The Effect of Customer Demand for Carbon Disclosures along Supply Chains

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Current Version: February 2025

Acknowledgments: I am deeply grateful to my committee members, Mingyi Hung, Shiheng Wang, and Daniel Yang, for their guidance and support. I thank Zhihong Chen, Qingkai Dong, Allen Huang, Hwa Young Kim, Arthur Morris, Chao Tang, Yue Zheng, and participants at the 2023 HKUST PhD seminar and 2025 HKUST accounting research seminar for helpful comments and suggestions. I thank discussions with James Chamberlayne, Nathan Cole, Paddy Dixon, Abygail Hall, Emma Light, Ben Robinson, Ruth Clark Wilkins, and Hanlin Zhang from the CDP. This document is not for circulation or citation without explicit permission. Any errors are my own.

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Abstract

This study examines how customer demand for suppliers' carbon disclosures affects suppliers' emission performance. My analysis utilizes the CDP Supply Chain Program in which participating customer firms request their suppliers to disclose greenhouse gas (GHG) information. I find that compared to benchmark suppliers, treatment suppliers exposed to this program experience a decrease in Scope 1 emissions after their customers joined the CDP Supply Chain program. These effects are more pronounced when customers have stronger incentives to monitor emission performance along supply chains and have greater bargaining power against their suppliers, and when suppliers face greater pressure to reduce emissions. Further analysis reveals that treatment suppliers also attract more new customers, receive better environmental performance scores, and have more customers willing to publicly disclose their relationship. Overall, my findings underscore the role of customer demand for carbon disclosures in shaping emission performance along supply chains.

Keywords: Emissions, Supply Chains, CDP Supply Chain Program
JEL classification: M14, M41, Q50, Q54

1. Introduction

In light of the challenges posed by climate change and increasing scrutiny from investors, stakeholders, and regulators, firms are increasingly concerned not only about their own environmental performance but also about that of their supply chain partners (Asgharian, Dzieliński, and Hashemzadeh 2024). Given that a significant portion of greenhouse gas (GHG) emissions in many sectors originates from corporate upstream supply chains, there is a growing awareness among managers to better understand, measure, and manage emissions within their supply chains (Jira and Toffel 2013). A crucial first step in this process is for customer firms to gather information from suppliers regarding their GHG emissions and climate change vulnerabilities, which facilitates customer firms' decision-making. In this study, I examine the effect of customer-initiated demand for carbon disclosures along the supply chain.

The literature shows that corporate disclosures can induce real effects on firm behavior (Kanodia and Sapra 2016). However, customer firms aiming to understand and manage supply chain emissions often encounter a lack of information disclosed by suppliers. To tackle this issue, some customers have taken steps by reaching out to their suppliers. For example, in 2008, Walmart requested its suppliers to provide GHG data to assess the sustainability of its supply chain. This independent approach can be costly, as customers need to invest considerable resources, and suppliers often receive multiple requests with inconsistent questions and requirements (CDP 2009).

Furthermore, there is an increasing need to report emissions around the life cycle of a product (CDP 2021), raising the pressure on customer firms to measure upstream Scope 3 emissions.[1] However, it is challenging for customer firms to measure their upstream Scope 3 emissions

[1] Scope 1 emissions refer to the direct GHG emissions that arise from sources owned or controlled by a company. Scope 3 emissions include all other indirect GHG emissions that occur within a company's value chain, which consists of both upstream emissions (originating from the production of goods or services acquired by the company) and downstream emissions (arising from the use and disposal of the products or services sold by the company).

(Blanco, Caro, and Corbett 2016). Since these emissions occur outside customer firms' operational boundaries, customer firms need to acquire the necessary data from their suppliers. According to the Greenhouse Gas Protocol standards, firms may use two types of data to calculate Scope 3 emissions: primary data and secondary data. Primary data refers to specific activity-related data within firms' value chains, while secondary data includes industry-average data (e.g., government statistics, academic studies). In an ideal world, if all firms report their direct and product life cycle emissions, a customer firm can rely on supplier-specific data to calculate its upstream emissions. This supplier-specific approach is more accurate, enabling customer firms to identify high-impact interventions instead of merely adjusting procurement quantities or seeking new suppliers (GHG Protocol Initiative 2013; CDP 2022). In practice, however, customer firms face a scarcity of information from suppliers as carbon disclosures have not been mandated in most countries, making it difficult to measure, report, and reduce upstream Scope 3 emissions.

To address these gaps, the CDP (formerly Carbon Disclosure Project) launched the Supply Chain Program (hereafter, "the CDP-SC program") in 2007 to help customer firms better understand the climate impacts within their supply chains through annual information requests (CDP 2008). The CDP-SC program creates a standardized process for supply chain reporting of carbon emissions, risks, opportunities, and strategies. In addition to providing firm-level carbon emissions, suppliers are encouraged to disclose emission information tailored to specific customers or product lines.

The CDP-SC program offers two advantages for studying the impact of customer demand for GHG information. First, customer firms must sign up for the CDP-SC program, which then enables the program to act on their behalf when sending requests to suppliers. This setting provides me an opportunity to observe time-series variations in customer firms' demand for suppliers' GHG

information, which could be viewed as exogenous shocks to suppliers. Second, because customer firms joined the CDP-SC program at different times, this staggered participation helps to alleviate concerns about confounding events.

I hypothesize that suppliers reduce direct emissions after their customer firms initiated requests for GHG information disclosures via the CDP-SC program. Customer firms can significantly influence suppliers (Pataoukas 2012), and their disclosure requests raise suppliers' awareness of customers' concerns regarding supply chain sustainability. Also, customer firms can set requirements and contractual obligations, as well as rewards such as contract extensions, to encourage participation (CDP 2024). These actions impose pressure on suppliers to engage in emission-reduction efforts. Furthermore, the GHG information provided by suppliers — at the supplier-firm level (i.e., aggregate Scope 1 emissions), supplier-customer pair level, and for specific products — helps reduce information asymmetry that customer firms face regarding their suppliers' emission performance. As a result, customer firms gain a comprehensive understanding of suppliers' emission performance, and their own upstream Scope 3 emissions. This enhanced understanding enables customer firms to identify opportunities to engage suppliers in emission reduction activities.

I begin my analysis by collecting the firm names and years that customers joined the CDP-SC program from the CDP website and supply chain annual reports from 2007 to 2019. Next, I identify all the public suppliers from the FactSet and the CDP Supply Chain public climate change spreadsheets. To measure changes in supplier firms' direct emissions performance, I require firms to have Scope 1 emission data from S&P Trucost. I then partition the suppliers into treatment and benchmark samples. The treatment sample consists of suppliers with at least one customer joining the CDP-SC program during 2007-2019. For each treatment supplier, I take the earliest year that

its customer firms joined the CDP-SC program as the beginning year of the treatment. For suppliers only covered by the CDP Supply Chain climate change spreadsheets, I use the earliest response submission year as the event year.[2] I limit the event window to five fiscal years before (i.e., [-5, -1]) and five fiscal years after (i.e., [0, 4]) the treatment year. The benchmark sample covers suppliers without any customer firms joining the CDP-SC program during 2007-2019. I apply entropy balancing and propensity score matching methods to create two alternative benchmark samples. The entropy-balanced sample comprises 2,161 treatment suppliers and 7,157 EB benchmark suppliers, while the propensity-score matched sample consists of 1,431 treatment suppliers and 1,209 benchmark suppliers.

I employ a difference-in-difference approach to study the effects of customers' demand for GHG information on suppliers' emission performance. Consistent with my hypothesis, I find that compared to benchmark suppliers, treatment suppliers reduce Scope 1 emissions after their customers initiated requests for carbon disclosures via the CDP-SC program. My results are economically significant. The effect is 1.83-1.85 percent of the standard deviation of treatment suppliers' Scope 1 emissions before the CDP-SC program. My findings remain robust to the use of alternative samples, measures, event windows, and clustering methods.

To explore the mechanisms by which treatment suppliers reduce their direct emissions, I perform several cross-sectional tests, leveraging the unique features of the CDP-SC program. First, I examine customers' incentives to use the requested information to monitor suppliers. The documented effect is stronger among treatment suppliers whose customers have higher incentives to monitor and improve suppliers' emission performance, measured by customers' emission performance before joining the CDP-SC program, usefulness of suppliers' GHG information in

[2] For each supplier, the CDP Supply Chain climate change spreadsheets do not provide the identities of the customer firms that make requests to them.

customers' decision-making, and whether customers participate in the CDP-SC program as a premium member. Second, I examine suppliers' incentives and bargaining power for carbon reduction. I find the documented effect on suppliers' Scope 1 emissions is stronger among treatment suppliers with a higher percentage of emissions before the CDP-SC program, among suppliers in countries with stronger environmental regulation and enforcement, and those that publicize responses on the CDP websites. These results suggest that suppliers under higher pressure are more likely to reduce emissions. In addition, I find stronger results in suppliers' emission reduction among suppliers with poor bargaining power against customers, as measured by the number of a supplier's customers participating in the CDP-SC program, and relationship duration with customers.

My additional analyses reveal that compared to benchmark suppliers, treatment suppliers attract more new customers and improve their environmental performance scores after exposure to the CDP-SC program. These findings suggest that enhanced transparency in carbon disclosures and reductions in carbon emissions induced by the CDP-SC program bring additional benefits to exposed suppliers. I also find that customer firms increase their public disclosures about supply chain relationships, especially with those suppliers who show a greater reduction in carbon emissions after being exposed to the CDP-SC program. These findings are consistent with prior literature that customers are more willing to disclose green suppliers (Shi et al. 2023).

My study contributes to the literature in several ways. First, it adds to studies examining the role of customers in influencing suppliers' ESG behaviors. Dai, Liang, and Ng (2021) demonstrate the transmission of socially responsible behavior from customers to their suppliers, as indicated by ESG scores. Asgharian et al. (2024) and Schiller (2018) investigate the propagation of environmental performance from customers to both suppliers and competitors. Cho et al. (2023)

find that suppliers reduce direct emissions after their major customers start to disclose Scope 3 emissions. I extend prior work by studying how customer demand for GHG information promotes sustainable behavior among suppliers. My study is most closely related to Bonetti et al. (2024), a concurrent working paper that identifies spillover effects in emissions disclosures from customers to their suppliers via the CDP. My research differs by focusing on the real effect of customers' demand for suppliers' carbon disclosures through the CDP-SC program.[3] Furthermore, I directly link the real effect to the key features of this program, such as premium membership and response status, illustrating the factors that affect the effectiveness of the centralized platform for supplier information requesting and reporting.

Second, my study adds to the literature on the economic consequences of ESG disclosures. Previous studies have shown that ESG disclosure regulations induce real effects on firms' ESG investments and operations (Christensen et al. 2017; Chen, Hung, Wang 2018; She 2021). While these studies primarily focus on government-mandated disclosure regulations and firms subject to these regulations, my research examines the influence of customer-driven disclosure requests on supplier firms. My findings provide evidence that customer-driven demand for carbon disclosures can also induce real effects on environmental performance along supply chains, which is relevant to policymakers promoting supply chain sustainability.

Third, my findings contribute to the literature that examines the role of inter-firm information sharing. Previous studies find that acquiring information from other firms mitigates information frictions and shapes a firm's information environment. Studying information sharing is challenging because the channels and formats of the information communication are often

[3] Although Bonetti et al. also examine the effect of customers' participation in the CDP-SC program in their Table 8, their focus is on suppliers' emissions disclosures, rather than emissions performance.

unobservable to researchers. Bourveau, She, and Zaldokas (2019) and Kepler (2019) investigate inter-firm communications in the context of collusion and strategic alliances. Bushee, Kim-Gina, and Keusch (2024) find that credible information sharing among competitors expands the managers' information sets. Liberti, Sturgess, and Sutherland (2022) study information sharing between lenders and its impact on borrowers. My study differs by focusing on information sharing within the supply chain. Bushee, Kim-Gina, and Leung (2020) investigate the private information that customer firms share with their suppliers, focusing specifically on private forecasts included in material contracts. In my study, suppliers are requested to share private GHG information with customer firms through the CDP-SC program.

Finally, my study responds to the call to understand the role of the CDP Supply Chain program (Hales 2023). Jira and Toffel (2013) study the factors associated with the likelihood of suppliers sharing information with customer firms via the CDP-SC program. My research complements their study by examining the real economic consequences of the CDP-SC program. My paper also complements Cohen, Kadach, and Ormazabal (2023), who find that ownership by institutional investors who are CDP signatories is positively associated with the probability of disclosing to CDP and subsequent improvement in environmental performance. Customers and institutional investors possess different incentives and information needs for carbon disclosures. Institutional investors primarily focus on the financial implications of emissions performance for portfolio firms. Unlike customer firms, institutional investors typically keep an arm's length relationship with surveyed firms and do not have direct business relationships with them. On the other hand, customer firms seek transparency in suppliers' GHG information to manage emissions along their supply chains. They have operational ties with suppliers, involving procurement decisions and production activities. Thus, ex-ante, the insights from Cohen et al. (2023) may not

apply to customer-supplier relationships.[4]

2. Institutional background and hypothesis development

2.1. Institutional background

The CDP is a UK-based not-for-profit organization founded in 2000 to promote sustainable economic growth by encouraging firms to disclose their environmental impact. To achieve this, the CDP develops a comprehensive and standardized reporting framework, distributes questionnaires to surveyed firms, and compiles the collected responses into a database of corporate climate change information. In 2007, the CDP launched its Supply Chain Program to create a standardized process for supply chain reporting of carbon emissions, risks, opportunities, and strategies.[5] Through this program, customer firms can request disclosures from suppliers in their supply chains, helping them better understand carbon emissions embedded within supply chains (CDP 2008). Participating customer firms (hereafter, "CDP-SC customers") can choose to become a lead, premium, or standard member, each with different fees and varying levels of benefits.[6]

Each year, customer firms submit a list of suppliers to the CDP-SC program[7]. On behalf of customer firms, the CDP notifies and communicates with suppliers, inviting them to complete the questionnaire through the CDP Portal. Suppliers' participation in the questionnaire is voluntary.

[4] Firms may respond differently to survey requests and engagements from customer firms compared to institutional investors. For instance, a firm may be more inclined to respond to major customers and develop emission reduction plans closely aligned with the production needs of those customers. Additionally, customer firms are more likely to have domain knowledge than investors, and their engagement may have a greater impact on suppliers.
[5] The standardized disclosure format and guidance lower the costs of information collection and processing for customers. Notably, response rates are higher when relying on the CDP-SC program compared to when customers distribute the survey by themselves (CDP 2008).
[6] The annual membership fee for a standard member is about £16,000 in 2009 (CDP 2009). Lead members pay the highest membership fees and receive the most benefits from the CDP-SC program (i.e., data analysis of supplier responses). Currently, the membership fee is decided by business type (profit/non-profit), region, and discount policies.
[7] The CDP-SC program is designed to gather data from current suppliers of customer firms, and customer firms are not encouraged to invite suppliers without an active business relationship.

To support the reporting process for suppliers, the CDP provides reporting guidance (i.e., webinars). In addition, customer firms are allowed to communicate directly with suppliers to encourage them to respond to the questionnaire. The CDP Portal usually opens around March, with the reporting window typically closing in October.

Suppliers receive a combination of standard climate change questionnaires and a specific supply chain module, "SC Supply Chain." The standard climate change questionnaires include questions regarding firm-level GHG data and other climate-related topics (Cohen et al. 2023). The supply chain module includes the following sections: "Supply chain introduction," "Allocating your emissions to your customers," "Collaborative opportunities," "Action exchange," and "Product (goods and services) level data." Appendix A provides excerpts of the supply chain module.

The module begins with the "Supply chain introduction," where suppliers describe their organization, provide revenue, and include their International Securities Identification Number. Next, the "Allocating your emissions to your customers" section features a table where suppliers are asked to disclose emissions related to each specific requesting customer. This table guides suppliers in allocating their emissions to each requesting customer based on the goods or services sold to that particular customer, along with the allocation methods and explanations.[8] This table includes a drop-down menu that allows suppliers to view a list of requesting customers, select a specific customer, and provide relevant information. This section also includes qualitative questions on suppliers' challenges when allocating emissions to different customers.

Building on this, the "Collaborative opportunities" section allows suppliers to propose mutually beneficial climate-related projects to each customer. The supply chain module further

[8] See question SC1.1 in Appendix A: "Allocate your emissions to your customers listed below according to the goods or services you have sold them in this reporting period."

assesses suppliers' willingness to participate in emission reduction activities through the "Action exchange" section.

Finally, the "Product (goods and services) level data" section requires suppliers to report emissions associated with each product or service, detailing the product type and stock-keeping unit (SKU). Additionally, suppliers are asked to report emissions across all stages of their goods' and services' life cycles, providing a comprehensive view of their environmental impact.

Responses to the entire supply chain module are kept private and are only accessible to CDP-SC customers who requested suppliers to complete the questionnaire.[9] Customer-specific questions (e.g., SC1.1) are designed so that only the selected requesting customer can view relevant responses, while other requesting customers cannot access this information, thereby protecting proprietary data.[10]

2.2. Hypothesis development

Prior work suggests that relationships with major customers have a significant impact on suppliers' operating performance (Pataoukas 2012), disclosures (Ellis, Fee, and Thomas 2012; Crawford et al. 2020; Chen et al. 2022), environmental and social performance (Schiller 2018), and socially responsible behavior (Dai et al. 2021). When requesting carbon disclosure via the CDP-SC program, customer firms demonstrate the importance of climate change in their corporate strategy and their commitment to supply chain sustainability (CDP 2010). These requests raise suppliers' awareness of their customers' focus on GHG performance. In addition to contacting suppliers to complete surveys, customers may establish contractual requirements to encourage

[9] For the standard climate change questionnaire that suppliers are invited to respond to, they have the option to mark their response "Public" or "Private." If suppliers choose to mark their responses as "Public", they can be accessed by the public free of charge. I cannot access all suppliers' responses because many are private. Additionally, some suppliers may refuse to respond to customers' requests due to concerns about their poor emission performance.
[10] If suppliers enter information without selecting any requesting member, responses will not be visible to anyone.

response, particularly for non-responsive suppliers (CDP 2024). They may also reward suppliers' efforts by offering benefits such as contractual extensions and preferential financing rates (CDP 2024). These actions exerts pressure on suppliers, as they may be concerned about fewer contracts or even losing customers after revealing unsatisfactory GHG performance (CDP 2009). Consequently, suppliers may be motivated to take steps to reduce their emissions.

Furthermore, customer firms use information collected to monitor and engage with suppliers, prompting them to reduce emissions. The literature suggests that corporate disclosures help reduce information asymmetry (Healy and Palepu 2001) and improve firms' information environment (Cho, Lee, and Pfeiffer 2013; Dhaliwal et al. 2012). Suppliers' disclosures at the supplier-firm level, supplier-customer pair level, and product level, along with CDP's data analysis, mitigate the information asymmetry that customers face regarding their suppliers' emission performance. This increased transparency facilitates customers' monitoring of suppliers (Christensen, Hail, and Leuz 2021) and enables customers to identify opportunities for targeted engagement with specific suppliers and products. Anecdotal evidence supports this argument. Nissan Motor, for instance, actively monitors suppliers' response rates to the CDP questionnaire and shares experiences with suppliers to help them lower energy costs and emissions (CDP 2016). Similarly, Philips utilizes the CDP-SC program to gather a wealth of information on climate change activities from suppliers, and has developed engagement strategies like offering light-as-a-service which delivers carbon savings without up-front investment costs (CDP 2014; CDP 2017).

In addition, customers use carbon disclosures to estimate their own upstream Scope 3 emissions. By encouraging suppliers to reduce emissions, customers can effectively decrease upstream Scope 3 emissions, as suppliers' direct emissions constitute a substantial portion of customers' indirect emissions (Matthews, Hendrickson, and Weber 2008). Notably, most potential

upstream Scope 3 reductions are found in Scope 3 category 1: Purchased Goods & Services (CDP 2024).[11] The CDP supply chain module asks suppliers to specify their contributions to CDP-SC customers' Scope 3 emissions, and to report emissions at the product/service and stock-keeping unit levels. Therefore, customers can learn how suppliers' emissions affect their upstream Scope 3 emissions and make informed decisions about which specific suppliers and product lines to target for emission reduction efforts (Imperial Brands 2023).

The above discussion leads to my hypothesis:

Hypothesis: *Suppliers reduce Scope 1 emissions following their customers' requests for carbon disclosures.*

My hypothesis may not hold for several reasons. First, customers may participate in the CDP-SC program to brand their association with the CDP-SC program on their corporate websites and ESG reports without actually monitoring their suppliers. In this scenario, suppliers may not respond to customers' requests. Second, suppliers may not take customers' requests seriously, as asking for information does not necessarily indicate a direct requirement for emission reductions. Third, suppliers' responses may lack reliability, as underreporting emissions is possible. The CDP collects responses as they are submitted and does not provide verification or auditing. This may weaken customers' incentives to assess and pressure suppliers effectively. Consequently, suppliers might not feel compelled to take action. Finally, for customers who already have established private communication channels and collaborations with suppliers, the CDP-SC program may not provide additional information and pressure to drive further action, limiting its effectiveness compared to existing private engagements.

[11] On average, Scope 3 emissions are 11.4 times greater than the combined total of Scope 1 and Scope 2 emissions (CDP 2021).

3. Sample and Research Design

3.1. Sample and data

To construct my supplier sample, I start with the universe of customers that joined the CDP-SC program as membership firms by obtaining their names and participation years from the CDP supply chain annual reports from 2007 to 2019. Table 1 Panel A outlines the sample selection procedures. I exclude customers with a membership duration of less than three years due to their low commitment to the CDP-SC program.[12] For long-term CDP-SC customer firms, I obtain their publicly listed suppliers from the FactSet Revere Supply Chain database from 2003 to 2023, due to the lack of accounting variables for private suppliers. I also obtain public suppliers from the CDP supply chain climate change spreadsheets, which include suppliers that have submitted public responses to CDP-SC customers.[13] Taken together, I obtain a list of public suppliers.

Next, I use the following steps to create the treatment sample. This sample starts from suppliers with at least one customer joining the CDP-SC program or submitted public responses to CDP-SC customers. I exclude suppliers whose relationship with CDP-SC customers ended before the year those customers engaged with the CDP-SC program, as they are unaffected due to inactive relationships with CDP-SC customers. I assume that the customers' governance effect through the CDP-SC program can influence all requested suppliers, even though some may decline to respond due to concerns about data accuracy (CDP 2021) or proprietary costs. Ideally, my treatment sample should consist of suppliers requested by CDP-SC customers each year. However,

[12] These customers may lack long-term incentives because they intend to benchmark suppliers only once or twice, find the disclosures less informative than expected, perceive the membership fee as too expensive, or prefer to communicate with suppliers directly after CDP has helped establish the infrastructure.

[13] FactSet primarily gathers customer-supplier relationships primarily from public disclosures. While there is an overlap between the CDP data and the FactSet data, the CDP data includes supplier firms that are not captured in the FactSet data.

the CDP-SC program does not provide lists of requested suppliers and their requesting customers. The CDP Supply Chain climate change spreadsheets only include those suppliers who participated in the CDP-SC program and submitted public responses, omitting those who submitted private responses or rejected to respond.

To address this empirical challenge, I collect statistics from the CDP-SC annual reports, which are presented in Appendix B. This table presents the annual number of CDP-SC customers, the number of suppliers requested to complete the survey, the number of suppliers who responded, and the number of suppliers that publicized responses.[14] These figures indicate that, on average, customers survey approximately 100 suppliers each year. Customers typically prioritize their most important suppliers due to their greater economic importance, larger emissions, and heightened public scrutiny. Additionally, the CDP-SC annual reports and customer firms' voluntary disclosures show that customers tend to focus on surveying their major suppliers (CDP 2008).[15] Therefore, in my main analysis, I keep the top 100 suppliers for each customer based on FactSet data, along with suppliers included in the CDP Supply Chain climate change spreadsheets but not covered by FactSet.[16]

For each of these treatment suppliers, I identify the earliest year that its customers joined the CDP-SC program as the event year. For suppliers covered by the CDP Supply Chain climate change spreadsheets but not FactSet, I do not know who their CDP-SC customers are and use the earliest year that a supplier submitted a response as the event year. I exclude event years after

[14] 2007 is the year of the CDP-SC pilot program, which had relatively fewer participating customers and requested suppliers.
[15] For example, Dell surveyed major suppliers in 2007 (CDP 2008). Samsung Electronics planned to survey their most important 100 suppliers after joining the CDP-SC program (https://www.samsung.com/us/aboutsamsung/sustainability/environment/climate-action/).
[16] For each year, I obtain a customer's top 100 suppliers. If a customer has fewer than 100 suppliers, I include all of them in the analysis. It is possible that customers initially survey only important suppliers and gradually expand their lists. I assume that customers' adoption of the CDP-SC program creates a spillover effect on top 100 suppliers who are not surveyed.

2020. The event window includes five fiscal years before (i.e., the [-5, -1] years) and after (i.e., the [0, 4] years) the event year. If all the customers of a treatment supplier joined the CDP-SC program before they established a relationship with this supplier, I use the earliest year that this supplier formed a relationship with those customers as the event year for this supplier.

The benchmark sample consists of suppliers without any customers participating in the CDP-SC program from 2007 to 2019. I merge both the treatment and benchmark samples with Global Vantage to obtain firm characteristics and S&P Trucost to obtain emissions data. Trucost collects carbon emissions data from firms' public disclosures, such as annual reports, CDP surveys, and corporate websites, and estimates emissions when firms do not publicly disclose this information. I exclude suppliers with missing Trucost emissions data, control variables, missing industry information, and those in financial (NAICS2=52) or public administration (NAICS2=92, 99) industries. To mitigate potential measurement errors in Scope 1 emissions, I exclude firm-years with an absolute growth rate in Scope 1 emissions exceeding 500%, as well as those with combined Scope 1 and 2 emissions below 1000 mt CO2e (Berg, Ma, and Streitz 2024).

To enhance the comparability between treatment and benchmark suppliers, I create two benchmark samples. First, I apply entropy balancing year by year based on the first and second moments of control variables with a tolerance level of 0.01 (Hainmueller 2012; McMullin and Schonberger 2022). Second, I construct a sample of propensity-score matched firms. I estimate a logit regression using control variables and Scope 1 emissions from the three years prior to the event. Since carbon emissions are correlated within industries, I include industry fixed effects in the logit regression. The matching is performed for each event year without replacement using a caliper of 0.05. Appendix C reports the PSM estimation results. To ensure that changes in carbon

emissions are not due to changes in sample composition over time, I require a supplier to have at least one observation in each of the pre- and post-periods.

I refer to the sample including both treatment and entropy-balanced benchmark suppliers as the "EB sample", and the sample including both treatment and propensity-score matched suppliers as the "PSM sample". As reported in Table 1 Panel A, the "EB sample" comprises 2,161 treatment suppliers and 7,157 EB benchmark suppliers, and the "PSM sample" consists of 1,431 treatment suppliers and 1,209 benchmark suppliers. Table 1 Panel B presents the sample distribution by year. Both the EB and PSM samples are balanced across years by construction. Table 1 Panel C displays the sample distribution by economy, with the U.S. having the highest number of suppliers. Finally, Table 1 Panel D reports industry distribution, showing comparable industry distribution between treatment and benchmark suppliers, with manufacturing (NAICS2=31, 32, 33) being the top industry segment.

3.2. Research design

To test my hypothesis, I examine the impact of customer demand for GHG information (reflected by their adoption of the CDP-SC program) on suppliers' carbon emission performance using the following model:

$$Y_{i,t} = \beta_0 + \beta_1 Treat_i \times Post_{i,t} + \sum \beta_i Control\ Variables + Firm\ FE + Year\ FE + \varepsilon_{it} \quad (1)$$

In this model, *i* and *t* denote supplier firm and year, respectively. My dependent variable is *Ln(Scope 1)*, the natural logarithm of a supplier firm's Scope 1 emission volume. *Treat* is a dummy variable equal to one for treatment suppliers and zero for benchmark suppliers. *Post* is a dummy variable that takes a value of one starting from the earliest year that a supplier's customer joined

the CDP-SC program onwards and zero otherwise[17]. My variable of interest is the coefficient of interaction term *Treat* × *Post*, β_1, which captures the change in treatment suppliers' Scope 1 emissions change after the event, relative to the change in benchmark suppliers' Scope 1 emissions. To control time-invariant firm characteristics, I include firm fixed effects. To account for time-invariant heterogeneity within supplier firms, I include year fixed effects.[18]

I include several variables used in prior studies to explain Scope 1 emissions: *Ln(Assets*), the log of total assets; *TobinQ*, growth opportunities; *Leverage*, total liabilities divided by total assets; *ROA*, return on assets; *Sales Growth*, percentage change in annual sales; *Tangibility*, tangible assets (property, plant, and equipment) divided by total assets; *R&D*, R&D expenditures. Appendix D provides variable definitions. To mitigate the influence of extreme values, all continuous variables are winsorized at 1% and 99% in the sample. In addition, all t-statistics are computed with robust standard errors clustered by supplier firm to control for correlation between observations for the same supplier.

3.3. Descriptive statistics

Table 2 presents descriptive statistics of the variables in my main analyses for the pre- and post- periods. Panel A presents descriptive statistics for the EB treatment and benchmark samples without applying any entropy-balancing weights. This approach allows for a clear illustration of the differences in variable distribution prior to conducting the entropy balancing. On average, EB and PSM treatment suppliers exhibit lower Scope 1 emissions in the post-period than the pre-period. Though benchmark suppliers of the PSM sample also experience a decrease in Scope 1 emissions, the magnitude is smaller than that of treatment suppliers of the PSM sample.

[17] For suppliers covered only in the CDP Supply Chain climate change spreadsheets, *Post* is a dummy variable that takes a value of one starting from the earliest year of response publication onwards and zero otherwise.
[18] The coefficients on *Treat* and *Post* are suppressed when firm fixed effects and year fixed effects are included, as there is no within-firm variation of *Treat* and no within-year variation of *Post*.

4. Empirical Results

4.1. Baseline results

Table 3 Panel A presents the regression results for model (1). Columns (1)–(3) and (4)–(6) display changes in Scope 1 emissions following the event for the EB and PSM samples, respectively. I report the baseline model with industry fixed effects in Columns (1) and (4), and the full regression specification with firm and year fixed effects in Columns (2) and (5). Consistent with my hypothesis, the coefficient on the interaction term *Treat* × *Post* is negative and significant in these specifications for both the EB and PSM samples, suggesting that treatment suppliers experience a greater decrease in Scope 1 emissions than benchmark suppliers after the event. In terms of economic significance, Columns (2) and (5) indicate that relative to changes in Scope 1 emissions in the benchmark suppliers in the EB and PSM samples, treatment suppliers experience a decrease in Scope 1 emissions by 8% and 6.9%, respectively, which are equivalent to 1.85% and 1.83% of the standard deviation of treatment suppliers' Scope 1 emissions before the event.[19]

To assess the validity of the parallel trends assumption for the difference-in-difference specification, I follow Bertrand and Mullainathan (2003) to run a timing regression. Specifically, I set Year -1 as the benchmark year and replace *Post* with nine year indicators (i.e., Years -5 to -2 and Years 1 to 4). As is shown in Columns (3) and (6), the coefficients on *Year -5* × *Treat, Year -3* × *Treat,* and *Year -2* × *Treat* are all insignificantly different from zero, suggesting similar trends in Scope 1 emissions for treatment and benchmark suppliers in the pre-period. The coefficients on the interaction terms are negative and significant since *Year 0* in Column (3) and *Year 1* in Column

[19] 1.85%=8%×3.19/13.82 and 1.83%=6.9%×2.49/9.41, where 3.19 and 13.82 are the mean and standard deviation (in million metric tonnes) of treatment suppliers' Scope 1 emissions during the pre-period for the EB sample. Similarly, 2.49 and 9.41 are the mean and standard deviation (in million metric tonnes) of treatment suppliers' Scope 1 emissions during the pre-period for the PSM sample.

(6), indicating that treatment suppliers exhibit greater decreases in Scope 1 emissions in the post-period. Overall, there appears to be no anticipation effect, and the influence of customers' adoption of the CDP-SC program takes effect only after it occurs.

Panel B of Table 3 presents robustness checks using alternative samples. I investigate whether short-term CDP-SC customers, excluded from my main analyses, also have an impact on their top suppliers. I construct a sample using only short-term CDP-SC customers and their top 100 suppliers, and I repeat my baseline specification. As shown in Columns (1) and (2), the results are weaker and significant only for the EB sample, consistent with my expectation that long-term CDP-SC customers exert a greater influence on suppliers compared to short-term CDP-SC customers.

Next, I vary my selection of suppliers to assess the robustness of my findings. First, I conduct a sensitivity test by eliminating suppliers that are also CDP-SC customers. The results presented in Panel B Columns (3) and (4) are inferentially similar to the main findings. Second, I adopt an alternative method for selecting the top 100 suppliers. Instead of ranking suppliers by firm size, I rank them based on revenue to identify the top 100 suppliers, providing a different perspective on supplier importance. I then repeat my baseline regression in Columns (5) and (6) using this new set of top 100 suppliers, and I continue to obtain robust results. Finally, my selection of the top 100 suppliers may miss some that customers have surveyed. For instance, a customer with a large supplier base might survey over 100 suppliers. To address this, I expand my scope by examining all suppliers, regardless of their importance to CDP-SC customers. The results in Columns (7) and (8) indicate that CDP-SC customers have a significant impact on all their suppliers, not just the top suppliers, highlighting the widespread influence of the CDP-SC program throughout the entire supply chain.

Panel C of Table 3 reports additional robustness tests that further validate my findings. In Columns (3) and (4), I rerun my analyses using an alternative eight-year window, [-4, -1] and [0, 3] windows for pre- and post- periods. The results remain consistent and robust for both the EB and PSM samples. However, when I narrow the event window further to [-3, -1] and [0, 2], the coefficients on *Treat* × *Post* are insignificant. This suggests that the influence of CDP-SC firms on their suppliers may take time to emerge. In Columns (5) and (6), I rerun my analyses using Scope 1 emission intensity obtained from S&P Trucost as an alternative emission measure. Both the EB and PSM samples exhibit significantly negative coefficients on *Treat* × *Post*. Last, I examine an alternative clustering method at the country level. The results in Columns (7) and (8) are comparable to those reported in Table 3 Panel A.

In summary, all the results in Table 3 imply that suppliers decrease Scope 1 emissions following their customers' participation in the CDP-SC program, reflecting the real effects of customer demand for GHG information among suppliers.

5. Cross-sectional Analyses

This section explores the mechanisms underlying the real effects of the customers' requests for carbon disclosures. I explore customers' incentives to monitor suppliers to reduce emissions, suppliers' incentives to reduce emissions, and the bargaining power between suppliers and customers.

5.1. Cross-sectional analyses of customers' incentives

Customers' incentives of using information provided by suppliers to discipline suppliers play a significant role in the effectiveness of their monitoring and engagement efforts. I expect stronger effects when customers have greater incentives to use requested information to prompt

suppliers to reduce emissions. I explore three measures to capture such incentives.

One reason customers choose to join the CDP-SC program is to gather information about their suppliers' emission performance, which directly affects their own indirect emissions. By having a clearer understanding of their suppliers' emissions, customers can identify potential avenues for reducing their indirect emissions. Thus, I expect that customers with higher emissions before joining the CDP-SC program are more likely to utilize this platform to gather relevant information and discipline suppliers. As a result, suppliers with more such customers will face increased pressure to reduce their emissions. To perform my test, I evaluate customers' emission performance by measuring total emissions, which is the sum of Scopes 1, 2, and upstream Scope 3 emissions, over the three years preceding their participation in the CDP-SC program. I classify customers into high and low groups based on the median values within their respective country-industry groups. I then count the number of high-emission customers each treatment supplier has and categorize suppliers with a number of high-emission (low-emission) customers above (below) the country-industry median into high-incentive (low-incentive) incentive groups. I exclude suppliers covered only by the CDP Supply Chain climate change data from all cross-sectional analyses because I cannot identify their customer-supplier relationships.

Columns (1) and (2) of Table 4 Panel A present the results of this analysis. The coefficient of *Treat* × *Post* × *High Incentive* is significantly negative in both the EB and PSM samples. The difference in coefficients between *Treat* × *Post* × *High Incentive* and *Treat* × *Post* × *Low Incentive* is negative, and the Wald test shows that these differences are significant, suggesting that suppliers in the high incentive group experience a greater reduction in Scope 1 emissions.

Second, I explore how customers utilize suppliers' greenhouse gas (GHG) information. Customers who use this information can incorporate GHG data into their supply chain

management and decision-making processes. For instance, customers may engage with suppliers to improve energy efficiency after identifying those with relatively poor emission performance. To assess whether customers utilize suppliers' GHG information, I use response data from the CDP Climate Change questionnaires. Specifically, I collect responses to question CC14.4c: "If you have data on your suppliers' GHG emissions and climate change strategies, please explain how you make use of that data".[20] I classify CDP-SC customers as users of suppliers' GHG information if they respond to this question, excluding those who state, "We do not have any data." For each supplier, I count the number of their customers who are users of GHG information and then partition suppliers into high and low subgroups based on country-industry median values.

Columns (3) and (4) of Table 4 Panel A present the results. The coefficient of *Treat* × *Post* × *High Incentive* is significantly negative, and the difference in coefficients between the two groups is significantly negative in both the EB and PSM samples. These results suggest that suppliers with more customers using GHG information have greater emission reductions. This finding supports the notion that the CDP-SC program plays a crucial role in enhancing the usefulness of suppliers' GHG information to their customers.

Third, I investigate customers' commitment to the CDP-SC program. The choice of membership type for participating in the CDP-SC program reflects customers' emphasis on and commitment to sustainable supply chain management.[21] Since the majority of participating firms are standard members, I classify lead and premium members together as premium members. For each CDP-SC customer, I collect its membership type from CDP-SC annual reports. Then, I count

[20] This question is included in CDP Climate Change questionnaires from 2013 to 2016.
[21] It is also possible that customer firms register more expensive types to enhance their reputations, as the CDP-SC program marks customers' membership types on the website and annual reports.

the number of premium customers associated with each treatment supplier, and partition suppliers into high and low subgroups based on country-industry median values.

Columns (5) and (6) of Table 4 Panel A report the results. The coefficient of *Treat* × *Post* × *High Incentive* is significantly negative, and the difference in coefficients between the two groups is significantly negative in both the EB and PSM samples. These findings suggest that suppliers with more premium CDP-SC customers are more effective at reducing their Scope 1 emissions.

Overall, the results presented in Table 4 Panel A imply that suppliers with a greater number of customers that have high incentives to monitor suppliers' GHG performance achieve greater reductions in their emissions.

5.2. Cross-sectional analyses of suppliers' incentives

In this section, I examine the mechanisms that influence the reduction of suppliers' Scope 1 emissions. I first investigate the incentives that motivate suppliers to lower their emissions. Given that suppliers face increased pressure to provide emission information after CDP-SC customers send them survey requests, they may be concerned that these customers will use emission performance in their supplier benchmarking processes, cost reduction methods, and even contract termination (CDP 2009). Therefore, I expect that suppliers with higher emissions prior to the event will have stronger incentives to lower their emissions. To conduct this test, I collect Scope 1, Scope 2, and upstream Scope 3 emissions during the most recent three years before the event year. I then compute the average ratio of Scope 1 emission over total emissions and classify treatment suppliers into *High Incentive* and *Low Incentive* subgroups of Scope 1 percentage based on country-industry median values.[22]

[22] Total emissions are calculated as the sum of Scope 1, Scope 2, and upstream Scope 3 emissions. Downstream Scope 3 emissions are not included because its data is scarce.

Columns (1) and (2) of Table 4 Panel B report the results. The coefficient of *Treat* × *Post* × *High Incentive* is significantly negative in both the EB and PSM samples. The difference in coefficients between *Treat* × *Post* × *High Incentive* and *Treat* × *Post* × *Low Incentive* is negative, and the Wald test shows that these differences are significant, suggesting that suppliers in the high incentive groups have a greater reduction in Scope 1 emissions.

Next, I examine the role of environmental regulation and enforcement in supplier countries. I expect that suppliers in countries with strong environmental regulations and enforcement are more likely to reduce their emissions, as customers may be concerned about potential environmental violations by these suppliers. To capture the stringency of environmental regulation and enforcement in supplier countries, I follow Ben-David et al. (2021) and Dai et al. (2022) to obtain the stringency of environmental regulation score (SER) and enforcement of environmental regulation score (EER score) from World Economic Forum's Travel & Tourism Competitive reports from 2011–2017. Since SER and EER scores are highly correlated, I combine them into a single variable SEER (Ben-David et al. 2021), defined as (SER×EER)/7. For each supplier country, I compute the mean value of SEER and partition these countries into *High Incentive* and *High Incentive* groups based on the sample median.

Columns (3) and (4) of Table 4 Panel B display the results of this analysis. The coefficient of *Treat* × *Post* × *High Incentive* is significantly negative, while the coefficient of *Treat* × *Post* × *Low Incentive* is insignificant in both the EB and PSM samples. The difference in coefficients between the two groups is negative and significant, indicating that suppliers in countries with strong environmental regulations and enforcement have stronger incentives to reduce emissions following their customers' adoption of the CDP-SC program.

Finally, I investigate whether suppliers that publicly respond to the CDP-SC customers

achieve greater emission reductions. Since public responses to the standard climate change questionnaire but not the supply chain module are available to the public free of charge, suppliers receive more attention by choosing to disclose their emission performance and management. This increased scrutiny from investors and stakeholders may incentivize suppliers to improve emissions performance. I partition the treatment suppliers into the *High Incentive* group if they have submitted public responses to CDP-SC customers, and into the *Low Incentive* group if they have not. The results are shown in Columns (5) and (6) in Panel B. Consistent with previous findings, I observe that suppliers in the *High Incentive* group exhibit greater emission reductions.

Taken together, these results provide evidence suggesting that suppliers with greater incentives to improve emission performance are more likely to reduce their emissions after their customers participated in the CDP-SC program.

5.3. Cross-sectional analyses of bargaining power between suppliers and customers

I also explore how suppliers' bargaining power against CDP-SC customers affects their behavior regarding emission reductions. Given that customers are a major stakeholder driving suppliers' socially responsible behaviors (Dai, Liang and Ng 2021), I predict that suppliers with weaker bargaining power are more likely to improve emission performance. I assume that a supplier has weaker bargaining power against CDP-SC firms when it has: (1) a higher number of CDP-SC customers; (2) a longer relationship duration with CDP-SC firms.

First, when a supplier has a high number of customers registered with the CDP-SC program, it indicates that multiple customers are simultaneously requesting GHG information from that supplier. This concentrated attention and the inflow of requests can exert considerable pressure on suppliers to meet customer demands. As a result, suppliers may become increasingly concerned about their emission performance when faced with many customers who are actively seeking

information. To quantify this, I count the number of CDP-SC customers for each supplier and classify those suppliers with a customer count above the country-industry median value as having weaker bargaining power.

Second, suppliers with longer relationships with CDP-SC customers are likely to be more economically dependent on these customers, making them more inclined to meet their customers' needs and expectations. To measure the duration of these relationships, I calculate the length of time each supplier has been associated with their CDP-SC customers up to *Year 2* following the event. I then calculate the average duration of the relationship for each supplier, and partition suppliers within each country-industry into a low (high) subsample if their average duration is above (below) the country-industry median value.

The results in Table 4 Panel C are consistent with my expectations. The findings in Columns (1)–(2) of Table 4 Panel C suggest that suppliers with more CDP-SC customers reduce more Scope 1 emissions in the post-period, as indicated by the significantly negative coefficient of *Treat* × *Post* × *Low Bargain*. The difference in coefficients between the two groups is significantly negative in the EB sample. Similarly, the results in Columns (3)–(4) of Table 4 Panel C suggest that suppliers with longer relationship duration achieve greater emission reductions after their customers adopted the CDP-SC program.

Overall, suppliers with weaker bargaining power against CDP-SC customers experience a greater reduction in emissions, compared to those with stronger bargaining power. This finding highlights the significant impact that customer influence can have on suppliers' emission performance, particularly when suppliers are more dependent on their customers.

6. Additional analyses

6.1. Analysis of economic consequences

In this section, I explore whether treatment suppliers enjoy other benefits following their customers' adoption of the CDP-SC program. For those treatment suppliers that lowered their Scope 1 emissions, improved emission performance may attract more customers (Darendeli et al. 2022). To compare the changes in customer growth between treatment suppliers and benchmark suppliers, I measure the number of unique customers for each supplier-year using FactSet Revere Supply Chain databases. In addition to measuring the overall number of customers, I also consider the number of unique new customers that each supplier-year has attracted.

Table 5 presents the results for both the EB and PSM samples. Columns (1) and (2) show the results using the total number of customers as the dependent variable, while Columns (3) and (4) show the results using the number of new customers as the dependent variable. All the columns report significant negative coefficients on *Treat* × *Post*, implying that treatment suppliers experience a greater increase in both the total number customers and new customers compared to benchmark suppliers in the post-period.

These results suggest that suppliers gain advantages by expanding their customer base, highlighting the potential for suppliers to enhance their market position through environmentally responsible practices.

6.2. Analysis of environmental performance scores

Given that treatment suppliers exhibit lower emissions than benchmark suppliers, they are likely to obtain higher environmental performance scores, as suppliers exposed to the CDP-SC program may enhance their overall environmental awareness and related behaviors. Also, emissions are a key factor considered by ESG rating agencies when preparing a firm's ESG scores (Refinitiv 2022). I obtain environmental performance scores from Refinitiv for the sample

suppliers. Specifically, I examine emission scores and environmental scores. Table 6 presents the results using these measures as the dependent variables in my baseline specification for both the EB and PSM samples. In Columns (1) and (2), the emission score serves as the dependent variable, while Columns (3)–(4) use the environmental score as their respective dependent variables. For the emission score, the coefficient of *Treat* × *Post* is significantly positive for both samples, which is consistent with my expectation that suppliers achieve better emission scores due to their improved emission performance. For the environmental score, the coefficients of *Treat* × *Post* are significantly positive for the PSM sample, but not the EB sample. This suggests that suppliers enhance their environmental performance as a result of the increased environmental awareness promoted by CDP-SC customers. Overall, the evidence presented in Table 6 suggests that treatment suppliers indeed receive better environmental scores, highlighting the positive impact of lower emissions on their ESG performance assessments.

6.3. Analysis of customers' supply chain disclosures

The literature suggests that customer firms are more likely to disclose green suppliers to promote their own brand and reputation in environmental protection and strengthen stakeholder relationships (Shi et al. 2024). I expect that customer firms are also more likely to disclose treatment suppliers who have been exposed to the CDP-SC program and improved emission performance. To investigate this, I utilize FactSet Revere Supply Chain databases which track records of which party out of a business pair, the customer or the supplier, publicly discloses the business relationship. For each supplier firm that is covered in my sample, I count the number of customers who disclose their relationship with this supplier. I take this measure as the dependent variable in Model (1) and rerun the regression. Columns (1) and (2) in Table 7 show that treatment suppliers experience a greater increase in the number of customers who disclose the supply chain

relationship after these suppliers are exposed to the CDP-SC program, compared to benchmark suppliers.

To further investigate the potential differential impact of emission performance following customers' adoption of the CDP-SC program, I partition the treatment suppliers into high and low groups based on their percentage change in emissions within industry during the post-period. Specifically, for each treatment supplier, I compute the average percentage change in Scope 1 emissions during three years after the event. I then create an indicator variable labeled "More Emission Reductions", which takes the value of one if a supplier's average percentage change is below the median value of treatment suppliers, and zero otherwise. For the remaining treatment suppliers, I create an indicator variable "Less Emissions Reductions" that takes the value of one. Columns (3)–(4) of Table 7 present the results of this partitioning analysis, which shows significantly positive coefficients on *Treat* × *Post* in both groups. Moreover, the Wald test reported at the bottom of the Panel shows that the coefficient for the "More Emission Reductions" group is significantly higher than that for the "Less Emission Reductions" group for the EB sample, suggesting that treatment suppliers with better emission performance in the post-period experience a greater increase in the number of customers disclosing supply-chain relationship, compared to those with poorer emission performance in the post-period. Overall, these results imply that treatment suppliers are indeed more likely to be revealed by customers, receiving potentially greater visibility in the market. This may provide suppliers with additional opportunities due to their improved environmental performance, thereby reinforcing the importance of emission reductions in fostering more visible customer relationships.

7. Conclusion

In this study, I examine the effect of customer demand for carbon disclosures along the supply chain. My analysis exploits customers' staggered participation in the CDP Supply Chain Program, which enables customer firms to request GHG information from suppliers at both the firm level and a more granular level tailored to customers' specific needs.

My main analysis focuses on a sample of the top 100 suppliers to customers that are membership firms of the CDP-SC program. Compared to suppliers in two matched benchmark samples, I find that treatment suppliers experience a decrease in Scope 1 emissions following their customers' enrollment in the CDP-SC program. This finding remains robust to the use of alternative samples, measures, event windows, and clustering methods. I leverage the unique features of the CDP-SC pogram when exploring underlying mechasnims. I find that the decrease in Scope 1 emissions is more pronounced when customers have stronger incentives to monitor emissions along supply chains and have greater bargaining power against their suppliers, and when suppliers face greater pressure to reduce emissions.

Furthermore, I find that suppliers benefit from an expanded supply chain network, as well as improved environmental performance scores. There is also evidence suggesting that customers are more likely to publicly reveal their supply chain relationship with suppliers that achieve greater emission reductions in the post-period.

Overall, my study suggests that customer demand for carbon disclosures is associated with improved emission performance among suppliers, highlighting the role customers play in driving suppliers' sustainable behaviour within the supply chain.

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Appendix A
Excerpts of the CDP climate change questionnaire supply chain module

This appendix contains excerpts from the 2018 CDP supply chain module questionnaires. There are five sections in total.

Section 1: Supply chain introduction

(SC0.0) If you would like to do so, please provide a separate introduction to this module.

(SC0.1) What is your company's annual revenue for the stated reporting period?

(SC0.2) Do you have an ISIN for your company that you would be willing to share with CDP?

…

Section 2: Allocating your emissions to your customers

(SC1.1) Allocate your emissions to your customers listed below according to the goods or services you have sold them in this reporting period.

Please complete the following table. The table is displayed over several rows for readability. You are able to add rows by using the "Add Row" button at the bottom of the table.

Requesting member	**Scope of emissions**	**Emissions in metric tons of CO2e**	**Uncertainty (± %)**
[Drop-down menu of requesting members]	Select from: ● Scope 1 ● Scope 2 ● Scope 3	Numerical field [enter a number from 0-999,999,999,999 using a maximum of 4 decimal places and no commas]	Percentage field [enter a percentage from 0-999,999 using a maximum of 4 decimal places and no commas]
Major sources of emissions	**Verified***	**Allocation method**	**Please explain how you have identified the GHG source…**
Text field [maximum 2,500 characters]	Select from: ● Yes ● No	Select from drop-down options below	Text field [maximum 5,000 characters]

…

Description of allocation method drop-down options (column 7). Select one of the following options:

• Allocation not necessary due to type of primary data available • Allocation not necessary as secondary data used • Allocation based on mass of products purchased • Allocation based on the volume of products purchased • Allocation based on the energy content of products purchased • Allocation based on the chemical content of products purchased	• Allocation based on the number of units purchased • Allocation based on area • Allocation based on another physical factor • Allocation based on the market value of products purchased • Other, please specify

(SC1.2) Where published information has been used in completing SC1.1, please provide a reference(s).

(SC1.3) What are the challenges in allocating emissions to different customers, and what would help you to overcome these challenges?

…

Section 3: Collaborative opportunities

(SC2.1) Please propose any mutually beneficial climate-related projects you could collaborate on with specific CDP supply chain members.

…

Section 4: Action exchange

(SC3.1) Do you want to enroll in the 2018-2019 CDP Action Exchange initiative?

…

Section 5: Product (goods and services) level data

(SC4.1a) Give the overall percentage of total emissions, for all Scopes, that are covered by these products.

(SC4.2a) Complete the following table for the goods/services for which you want to provide data.

Name of good/ service	**Description of good/ service**	**Type of product**	**SKU (Stock Keeping Unit)**
Text field [maximum 2,400 characters]	Text field [maximum 2,400 characters]	Select from: • Final • Intermediate	Text field [maximum 50 characters]

Total emissions in kg CO2e per unit	**± % change from previous figure supplied**	**Date of previous figure supplied**	**Explanation of change**	**Methods used to estimate lifecycle emissions**
Numerical field	Numerical field		Text field [maximum 2,400 characters]	Select from: …

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Appendix B
CDP-SC survey participation statistics

Year	# CDP-SC customers	# Suppliers invited	# Suppliers responded	# Suppliers publicize response
2007	12	328	144	-
2008	34	2,318	634	-
2009	44	1,402	715	375
2010	57	1,853	1,000	659
2011	50	4,234	1,864	958
2012	54	6,215	2,415	1625
2013	64	5,624	2,868	1879
2014	66	6,503	3,396	2209
2015	75	7,800	4,005	2523
2016	89	8,200	4,300	2882
2017	99	9,139	4,800	1578
2018	115	11,692	5,600	2719
2019	125	13,111	6,958	3302

This appendix provides the annual statistics for the number of customer firms participating in the CDP-SC program, the number of suppliers invited to the survey, the number of suppliers that responded to the survey, and the number of suppliers that publicized responses. Information for the number of suppliers that publicized responses is not available for the years 2007 and 2008.

Appendix C
Propensity score matching for supplier samples

Panel A: Logit regression used to calculate the propensity score

Dep Var =	Prob (Treat=1)	
Sample =	**Pre-match**	**Post-match**
	(1)	(2)
Size	0.847***	0.024
	(0.010)	(0.041)
Leverage	0.517***	0.003
	(0.066)	(0.014)
ROA	2.085***	-0.163
	(0.142)	(0.200)
Sales Growth	-0.618***	-0.127
	(0.041)	(0.426)
Tangibility	-1.118***	-0.009
	(0.063)	(0.048)
R&D	8.719***	0.102
	(0.299)	(0.233)
TobinQ	-0.001	-0.348
	(0.005)	(0.789)
Ln(Scope1)	-0.011*	0.007
	(0.006)	(0.026)
Industry FE	Yes	Yes
# Firms	9,318	2,640
Pseudo R^2	0.226	0.004

Table B: Statistics for firm characteristics before the event for the PSM sample

	Treatment		**Benchmark**		**Difference in mean**	
	Mean	**Median**	**Mean**	**Median**	**Treat. - Bench.**	**t-stats**
Size	8.017	8.061	7.989	7.984	0.028	0.470
TobinQ	0.249	0.239	0.25	0.236	-0.001	-0.130
Leverage	0.052	0.047	0.052	0.044	0.000	0.040
ROA	0.150	0.066	0.143	0.069	0.007	0.240
Sales Growth	0.300	0.264	0.298	0.245	0.003	0.270
Tangibility	0.016	0.002	0.014	0.001	0.002	1.360
R&D	2.331	1.590	2.336	1.488	-0.006	-0.030
Ln(Scope 1)	11.348	11.105	11.284	10.841	0.065	0.550

Panel A reports the results of the logistic regressions for the PSM method, using the average value of firm characteristics during the [-3, -1] window. I use single nearest-neighbor propensity score matching without replacement within a caliper width of 0.05. ***, **, * represent the significance at the 1%, 5% and 10% two-tailed levels, respectively. Panel B compares the differences in firm characteristics between treatment and benchmark samples and their t-statistics.

Appendix D
Variable definitions

Variable	Definition
Dependent variables	
Ln(Scope 1)	The natural logarithm of Scope 1 emissions, where Scope 1 emissions are direct carbon emissions (in metric tons) stemming from sources controlled or owned by the firm.
Ln(Scope 1 intensity)	The natural logarithm of Scope 1 intensity, where Scope 1 intensity is Scope 1 emissions scaled by revenue.
Ln(Num customer)	The natural logarithm of number of customers that a supplier has supply chain relationships with.
Ln(Num new customer)	The natural logarithm of number of new customers that a supplier has supply chain relationships with.
Ln(Emission score)	The natural logarithm of Refinitiv emission score of a firm-year.
Ln(Environmental score)	The natural logarithm of Refinitiv environmental score of a firm-year.
Ln(Num customers disclose)	The natural logarithm of number of customers identified in FactSet Revere Supply Chain databases that disclosed relationships with a firm during a fiscal year.
Test variables	
Post	An indicator variable taking the value of one since the earliest year a supplier's customer adopt the CDP Supply Chain Program, and zero otherwise.
Treat	An indicator variable equals to one if a supplier's customers adopt CDP Supply Chain Program, and zero otherwise.
Control variables	
Size	The natural logarithm of book value of assets at the end of a fiscal year (in millions of US dollars).
TobinQ	Total assets plus the market value of equity minus deferred taxes minus the book value of equity divided by total assets at the end of a fiscal year.
Leverage	Sum of long-term debt and short-term debt, scaled by total assets at the end of a fiscal year.
ROA	Earnings before extraordinary items scaled by the average total assets at the beginning and the end of a fiscal year.
Sales Growth	Percentage change in annual sales.

Tangibility	Net book value of property, plant, and equipment scaled by total assets at the end of a fiscal year.
R&D	Annual R&D expenditure scaled by total assets at the end of a fiscal year. Missing R&D expenditure is set to zero.

Appendix E
Summary statistics for additional variables

	EB sample				PSM sample			
	N	**Mean**	**Median**	**Std dev**	**N**	**Mean**	**Median**	**Std dev**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln(Num customer)	46,263	1.414	1.386	1.206	15,645	1.747	1.609	1.255
Ln(Num new customer)	46,263	0.576	0.000	0.910	15,645	0.747	0.000	1.008
Ln(ESG score)	28,097	-0.904	-0.616	0.902	10,038	-0.893	-0.602	0.888
Ln(Emission score)	20,836	-0.993	-0.708	0.970	6,797	-0.988	-0.694	0.989
Ln(Environmental score)	44,998	0.550	0.000	0.898	14,666	0.773	0.693	0.915
Ln(Num customers disclose)	46,263	1.414	1.386	1.206	15,645	1.747	1.609	1.255

This appendix provides summary statistics for variables used in Tables 5-7. See Appendix D for variable definitions.

Table 1
Sample distribution

Panel A: Sample selection procedure

	# CDP-SC Customer firms	Treatment sample		Benchmark sample	
		# Firms	# Firm-years	# Firms	# Firm-years
All CDP-SC participating customers	378	-	-	-	-
Long-term customers	182	-	-	-	-
Long-term customers' public suppliers in FactSet Supply Chain database 2003-2023	170	11,613	-	19,596	-
After adding public suppliers from CDP Supply Chain climate change data	-	11,944	-	-	-
After removing suppliers ended relationships with customers prior to joining year	-	11,923	-	-	-
After removing non-top 100 suppliers	-	7,675	-	-	-
After removing suppliers with event year after 2020	-	4,854	-	-	-
With available control variables for firm characteristics	-	4,596	72,704	18,081	231,206
After removing missing Trucost carbon emission data	-	3,757	44,115	8,110	62,779
After removing missing NAICS2, financial firms (NAICS2=52), or public administration (NAICS2=92,99)	-	3,553	41,091	7,221	53,461
After removing outliers in Scope 1 emissions	-	3,525	40,392	7,157	52,228
Final EB samples (with observations present during both pre- and post-periods)	-	**2,161**	**18,380**	**7,157**	**52,228**
Remove firms that are not propensity-score matched		(730)	(6,530)	(5,948)	(41,081)
PSM samples		**1,431**	**11,850**	**1,209**	**11,147**

Table 1, Continued

Panel B: Sample distribution by year

Calendar year	EB treatment sample	EB benchmark sample	PSM treatment sample	PSM benchmark sample
	# Firm-years	# Firm-years	# Firm-years	# Firm-years
2003	110	240	49	27
2004	188	548	87	70
2005	304	797	154	124
2006	409	896	207	170
2007	589	941	303	258
2008	724	943	371	319
2009	865	1,059	441	397
2010	956	1,137	495	469
2011	1,098	1,187	579	529
2012	1,160	1,221	631	547
2013	1,248	1,439	732	630
2014	1,344	1,528	817	681
2015	1,356	1,635	857	725
2016	1,578	4,253	1,100	1,101
2017	1,437	4,712	1,041	1,048
2018	1,328	5,078	992	997
2019	1,169	5,321	909	909
2020	1,034	5,743	828	811
2021	869	5,948	724	713
2022	546	5,947	469	542
2023	68	1,655	64	80
Total	**18,380**	**52,228**	**11,850**	**11,147**

Table 1, Continued

Panel C: Sample distribution by economy

	EB sample				PSM sample			
	Treatment sample		Benchmark sample		Treatment sample		Benchmark sample	
	# Firms	# Firm-years	# Firms	# Firm-years	# Firms	# Firm-years	# Firms	# Firm-years
Argentina	1	4			1	4	1	10
Australia	34	276	222	1,823	27	219	32	313
Austria	8	76	8	101	6	59	5	45
Bahrain							1	9
Barbados			1	1				
Belgium	10	88	18	149	7	58	4	30
Bermuda	5	42	12	108	4	33	2	14
Brazil	54	455	48	305	41	338	9	82
British Virgin Islan			1	3				
Canada	52	429	216	1,679	36	292	28	313
Cayman Islands	4	34	5	40	3	28	1	9
Chile	20	177	6	76	18	158	1	10
China	125	898	1,425	9,382	98	690	299	2,664
Colombia	2	17	4	33	1	7		
Costa Rica			1	2				
Croatia							1	6
Cyprus	1	7			1	7	1	7
Denmark	19	166	16	111	7	58	4	49
Egypt	3	25	16	144	3	25	1	10
Faroe Islands			1	10				
Finland	21	187	23	146	14	124	2	20
France	92	797	91	486	46	385	10	74
Germany	69	606	71	530	37	314	17	182
Greece	5	35	17	135	4	25	2	19
Hong Kong	29	238	276	2,110	20	166	45	402
India	65	509	266	1,923	45	347	48	451
Indonesia	9	63	82	625	8	54	10	98
Ireland	15	135	13	84	10	93	2	14
Israel	13	91	46	328	10	70	10	100
Italy	19	167	59	471	15	127	20	183
Japan	291	2,484	1,125	8,750	186	1,486	200	1,869
Kazakhstan							1	9
Kenya							1	9
Kuwait	1	6	10	49			2	11
Luxembourg	13	114	9	70	9	79	5	51
Macau	1	9	3	24	1	9		
Malaysia	8	73	110	848	7	64	15	114
Mauritius			1	2				
Mexico	17	144	23	238	13	111	8	61

Table 1, Continued

Monaco			4	29			1	7
Mongolia			1	10				
Morocco							1	8
Netherlands	34	288	24	141	18	148	4	26
New Zealand	3	26	29	233	3	26	4	30
Nigeria	1	6	11	111	1	6	2	16
Norway	16	131	33	239	10	79	5	81
Pakistan	1	8	29	258	1	8	5	40
Peru	1	10	9	94	1	10	1	7
Philippines	5	43	31	286	5	43	3	47
Poland	4	34	38	324	2	17	4	39
Portugal	3	29	10	101	2	20	2	17
Qatar			11	90			1	8
Russian Federation	12	101	34	275	6	50	13	124
Saudi Arabia	2	12	52	261	2	12	3	14
Singapore	18	152	47	290	10	84	4	27
Slovenia							1	6
South Africa	21	191	56	658	20	183	8	89
South Korea	82	700	583	4,277	59	490	86	748
Spain	31	273	29	240	14	118	7	79
Sweden	35	315	87	520	23	203	13	112
Switzerland	42	369	52	432	26	223	13	140
Taiwan	83	695	430	3,164	53	443	61	538
Thailand	13	107	103	790	12	97	15	137
Turkey	8	68	48	330	8	68	2	9
Ukraine	1	10	1	13	1	10		
United Arab Emirates	4	28	13	86	3	19	2	15
United Kingdom	170	1,533	175	1,586	120	1,075	24	235
United States	564	4,892	984	6,541	353	2,988	135	1,303
Uruguay	1	7						
Vietnam			8	63				
Zimbabwe							1	7
Total	**2,161**	**18,380**	**7,157**	**52,228**	**1,431**	**11,850**	**1,209**	**11,147**

Table 1, Continued

Panel D: Sample distribution by industry

NAICS2 - industry description	Treatment sample		EB Benchmark		PSM Treatment		PSM Benchmark	
	# Firm-years	%	# Firm-years	%	# Firm-years	%	# Firm-years	%
11 - agriculture, forestry, fishing & hunting	33	0.18%	351	0.67%	33	0.28%	6	0.05%
21 - mining, quarrying, and oil land gas extraction	367	2.00%	4,528	8.67%	314	2.65%	349	3.13%
22 - utilities	834	4.54%	2,737	5.24%	656	5.54%	685	6.15%
23 - construction	507	2.76%	1,949	3.73%	393	3.32%	450	4.04%
31 - manufacturing-food, textile, apparel	1,520	8.27%	3,631	6.95%	1,037	8.75%	931	8.35%
32 - manufacturing-wood, paper, printing, petroleum, chemicals, plastics	3,152	17.15%	9,520	18.23%	2,115	17.85%	1,826	16.38%
33 - manufacturing-metals, machinery, computers, electrical, furniture	5,960	32.43%	11,733	22.46%	3,320	28.02%	2,982	26.75%
42 - wholesale trade	600	3.26%	2,085	3.99%	484	4.08%	471	4.23%
44 - retail trade-motor vehicles, furniture, electronics, food, gas	285	1.55%	2,086	3.99%	220	1.86%	172	1.54%
45 - retail trade-sporting goods, books, florists, office supplies, mail-order, vending	238	1.29%	1,341	2.57%	192	1.62%	227	2.04%
48 - transportation & warehousing-air transport, water transport, trucks, pipelines	689	3.75%	2,366	4.53%	609	5.14%	528	4.74%
49 - transportation & warehousing-post service, courier & express delivery service, local messengers, warehousing & storage	74	0.40%	93	0.18%	15		19	
51 - information	2,015	10.96%	3,533	6.76%	1,173	9.90%	1,111	9.97%
53 - real estate & rental & leasing	269	1.46%	878	1.68%	171	1.44%	186	1.67%
54 - professional, scientific & technical services	1,130	6.15%	1,684	3.22%	554	4.68%	551	4.94%
56 - admin/support waste management/remediation	315	1.71%	808	1.55%	249	2.10%	289	2.59%
61 - educational services	25	0.14%	287	0.55%	25	0.21%	22	0.20%
62 - health care and social assistance	94	0.51%	919	1.76%	83	0.70%	135	1.21%
71 - arts, entertainment & recreation	34	0.18%	507	0.97%	33	0.28%	55	0.49%
72 - accommodation & food services	215	1.17%	1082	2.07%	150	1.27%	120	1.08%
81 - other services (except public administration)	24	0.13%	110	0.21%	24	0.20%	32	0.29%
Total	**18,380**	**100%**	**52,228**	**100%**	**11,850**	**100%**	**11,147**	**100%**

This table presents the sample distribution for the EB and PSM samples. Panel A lists the sample selection procedure. Panel B presents sample distribution by year. Panel C presents sample distribution by economy. Panel D presents sample distribution by the NAICS2 industry.

Table 2
Summary statistics

Panel A: EB Treatment and benchmark suppliers

	EB treatment firms (N = 18,380 firm-years)					Benchmark firms (N = 52,228 firm-years, before	
	Pre-period		Post-period		Difference		
	Mean	Median	Mean	Median	Mean (Post - Pre)	Mean	Median
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Scope 1	3,193,107.187	92,465.710	2,746,018.896	75,613.706	-447,088.291*	1,827,288.586	21,732.201
Ln(Scope 1)	11.633	11.435	11.358	11.233	-0.275***	539.494	24.294
Ln(Intensity 1)	3.396	3.095	3.146	2.853	-0.250***	3.757	3.190
Size	8.500	8.516	8.568	8.593	0.069**	6.999	6.979
Leverage	0.247	0.239	0.264	0.250	0.016***	0.232	0.206
ROA	0.050	0.046	0.043	0.043	-0.007***	0.031	0.040
Sales Growth	0.097	0.063	0.067	0.043	-0.030***	0.129	0.070
Tangibiltiy	0.279	0.236	0.271	0.226	-0.008**	0.326	0.281
R&D	0.022	0.004	0.023	0.005	0.001	0.016	0.000
TobinQ	2.276	1.592	2.482	1.675	0.205***	2.375	1.501

Panel B: PSM treatment suppliers (N = 11,850 firm-years)

	Pre-period		Post-period		Difference
	Mean	Median	Mean	Median	Mean (Post - Pre)
	(1)	(2)	(3)	(4)	(5)
Scope 1	2,492,886.365	77,655.136	2,109,984.604	62,165.709	-382,901.761*
Ln(Scope 1)	11.511	11.260	11.197	11.038	-0.314***
Ln(Intensity 1)	3.662	3.325	3.367	3.115	-0.295***
Size	8.088	8.124	8.168	8.199	0.080**
Leverage	0.251	0.242	0.270	0.258	0.019***
ROA	0.053	0.047	0.042	0.042	-0.011***
Sales Growth	0.129	0.065	0.086	0.046	-0.044*
Tangibiltiy	0.307	0.270	0.300	0.261	-0.007
R&D	0.015	0.001	0.016	0.002	0.001
TobinQ	2.589	1.568	2.729	1.618	0.141

	Pre-period		Post-period		Difference
	Mean	Median	Mean	Median	Mean (Post - Pre)
	(1)	(2)	(3)	(4)	(5)
Scope 1	4,295,831.123	57,065.356	4,260,231.289	45,391.059	-35,599.834
Ln(Scope 1)	11.433	10.952	11.123	10.723	-0.310***
Ln(Intensity 1)	3.824	3.259	3.533	3.073	-0.291***
Size	8.032	8.009	8.117	8.100	0.085**
Leverage	0.252	0.239	0.285	0.236	0.032*
ROA	0.055	0.045	0.035	0.036	-0.020***
Sales Growth	0.153	0.074	0.090	0.046	-0.064***
Tangibiltiy	0.311	0.265	0.289	0.230	-0.022***
R&D	0.012	0.000	0.016	0.002	0.004***
TobinQ	2.273	1.477	2.278	1.426	0.006

This table presents the descriptive statistics of the variables for regression analyses, by EB and PSM samples, respectively. See Appendix D for variable definitions.

Table 3
The effect of customer demand for carbon disclosures on suppliers

Panel A: Main analysis

Dep Var =				***Ln(Scope 1)***		
Sample =		EB sample			PSM sample	
	(1)	(2)	(3)	(4)	(5)	(6)
Treat×Post	**-0.249*** **	**-0.080*** **		**-0.061***	**-0.069****	
	(0.020)	**(0.022)**		**(0.036)**	**(0.027)**	
Treat	0.069			0.113**		
	(0.048)			(0.057)		
Post				-0.225***		
				(0.029)		
Treat×Year - 5			0.052			0.061
			(0.033)			(0.040)
Treat×Year - 4			0.047*			0.066*
			(0.026)			(0.035)
Treat×Year - 3			0.011			0.009
			(0.020)			(0.028)
Treat×Year - 2			-0.001			-0.001
			(0.013)			(0.020)
Treat×Year 0			**-0.023***			-0.010
			(0.013)			(0.016)
Treat×Year 1			**-0.054*** **			**-0.046***
			(0.019)			**(0.024)**
Treat×Year 2			**-0.077*** **			**-0.065****
			(0.024)			**(0.031)**
Treat×Year 3			**-0.099*** **			**-0.071***
			(0.029)			**(0.036)**
Treat×Year 4			**-0.088****			**-0.083****
			(0.035)			**(0.040)**
Size	0.978***	0.717***	0.695***	1.025***	0.639***	0.670***
	(0.018)	(0.029)	(0.030)	(0.023)	(0.033)	(0.034)
Leverage	-0.297**	-0.304***	-0.324***	-0.018	-0.220*	0.026*
	(0.144)	(0.111)	(0.125)	(0.186)	(0.120)	(0.015)
ROA	1.887***	0.692***	0.693***	2.656***	0.695***	0.386***
	(0.268)	(0.114)	(0.129)	(0.314)	(0.144)	(0.115)
Sales Growth	-0.004	0.118***	0.093***	-0.024	0.138***	0.003
	(0.044)	(0.023)	(0.022)	(0.063)	(0.026)	(0.008)
Tangibility	2.488***	0.349**	0.299**	2.269***	0.235	0.135
	(0.154)	(0.152)	(0.149)	(0.211)	(0.169)	(0.159)
R&D	-2.331***	3.973***	4.089***	-3.847***	4.722***	1.371***
	(0.778)	(0.689)	(0.754)	(1.067)	(0.920)	(0.470)
TobinQ	-0.074***	-0.001	0.002	-0.079***	-0.011*	-0.000
	(0.009)	(0.006)	(0.006)	(0.011)	(0.006)	(0.001)
Observations	70,608	70,608	70,608	22,997	22,997	22,997
Adjusted R-squared	0.738	0.949	0.95	0.737	0.963	0.963
Industry FE	Yes	No	No	Yes	No	No
Year FE	No	Yes	Yes	No	Yes	Yes
Firm FE	No	Yes	Yes	No	Yes	Yes

This table presents the regression results that examine the impact of customer demand for GHG information (reflected by adoption of the CDP-SC program) on suppliers' Scope 1 emissions. *Post* is an indicator variable for the post-period. *Treat* is an indicator variable equal to one if a supplier's customers adopt the CDP-SC program, and zero otherwise. See Appendix D for variable definitions. Standard errors are clustered by firm and reported in parentheses. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 two-tailed levels, respectively.

Table 3, Continued

Panel B: Robustness tests using alternative samples

Dep Var =	***Ln(Scope 1)***							
	Alternative CDP-SC customer sample		**Alternative supplier sample**					
	Short-term customers		**Remove suppliers also CDP-SC participants**		**Rank top 100 suppliers by revenue**		**All suppliers**	
Sample =	EB sample	PSM sample	EB sample	PSM sample	EB sample	PSM sample	EB sample	PSM sample
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat×Post	**-0.045***	**-0.037**	**-0.035***	**-0.098*****	**-0.049****	**-0.119*****	**-0.031***	**-0.049****
	(0.026)	**(0.04)**	**(0.021)**	**(0.03)**	**(0.023)**	**(0.03)**	**(0.018)**	**(0.02)**
Size	0.657***	0.643***	0.718***	0.739***	0.712***	0.706***	0.706***	0.683***
	(0.029)	(0.04)	(0.029)	(0.04)	(0.028)	(0.04)	(0.022)	(0.03)
Leverage	-0.040	-0.078	-0.296***	-0.145***	-0.298***	-0.023	-0.134*	-0.130
	(0.109)	(0.06)	(0.103)	(0.05)	(0.099)	(0.05)	(0.074)	(0.09)
ROA	0.691***	0.203	0.670***	0.101	0.659***	0.368**	0.727***	0.622***
	(0.118)	(0.15)	(0.117)	(0.10)	(0.117)	(0.15)	(0.088)	(0.11)
Sales Growth	0.130***	-0.001	0.075***	0.000	0.091***	-0.000	0.125***	0.176***
	(0.020)	(0.00)	(0.020)	(0.00)	(0.020)	(0.00)	(0.014)	(0.02)
Tangibility	0.360**	0.145	0.351**	0.374*	0.374**	0.327	0.426***	0.470***
	(0.142)	(0.17)	(0.142)	(0.20)	(0.145)	(0.21)	(0.110)	(0.15)
R&D	3.305***	0.234	4.152***	1.343***	3.949***	2.005***	3.057***	3.294***
	(0.511)	(0.55)	(0.664)	(0.34)	(0.678)	(0.58)	(0.376)	(0.61)
TobinQ	0.000	-0.001	-0.005	-0.000	-0.005	-0.000	-0.007	-0.006
	(0.005)	(0.00)	(0.006)	(0.00)	(0.006)	(0.00)	(0.004)	(0.01)
Observations	64,684	18,005	67,262	20,869	69,906	22,700	74,550	33,593
Adjusted R-squared	0.95	0.951	0.96	0.948	0.95	0.950	0.96	0.957
Industry FE	No	No	No	No	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3, Continued

Panel C: Additional robustness tests

Dep Var =	***Ln(Scope 1)***							
	Alternative event windows				**Alternative measures**		**Alternative specifications**	
Specification=	**[-4,-1] vs. [0,3]**		**[-3,-1] vs. [0,2]**		**Ln(Scope 1 intensity)**		**Country cluster**	
Sample =	EB sample	PSM sample	EB sample	PSM sample	EB sample	PSM sample	EB sample	PSM sample
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat×Post	**-0.035***	**-0.075****	**-0.015**	**-0.022**	**-0.069*****	**-0.067****	**-0.080*****	**-0.073*****
	(0.021)	**(0.03)**	**(0.019)**	**(0.030)**	**(0.021)**	**(0.027)**	**(0.025)**	**(0.025)**
Size	0.718***	0.641***	0.714***	0.693***	-0.083***	-0.139***	0.717***	0.649***
	(0.029)	(0.04)	(0.030)	(0.050)	(0.025)	(0.028)	(0.042)	(0.055)
Leverage	-0.296***	-0.046**	-0.305***	-0.297**	-0.053	-0.007	-0.304**	-0.100***
	(0.103)	(0.02)	(0.109)	(0.130)	(0.100)	(0.009)	(0.116)	(0.008)
ROA	0.670***	0.131	0.595***	0.135	-0.053	-0.005	0.692***	0.418***
	(0.117)	(0.10)	(0.123)	(0.140)	(0.087)	(0.084)	(0.151)	(0.097)
Sales Growth	0.075***	0.000	0.075***	0.001	-0.052***	-0.010	0.118***	0.004
	(0.020)	(0.00)	(0.021)	(0.00)	(0.019)	(0.009)	(0.033)	(0.005)
Tangibility	0.351**	0.169	0.368***	0.529**	0.218	0.232*	0.349**	0.115
	(0.142)	(0.21)	(0.138)	(0.220)	(0.134)	(0.125)	(0.167)	(0.192)
R&D	4.152***	1.622***	4.380***	1.623**	0.862*	0.006	3.973***	1.257**
	(0.664)	(0.47)	(0.706)	(0.680)	(0.511)	(0.194)	(0.743)	(0.492)
TobinQ	-0.005	0.004***	-0.006	0.002*	-0.011*	-0.001*	-0.001	-0.000
	(0.006)	(0.00)	(0.006)	(0.000)	(0.005)	(0.001)	(0.008)	(0.001)
Observations	67,262	18,768	64,834	14,845	70,608	22,997	70,608	22,997
Adjusted R-squared	0.96	0.954	0.96	0.962	0.923	0.935	0.949	0.961
Industry FE	No	No	No	No	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm	Country	Country

Panel B presents robustness tests for alternative samples and Panel C presents additional robustness tests. See Appendix D for variable definitions of other variables. Standard errors are reported in parentheses. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 two-tailed levels, respectively.

Table 4
Cross-sectional analysis

Panel A: Analysis of CDP-SC customers' incentives

Dep Var =	***Ln(Scope 1)***					
	Emission performance before joining CDP-SC		**Customers' usage of supplier GHG information**		**Premium CDP-SC member**	
Sample =	EB sample	PSM sample	EB sample	PSM sample	EB sample	PSM sample
	(1)	(2)	(3)	(4)	(5)	(6)
Treat×Post×Low Incentive (β1)	-0.084***	-0.091***	-0.050*	-0.092***	-0.013	-0.059*
	(0.025)	(0.032)	(0.027)	(0.036)	(0.028)	(0.032)
Treat×Post×High Incentive (β2)	**-0.148*** **	**-0.110*** **	**-0.112*** **	**-0.220*** **	**-0.140*** **	**-0.129*** **
	(0.031)	**(0.042)**	**(0.034)**	**(0.045)**	**(0.032)**	**(0.038)**
Difference (β2-β1)	*-0.064** *	*-0.019*	*-0.062** *	*-0.128*** *	*-0.127*** *	*-0.070** *
Test of difference (p-value)	*0.089*	*0.667*	*0.095*	*0.006*	*0.000*	*0.086*
Observations	66,681	18,692	66,681	18,692	66,681	18,692
Adjusted R-squared	0.947	0.963	0.951	0.959	0.951	0.965
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 4, Continued

Panel B: Analysis of suppliers' incentives

Dep Var =	***Ln(Scope 1)***					
	Emission performance in the pre-period		**Country environment regulation and enforcement**		**Whether suppliers publicize responses**	
Sample =	EB sample	PSM sample	EB sample	PSM sample	EB sample	PSM sample
	(1)	(2)	(3)	(4)	(5)	(6)
Treat×Post×Low Incentive (β1)	-0.020	-0.085**	-0.003	-0.042	-0.035	-0.085**
	(0.029)	(0.036)	(0.045)	(0.044)	(0.027)	(0.033)
Treat×Post×High Incentive (β2)	**-0.132*** **	**-0.130*** **	**-0.102*** **	**-0.124*** **	**-0.121*** **	**-0.121*** **
	(0.031)	**(0.037)**	**(0.026)**	**(0.032)**	**(0.033)**	**(0.040)**
Difference (β2-β1)	*-0.112*** *	*-0.045*	*-0.099** *	*-0.82** *	*-0.86** *	*-0.036*
Test of difference (p-value)	*0.002*	*0.294*	*0.038*	*0.071*	*0.021*	*0.386*
Observations	66,681	18,692	66,681	18,692	66,681	18,692
Adjusted R-squared	0.951	0.963	0.951	0.963	0.951	0.963
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 4, Continued

Panel C: Analysis of suppliers' bargaining power

Dep Var =	*Ln(Scope 1)*			
	Number of CDP-SC customers		**Relationship duration with CDP-SC customers**	
Sample =	EB sample	PSM sample	EB sample	PSM sample
	(1)	(2)	(3)	(4)
Treat×Post×Strong Bargain (β1)	-0.023	-0.098***	-0.072*	0.034
	(0.027)	(0.033)	(0.041)	(0.043)
Treat×Post×Weak Bargain (β2)	**-0.090*** **	**-0.119*** **	**-0.079***	**-0.086***
	(0.031)	**(0.040)**	**(0.041)**	**(0.047)**
Difference (β2-β1)	*-0.067*** *	*-0.021*	*-0.007*	*-0.052*** *
Test of difference (p-value)	*0.064*	*0.633*	*0.895*	*0.045*
Observations	70,610	18,692	66,681	18,692
Adjusted R-squared	0.953	0.963	0.951	0.963
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

This table compares the cross-sectional differences in the reduction of Scope 1 emissions following the event. Panels A-C present cross-sectional regression results conditional on suppliers' incentives, customers' incentives, and suppliers' bargaining power. *Post* is an indicator variable for the post-period. *Treat* is an indicator variable equal to one if a supplier's customers adopt the CDP-SC program, and zero otherwise. See Appendix D for variable definitions. All the regressions control for firm characteristics and include firm- and year- fixed effects. Standard errors are clustered by firm and reported in parentheses. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 two-tailed levels, respectively.

Table 5
The effect of customer demand for carbon disclosures on the supply-chain network

Dep Var =	***Ln(Num customer)***		***Ln(Num new customer)***	
Sample =	EB sample	PSM sample	EB sample	PSM sample
	(1)	(2)	(3)	(4)
Treat*×*Post	**0.554*** **	**0.562*** **	**0.325*** **	**0.276*** **
	(0.034)	**(0.044)**	**(0.032)**	**(0.038)**
Size	0.129***	0.172***	0.129***	0.086**
	(0.034)	(0.044)	(0.038)	(0.036)
Leverage	-0.183	-0.015	-0.322**	-0.002
	(0.127)	(0.010)	(0.131)	(0.010)
ROA	-0.208	-0.124	-0.031	-0.088
	(0.128)	(0.096)	(0.146)	(0.091)
Sales Growth	-0.086***	-0.010**	0.020	-0.006
	(0.024)	(0.005)	(0.037)	(0.005)
Tangibility	0.304	0.036	0.191	-0.112
	(0.207)	(0.168)	(0.179)	(0.158)
R&D	-0.290	0.192	0.067	-0.053
	(0.863)	(0.414)	(0.801)	(0.352)
TobinQ	0.002	0.001	0.000	0.000
	(0.008)	(0.000)	(0.007)	(0.001)
Observations	46,263	15,645	46,263	15,645
Adjusted R-squared	0.780	0.750	0.401	0.359
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes

This table presents regression analysis on changes in suppliers' supply chain network. *Post* is an indicator variable for the post-period. *Treat* is an indicator variable equal to one if a supplier's customers adopt the CDP-SC Program, and zero otherwise. See Appendix D for definitions of additional variables and Appendix E for their summary statistics. All the regressions include firm- and year- fixed effects. Standard errors are clustered by firm and reported in parentheses. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 two-tailed levels, respectively.

Table 6
The effect of customer demand for carbon disclosures on environmental performance scores

Dep Var =	***Ln(Emission score)***		***Ln(Environmental score)***	
Sample =	EB sample	PSM sample	EB sample	PSM sample
	(1)	(2)	(3)	(4)
Treat*×*Post	**0.046****	**0.097****	0.028	**0.228*****
	(0.021)	**(0.045)**	(0.030)	**(0.063)**
Size	0.084**	0.108**	0.204***	0.100
	(0.035)	(0.053)	(0.072)	(0.091)
Leverage	0.093	0.042	0.342	0.237
	(0.153)	(0.183)	(0.236)	(0.309)
ROA	0.124	-0.031	0.350	-0.086
	(0.132)	(0.194)	(0.242)	(0.308)
Sales Growth	-0.076***	-0.039	-0.193***	-0.128**
	(0.023)	(0.038)	(0.061)	(0.062)
Tangibility	-0.094	0.110	-0.370**	-0.476
	(0.103)	(0.194)	(0.169)	(0.326)
R&D	0.259	0.944	-2.465	-0.600
	(0.888)	(1.979)	(2.208)	(2.681)
TobinQ	0.008	0.012	0.011	0.020*
	(0.006)	(0.014)	(0.009)	(0.012)
Observations	28,097	10,038	20,836	6,797
Adjusted R-squared	0.650	0.609	0.537	0.477
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes

This table presents regression analysis on changes in suppliers' ESG scores. *Post* is an indicator variable for the post-period. *Treat* is an indicator variable equal to one if a supplier's customers adopt the CDP-SC Program, and zero otherwise. See Appendix D for definitions of additional variables and Appendix E for their summary statistics. All the regressions include firm- and year-fixed effects. Standard errors are clustered by firm and reported in parentheses. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 two-tailed levels, respectively.

Table 7
The effect of customer demand for carbon disclosures on customers' disclosure strategy

Dep Var =	***Ln(Num customers disclose)***		***Ln(Num customers disclose)***	
Sample =	EB sample	PSM sample	EB sample	PSM sample
	(1)	(2)	(3)	(4)
Treat×Post	**0.150*** **	**0.117*** **		
	(0.028)	**(0.030)**		
Treat×Post×More Emission Reductions (β1)			**0.144*** **	**0.120*** **
			(0.028)	**(0.036)**
Treat×Post×Less Emission Reductions (β2)			**0.091*** **	**0.094*** **
			(0.029)	**(0.035)**
Size	0.166***	0.187***	0.206***	0.172***
	(0.035)	(0.038)	(0.029)	(0.035)
Leverage	-0.201*	0.009	-0.199**	0.009
	(0.115)	(0.006)	(0.091)	(0.006)
ROA	-0.051	-0.037	-0.038	-0.021
	(0.110)	(0.065)	(0.093)	(0.060)
Sales Growth	-0.059***	-0.005	-0.074***	-0.005
	(0.018)	(0.003)	(0.016)	(0.003)
Tangibility	0.176	0.052	0.069	0.068
	(0.136)	(0.134)	(0.108)	(0.131)
R&D	0.059	0.189	-0.162	0.177
	(0.593)	(0.189)	(0.474)	(0.184)
TobinQ	-0.002	-0.000	-0.002	-0.000
	(0.006)	(0.000)	(0.006)	(0.000)
Difference (β1-β2)			*0.053** *	*0.026** *
Test of difference (p-value)			*0.075*	*0.494*
Observations	44,998	14,666	44,998	14,666
Adjusted R-squared	0.847	0.792	0.846	0.784
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes

This table presents changes in customers' disclosure strategy of supply-chain relationships. *Post* is an indicator variable for the post-period. *Treat* is an indicator variable equal to one if a supplier's customers adopt the CDP-SC Chain Program, and zero otherwise. See Appendix D for definitions of additional variables and Appendix E for their summary statistics. All the regressions include firm- and year- fixed effects. Standard errors are clustered by firm and reported in parentheses. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 two-tailed levels, respectively.