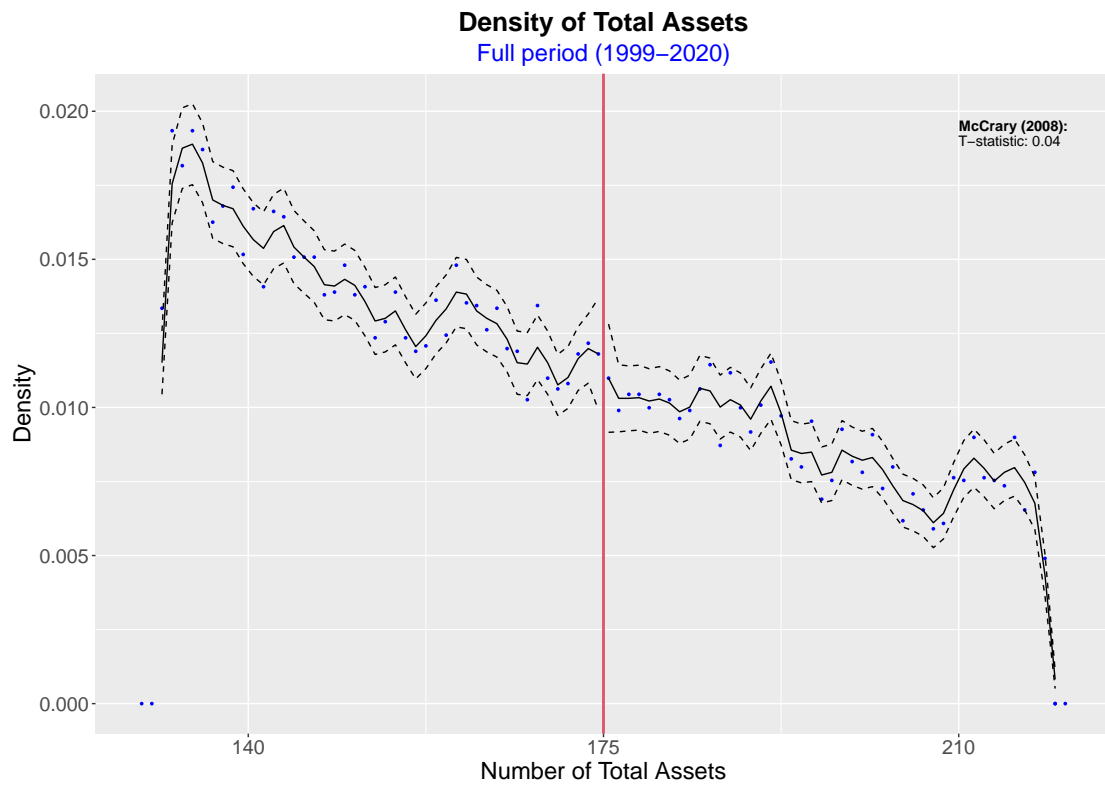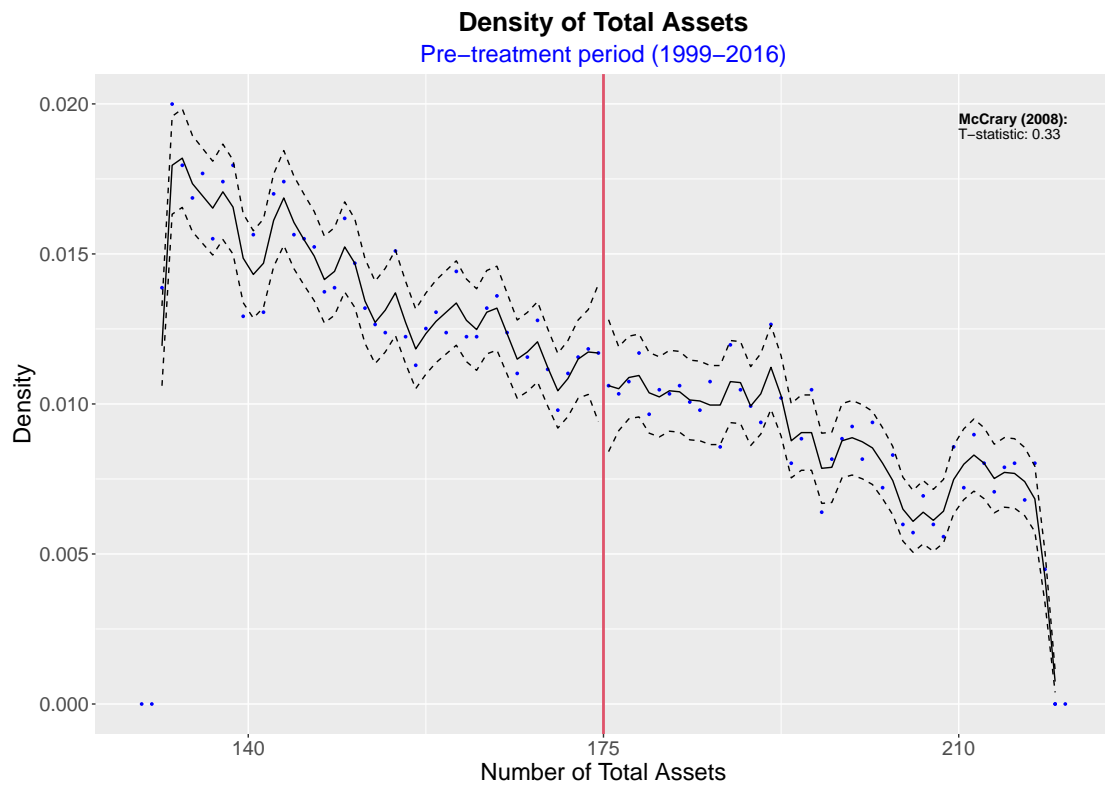
Panel B. Pre-treatment period.

Panel C. Post-treatment period.

Density of Total Assets

Post−treatment period (2017−2020)

McCrary (2008):
T−statistic: 0.13
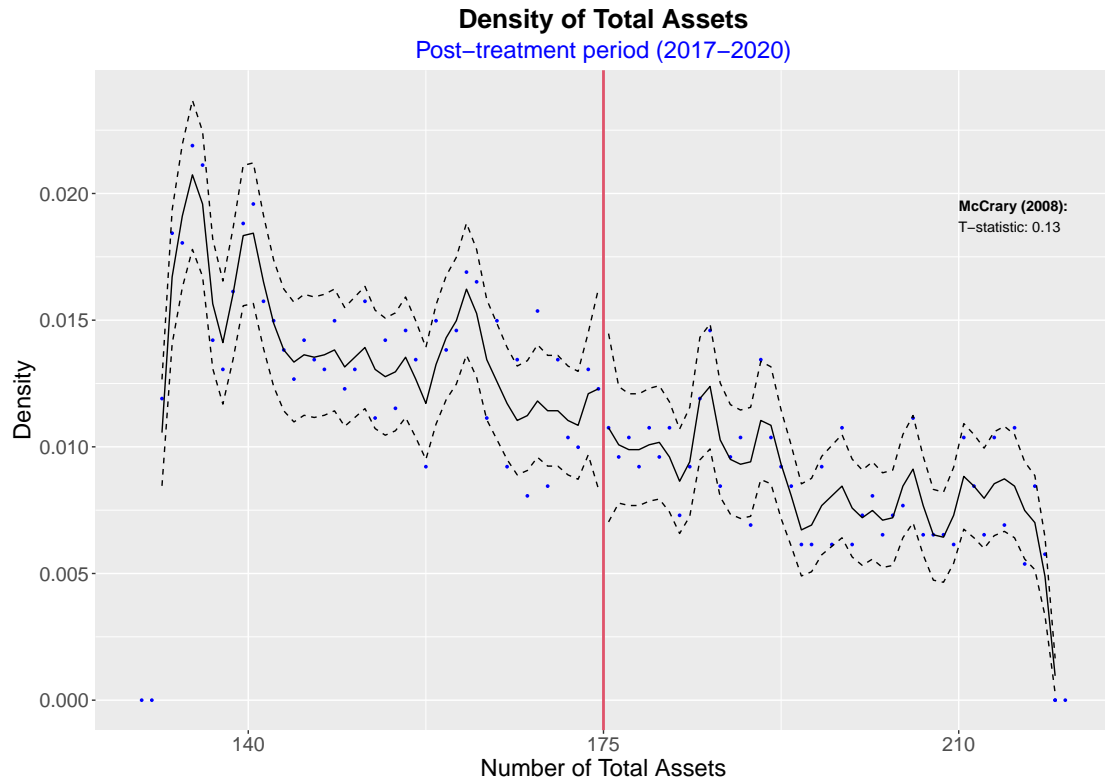
This figure shows the histogram, estimated densities and 95% confidence intervals of total assets around the 175 threshold. The absolute values of the McCrary [2008] test statistic are included in all three figures. Panel A uses the full sample period from 1999 to 2020. Panel B uses the pre-treatment sample period from 1999 to 2016. Panel C uses the post-treatment sample period from 2017 to 2020.

Figure 7. Density tests: Sales.

Panel A. Full period.
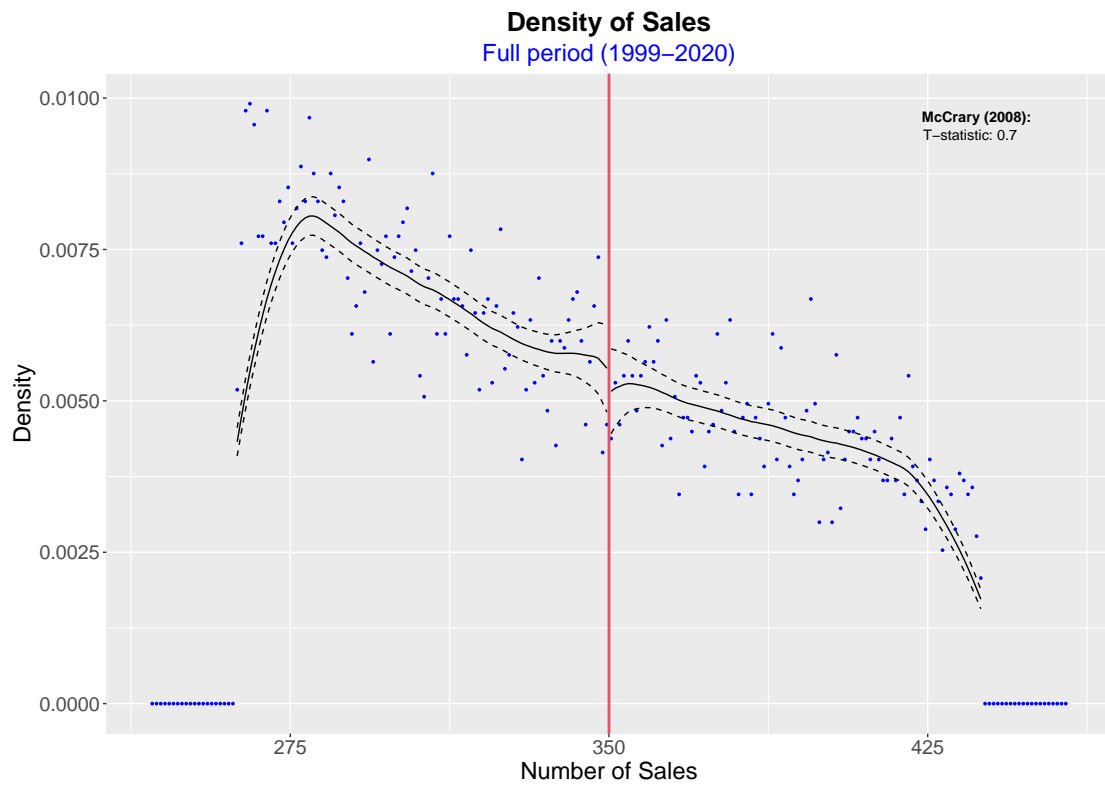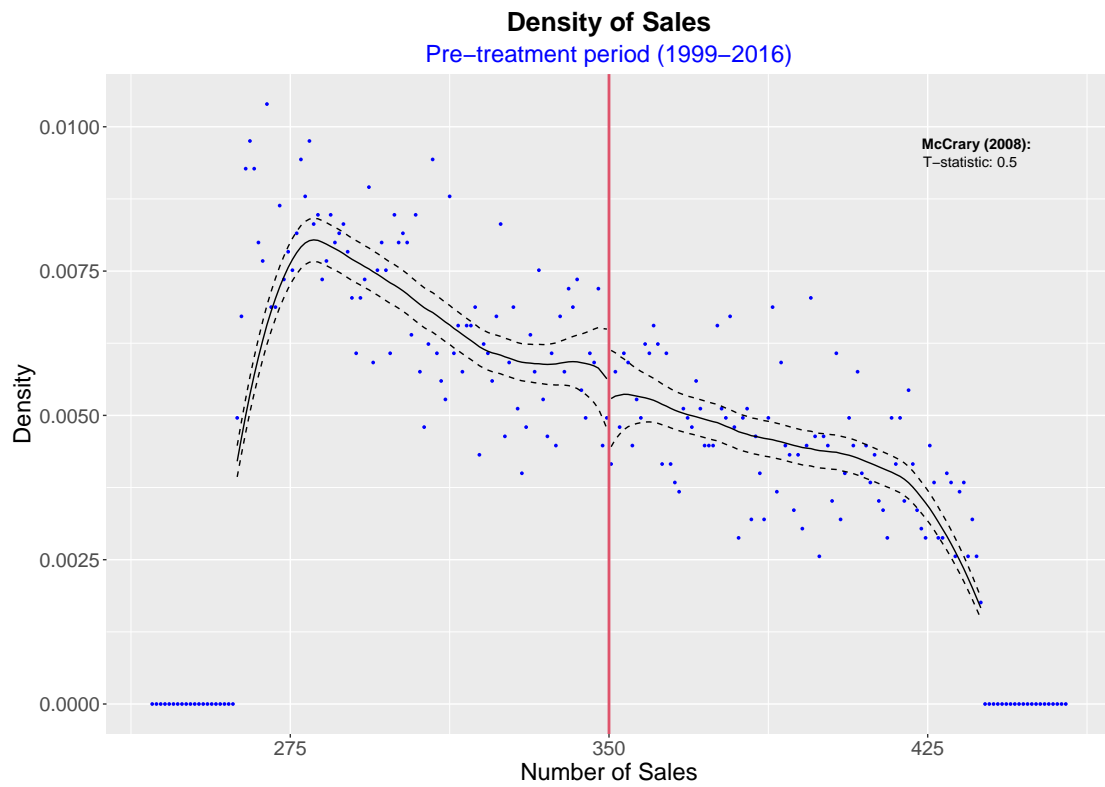
Density of Sales
Full period (1999–2020)

McCrary (2008):
T–statistic: 0.7

Panel B. Pre-treatment period.

Density of Sales
Pre–treatment period (1999–2016)

McCrary (2008):
T–statistic: 0.5

Panel C. Post-treatment period.

Density of Sales
Post–treatment period (2017–2020)
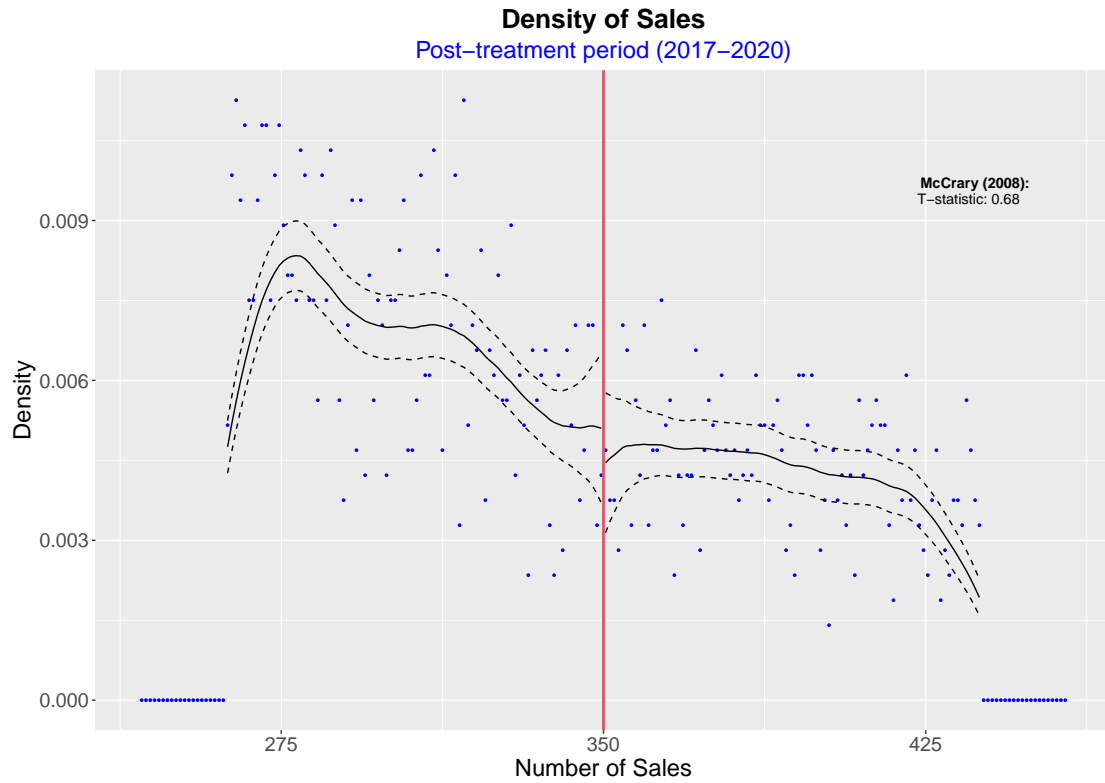
This figure shows the histogram, estimated densities and 95% confidence intervals of sales around the 350 threshold. The absolute values of the McCrary [2008] test statistic are included in all three figures. Panel A uses the full sample period from 1999 to 2020. Panel B uses the pre-treatment sample period from 1999 to 2016. Panel C uses the post-treatment sample period from 2017 to 2020.

Figure 8. Leads-and-lags model

Panel A. ROA_(EBITDA).
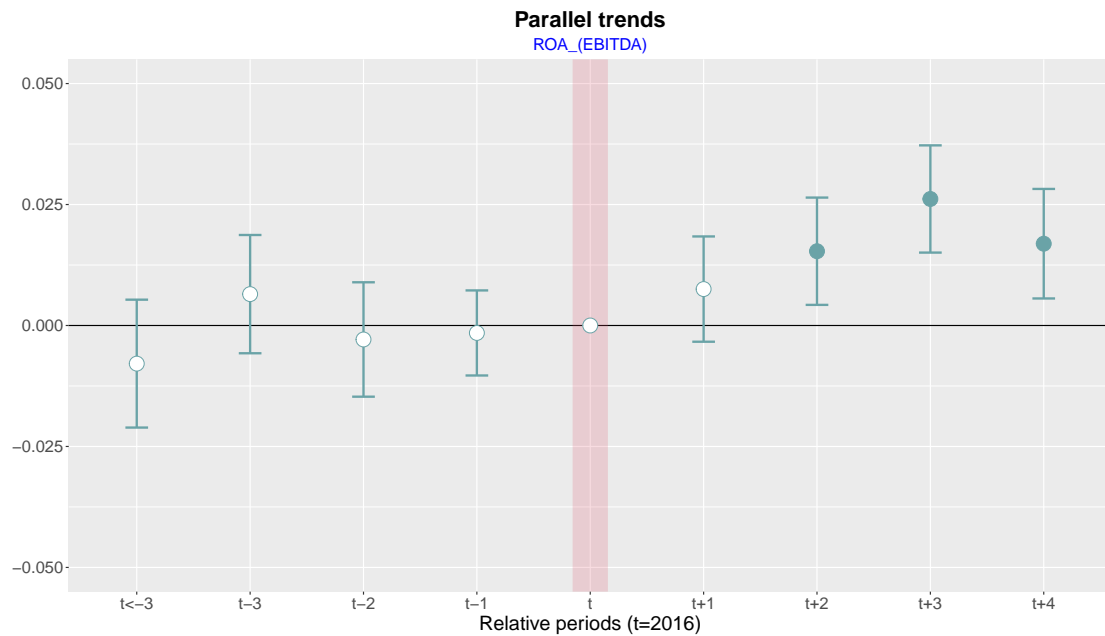
Panel B. ROA_(NI).
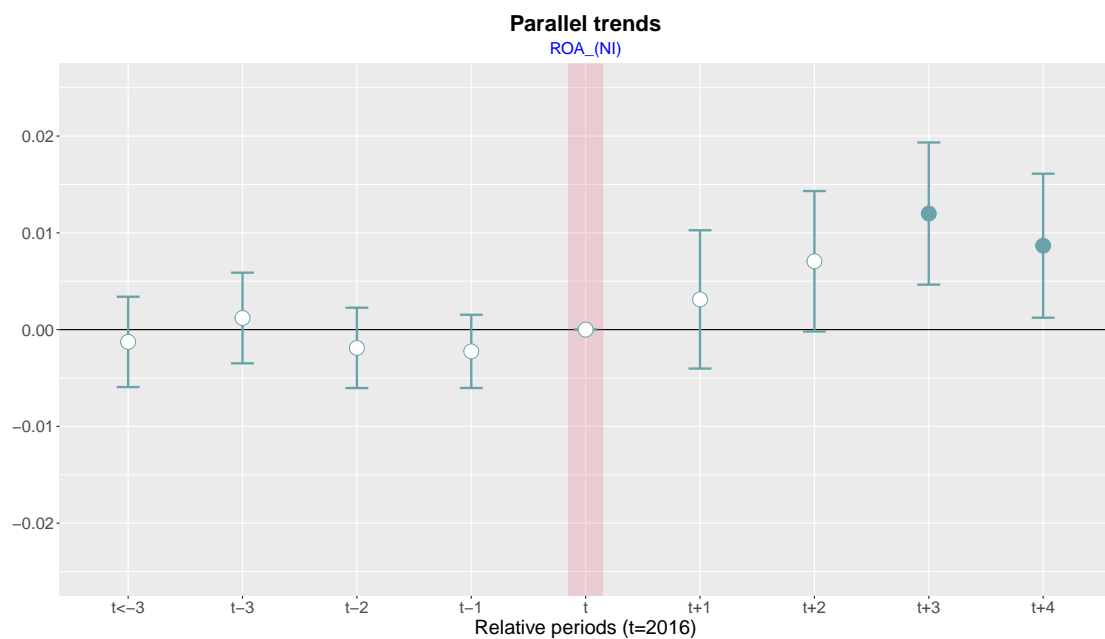
This figure shows the results with respect to the parallel trends assumption on the ESG reporting mandate's impact on corporate performance. Each figure provides the coefficients and their 95% confidence level intervals. The baseline year (t) is 2016. We aggregate all years before 2012 in the indicator $t < -3$. Shaded coefficients indicate statistical significance at the 5% significance level. Blank coefficients indicate lack of statistical significance at the 5% significance level. Panel A uses $ROA\_(EBITDA)$ as the corporate performance measure. Panel B uses $ROA\_(NI)$ as the corporate performance measure.

B Tables

Table 1. Sample selection process.

Sample Selection	Firm-year obs	Unique firms
Serrano data for limited liability firms (Aktiebolag) (1998-2020)	**9,960,434**	**995,847**
Dropping government owned firms	9,909,634	993,378
Dropping inactive firms	7,898,565	817,924
Dropping firms in the finance and insurance sector	7,539,550	793,042
Merging with Bokslut (financial statement data) for private firms	**6,357,238**	**730,126**
Dropping micro-firms (those with less than 10 employees on average)	3,141,490	329,296
Dropping Swedish subsidiaries	2,401,539	280,893
Restriction to non missing observations in main controls and outcomes (final sample)	**1,109,476**	**146,214**

We begin by restricting our sample to limited liability firms (Aktiebolag or AB) for the 1998 to 2020 period. We proceed to exclude firms owned by the public administration and those that are inactive. Serrano defines active limited liability firms as those that have either more than: either 10 thousand SEK of net sales, other operating income, financial income, financial expenses, dividend amount; or more than 500 thousand SEK in total assets. We continue to drop firms in the finance and insurance sectors as their reporting scheme and calculation of corporate performance differs from that of other corporations. Later, we merge the remainder dataset with financial statement data for privately held firms from Bokslut. We do so after identifying and eliminating publicly quoted firms from Bokslut using the listing status from Nordic Compass and Orbis. Finally, we drop micro firms (those with fewer than 10 employees on average over our sample period), Swedish subsidiaries (which are not subject to the disclosure requirements), and we restrict the final sample to observations with available data (non-missing) for the main corporate performance analyses. This final sample consists of close to 150,000 firms that yield over 1.1 million firm-year observations for the period 1999-2020.

Table 2. Descriptive statistics

	N	Mean	S.D.	P25	P50	P75
ROA_ (EBITDA)	1,109,476	0.15	0.20	0.02	0.12	0.25
ROA_ (NI)	1,109,476	0.06	0.15	0.00	0.04	0.13
Total Assets (SEK Thousands)	1,109,476	9,999	18,972	867	2,752	8,679
Sales (SEK Thousands)	1,109,476	14,849	25,331	1,064	4,444	14,816
Employee (Average)	1,109,476	16.02	128.56	1.00	4.00	11.00
Interest_ Rate	438,619	0.07	0.03	0.05	0.08	0.10
Pledged_ Assets	426,355	0.56	0.70	0.25	0.45	0.72
Debt-to-Equity	1,109,476	0.68	1.44	0.00	0.00	0.50
Cash-to-Assets	1,109,476	0.27	0.26	0.04	0.19	0.45
Tangibility	1,109,476	0.20	0.25	0.01	0.08	0.34
Sales_ Growth	1,109,476	0.05	0.37	-0.13	0.03	0.19
Asset_ Growth	1,109,476	0.08	0.31	-0.11	0.03	0.20
Employee_ Growth	1,109,476	0.02	0.22	0.00	0.00	0.00
Firm_ Age	1,109,476	16.21	11.02	7.00	14.00	22.00

In this table, we report the descriptive statistics for our main sample. *ROA_ (EBITDA)* is operating income (*rorresul*) plus depreciation and amortization (*avskriv*) over the opening balance of total assets (*tillgsu*). *ROA_ (NI)* is net income (*resar*) over the opening balance of total assets (*tillgsu*). *Total Assets* is total asset size measured in thousands of SEK (*tillgsu/1,000*). *Sales* is sales volume measured in thousands of SEK (*ntoms/1,000*). *Employee (Average)* is defined as the average number of employees (*antanst*) during a year. *Interest_ Rate* is the external interest rate, i.e., the interest paid on short-term and long-term loans to credit institutions (*rtekoext*) over the opening balance of short-term and long-term loans (*kskkrin + lskkrin*). *Pledged_ Assets* is the sum of pledged assets, i.e., the company's property used as a security in connection with a loan arrangement, usually a bank loan, over the value of total assets (*tillgsu). Debt-to-Equity* is short-term and long-term loans (*kskkrin + lskkrin*) over the book value of equity (*eksu*). *Cash-to-assets* is cash and cash equivalents (*kabasu + kplacsu*) over total assets (*tillgsu*). *Tangibility* is tangible fixed assets (*matanlsu*) over total assets (*tillgsu*). *Sales_ Growth$_{i,t}$* is the yearly firm growth rate of sales (*ntoms*), *Assets_ Growth$_{i,t}$* is the yearly firm growth rate of total assets (*tillgsu*), and *Employee_ Growth$_{i,t}$* is the yearly firm growth rate of the number of employees (*antanst*). *Firm_ Age* is the number of years since the company registered with the Swedish Companies Registration Office.

Table 3. Compliance with reporting mandate

Period	Voluntary regime Pre-treatment (2013-2016)	Mandatory Post-treatment (2017-2020)	Full period (2013-2020)	
	% Disclosing	% Disclosing	% Disclosing	Total number
Control	0.41	1.08	1.10	1,451
Treatment	4.91	45.34	25.08	1,463

In this table, we report private Swedish firms' compliance with the ESG reporting mandate. We disclose this information in a disaggregated manner for the pre-treatment (voluntary regime), the post-treatment (mandatory regime) and the full period (2013-2020). We provide these data for the control and treatment groups, which we obtain as follows: (1) we begin by placing all firms that meet our main assignment rule in the treatment group in the year 2016, which gives us 840 firms that are subjected to the ESG reporting mandate. We randomly select 250 firms out of the 840 mandated firms. We then hand collect data from 2013 to 2020 from companies' websites and the Swedish company registry for these treated firms. We are able to obtain such data for only 240 treated firms for the 2013-2020 period. We match these treated firms in the 2016 cross-section to firms in the control group using their propensity score with a 1:1 nearest neighbor algorithm[34], which gives us a total of 1,463 (1,451) treated (control) firm-year observations.

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[34]Please refer to Section OA.2 in the Online Appendix for more details of the propensity score matching procedure that we use in our paper.

Table 4. Mandatory ESG reporting and corporate performance

	$\text{ROA\_(EBITDA)}_{i,t}$			$\text{ROA\_(NI)}_{i,t}$		
	(1)	(2)	(3)	(4)	(5)	(6)
$Mandatory\_ESG\_Reporting_{i,t}$	0.012*	0.014**	0.016**	0.012**	0.016***	0.016***
	(1.76)	(2.13)	(2.05)	(2.21)	(3.05)	(2.57)
Firm controls?	No	Yes	Yes	No	Yes	Yes
$h(Dimension^{TA})$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{SA})$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{EMP})$?	Yes	Yes	Yes	Yes	Yes	Yes
$Size^{TA}$?	Yes	Yes	Yes	Yes	Yes	Yes
$Size^{SA}$?	Yes	Yes	Yes	Yes	Yes	Yes
$Size^{EMP}$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{TA}) \times Size^{TA}$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{SA}) \times Size^{SA}$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{EMP}) \times Size^{EMP}$?	Yes	Yes	Yes	Yes	Yes	Yes
Total Assets Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Sales Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Employee Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Control function?	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year
Balanced sample?	No	No	Yes	No	No	Yes
Unique firms	126,397	126,397	67,128	126,397	126,397	67,128
Firm-year observations	1,088,674	1,088,674	703,882	1,088,674	1,088,674	703,882
Adjusted R²	50.19%	51.92%	53.06%	43.93%	47.62%	48.59%

This table provides results for the main specification examining the impact on corporate performance of an ESG reporting mandate for private Swedish firms from 1999

to 2020. In Columns (1) to (3), we regress $ROA\_(EBITDA)_{it}$ (operating income ($rorresul$) plus depreciation and amortization ($avskriv$) over the opening balance of total assets ($tillgsu$)) on an indicator, $Mandatory\_ESG\_Reporting_{it}$, that takes a value 1 for firm-year observations that meet the criteria for ESG mandatory reporting after 2016. In Columns (4) to (6), we measure corporate performance as $ROA\_(NI)_{it}$, which is net income ($resar$) over the opening balance of total assets ($tillgsu$). Columns (1), (2), (4) and (5) use the main sample specified in Table (1), and Columns (3) and (6) use the balanced sample that requires all firms to possess data 3 years around the adoption of the ESG mandate. Columns (1) and (4) do not include firm-level controls, whereas the remaining specifications do. These controls are the following: $Debt\text{-}to\text{-}equity_{it}$ is short-term and long-term loans ($kskkrin + lskkrin$) over the book value of equity ($eksu$). $Cash\text{-}to\text{-}Assets_{it}$ is cash and cash equivalents ($kabasu + kplacsu$) over total assets ($tillgsu$). $Tangibility_{it}$ is tangible fixed assets ($matanlsu$) over total assets ($tillgsu$). $Sales\_Growth_{i,t}$ is the yearly firm growth rate of sales ($ntoms$), $Assets\_Growth_{i,t}$ is the yearly firm growth rate of total assets ($tillgsu$), and $Employee\_Growth_{i,t}$ is the yearly firm growth rate of the number of employees ($antanst$). $Firm\_Age_{it}$ is the number of years since the company registered with the Swedish Companies Registration Office. All columns include controls for firm size in terms of total assets, sales and average number of employees as well as firm and industry-year fixed effects. The size controls are as follows: $h(Dimension^{TA})$ is the natural logarithm of total assets over the total assets threshold ($175\ M\ SEK$). $h(Dimension^{SA})$ is the natural logarithm of sales over the sales threshold ($350\ M\ SEK$). $h(Dimension^{EMP})$ is the natural logarithm of the average number of employees over the average employee threshold ($250\ employees$). $Size^{TA}$ is an indicator variable that takes a value of one if total assets exceed the total assets threshold ($175\ M\ SEK$) and zero otherwise. $Size^{SA}$ is an indicator variable taking a value of one if sales exceed the sales threshold ($350\ M\ SEK$) and zero otherwise. $Size^{EMP}$ is an indicator variable taking a value of one if the average number of employees exceeds the average number of employees threshold ($250\ employees$) and zero otherwise. All of the controls, both firm level controls and size controls, are interacted with the variable $Post\_Treatment_{t}$, which takes a value of 1 for observations after 2016. For brevity, the results for size and firm-level controls are not reported. We report coefficients and firm-clustered robust T statistics in parentheses. $*$, $**$, and $***$ denote statistical significance at the two-tailed 10%, 5%, and 1% levels, respectively.

Table 5. Mandatory ESG reporting and compliance: supply-chain mechanism

Panel A. Business-to-business versus business-to-consumers				
	N	Mean	Difference (1)-(2)	T-statistic
B2C (1)	418	0.414	-0.117***	-3.09
B2B (2)	294	0.531		

Panel B. Differentiation strategy versus cost leadership.				
	N	Mean	Difference (1)-(2)	T-statistic
Cost (1)	293	0.457	-0.059	-1.18
Differentiation (2)	155	0.516		

Panel C. High versus low competition.				
	N	Mean	Difference (1)-(2)	T-statistic
Low Competition (1)	246	0.378	-0.128***	-3.29
High Competition (2)	466	0.506		

In this table, we test the compliance of private Swedish firms with the ESG reporting mandate for a cross-section of: (1) firms that are members of the B2B/B2C industries (Panel A); (2) firms following a differentiation strategy versus those following cost leadership (Panel B); and (3) firms that are exposed to high competition markets versus those that experience lower levels of product market competition. *B2C* is an indicator that takes a value of 1 if a company belongs to a B2C industry. *B2B* is an indicator that takes the value 1 if a company belongs to a B2B industry. *Cost* is an indicator that takes a value of 1 if a company follows a cost leadership strategy, which we define as a company that shows a lower than industry median level of return on sales (*resar/ntoms*) and a higher than industry median of asset turnover (*ntoms/tillgsu*). *Differentiation* is an indicator that takes a value of 1 if a company follows a differentiation strategy, which we define as a company that shows a higher than the industry median level of return on sales (*resar/ntoms*) and a lower than the industry median of asset turnover (*ntoms/tillgsu*). We define the remaining firms that do not follow either of the two strategies as a *Mixed_Strategy* firm, which we do not include in this analysis. *Low Competition* is an indicator that takes a value of 1 if an industry faces a level of product market competition (Herfindahl-Hirschman index based on sales calculated at the industry level) that is lower than the yearly median. *High Competition* is an indicator that takes a value of 1 if an industry faces a level of product market competition (Herfindahl-Hirschman index based on sales calculated at the industry level) that is higher than the yearly median. All observations are from firms in the treated group and for the post-treatment (mandatory) period. $*$, $**$, and $***$ denote statistical significance at the two-tailed 10%, 5%, and 1% levels, respectively.

Table 6. Mandatory ESG reporting and corporate performance: supply-chain mechanism

Panel A. Business-to-business versus business-to-consumers.

	ROA_(EBITDA)$_{i,t}$			ROA_(NI)$_{i,t}$		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Mandatory_ESG_Reporting$_{i,t}$	0.011**	0.010**	0.013**	0.006*	0.007**	0.008**
	(2.33)	(2.15)	(2.48)	(1.77)	(2.10)	(2.30)
Mandatory_ESG_Reporting$_{i,t} \times B2B_j$	**0.006***	**0.004**	**0.004**	**0.001**	**0.000**	**-0.000**
	(1.92)	**(1.01)**	**(1.08)**	**(0.37)**	**(0.08)**	**(-0.01)**
Firm controls?	No	Yes	Yes	No	Yes	Yes
$h(Dimension^{TA})$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{SA})$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{EMP})$?	Yes	Yes	Yes	Yes	Yes	Yes
$Size^{TA}$?	Yes	Yes	Yes	Yes	Yes	Yes
$Size^{SA}$?	Yes	Yes	Yes	Yes	Yes	Yes
$Size^{EMP}$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{TA}) \times Size^{TA}$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{SA}) \times Size^{SA}$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{EMP}) \times Size^{EMP}$?	Yes	Yes	Yes	Yes	Yes	Yes
Total Assets Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Sales Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Employee Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Control function?	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Firm & Year	Firm & Year	Firm & Year	Firm & Year	Firm & Year	Firm & Year
Balanced sample?	No	No	Yes	No	No	Yes
Unique firms	126,397	126,397	67,128	126,397	126,397	67,128
Firm-year observations	1,088,674	1,088,674	703,882	1,088,674	1,088,674	703,882
Adjusted R^2	49.84%	51.61%	52.66%	43.59%	47.34%	48.23%

In this table, we test the impact of mandatory ESG reporting on the corporate performance of private Swedish firms for a cross-section of: (1) firms that are members of the B2B/B2C industries (Panel A); (2) firms following a differentiation strategy versus those following cost leadership (Panel B); and (3) firms that are exposed to high competition markets versus those that experience lower levels of product market competition. In Panel A, Columns (1) to (3), we regress $ROA\_(EBITDA)_{it}$ (operating income ($rorresul$) plus depreciation and amortization ($avskriv$) over the opening balance of total assets ($tillgsu$)) on an indicator, $Mandatory\_ESG\_Reporting_{it}$, that takes a value of 1 for firm-year observations that meet the criteria for ESG mandatory reporting after 2016 plus the interaction of $Mandatory\_ESG\_Reporting_{it}$ with $B2B$, an indicator that takes a value of 1 if a company belongs to a B2B industry. In Columns (4) to (6), we measure corporate performance as $ROA\_(NI)_{it}$, which equals net income ($resar$) over the opening balance of total assets ($tillgsu$). Columns (1), (2), (4) and (5) use the main sample specified in Table (1), and Columns (3) and (6) use the balanced sample that requires all firms to possess data 3 years around the adoption of the ESG mandate. Columns (1) and (4) do not include firm-level controls, whereas the remaining specifications do. These controls are the following: $Debt\text{-}to\text{-}equity_{it}$ is short-term and long-term loans ($kskkrin + lskkrin$) over the book value of equity ($eksu$). $Cash\text{-}to\text{-}Assets_{it}$ is cash and cash equivalents ($kabasu + kplacsu$) over total assets ($tillgsu$). $Tangibility_{it}$ is tangible fixed assets ($matanlsu$) over total assets ($tillgsu$). $Sales\_Growth_{i,t}$ is the yearly firm growth rate of sales ($ntoms$), $Assets\_Growth_{i,t}$ is the yearly firm growth rate of total assets ($tillgsu$), and $Employee\_Growth_{i,t}$ is the yearly firm growth rate of the number of employees ($antanst$). $Firm\_Age_{it}$ is the number of years since the company registered with the Swedish Companies Registration Office. All columns include controls for firm size in terms of total assets, sales and average number of employees as well as firm and year fixed effects. The size controls are as follows: $h(Dimension^{TA})$ is the natural logarithm of total assets over the total assets threshold ($175\ M\ SEK$). $h(Dimension^{SA})$ is the natural logarithm of sales over the sales threshold ($350\ M\ SEK$). $h(Dimension^{EMP})$ is the natural logarithm of the average number of employees over the average employee threshold ($250\ employees$). $Size^{TA}$ is an indicator variable taking a value of one if total assets exceed the total assets threshold ($175\ M\ SEK$) and zero otherwise. $Size^{SA}$ is an indicator variable taking a value of one if sales exceed the sales threshold ($350\ M\ SEK$) and zero otherwise. $Size^{EMP}$ is an indicator variable taking a value of one if the average number of employees exceeds the average number of employees threshold ($250\ employees$) and zero otherwise. All of the controls, both firm level controls and size controls, are interacted with the variable $Post\_Treatment_t$, which takes a value of 1 for observations after 2016. For brevity, the results for size and firm-level controls are not reported. We report coefficients and firm-clustered robust T statistics in parentheses. $*$, $**$, and $***$ denote statistical significance at the two-tailed 10%, 5%, and 1% levels, respectively.

Table 6. Cont'd.

Panel B. Differentiation strategy versus cost leadership.

	ROA_(EBITDA)$_{i,t}$			ROA_(NI)$_{i,t}$		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Mandatory_ESG_Reporting$_{i,t}$	0.017***	0.014**	0.015**	0.004	0.005	0.004
	(2.60)	(2.25)	(2.37)	(0.83)	(0.95)	(0.87)
Mandatory_ESG_Reporting$_{i,t}$ $\times Differentiation_{i,t}$	**0.019***	**0.020***	**0.017***	**0.023***	**0.023***	**0.022***
	(3.43)	**(3.39)**	**(3.08)**	**(5.41)**	**(5.29)**	**(5.55)**
Firm controls?	No	Yes	Yes	No	Yes	Yes
h(Dimension^{TA})?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{SA})?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{EMP})?	Yes	Yes	Yes	Yes	Yes	Yes
Size^{TA}?	Yes	Yes	Yes	Yes	Yes	Yes
Size^{SA}?	Yes	Yes	Yes	Yes	Yes	Yes
Size^{EMP}?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{TA})$\times$Size^{TA}?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{SA})$\times$Size^{SA}?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{EMP})$\times$Size^{EMP}?	Yes	Yes	Yes	Yes	Yes	Yes
Total Assets Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Sales Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Employee Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Control function?	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year
Balanced sample?	No	No	Yes	No	No	Yes
Unique firms	126,397	126,397	67,128	126,397	126,397	67,128
Firm-year observations	1,088,674	1,088,674	703,882	1,088,674	1,088,674	703,882
Adjusted R^2	59.71%	60.40%	61.05%	57.34%	59.29%	59.53%

In Panel B, Columns (1) to (3), we regress $ROA\_(EBITDA)_{it}$ (operating income ($rorresul$) plus depreciation and amortization ($avskriv$) over the opening balance of total assets ($tillgsu$)) on an indicator, $Mandatory\_ESG\_Reporting_{it}$, which takes a value of 1 for firm-year observations that meet the criteria for ESG mandatory reporting after 2016 plus the interaction of $Mandatory\_ESG\_Reporting_{it}$ with $Differentiation$, an indicator that takes a value of 1 if a company follows a differentiation strategy, which we define as a company that shows a higher than industry median level of return on sales ($resar/ntoms$) and a lower than industry median of asset turnover ($ntoms/tillgsu$). We define the remaining firms that do not follow either of the two strategies as a $Mixed\_Strategy$ firm. We include the latter in this analysis and interact it as well with $Mandatory\_ESG\_Reporting_{it}$ so that the basis for comparison are firms that follow a cost leadership strategy. In Columns (4) to (6), we measure corporate performance as $ROA\_(NI)_{it}$, which is net income ($resar$) over the opening balance of total assets ($tillgsu$). Columns (1), (2), (4) and (5) use the main sample specified in Table (1), and Columns (3) and (6) use the balanced sample that requires all firms to possess data 3 years around the adoption of the ESG mandate. Columns (1) and (4) do not include firm-level controls, whereas the remaining specifications do. These controls are as follows: $Debt\text{-}to\text{-}equity_{it}$ is short-term and long-term loans ($kskkrin+lskkrin$) over the book value of equity ($eksu$). $Cash\text{-}to\text{-}Assets_{it}$ is cash and cash equivalents ($kabasu+kplacsu$) over total assets ($tillgsu$). $Tangibility_{it}$ is tangible fixed assets ($matanlsu$) over total assets ($tillgsu$). $Sales\_Growth_{i,t}$ is the yearly firm growth rate of sales ($ntoms$), $Assets\_Growth_{i,t}$ is the yearly firm growth rate of total assets ($tillgsu$), and $Employee\_Growth_{i,t}$ is the yearly firm growth rate of the number of employees ($antanst$). $Firm\_Age_{it}$ is the number of years since the company registered with the Swedish Companies Registration Office. All columns include controls for firm size in terms of total assets, sales and average number of employees as well as firm and industry-year fixed effects. The size controls are as follows: $h(Dimension^{TA})$ is the natural logarithm of total assets over the total assets threshold ($175\ M\ SEK$). $h(Dimension^{SA})$ is the natural logarithm of sales over the sales threshold ($350\ M\ SEK$). $h(Dimension^{EMP})$ is the natural logarithm of the average number of employees over the average employee threshold ($250\ employees$). $Size^{TA}$ is an indicator variable taking a value of one if total assets exceed the total assets threshold ($175\ M\ SEK$) and zero otherwise. $Size^{SA}$ is an indicator variable taking a value of one if sales exceed the sales threshold ($350\ M\ SEK$) and zero otherwise. $Size^{EMP}$ is an indicator variable taking a value of one if the average number of employees exceeds the average number of employees threshold ($250\ employees$) and zero otherwise. All of the controls, both firm level controls and size controls, are interacted with the variable $Post\_Treatment_t$, which takes a value of 1 for observations after 2016. For brevity, the results for size and firm-level controls are not reported. We report coefficients and firm-clustered robust T statistics in parentheses. $*$, $**$, and $***$ denote statistical significance at the two-tailed 10%, 5%, and 1% levels, respectively.

Table 6. Cont'd.

Panel C. High versus low competition.

	ROA_(EBITDA)$_{i,t}$			ROA_(NI)$_{i,t}$		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Mandatory_ ESG_ Reporting$_{i,t}$	0.011**	0.007	0.008	0.004	0.005	0.006
	(2.08)	(1.37)	(1.39)	(1.22)	(1.38)	(1.47)
Mandatory_ ESG_ Reporting$_{i,t}$ ×*High_ Competition*$_{i,t}$	**0.007***	**0.012***	**0.013***	**0.006***	**0.007***	**0.008***
	(1.65)	**(2.75)**	**(2.88)**	**(1.89)**	**(2.33)**	**(2.38)**
Firm controls?	No	Yes	Yes	No	Yes	Yes
h(Dimension^{TA})?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{SA})?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{EMP})?	Yes	Yes	Yes	Yes	Yes	Yes
Size^{TA}?	Yes	Yes	Yes	Yes	Yes	Yes
Size^{SA}?	Yes	Yes	Yes	Yes	Yes	Yes
Size^{EMP}?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{TA})×Size^{TA}?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{SA})×Size^{SA}?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{EMP})×Size^{EMP}?	Yes	Yes	Yes	Yes	Yes	Yes
Total Assets Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Sales Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Employee Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Control function?	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year
Balanced sample?	No	No	Yes	No	No	Yes
Unique firms	126,397	126,397	67,132	126,397	126,397	67,128
Firm-year observations	1,088,674	1,088,674	703,882	1,088,674	1,088,674	703,882
Adjusted R^2	50.19%	51.92%	53.06%	43.93%	47.62%	48.59%

In Panel C, Columns (1) to (3), we regress $ROA\_(EBITDA)_{it}$ (operating income ($rorresul$) plus depreciation and amortization ($avskriv$) over the opening balance of total assets ($tillgsu$)) on an indicator, $Mandatory\_ESG\_Reporting_{it}$, that takes a value of 1 for firm-year observations that meet the criteria for ESG mandatory reporting after 2016 plus the interaction of $Mandatory\_ESG\_Reporting_{it}$ with $High\ Competition$, which is an indicator that takes a value of 1 if an industry faces a level of product market competition (HerfindahlHirschman index based on sales calculated at the industry level) that is higher than the yearly median. In Columns (4) to (6), we measure corporate performance as $ROA\_(NI)_{it}$, which equals net income ($resar$) over the opening balance of total assets ($tillgsu$). Columns (1), (2), (4) and (5) use the main sample specified in Table (1), and Columns (3) and (6) use the balanced sample that requires all firms to possess data 3 years around the adoption of the ESG mandate. Columns (1) and (4) do not include firm-level controls, whereas the remaining specifications do. These controls are as follows: $Debt\text{-}to\text{-}equity_{it}$ is short-term and long-term loans ($kskkrin+lskkrin$) over the book value of equity ($eksu$). $Cash\text{-}to\text{-}Assets_{it}$ is cash and cash equivalents ($kabasu+kplacsu$) over total assets ($tillgsu$). $Tangibility_{it}$ is tangible fixed assets ($matanlsu$) over total assets ($tillgsu$). $Sales\_Growth_{i,t}$ is the yearly firm growth rate of sales ($ntoms$), $Assets\_Growth_{i,t}$ is the yearly firm growth rate of total assets ($tillgsu$), and $Employee\_Growth_{i,t}$ is the yearly firm growth rate of the number of employees ($antanst$). $Firm\_Age_{it}$ is the number of years since the company registered with the Swedish Companies Registration Office. All columns include controls for firm size in terms of total assets, sales and average number of employees as well as firm and industry-year fixed effects. The size controls are as follows: $h(Dimension^{TA})$ is the natural logarithm of total assets over the total assets threshold ($175\ M\ SEK$). $h(Dimension^{SA})$ is the natural logarithm of sales over the sales threshold ($350\ M\ SEK$). $h(Dimension^{EMP})$ is the natural logarithm of the average number of employees over the average employee threshold ($250\ employees$). $Size^{TA}$ is an indicator variable taking a value of one if total assets exceed the total assets threshold ($175\ M\ SEK$) and zero otherwise. $Size^{SA}$ is an indicator variable taking a value of one if sales exceed the sales threshold ($350\ M\ SEK$) and zero otherwise. $Size^{EMP}$ is an indicator variable taking a value of one if the average number of employees exceeds the average number of employees threshold ($250\ employees$) and zero otherwise. All of the controls, both firm level controls and size controls, are interacted with the variable $Post\_Treatment_t$, which takes a value of 1 for observations after 2016. For brevity, the results for size and firm-level controls are not reported. We report coefficients and firm-clustered robust T statistics in parentheses. $*$, $**$, and $***$ denote statistical significance at the two-tailed 10%, 5%, and 1% levels, respectively.

Table 7. Mandatory ESG reporting and financing outcomes

	Interest_Rate$_{i,t}$			Pledged_Assets$_{i,t}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Mandatory_ESG_Reporting$_{i,t}$	-0.005**	-0.004**	-0.005**	-0.105***	-0.110***	-0.123***
	(-2.49)	(-2.36)	(-2.27)	(-4.44)	(-4.66)	(-4.51)
Firm controls?	No	Yes	Yes	No	Yes	Yes
h(Dimension^{TA})?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{SA})?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{EMP})?	Yes	Yes	Yes	Yes	Yes	Yes
Size^{TA}?	Yes	Yes	Yes	Yes	Yes	Yes
Size^{SA}?	Yes	Yes	Yes	Yes	Yes	Yes
Size^{EMP}?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{TA})×Size^{TA}?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{SA})×Size^{SA}?	Yes	Yes	Yes	Yes	Yes	Yes
h(Dimension^{EMP})×Size^{EMP}?	Yes	Yes	Yes	Yes	Yes	Yes
Total Assets Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Sales Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Employee Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Control function?	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year
Balanced sample?	No	No	Yes	No	No	Yes
Unique firms	60,627	60,627	34,817	58,497	58,497	33,652
Firm-year observations	422,093	422,093	279,764	410,633	410,633	271,595
Adjusted R^2	52.24%	54.42%	55.01%	63.12%	63.00%	64.00%

This table provides results for the specification that explores the impact of mandatory ESG reporting on firms' financial outcomes. In Columns (1) to (3), we regress *Interest_Rate$_{i,t}$* as the external interest rate, i.e., the interest paid on short-term and long-term loans to credit institutions (*rtekoext*) over the opening balance of short-term and long-term loans (*kskkrin + lskkrin*) on an indicator, *Mandatory_ESG_Reporting$_{it}$*, which takes a value of 1 for firm-year observations that meet the

criteria for ESG mandatory reporting after 2016. In Columns (4) to (6), we use $Pledged\_Assets_{i,t}$ as an outcome, which we define as the sum of pledged assets, i.e., company's property used as security in connection with a loan arrangement, usually a bank loan, over the value of total assets ($tillgsu$). Columns (1), (2), (4) and (5) use the main sample specified in Table (1), and Columns (3) and (6) use the balanced sample that requires all firms to possess data 3 years around the adoption of the ESG mandate. The data is restricted to firms that show positive levels of debt and therefore possess information on interest paid on short-term and long-term loans to credit institutions ($rtekoext$). Columns (1) and (4) do not include firm-level controls, whereas the remaining specifications do. These controls are as follows: $Debt$-to-$equity_{it}$ is short-term and long-term loans ($kskkrin + lskkrin$) over the book value of equity ($eksu$). $Cash$-to-$Assets_{it}$ is cash and cash equivalents ($kabasu + kplacsu$) over total assets ($tillgsu$). $Tangibility_{it}$ is tangible fixed assets ($matanlsu$) over total assets ($tillgsu$). $Sales\_Growth_{i,t}$ is the yearly firm growth rate of sales ($ntoms$), $Assets\_Growth_{i,t}$ is the yearly firm growth rate of total assets ($tillgsu$), and $Employee\_Growth_{i,t}$ is the yearly firm growth rate of the number of employees ($antanst$). $Firm\_Age_{it}$ is the number of years since the company registered with the Swedish Companies Registration Office. All columns include controls for firm size in terms of total assets, sales and average number of employees as well as firm and industry-year fixed effects. The size controls are as follows: $h(Dimension^{TA})$ is the natural logarithm of total assets over the total assets threshold ($175\ M\ SEK$). $h(Dimension^{SA})$ is the natural logarithm of sales over the sales threshold ($350\ M\ SEK$). $h(Dimension^{EMP})$ is the natural logarithm of the average number of employees over the average employee threshold ($250\ employees$). $Size^{TA}$ is an indicator variable taking a value of one if total assets exceed the total assets threshold ($175\ M\ SEK$) and zero otherwise. $Size^{SA}$ is an indicator variable taking a value of one if sales exceed the sales threshold ($350\ M\ SEK$) and zero otherwise. $Size^{EMP}$ is an indicator variable taking a value of one if the average number of employees exceeds the average number of employees threshold ($250\ employees$) and zero otherwise. All of the controls, both firm level controls and size controls, are interacted with the variable $Post\_Treatment_t$, which takes a value of 1 for observations after 2016. For brevity, the results for size and firm-level controls are not reported. We report coefficients and firm-clustered robust T statistics in parentheses. $*$, $**$, and $***$ denote statistical significance at the two-tailed 10%, 5%, and 1% levels, respectively.

Online Appendix

Mandatory ESG Reporting and Corporate Performance

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OA.1 Further channels: the credible commitment channel

In our mechanism discussion (Section 2), we focus on two main channels–namely, the supply chain channel and the financing channel–through which an ESG reporting mandate potentially affects firms' corporate performance. We expect these two main channels to largely explain the consequences of mandatory ESG reporting on corporate performance; however, we acknowledge that there are other channels that, in addition to our previous discussed channels, could partially explain the effect on corporate performance.

In this section, we explore a credible commitment channel through one of the main stakeholders: employees. We posit that investments in establishing credible commitments with employees can also increase employee productivity, which is a plausible mechanism through which corporate performance can increase (Chen et al. [2016]; Gubler et al. [2018]; Sandvik et al. [2021]). We test whether the Swedish ESG reporting mandate impacted two employee-level outcomes: employee salaries ($Ln(Salary)_{i,t}$) and employee productivity ($Emp\_Productivity_{i,t}$), as a channel of the corporate performance increase among firms subject to the mandate.

Table OA.1 reports the estimation results for $Ln(Salary)_{i,t}$ and $Emp_P roductivity_{i,t}$. We find, on average, that once the ESG reporting mandate comes into effect, mandated firms experience an increase in $Ln(Salary)_{i,t}$ that ranges from 14% (t-statistic: 1.92) to 19.9% (t-statistic: 2.44). These effects imply an increase in personnel expenses (salary and contributions to social security) of SEK 32,700 ($\approx$ USD 3,924) per employee to SEK 46,500 ($\approx$ USD 5,580) per employee approximately. In terms of productivity, after the mandate becomes effective, mandate firms exhibit an average increase in $Emp\_Producitivity_{i,t}$ that ranges from 5.9% (t-statistic: 2.68) to 6.2% (t-statistic: 3.10).

In sum, these results suggest that the ESG reporting mandate incentivizes firms to credibly invest in their stakeholders and, in this case, improve the relationship with their employees, which materializes in higher employee productivity. Thus, establishing credible commitments towards core firm stakeholders can enhance firm performance. However, this channel is more likely to only partially explain the effect on corporate performance from mandatory ESG reporting in the setting we study.

OA.2 Description of matched samples

In this section, we provide detailed instructions on how we obtained our matched sample evidence for our robustness checks. We employ the same matching methodology for our RDD robustness check in the following section of the Online Appendix.

First, we start with a propensity score matching algorithm. We begin by basing our matched sample using data from the last pre-treatment period, i.e., 2016. We use our firm-level controls, growth in the size variables

and industry membership, to obtain our matched sample. We do not include size dimensions in levels for our matching procedures as we matched on our main assignment rule, which is based in 2016 and thus would be perfectly explained by the size variables of levels. These covariates are as follows: $Leverage_{i,t}$ is short-term and long-term loans ($kskkrin + lskkrin$) over the book value of equity ($eksu$), $Liquidity_{i,t}$ is cash and cash equivalents ($kabasu + kplacsu$) over total assets ($tillgsu$), $Tangibility_{i,t}$ is tangible fixed assets ($matanlsu$) over total assets ($tillgsu$), and $Firm\_Age_{it}$ is the number of years since the company registered with the Swedish Companies Registration Office. And our growth variables are the following: $Sales\_Growth_{i,t}$ is the yearly firm growth rate of sales ($ntoms$), $Assets\_Growth_{i,t}$ is the yearly firm growth rate of total assets ($tillgsu$), and $Employee\_Growth_{i,t}$ is the yearly firm growth rate of the number of employees ($antanst$).

We identify the firms that in 2016 fulfill the criteria outlined in the amendment to Årsredovisningslag (1995:1554), Chapter 6 Section 10. We simplify these criteria to be met for only one period, i.e., only for 2016. The criteria are as follows: (a) on average, firms report more than 250 employees; (b) firms report total assets exceeding SEK 175 million ($\approx$ USD 21 million); or (c) firms report net sales larger than SEK 350 million ($\approx$ USD 42 million). We have 840 firms that meet the aforementioned requirements, and 840 control firms are matched on their propensity score. We use the following options for our propensity score matching process: a one-to-one matching algorithm, without replacement, using a descending order and the logit option. After populating the remaining data based on the 2016 match, we have 24,494 firm-year observations for the 1999-2020 period. Of these, approximately 44% pertains to treated firms and approximately 56% to control firms. In our regression analysis, these observations are lower, given singletons in the fixed effects groupings.

Alternatively, we provide evidence for an alternative propensity score matching algorithm. Instead of using a one-to-one matching algorithm, we use a one-to-ten matching algorithm requiring a caliper of 0.05 and common support between the matched groups. We also use the logit option in this instance as well. In this case, several control firms in 2016 can be matched controls to the same treated firm. In this instance, we obtain 97,404 firm-year observations.

Furthermore, we employ a coarsened exact matching procedure where we use the same variables and base year as in our propensity score matching procedure. We use Sturges algorithm to allow for the autocuts in our variables except for industry membership, in which we require that the treated and control firm be in the same industry (exact matching without coarsening). With this procedure, we obtain 34,382 firm-year observations. We allow for control firms to be matches for several treated firms. In our regression analysis, these observations are lower, given singletons in the fixed effects groupings.

Finally, we provide evidence using the entropy balancing method. In this instance, we re-weight the observations in our main specification after the balancing procedure generates new weights for treated and control

observations. We use the full sample and the same variables as before with the following requirements: we use the first moment in the distributions of our variables, and the maximum difference between the first moment of the matched treatment and control observations should be 0.05.

All the matching procedures are consistent with our main results. These tests are provided in this Online Appendix Table OA.2.

OA.3   Regression discontinuity design

Our main research design is based on a difference-in-differences setting and a regression discontinuity design. We adopt this approach to exploit both cross-sectional and time series variation in our setting. Alternatively, we may exploit the cross-sectional variation in Sweden's adoption of the EU directive. This legislation provides variation in firms' nonfinancial disclosure resulting from the multithreshold size criteria associated with mandatory disclosure requirements. Sweden's annual reporting law requires firms that, for the last two financial years, have met two of three criteria ((a) on average, they have more than 250 employees; (b) they report total assets exceeding SEK 175 million ($\approx$ USD 21 million); or (c) they report net sales larger than SEK 350 million ($\approx$ USD 42 million)) to disclose nonfinancial information regarding their policies and outcomes on ESG issues. This requirement should lead to discontinuous nonfinancial disclosure for similar firms around the thresholds. This setting allows us to implement a variant of the regression discontinuity design where the treatment is assigned based on multiple assignment variables, in this case, assets, sales and the average number of employees. Following Reardon and Robinson [2012] and Breuer et al. [2018], the decision rule is as follows for the last year before adoption, i.e., 2016:

$$
Treatment_{i,2016} = \begin{cases} 1 & if\ min\left\{ \sum_{n=1}^{3} \sum_{n \neq m} Size_{i,2016}^n Size_{i,2016}^m \right\} > 0 \\ 0 & if\ min\left\{ \sum_{n=1}^{3} \sum_{n \neq m} Size_{i,2016}^n Size_{i,2016}^m \right\} = 0 \end{cases} \tag{1}
$$

where $Size_{i,2016}^1$ is an indicator equal to one if the $Total\_Assets_{i,2016}$ ($Dimension_{i,2016}^{TA}$) of firm i exceeds the total assets threshold ($T_2^{TA}016$), $Size_{i,2016}^2$ is an indicator equal to one if the $Sales_{i,2016}$ ($Dimension_{i,2016}^{Sale}$) of firm i exceeds the sales threshold ($T_2^{Sale}016$) and $Size_{i,2016}^3$ is an indicator equal to one if the number $Avg\_Employees_{i,2016}$ ($Dimension_{i,2016}^{EMP}$) of firm i exceeds the employee threshold ($T_2^{EMP}016$). $Mandatory\_ESG\_Reporting_{i,2016}$ is a discontinuous function of the three criteria that classifies firms based on whether they are required to disclose nonfinancial information. Firms are subject to mandatory nonfinancial disclosure if they have surpassed two of the three thresholds (total assets, sales or average number of employees) for 2016. We employ 2016 as a reference because it is the year right before the adoption of the amendment and to obtain a

time invariant treatment. We follow this rule as well for our main diff-in-diff RDD specification. In this instance, we do not use the time variation in the timing of the adoption but rather, focus only on the post-treatment period, i.e., 2017 to 2020.

We estimate the following specification:

$$ROA_{i,t} = \alpha Treatment_{i,2016} + \pi f(Dimension_{i,t}) + \gamma Controls + \theta_j \times \iota_t + \epsilon_{i,t} \tag{2}$$

where $ROA_{i,t}$ is the measure of corporate performance of firm i in year t, $Treatment_{i,2016}$ is the time invariant decision rule, and $f(Dimension_{i,t})$ is a control function similar to that of Breuer et al. [2018]:

$$\psi f(Dimension_{i,t}) = \sum_{n=1}^{3} \psi_n Size_{i,t}^n + \sum_{n=1}^{3} \psi_{3+n} h(Dimension_{i,t}^n)$$
$$+ \sum_{n=1}^{3} \psi_{6+n} Size_{i,t}^n \times h(Dimension_{i,t}^n)$$

where $h(Dimension_{i,t}^n)$ is the natural logarithm of $Dimension_{i,t}^n$ over T_t^n. $Controls$ is a vector including firm-level variables such as leverage, liquidity, tangibility and firm age, plus growth variables for total assets, sales and the number of employees. θ_j is industry fixed effects, and ι_t is year fixed effects. We cluster standard errors at the firm level.

Studies that implement regression discontinuity designs tend to restrict their sample to observations close to the bandwidth. However, since, in our setting, there are three thresholds for the different dimensions, we follow prior literature in choosing the full sample to carry out the analyses (Reardon and Robinson [2012]; Breuer et al. [2018]). Alternatively, we provide consistent results using alternative data winsorization procedures, clustering, fixed effects structures, treatment and control assignment rules, different functional forms, matched sample evidence and alternative measures of corporate performance. All these tests are included in this Online Appendix Table OA.3.

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OA.4 Tables

Table OA.1. Mandatory ESG reporting and employee outcomes

	$\mathbf{Ln(Salary)}_{i,t}$			$\mathbf{Emp\_Productivity}_{i,t}$		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Mandatory_ ESG_ Reporting$_{i,t}$	**0.156****	**0.140***	**0.199*****	**0.062*****	**0.060*****	**0.059*****
	(2.13)	**(1.92)**	**(2.69)**	**(3.10)**	**(3.02)**	**(2.68)**
Firm controls?	No	Yes	Yes	No	Yes	Yes
$h(Dimension^{TA})$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{SA})$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{EMP})$?	Yes	Yes	Yes	Yes	Yes	Yes
$Size^{TA}$?	Yes	Yes	Yes	Yes	Yes	Yes
$Size^{SA}$?	Yes	Yes	Yes	Yes	Yes	Yes
$Size^{EMP}$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{TA}) \times Size^{TA}$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{SA}) \times Size^{SA}$?	Yes	Yes	Yes	Yes	Yes	Yes
$h(Dimension^{EMP}) \times Size^{EMP}$?	Yes	Yes	Yes	Yes	Yes	Yes
Total Assets Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Sales Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Employee Growth?	Yes	Yes	Yes	Yes	Yes	Yes
Control function?	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year	Firm & Industry-Year
Balanced sample?	No	No	Yes	No	No	Yes
Unique firms	126,397	126,397	67,128	122,429	122,429	65,634
Firm-year observations	1,088,674	1,088,674	703,882	1,055,033	1,055,033	686,085
Adjusted R^2	73.97%	73.99%	74.14%	93.83%	93.83%	94.28%

This table provides results for the specification that explores the impact of mandatory ESG reporting on firms' employee level outcomes. In Columns (1) to (3), we regress $Ln(Salary)_{i,t}$, which equals the natural logarithm of one plus the annual total salary and social security expenditure ($perskos$), on an indicator, $Mandatory\_ESG\_Reporting_{it}$, which takes a value of 1 for firm-year observations that meet the criteria for ESG mandatory reporting after 2016. In Columns (4) to (6), we use $Emp\_Productivity_{it}$ as an outcome, which is the natural logarithm of sales ($ntoms$) per employee ($antanst$). Columns (1), (2), (4) and (5) use the main sample specified in Table (1) of the main manuscript, and Columns (3) and (6) use the balanced sample that requires all firms to possess data 3 years around the adoption of the ESG mandate. Columns (1) and (4) do not include firm-level controls, whereas the remaining specifications do. These controls are as follows: $Debt\text{-}to\text{-}equity_{it}$ is short-term and long-term loans ($kskkrin + lskkrin$) over the book value of equity ($eksu$). $Cash\text{-}to\text{-}Assets_{it}$ is cash and cash equivalents ($kabasu + kplacsu$) over total assets ($tillgsu$). $Tangibility_{it}$ is tangible fixed assets ($matanlsu$) over total assets ($tillgsu$). $Sales\_Growth_{i,t}$ is the yearly firm growth rate of sales ($ntoms$), $Assets\_Growth_{i,t}$ is the yearly firm growth rate of total assets ($tillgsu$), and $Employee\_Growth_{i,t}$ is the yearly firm growth rate of the number of employees ($antanst$). $Firm\_Age_{it}$ is the number of years since the company registered with the Swedish Companies Registration Office. All columns include controls for firm size in terms of total assets, sales and average number of employees as well as firm and industry-year fixed effects. The size controls are as follows: $h(Dimension^{TA})$ is the natural logarithm of total assets over the total assets threshold ($175\ M\ SEK$). $h(Dimension^{SA})$ is the natural logarithm of sales over the sales threshold ($350\ M\ SEK$). $h(Dimension^{EMP})$ is the natural logarithm of the average number of employees over the average employee threshold ($250\ employees$). $Size^{TA}$ is an indicator variable taking a value of one if total assets exceed the total assets threshold ($175\ M\ SEK$) and zero otherwise. $Size^{SA}$ is an indicator variable taking a value of one if sales exceed the sales threshold ($350\ M\ SEK$) and zero otherwise. $Size^{EMP}$ is an indicator variable taking a value of one if the average number of employees exceeds the average number of employees threshold ($250\ employees$) and zero otherwise. All of the controls, both firm level controls and size controls are interacted with the variable $Post\_Treatment_t$, which takes a value of 1 for observations after 2016. For brevity, the results for size and firm-level controls are not reported. We report coefficients and firm-clustered robust T statistics in parentheses. $*$, $**$, and $***$ denote statistical significance at the two-tailed 10%, 5%, and 1% levels, respectively.

Table OA.2. Difference-in-differences regression discontinuity design robustness tests

Equation (2) in Table 4 Columns (2) and (5) serve as base specification	N	ROA_(EBITDA)$_{i,t}$	ROA_(NI)$_{i,t}$
(1) Alternative winsorization [5% top and bottom]:			
- Double winsorization: winsorizing both raw data and final variables	1,088,674	0.014***	0.010***
		(3.13)	(3.19)
- Winsorization at the year level	1,088,674	0.014***	0.010***
		(3.11)	(3.12)
- Winsorization at the industry level	1,088,674	0.011**	0.008**
		(2.45)	(2.40)
- Winsorization at the year-industry level	1,088,674	0.013**	0.008**
		(2.54)	(2.29)
(2) Alternative clustering:			
- Clustering by firm and year	1,088,674	0.013**	0.009*
		(2.05)	(1.92)
- Clustering by year	1,088,674	0.013**	0.009**
		(2.26)	(2.11)
- Clustering by industry	1,088,674	0.013***	0.009***
		(3.17)	(2.80)
- Clustering by location	1,087,239	0.013***	0.008***
		(3.41)	(4.78)
(3) Alternative fixed effects structures:			
- Firm and Year	1,090,014	0.012***	0.007**
		(2.79)	(2.34)
- Firm and Location-Year	1,088,271	0.011**	0.006**
		(2.45)	(1.97)
- Firm and Location-Industry-Year	1,033,684	0.013**	0.007*
		(2.43)	(1.68)
- Firm and Group Status-Year	1,090,014	0.010**	0.008***
		(2.44)	(2.76)

Table OA.2. Cont'd.

Equation (2) in Table 4 Columns (2) and (5) serve as base specification	N	ROA_(EBITDA)$_{i,t}$	ROA_(NI)$_{i,t}$
(4) Alternative treatment and control assignment rules			
- Dynamic assignment based on two consecutive years	1,088,674	0.029***	0.007**
		(11.00)	(2.01)
- Dynamic assignment based on one year	1,088,674	0.036***	0.013***
		(9.69)	(2.98)
- Assignment based on two consecutive years in 2016	1,088,674	0.009**	0.006*
		(2.00)	(1.88)
(5) Alternative control functions [no interaction with post treatment]:			
- Adding lagged control function for size variables [2-year dynamic assignment]	904.618	0.004*	0.011*
		(1.95)	(1.76)
- Adding lagged control function for size variables [2-year 2016 assignment]	904.618	0.004*	0.012**
		(1.87)	(2.23)
(6) Alternative functional forms [no interaction with post treatment]:			
- Second order polynomial	1,088,674	0.025***	0.008***
		(10.90)	(4.83)
- Third order polynomial	1,088,674	0.017***	0.003**
		(8.27)	(2.14)
- Fourth order polynomial	1,088,674	0.017***	0.004***
		(8.40)	(2.82)
- Fifth order polynomial	1,088,674	0.018***	0.004***
		(8.57)	(2.82)
- Interaction of treatment with functional form	1,088,674	0.042***	0.023***
		(3.71)	(2.67)
- 25 equally spaced linear splines [of size variables]	1,088,674	0.018***	0.004***
		(8.56)	(2.75)
- 50 equally spaced bins [of size variables]	1,088,674	0.011***	0.004
		(2.81)	(1.60)

OA.10

Table OA.2. Cont'd.

Equation (2) in Table 4 Columns (2) and (5) serve as base specification	N	ROA_(EBITDA)$_{i,t}$	ROA_(NI)$_{i,t}$
(7) Matched sample analyses:			
- Propensity Score Matching (1:1)	21,039	0.028***	0.011***
		(5.55)	(2.73)
- Propensity Score Matching (1:10)	94,756	0.026***	0.012***
		(9.28)	(6.04)
- Coarsened Exact Matching	31,137	0.024***	0.011***
		(4.97)	(3.02)
- Entropy Balancing	1,088,674	0.029***	0.017***
		(5.15)	(4.03)
(8) Alternative dependent variables:		$ROE_{i,t}$	$Total\_Factor\_Prod_{i,t}$
- Coefficient		0.019**	0.089***
- T-statistic		(2.48)	(5.01)
- N		904,618	906,863

OA.11

This table reports a battery of robustness tests for our main result provided in Table 4 of the main text. First, we find evidence of alternative winsorization schemes in robustness test (1). In the main analyses, we winsorize all of the continuous variables (final variables) at the bottom and top 5% of their distributions. So, in this robustness check, we winsorize at the bottom and top 5%: (1) at the raw data and final variables; (2) at the year level; (3) at the industry level; and (4) at the year and industry level. In the following robustness test, we provide evidence of alternative clustering variables. In our main analyses, we cluster standard errors at the firm level, which allows for series correlation of the error term. In robustness check (2), we cluster our standard errors: (1) at the firm and year level; (2) at the year level; (3) at the industry level; and (4) at the location level (we define location as the county where the company is headquartered). Additionally, we provide evidence for alternative fixed effects structures in robustness check (3). In the main analyses, we employ firm and year-industry fixed effects, but we also provide evidence of alternative fixed effects structures such as: (1) firm and year fixed effects; (2) firm and location-year fixed effects; (3) firm and location-industry-year; (4) firm and group

status-year (where group status is defined in terms of independent firms, parent companies or foreign subsidiaries). Furthermore, we probe the functional form we use as a control for the size dimensions. We start by providing evidence of alternative treatment and control assignment rules; in the main analyses, we use a time invariant assignment rule based on 2016 data for only one period, i.e., a company is assigned to the treatment group if it surpasses two of the three size criteria thresholds for one period (the year 2016). In robustness test (4), we use the following alternative classification rules: (1) we use a time variant (dynamic) treatment definition based on the past two consecutive years; (2) we use a time variant (dynamic) treatment definition based on the past year (not restricted to the year 2016); and (3) we use a time variant (dynamic) treatment definition based on the past two consecutive years right before adoption of the treatment, i.e., 2015 and 2016. We also probe the size control function by adding the lagged size control function. The size controls are as follows: $h(Dimension^{TA})$ is the natural logarithm of total assets over the total assets threshold (*175 M SEK*). $h(Dimension^{SA})$ is the natural logarithm of sales over the sales threshold (*350 M SEK*). $h(Dimension^{EMP})$ is the natural logarithm of the average number of employees over the average employee threshold (*250 employees*). $Size^{TA}$ is an indicator variable taking a value of one if total assets exceed the total assets threshold (*175 M SEK*) and zero otherwise. $Size^{SA}$ is an indicator variable taking a value of one if sales exceed the sales threshold (*350 M SEK*) and zero otherwise. $Size^{EMP}$ is an indicator variable taking a value of one if the average number of employees exceeds the average number of employees threshold (*250 employees*) and zero otherwise. Robustness test (5) includes said controls and the lagged size controls for: (1) the two-year dynamic assignment rule; and (2) the two-year 2016 assignment rule. These latter specifications do not include the size controls interacted with the $Post\_Treatment_t$ variable. In robustness test (6), we use alternative functional forms such as higher order polynomials (up to a fifth order polynomial) for the size control function, interact the treatment with the functional form, and create 25 equally spaced linear splines for the size variables and 50 equally spaced bins of the size variables. Then, in robustness test (7), we provide results for a matched sample using the following methods: (1) one-to-one propensity score matching; (2) one-to-ten propensity score matching; (3) coarsened exact matching; and (4) entropy balancing. Finally, robustness test (8) provides the results from using alternative measures of corporate performance. More specifically, we use ROE_{it} measured as the ratio of net income (*resar*) to the opening balance of equity (*eksu*), and $Total\_Factor\_Prodi_{i,t}$ measured as the residual from a regression of firm-level sales (natural logarithm of sales) on employee (natural logarithm of number of employees) and capital inputs (natural logarithm of property, plant and equipment productivity).

Table OA.3. Regression discontinuity design: main result and robustness tests

Equation (2) from OA.3 serves as a base specification	N	ROA_(EBITDA)$_{i,t}$	ROA_(NI)$_{i,t}$
(1) Main RDD results:			
- No firm-level controls	187,853	0.033***	0.025***
		(7.97)	(8.24)
- Firm-level controls included	187,853	0.065***	0.045***
		(16.67)	(15.06)
(2) Alternative winsorization [5% top and bottom]:			
- Double winsorization: winsorizing both raw data and final variables	187,853	0.017***	0.016***
		(6.22)	(7.27)
- Winsorization at the year level	187,853	0.017***	0.016***
		(6.12)	(7.04)
- Winsorization at the industry level	187,853	0.018***	0.016***
		(6.33)	(7.28)
- Winsorization at the year-industry level	187,853	0.021***	0.018***
		(6.30)	(6.61)
(3) Alternative clustering:			
- Clustering by firm and year	187,853	0.065***	0.045***
		(12.12)	(10.46)
- Clustering by year	187,853	0.065***	0.045***
		(14.00)	(12.04)
- Clustering by industry	187,853	0.065***	0.045***
		(13.59)	(12.65)
- Clustering by location	187,510	0.065***	0.045***
		(11.53)	(9.96)

Table OA.3. Cont'd.

Equation (2) from OA.3 serves as a base specification	N	ROA_(EBITDA)$_{i,t}$	ROA_(NI)$_{i,t}$
(4) Alternative fixed effects structures:			
- Year	188,059	0.066***	0.044***
		(17.49)	(15.50)
- Location-Year	187,716	0.066***	0.044***
		(17.39)	(15.49)
- Location-Industry-Year	177,580	0.066***	0.044***
		(14.97)	(13.19)
- Group Status-Year	188,059	0.067***	0.046***
		(17.69)	(15.98)
(5) Alternative treatment and control assignment rules			
- Dynamic assignment based on two consecutive years	187,853	0.092***	0.070***
		(20.31)	(20.63)
- Dynamic assignment based on one year	187,853	0.060***	0.050***
		(10.58)	(11.84)
- Assignment based on two consecutive years in 2016	187,853	0.058***	0.040***
		(16.05)	(14.28)
- Assignment 1 year 2016 instrumented by 1 year 2013 assignment	187,739	0.075***	0.085***
		(4.07)	(5.94)
	First stage F-Stat	290.42	290.42
(6) Alternative control functions:			
- Adding lagged control function for size variables [2-year dynamic assignment]	117,381	0.053***	0.043***
		(10.55)	(11.42)
- Adding lagged control function for size variables [2-year 2016 assignment]	117,381	0.027***	0.018***
		(7.66)	(6.56)

Equation (2) from OA.3 serves as a base specification	N	ROA_(EBITDA)$_{i,t}$	ROA_(NI)$_{i,t}$
(7) Alternative functional forms:			
- Second order polynomial	187,853	0.050***	0.031***
		(13.66)	(11.54)
- Third order polynomial	187,853	0.047***	0.028***
		(12.67)	(9.93)
- Fourth order polynomial	187,853	0.051***	0.032***
		(13.87)	(11.43)
- Fifth order polynomial	187,853	0.050***	0.031***
		(13.42)	(11.08)
- Interaction of treatment with functional form	187,853	0.013	0.004
		(1.33)	(0.56)
- 25 equally spaced linear splines [of size variables]	187,853	0.050***	0.031***
		(13.64)	(11.13)
- 50 equally spaced bins [of size variables]	187,853	0.049***	0.029***
		(14.55)	(11.68)
(8) Matched sample analyses:			
- Propensity Score Matching (1:1)	4,714	-0.004	-0.008
		(-0.48)	(-1.06)
- Propensity Score Matching (1:10)	19,904	0.030***	0.016***
		(5.75)	(3.84)
- Coarsened Exact Matching	5,475	0.028***	0.022***
		(2.89)	(2.82)
- Entropy Balancing	187,853	0.008**	0.004
		(2.43)	(1.45)
(9) Alternative dependent variables:		ROE$_{i,t}$	Total_Factor_Prodi$_{i,t}$
- Coefficient		1.035	0.138***
- T-statistic		(1.27)	(6.60)
- N		160,406	130,110

This table reports the main results and a battery of robustness tests for a regression discontinuity design for the 2017-2020 period. First, we provide evidence on the impact of mandatory ESG reporting on corporate performance for Equation (2) in Section OA.3 as a base specification. Robustness test (1) shows the results using no firm-level controls and firm-level controls. We provide evidence for alternative winsorization schemes in robustness test (2). In the main analyses with the RDD identification strategy, we winsorize all continuous variables (final variables) at the bottom and top 5% of their distributions. Accordingly, in this robustness check, we winsorize at the bottom and top 5%: (1) at the raw data and final variables; (2) at the year level; (3) at the industry level; and (4) at the year and industry level. In the following robustness test, we provide evidence of alternative clustering variables. In our main analyses for the RDD strategy, we cluster our standard errors at the firm level, which allows for series correlation of the error term. In robustness check (3), we cluster our standard errors: (1) at the firm and year level; (2) at the year level; (3) at the industry level; and (4) at the location level (we define location as the county where the company is headquartered). Additionally, we provide evidence for alternative fixed effects structures in robustness check (4). In the main analyses with the RDD design, we employ firm and year-industry fixed effects and provide evidence of alternative fixed effects structures such as: (1) firm and year fixed effects; (2) firm and location-year fixed effects; (3) firm and location-industry-year; (4) firm and group status-year (where group status is defined in terms of independent firms, parent companies or foreign subsidiaries). Furthermore, we probe the functional form we use as a control for the size dimensions. We start by providing evidence on alternative treatment and control assignment rules. In the main analyses, we use a time invariant assignment rule based on 2016 data for only one period, i.e., a company is assigned to the treatment group if it surpasses two of the three size criteria thresholds for one period (the year 2016). In robustness test (5), we use the following alternative classification rules: (1) we use a time variant (dynamic) treatment definition based on the past two consecutive years; (2) we use a time variant (dynamic) treatment definition based on the past year (not restricted to 2016); (3) we use a time variant (dynamic) treatment definition based on the past two consecutive years right before adoption of the treatment, i.e., 2015 and 2016; and (4) we instrument our main assignment rule by an assignment rule based on one period for 2013 before the EU directive of 2014 when private Swedish firms did not have a reason to manipulate their size variables to avoid treatment. We also probe the size control function by adding the lagged size control function. The size controls are as follows: $h(Dimension^{TA})$ is the natural logarithm of total assets over the total assets threshold ($175\ M\ SEK$). $h(Dimension^{SA})$ is the natural logarithm of sales over the sales threshold ($350\ M\ SEK$). $h(Dimension^{EMP})$ is the natural logarithm of the average number of employees over the average employee threshold ($250\ employees$). $Size^{TA}$ is an indicator variable taking a value of one if total assets exceed the total assets threshold ($175\ M\ SEK$) and zero otherwise. $Size^{SA}$ is an indicator variable taking a value of one if sales exceed the sales threshold ($350\ M\ SEK$) and zero otherwise. $Size^{EMP}$ is an indicator variable taking a value of one if the average number of

employees exceeds the average number of employees threshold (*250 employees*) and zero otherwise. Robustness test (6) includes said controls and the lagged size controls for (1) the two-year dynamic assignment rule and (2) the two-year 2016 assignment rule. These latter specifications do not include the size controls interacted with the $Post\_Treatment_t$ variable. In robustness test (7), we use alternative functional forms such as higher order polynomials (up to a fifth order polynomial) for the size control function, interact the treatment with the functional form, and create 25 equally spaced linear splines for the size variables and 50 equally spaced bins of the size variables. In robustness test (8), we provide results for a matched sample using the following matching methods: (1) one-to-one propensity score matching; (2) one-to-ten propensity score matching; (3) coarsened exact matching; and (4) entropy balancing. Finally, robustness test (9) provides the results from using alternative measures of corporate performance. More specifically, we use ROE_{it} measured as the ratio of net income (*resar*) to the opening balance of equity (*eksu*), and $Total\_Factor\_Prod_{i,t}$ measured as the residual from a regression of firm-level sales (natural logarithm of sales) on employee (natural logarithm of number of employees) and capital inputs (natural logarithm of property, plant and equipment productivity).