Climate Policies in Supply Chains

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11th May, 2023

Abstract

We show that supply chain connections influence the adoption of climate-responsible policies. Using granular firm-level disclosures, we show that suppliers adopt climate action and governance policies following customer firms' adoption of emission reduction targets. Such transmissions are driven by relative bargaining power rather than through a reconfiguration of customer firms' supply chain. However, we find no effect on adopting suppliers' climate outcomes or its leading indicators. This policy-outcome gap is lower when suppliers have higher gross margins and customers can better monitor suppliers' climate actions. Our results have important implications for public policies on environmental due diligence in supply chains.

JEL-Classification: F18, F64, G34, G38, L16, L24, Q54

Keywords: Corporate Emissions, Climate Governance, Supply Chain Networks

Acknowledgement: We thank the participants at the American Economic Association Annual Meeting 2023, FMA Europe, Baltic Economic Association, and the University of St Andrews seminar series for their constructive comments. We also thank Becky Annison, Marc Anner, Sonny Biswas, Vidhi Chhaochharia, Sarah Dadush, Sudipto Dasgupta, Sapnoti Eswar, Beata Javorcik, Abe de Jong, Egle Karmaziene, Sarosh Kuruvilla, Györgyi Lóránth, Lukas Linsi, Nandini Gupta, Steven Ongena, Xiaoling Pu, Rex Wang, Alminas Žaldokas and Xiao Zhao for their suggestions and inputs into supply chain contracting. Bas Meijer and Cleo Luxembourg have provided excellent research assistance.

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Electronic copy available at: https://ssrn.com/abstract=4446166

Conflict-of-interest disclosure statement

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I have nothing to disclose.

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I have nothing to disclose.

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1 Introduction

The corporate sector faces growing pressure from investors, employees, activists, and consumers to be sustainable. In response, corporations have been making numerous climate commitments, with at least one-fifth of the world's largest 2,000 firms pledging some form of "net zero" commitment to lower their carbon emissions (Hsu et al. 2016). These commitments have also provoked legitimate green-washing concerns. A particularly pernicious form of green-washing could happen if a firm makes strong commitments about the climate impacts of its own operations while ignoring the environmental harm caused by its suppliers outside of this commitment. In fact, the United States Environmental Protection Agency estimates that 92% of corporate emissions come from their supply chains (United States Environmental Protection Agency 2021). Therefore, decarbonizing supply chains is a crucial step towards achieving global carbon neutrality targets. Towards that end, the US government launched the Federal Supplier Greenhouse Gas Emissions Inventory Pilot in 2010 (United States Environmental Protection Agency 2021). Elsewhere, the European Commission is drafting regulations on environmental due diligence in corporate supply chains. Despite this institutional focus, little is known about how firms engage with their suppliers in developing climate-resilient practices.

The issue of how corporations engage with their supply chain on climate actions is salient because environmental protection and natural resource management problems occur across international borders, making it difficult for any single government to regulate. In addition to national climate policies, regulators are increasingly holding firms responsible for the climate impact of their suppliers. Customer firms, typically much larger than their suppliers, can respond to stakeholder pressures to be sustainable by reconfiguring their supply chain and replacing 'brown' with 'green' suppliers (Bisetti, She, and Žaldokas 2023, Pankratz and Schiller 2021). However, current supply chain arrangements are economically efficient outcomes, and it is costly for firms to switch suppliers (Antràs 2020a, Garcia-Appendini, Boissay, and Ongena 2022). An alternative approach can be for customer firms to transmit their climate-responsible practices upstream and commit to private regulation of suppliers' environmental practices (Adelino et al. 2022, Chu, Tian, and Wang 2019, Cen et al. 2017, Cen and Dasgupta 2021, Hertzel et al. 2023). Private regulation of environmental standards, whereby large firms enter into bilateral monitoring of their suppliers, can overcome the challenges of international political cooperation and foster global climate-resilient practices (Vandenbergh and Moore 2022). For example, Dell Inc requests climate-related disclosures from its suppliers and "intends to work with suppliers on emission reduction strategies".

In this paper, we examine whether supplier firms adopt climate-responsible policies when they face climate-related pressure from customers. We use granular firm-level climate-related disclosures from CDP, which gives us information on climate action (such as emission-reduction initiatives and setting emission targets) and climate governance (such as having a climate-resilient business strategy, board oversight of climate-related issues and climate-related incentives for managers) practices for a sample of 793 firms from 2010-2020. To credibly commit to relation-specific investments,

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supplier firms can adopt climate-action policies. Additionally, since climate-responsible practices are costly to implement, firms often have board-level oversight of their climate actions and provide explicit incentives to top managers to attain targets related to climate actions (Homroy, Mavruk, and Nguyen 2023, Qin and Yang 2022, Tsang et al. 2021). These detailed voluntary corporate climate-related disclosures are likely to be a more reliable measure of firms' environmental strategies compared to third-party vendor-estimated environmental and social (ES) scores (Aswani, Raghunandan, and Rajgopal 2023). We combine the CDP data with information on first-tier suppliers of US firms from Factset.[1] Our sample primarily includes North American customer and supplier firms and spans 24 industry groups. On average, a supplier in our sample has 11 customers.

We show that the fraction of firms adopting climate-responsible policies has grown significantly within our sample period. Approximately a quarter of the firms reported any climate-responsible policies in the CDP survey in 2011, but by 2020, over three-quarters of firms had adopted emission-reduction initiatives, and half of the respondents had set an explicit emission-reduction target. Climate governance policies show similar growth rates over this period, with 75% firms having a climate-integrated business strategy and board oversight of climate risks and about 50% of the firms having climate-linked targets in executive compensation.[2] As a measure of downstream pressures on climate-responsible policies, we calculate the fraction of suppliers that had at least one customer firm adopting an emission-reduction target. Since end-to-end emissions are typically higher than the direct emissions of a customer firm's own operations, their adoption of emission reduction targets is a good proxy for climate-related pressure on suppliers.[3] This fraction grew from 0.3 in 2011 to 0.8 in 2020.

We use both parametric and non-parametric methods to estimate the likelihood of suppliers adopting climate-responsible policies in response to downstream pressure. We hypothesize that suppliers who want to signal relation-specific investment would adopt *both* climate action (emission-reduction targets and emission initiatives) and climate governance (board oversight of climate issues and managerial incentives for climate targets). Consistent with this, we find that supplier firms are 6-8 percentage points more likely to adopt emission reduction targets and 10 percentage points more likely to link executive compensation to climate targets following downstream pressure. We find qualitatively similar effects of downstream pressure on other climate action measures (suppliers are 5 percentage points more likely to have emission-reduction initiatives) and climate governance policies (suppliers are 13 percentage points more likely to have board oversight of climate issues).

A challenge to drawing causal inferences on adopting climate policy spillovers in supply chains is that customer and supplier firms can adopt them simultaneously due to unobserved factors. For example, the focus on corporate sustainability practices has increased over the sample period. Consequently, the average effect could be an artefact of increasing climate awareness among (sup-

[1]We refer to the direct suppliers of a company as first-tier and suppliers of first-tier suppliers as lower-tier.

[2]We describe the construction of these measures in Table 1.

[3]For example, Walmart and Vodafone use climate change management information to rate the performance of their suppliers following the adoption of net-zero commitments (Barnett 2012).

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plier) firms, irrespective of supply chain dynamics. In addition, the baseline results could mask heterogeneous effects over time. Therefore, we employ a staggered difference-in-differences model to estimate the conditional probabilities for cohorts of firms based on when they first received downstream pressure. We show that downstream pressure has an increasing impact on the likelihood of suppliers adopting climate action and climate governance policies over time. For example, suppliers are 5.3 percentage points (p.p.) more likely to adopt an emission target in the first year of treatment, increasing to 13.4 p.p. in the fourth year. We also find an increasing impact of downstream pressure on suppliers' adoption of the other four climate policies over time. There is no statistically significant pre-trend on any of the five climate-policy measures, which provides supporting evidence for our common trends assumption.

The aggregate results can subsume heterogeneities across customer-supplier dyads. For example, unobserved dyad-specific factors (such as length of the relationship, specificity of products, and social connections between managers of the customer and supplier firms) can confound the main results (Dasgupta, Zhang, and Zhu 2021). Therefore, we use a sample of all customer-supplier dyads to estimate the propensity of a supplier to adopt climate-responsible policies when a specific customer adopts them. This approach allows us to condition the probabilities on customer-supplier time-invariant unobservable characteristics. The estimates from these models are qualitatively similar but of lower magnitude than the difference-in-differences models. The impact of an individual customer on supplier policies is likely to be lower than the collective effect of all customers in the supply chain.

All these findings suggest that there is an upstream transmission of climate actions and climate governance policies. An important question is what drives the transmission of these policies from customer to supplier firms. When a customer has higher bargaining power relative to the supplier, it is more likely to write non-financial clauses like labour standards and climate actions in the contracts (Barrot and Sauvagnat 2016, Kuruvilla 2021). Through such bilateral contracting, customer firms can enforce the suppliers to adopt similar climate-responsible policies. We use the HHI of a suppliers' industry as a measure of relative bargaining power - a lower competition in the suppliers' industry implies that each supplier possesses greater bargaining power than their customers. We find that the suppliers' likelihood of adopting climate policies following customer pressure decreases with market power in their own industry.[4]

Another possible transmission channel is that other stakeholder pressure on the supplier firm itself drives its climate policy adoption. If that is the case, these unobserved factors can confound our baseline estimates when they are concurrent with customers' pressure. For example, when customers and suppliers are located in the same state, they are more likely to be affected by region-specific regulatory pressure, climate risks and innovation capacity (Chu, Tian, and Wang 2019, Pankratz and Schiller 2021). Therefore, we examine if such spatial agglomeration effects drive our results. We estimate our baseline models for the subsample of U.S. customer and supplier firms,

[4] In another test of bargaining power, we show that suppliers' likelihood of climate policy adoption increases with the difference in firm size relative to the customer

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controlling for the fraction of customers and suppliers in the same state. Our results remain qualitatively unchanged. It mitigates concerns that unobserved factors related to spatial agglomeration drive our results. A further concern is that customer firms can start sourcing from more climate-responsible suppliers (Pankratz and Schiller 2021). Such assortative reconfiguration of the supply chain can confound our upstream transmission result. Within a sample of new customer-supplier pairs formed within our sample period, we examine whether a customer setting an emissions target increases the likelihood of new suppliers being 'green' (i.e., the supplier had already adopted climate policies before being linked to the customer). We do not find evidence that customer firms' setting emission targets increases the likelihood of sourcing from 'green' suppliers.

Customers and suppliers can also be affected by unobservable industry-specific pressures to be climate-sensitive (Krueger, Sautner, and Starks 2020). To alleviate this concern of bias from omitted variables, we estimate the effect of customers' adoption of climate-responsible practices in an instrumental variable setup. In the first stage, we predict the likelihood of the customer firms' adoption of climate-responsible practices when there are shareholder proposals on environmental issues in its peer firms. The identifying assumption is that shareholder proposals on sustainability in peer-group firms create pressure on the focal firm to adopt climate-responsible practices without directly affecting its suppliers (He, Kahraman, and Lowry 2023). We show that a focal firm is more likely to adopt emission targets following shareholder proposals on environmental issues in a peer firm. The customer firm's adoption of emission targets increases suppliers' likelihood of adopting emission targets by 17 percentage points.[5]

Ultimately, the socially relevant question is whether the transmission of climate policies along the supply chain affects the real climate outcomes of suppliers. To examine that, we investigate whether there are improvements in supplier firms' climate-related outcomes following downstream pressures. Using both linear and staggered difference-in-differences models, we find that there is no statistically significant reduction of CO_2e emissions and energy expenditure as a fraction of the operating expenditure of suppliers following downstream pressures.[6] However, it is difficult to draw a strong inference about climate outcomes from these results alone because emissions and energy inputs are inherent to production technology, and substantial changes may not happen in the short run. Hence, we also examine whether there are changes in the leading indicators of climate outcomes following customer pressure. In other words, we seek to detect whether suppliers change their business activities, which can lead to lower emissions in the long run. Real changes in long-term climate outcomes will require investments in green assets or undertaking green innovation. Therefore, we focus on two leading indicators of emission abatement: capital expenditures (CapEx) and Research and Development (R&D) expenditure (Li et al. 2023). In both constant and dynamic effects models, we do not find a statistically significant change in either of these two leading indicators. These results highlight a *policy-outcome gap* in the private regulation of climate

[5]This empirical setup does not suffer from a weak-instrument problem. The instrumental variable does not affect suppliers' adoption through an alternate channel, such as shareholder proposals on environmental issues at the focal firm itself.

[6]CO_2e includes all GHG emissions expressed in equivalents of CO_2.

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actions in global supply chains. It appears that customer pressure leads to only a symbolic adoption of climate policies without an associated effect on climate-related outcomes.

What explains this *policy-outcome gap*? There can be three reasons suppliers might adopt climate policies without investing in real climate outcomes. First, customer firms often have higher bargaining power relative to suppliers. Customers' bargaining power stems from size differences and competition among suppliers for orders from these large customers. The imbalance of bargaining power can result in poor commercial terms in supply chain contracts, which traditionally focus on price, delivery time and defect rates (Villena and Gioia 2020, Kuruvilla 2021). Therefore, suppliers are often financially constrained to make significant investments towards emission reduction (Vandenbergh and Moore 2022). In that case, suppliers can symbolically adopt climate policies to gain legitimacy and avoid sanctions from customers (Jira and Toffel 2013). If poor commercial terms impede the average supplier from implementing the climate policies in practice, then suppliers with higher gross margins should be better equipped to implement the policies they adopt following customer pressure. For example, when Pepsico offered guaranteed above-market prices to improve the sustainability practices of its potato supply chain in India, it led to a reduction in water consumption and a decrease in the use of harmful fertilizers (Lefebvre et al. 2021).[7] Therefore, we estimate the climate outcome of suppliers with high gross margins (above the 80th percentile of the gross margins distribution) conditional on adopting climate policies following customer pressure. We find that firms with higher gross margins increase capital expenditure after they adopt emission-reduction targets following customer pressure, even though emissions do not fall in the short run. These results show that the policy-outcome gap in climate action is smaller when suppliers retain a larger fraction of their revenues. A direct implication of this result is that better commercial terms in supply chain contracts can enable suppliers to invest in climate actions.

Second, it is often difficult for customers to monitor suppliers' operating activities (Jira and Toffel 2013, Prahalad and Ramaswamy 2004). Environmental audits are rare and can often be misleading (Kuruvilla 2021). In 2019, Tesco Plc, a large UK supermarket, pledged to have deforestation-free supply chains by 2025. Towards that end, it committed to engaging with its suppliers on responsible sourcing practices and introduced certification requirements. Despite this, recent investigations by environmental organizations using satellite data directly link Tesco's supplier Cargill to illegal deforestation in the Amazon rainforest (Mighty Earth 2021). Following a large literature on better monitoring by closely located stakeholders, we hypothesize that if customers' inability to monitor leads to suppliers' symbolic adoption of climate policies, then this constraint should be decreasing in the distance between the two firms (Bae, Stulz, and Tan 2008, Kang and Kim 2008, Knyazeva and Knyazeva 2012, Malloy 2005). Therefore, we examine whether the policy-outcome gap reduces when customer-supplier pairs are located in close proximity. We show that when the distance from customers' headquarters is smaller, the suppliers' adoption of climate action policies following

[7] The guaranteed price offering was also accompanied by technological support and advice.

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customer pressure is associated with increased capital expenditure.[8] Therefore, the possibility of better monitoring by the customer firms lowers the policy-outcome gap.

Third, cultural friction can impede suppliers from implementing climate policies towards meaningful climate outcomes. For example, partisan polarization shapes the climate and energy attitudes of US citizens and corporations - Republicans oppose renewable electricity and other green energy policies, while the Democrats support them (Di Giuli and Kostovetsky 2014, Goldberg et al. 2021, Coley and Hess 2012, Antonio and Brulle 2011). The political views of supplier firms likely affect whether they adopt climate action policies symbolically. For example, Villena and Gioia (2020) find that suppliers of a major US carmaker resist sustainability programs of customers if it contradicts their conservative worldview. Using the information on political donations from Opensecrets, we test whether Democrat-leaning views of suppliers are associated with a lower policy-outcome gap. We find no evidence that political views affect suppliers' climate outcomes. These results indicate that the transmission of climate policies along the supply chain can lead to real climate outcomes when suppliers have better gross margins and customers can monitor suppliers' operating activities.

Our paper makes four contributions to the literature. It is among the first studies examining the adoption of climate actions and climate governance in supply chains. From the perspective of global decarbonization, examining climate-responsible practices in supply chains is crucial. In two related papers, Bisetti, She, and Žaldokas (2023) show that US customers trade relationships with international suppliers following E&S incidents at the suppliers' site, while Pankratz and Schiller (2021) show that firms use the information on physical climate risks to re-configure supply chain networks. While these papers focus mainly on physical climate risks, firms also face transition risks that are affected by their supply chains' climate-responsible practices (Ersahin, Giannetti, and Huang 2023). We contribute to this discussion to show that customer firms can address transition risks by leading the adoption of climate-responsible policies for their existing suppliers. Our results imply that, in addition to incorporating climate risks in a firm's supply chain choices, there are spillover effects of adopting climate policies across firms. It is an important result because a firm's supply chain choices are economically efficient outcomes. Large-scale reconfiguration to build climate resilience is likely to be at the cost of economic resilience. Firms incur relation-specific investments with their suppliers; therefore, replacing existing suppliers can be costly (Barrot and Sauvagnat 2016, Antràs 2020a,b). If customer firms can cascade their climate-responsible policies to existing suppliers, then such a 'climate resilience-economic resilience' trade-off can be less binding.

Our emphasis on the real outcomes from suppliers' adoption of climate policies relates to the discussion on green-washing. Large firms are often criticized for adopting superficial practices whilst passing on the emissions further upstream (Kitzmueller and Shimshack 2012, Dowell, Hart, and Yeung 2000, Jira and Toffel 2013). The lesson from the cognate area of private regulation of labour standards in supply chains is that despite the proliferation of private regulation over the last thirty

[8]The distance between the headquarters of customer-supplier pairs is a good proxy for monitoring ability because climate action adoption and implementation plans are driven by executives who generally work at the headquarters.

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years, labour standards at supplier sites remain persistently low (Kuruvilla 2021, Vandenbergh and Moore 2022). Our headline results find no statistically significant change in climate outcomes or leading emission reduction indicators. This policy-outcome gap suggests a green-washing motive in suppliers' adoption of climate policies.[9] Our main contribution to this strand is that we provide novel empirical evidence on factors that can mitigate the policy-outcome gap. We show that the upstream transmission of climate policies can improve climate outcomes when suppliers have higher gross margins, and the customers can better monitor suppliers. It is consistent with the survey evidence on the sustainability practices of a selection of US suppliers (Villena and Gioia 2020). These results highlight the need for a more nuanced discussion on green-washing in supply chains.

Our paper also contributes to the literature on the information-diffusion role of customer-supplier relationships. An established body of work focuses on information-sharing along the supply chain on labour standards and workplace safety (Levine and Toffel 2010, Locke et al. 2007, Weil and Mallo 2007).[10] More recently, Schiller (2018), Banerjee, Homroy, and Slechten (2022) and Dai, Liang, and Ng (2021) show that the social preference of customers informs suppliers' corporate social responsibility practices. Consistent with these papers, we show that suppliers adopt climate-responsible policies following pressures from customer firms. These adoptions are more likely when customers have higher bargaining power. However, much of the research that examines the propagation of socio-environmental practices along the supply chain relies on aggregate third-party ES scores and does not examine the suppliers' operating choices that may drive the headline measures. These vendor-reported scores have recently been criticized for data coverage problems, inconsistencies in methodologies, and outright manipulation by firms (Aswani, Raghunandan, and Rajgopal 2023, Berg, Koelbel, and Rigobon 2022). The advantage of our setting is that we use voluntary disclosure of firms from a widely used and reliable global survey used by investors and supply-chain partners. Additionally, we use granular disclosure of firms' socio-environmental policies and practices, which allows us to focus sharply on supplier firms' underlying operational and governance adjustments in response to customers' sustainability pressures. For example, while Dai, Liang, and Ng (2021) and Schiller (2018) focus on the change in headline ES scores of suppliers, we show that suppliers adopt policies such as emission reduction targets, board oversight of climate risks and ES-linked executive compensation.

Finally, our paper has important implications for public policies on corporate climate actions. Regulators worldwide are increasingly focusing on corporate environmental due diligence to identify, prevent, and address environmental violations within their own and their direct suppliers' operations. Customer firms respond to such pressures by using bilateral private regulations of suppliers' environmental standards and climate policies (Kuruvilla 2021, Vandenbergh and Moore 2022). Supplier firms respond to such contracts by adopting climate policies aligned with the

[9] Since we focus on only first-tier and more visible suppliers, such practices of lower-tier suppliers are likely to be much worse (Villena and Gioia 2020, Vandenbergh and Moore 2022).

[10] There is also evidence that supplier firms benefit from technological information sharing and operating innovations such as tax avoidance and financing choices from their customers (Cen et al. 2017, Adelino et al. 2022). Chu, Tian, and Wang (2019) show spillovers in innovation activities from customer to supplier firms.

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customers as an implicit signalling mechanism to convey information about otherwise unobserved environmental attributes (Delmas and Montiel 2009). Since climate-related practices do not lend themselves well to explicit contracting because environmental outcomes are hard to measure and monitor in the short run, customer firms focus on terminating supply chain contracts, limiting legal liabilities and indemnifying suppliers in the event of an environmental scandal rather than investing in developing environmental capabilities of suppliers (Torr and Kuchler 2021, He, Kahraman, and Lowry 2023, Kuruvilla 2021). Such *governance by exit* strategy, as documented by Bisetti, She, and Žaldokas (2023) and Pankratz and Schiller (2021), may insulate the customer firm from stakeholder pressure without an improvement in global climate outcomes. A survey of sustainability practices of automotive, electronics, and pharmaceutical industries confirms that many suppliers violate the required sustainability standards of these private regulations, even though they often comply on paper (Villena and Gioia 2020). Respondent suppliers of this survey highlight that slim profit margins and lack of oversight contributed to symbolic engagements. Using a larger sample, we highlight that suppliers face price pressures from customers, which limits their flexibility to invest in sustainability practices. Customers also face high costs to monitor and collect climate-impact information from suppliers. Therefore, better commercial terms in supply chain contracts can foster the effective upstream transmission of climate action policies with real climate outcomes. Climate policies that aim to foster private regulation of climate standards in supply chains must combine climate due diligence requirements and economic incentives for better commercial terms and monitoring capabilities.

2 Data and Variables

2.1 Firms' Climate Policies

We first focus on the climate policies of firms. The primary source of data for these climate policies is the survey responses to the Carbon Disclosure Project (CDP).[11] CDP is a not-for-profit charity that collects carbon emissions data and their climate impacts of companies on behalf of institutional investors and corporate customers. It is one of the most comprehensive collections of corporate environmental data globally (Ilhan et al. 2023). CDP sends out a standardized questionnaire to firms, which is aligned with the Task Force on Climate-Related Financial Disclosures (TCFD) recommendations, on their performance on climate-change-related issues. The survey questions seek disclosure of information on their emissions, climate policies adopted by firms, and organizational processes focused on sustainability.[12] Since these responses are open to scrutiny from several stakeholders (who possibly requested the information in the first place), it disincentives firms from providing false responses. Therefore, these voluntary disclosures are likely to reliably reflect

[11] https://www.cdp.net/en/investor/data-and-tools

[12] The TCFD was established in December 2015 by the G20 Financial Stability Board. It consists of governance, strategy, risk management, metrics, and targets that firms should disclose. TCFD disclosures will soon become mandatory for firms in most developed economies.

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corporate policies and strategies on climate change (Fearnley 2018).

We collect CDP data from 2011 to 2020 and limit ourselves to those companies for which we are able to collect financial data from Compustat.[13] We augment this with supply-chain information from Factset Revere. The merged CDP-Factset database consists of 793 unique firms from US and Canada, spanning 24 industry groups. To investigate our research question, we need to observe both customer and supplier firms in this matched database. Therefore, our final sample consists of 699 unique supplier firms for whom we can identify at least one customer in the CDP dataset.

We focus on firms' responses to their organizational processes and strategy related to climate action. More specifically, we focus on questions which ask firms whether they have set a target for emissions reduction, whether a firm incentives management to reduce the adverse impact of the firm on climate, etc. We focus on 5 key questions asked in the ten yearly CDP surveys, which we present in Table 1.

[Insert Table 1 here]

Our choice of these 5 questions is motivated by three important factors. First, the selected questions elicit a response that reflects on the firms' broader outlook and actions on combating climate change. Therefore, we chose measures that reflect firms' headline climate policies, strategic choices and outcomes. Second, the questions should be informative about climate-responsible policies and practices of firms in a wide range of industries. This is an important consideration because climate risks and consequent corporate actions vary widely across industries. Finally, while a major advantage of CDP is that it provides insights into how firms gradually changed their governance and strategy over the sample period, it is important to have measures that are comparable over time. The CDP questionnaire evolved substantially over the past decade, and many questions were modified or added. Our selection of questions needs to be informative yet remain unchanged in spirit for us to construct a panel of responses.[14]

A major challenge with the CDP dataset is that firms don't respond to surveys every year, leading to gaps between observations. It poses a challenge if our estimands require within-firm variation. Moreover, we need to adjust for the secular trend in firms becoming more climate-conscious over the sample period. For this, we need a sufficiently large cross-section of firms each year. To get around these challenges, we make assumptions based on data properties that help us create a balanced sample of firm-year CDP responses to the questions in Table 1. The fundamental assumption is that the response to these questions will be sticky for a firm. If a firm responded 'Yes' to question C3.1 in (say) 2016, we could safely assume that the response is a 'Yes' in the subsequent

[13] Data from earlier years contain too few companies for any meaningful analysis. Additionally, we end our sample before the onset of the COVID-19 pandemic.

[14] Question C 1.1 was changed in 2018. Prior years of the survey asked: *Where is the highest level of direct responsibility for climate change within your organization?* One of the options was: *Board or individual/sub-set of the Board or other committee appointed by the Board.* From this response, we were able to impute, for previous years, the answer to the new question asked on and after 2018.

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years if the firm did not respond to further surveys. Similarly, for a firm which responded to C1.3 with a 'No' in (say) 2015, the response had likely been a 'No' in the earlier years.[15]

[Insert Table 2 here]

In Panel A of Table 2, we report the summary statistics of the survey responses. The responses are evenly distributed across firm-year, with means around 0.5 for most responses. We also provide information on the transition of the firms across the sample period. *Max Switched* reports the year when the maximum number of firms switched from 'No' to 'Yes'. Firms transitioned to climate-conscious governance practices soon after the Paris Agreement in December 2015. Firms were quick to put in place initiatives to reduce carbon emissions and set themselves a target. Having board-level oversight and incentives for the management of climate issues show a gradual increase over the sample period. It is noteworthy that a significant number of firms still did not answer affirmatively for many of the questions at the end of the sample period. *Unchanged* counts the number of such firms that never respond with a 'Yes' to the respective questions. This heterogeneity in adapting their businesses to climate change is an important source of variation that we exploit in this paper.

[Insert Figure 1 here]

In Figure 1, we report the evolution of the response of firms over time. We plot the fraction of firms which responded 'Yes' to the respective survey questions. We first note the secular trend among firms to adopt climate-sensitive governance and actions. More than 75% of the firms in our sample responded 'Yes' to all the survey questions in 2020. This is not unexpected, as the general level of climate awareness among firms has been on the rise, especially after the Paris Agreement in 2015. We also note that more firms were likely to institute climate governance practices than set GHG emissions reduction targets.

[Insert Figure 2 here]

An important source of variation in firms' climate consciousness is likely to be the industry it operates in. Thus, to better understand the heterogeneity in responses across industries and over time, we plot 'heat maps' of the responses. In Figure 2, we present the heatmap of firms' responses to the survey questions. Several insights can be gleaned from this. First, and on expected lines, there has been a secular trend among all industries to incorporate climate-related issues in their business strategy. Firms across industries became mindful of the impact of climate change on their businesses. They adopted related governance measures and undertook mitigatory action. Second, there is significant variation in this adaptation across industries. Some industries, such as financial firms, were quicker to react than manufacturing firms. This variation is likely driven by firms' trade-offs in pivoting their business towards being more climate sensitive. Firms which face a lower

[15] We discuss our sample creation process in detail in the appendix. We also note where we need further assumptions to encode CDP responses.

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cost are likely to switch earlier. This heterogeneity is also an important pointer to include either firm fixed effects or industry fixed effects in our identification of estimands of interest, as there could be substantial (unobserved) heterogeneity in the adoption of climate governance and climate action measures.

2.2 Firms' Climate Related Outcomes

Next, we focus on climate-related *outcomes*. We collect information on total emissions (linear summation of scopes 1,2 and 3) from Thomson Reuters Asset 4 and Eikon. We also collect data on operating expenditures on energy from the CDP surveys. If suppliers adopt climate policies to become more climate responsible following a customer firm setting an emission target, then we should expect to see an effect on their climate impacts. In this case, suppliers are likely to work towards emission abatement and switching to green energy.[16] In addition to scope 1 emissions and energy expenses, we also analyze the impact of the adoption of climate policies following customer pressure on suppliers' capital expenditure (CapEx) and research and development (R&D) expenditure. CapEx and R&D expenses are potential determinants of emission reduction, as they indicate the company's willingness to pursue innovation and efficiency (Li et al. 2023). Through investing in new or upgraded assets and technologies, a supplier can lower its emissions and improve energy efficiency. For instance, under the cap-and-trade regulation policy, a company can achieve emission reduction by adopting clean technologies or developing low-carbon products (Liu et al. 2021).

Panel B of Table 2 reports the summary statistics of the supplier firms in our sample and their direct customers in the supply chain. The median firm has assets of about 7.5 billion US dollars. On average, the suppliers' capital investments are approximately 4% of their assets. The average expenditure on research and development is approximately 5% of assets. 7.8% of the operating expenditure is on energy. On average, a supplier has 61 unique customers (as identified from the *Factset*) data set. We can identify, on average, 12 customers in the *CDP* data set. The average size of all the customer firms in our sample is over 55 billion US dollars. Although this is very similar to the average size of all the supplier firms in our sample (52 billion US dollars), the average paired size difference is more skewed. Customers are 73 billion US dollars larger than their suppliers.

2.3 Measuring Customer Pressure

We create a measure of downstream pressure by focusing on customers' actions on reducing GHG emissions. Our intuition is that when customers have a set target to reduce emissions, they influence their suppliers to adapt climate governance measures and actions. Thus they exert 'downstream pressure' on their supplier firms. A second reason for using emissions targets as the

[16] The effect of the adoption of climate policies on energy expenses is an empirical question. Suppliers' energy costs can increase if they switch to green energy since the marginal cost of green energy is higher than conventional sources. Alternatively, energy costs can decrease if suppliers lower energy consumption

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basis for customer pressure is that customer firms often set goals on reducing emissions across entire supply chains. For example, when Unilever set itself a net-zero and an emission reduction goal in early 2019, it "encouraged" its suppliers to set their own science-based targets. The net-zero goal includes reductions of Scope 3 emissions, which are emissions computed across the entire supply chain.

[Insert Figure 3 here]

We follow the following steps to create a measure of customer pressure. For each supplier-customer combination in our data set, we create a variable *Customer CO2e Target*, which switches from 0 to 1 (and remains 1) if a customer has set itself a target for reducing CO2e emissions. This switch from 0 to 1, in any given year, can happen either because an existing customer sets itself a new target or because the supplier gets a new customer already having an emissions target. We then collapse this variable for each supplier-year by looking at whether *any* current customer had set an emission target in a given year.[17] In Figure 3, we plot the fraction of supplier firms which had any customer with an emission target (i.e., our measure of customer pressure). Table 2 also summarizes this variable for all the supplier firms in our sample. The median firm faces downstream pressure -about 50% of the firms started facing customer pressure from year 2013.

3 Empirical Strategy & Results

3.1 The Effect of Pressure from Downstream Firms on Climate Policies

In this section, we develop the estimand of interest and spell out the research design for identification. We use the popular causal inference notations of potential outcomes to fix ideas. Let $Y_{it} \in \{0, 1\}$ denote the response of firm i in year t on any question on climate action. Let $Y_{it}(1)$ denote the response of a firm when the firm faces pressure from downstream firms, as measured in section 2.3. $Y_{it}(0)$, on the other hand, denotes the response of the same firm when it does not face downstream pressure. For any given firm, at time t, we define downstream customer pressure with variable $P_{it} \in \{0, 1\}$. The causal estimand of interest, which we define as ρ_t, is given as

$$\rho_t = [Prob(Y_{it}(1) = 1) - Prob(Y_{it}(0) = 1)] = E[Y_{it}(1) - Y_{it}(0)]. \tag{1}$$

This is the average treatment effect at time t. We begin by assuming that ρ_t is constant across time (i.e., $\rho_t = \rho$). This is a strong assumption that we relax later. We do this to explain the context of our identifying assumptions and introduce time variation in treatment effects later.

Equation 1 cannot be estimated from the data as we never observe the counterfactual for any given firm. We, therefore, discuss the assumptions that are necessary to make the statistical estimand that can be estimated from the data an unbiased and consistent estimator of ρ.

[17] In Appendix B, we provide the exact details on how we compute our pressure variable.

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Two assumptions are necessary here. The first is the *stable unit treatment value* assumptions. The second assumption is that of *ignorability*. Both are strong assumptions and merit discussions, especially in our context. We discuss these below and explore strategies to test some of these assumptions.

This first assumption of *Stable unit treatment value assignment* states that downstream pressure on any *particular* firm does not impact other firms. This assumption is standard in most causal inference studies. In our setting, the critical mass of this assumption rests on two key points; how individual firm-centric we make the downstream pressure measure and whether there are spillovers of this pressure to peer firms. In the online appendix, we explore this assumption and run placebo tests with the downstream pressure variable computed for other firms.

The *Ignorability* assumption, in our context, implies that the potential outcomes of firms' environmental actions are unrelated to whether the firms actually face downstream pressure in the observed data. That is, we can 'ignore' why some firms face downstream pressure, and some don't in the data. This assumption is almost certainly violated in our setting. Whether a firm faces downstream pressure is **not** independent of the firm's potential outcomes of climate policies and related outcomes. Downstream pressure is not randomly assigned to firms. They come about in equilibrium.

One way around this problem is to find a set of covariates, $\mathbf{X}$, which, when conditioned on, makes the potential outcomes mean independent. For example, if the level of fixed assets (property, plant and equipment (PP&E)) of a firm determines both whether the firm faces downstream pressure and whether the firm engages in climate-change adaptive actions, then controlling for the level of the PP&E can mitigate the problem. That is the potential outcomes, $Y_{it}(0)$ and $Y_{it}(1)$, are mean independent of P, when conditioned on $\mathbf{X}$. We formally state this *Conditional Ignorability* assumption as follows:

$$E[Y_{it}(g) \,|\, \mathbf{P_i}, \mathbf{X_i}] = E[Y_{it}(g) \,|\, \mathbf{X}], \quad g \in \{0, 1\}. \tag{2}$$

where $\mathbf{P_i}$ includes the entire history of customer pressure across all time periods, t. $\mathbf{X}$ includes a vector of covariates measured *before* at the beginning of the sample period (i.e., in 2010) and has no variation across time. This is necessary because we do not want to include in the set of covariates any variable that may also be affected by downstream customer pressure, as that would violate the conditional ignorability assumption.

Although conditional ignorability is still a strong assumption, it allows us to condition on firm observables, time trends, and in some cases, firm unobservables. It is an important consideration because the likelihood of a firm engaging in adaptive environmental actions is very likely driven by firm-specific variables, both observable and unobservable.

We need to estimate the two conditional probability functions:

$$Prob(Y_{it} = 1 | P_{it} = 1, \mathbf{X}) \ ; \ Prob(Y_{it} = 1 | P_{it} = 0, \mathbf{X}); . \tag{3}$$

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We use both non-parametric and parametric methods to estimate the above functions. The non-parametric procedure uses kernel estimators to estimate the functions. Parametric procedures assume a parametric form of the functions (linear and logistic) and employ regressions. Each approach has its own pros and cons. For example, in the non-parametric approach, we make no additional assumption and estimate the conditional mean by 'local averaging'. But data limitations can make the local averages noisy. On the other hand, in the linear parametric approach, we can control for time-invariant unobservable characteristics of firms (with firm fixed effects), but at the cost of strong functional form assumptions.[18] Finally, to estimate unconditional effects (as in equation 1), we average the estimated function over observed $\mathbf{X}$s (see Wooldridge (2010)).[19]

However, just averaging over observed $\mathbf{X}$s does not guarantee identification. We need a third assumption, the *Overlap* assumption, to ensure that. We formally state it as follows:

$$0 < Prob(P_{it}|\mathbf{X}) < 1 \quad \forall \;\; \mathbf{X} \in \mathscr{X}, \;\; t = 1, 2, ...T \tag{4}$$

where $\mathscr{X}$ includes the support of the covariates $\mathbf{X}$. In our context, this implies that when we estimate the two probability functions in equation 3, we should have enough observations with "similar" values of $\mathbf{X}$s for both kinds of suppliers, those who face customer pressure and those who don't. The conditioning set $\mathbf{X}$ includes standard firm-level controls such as firm size and firm profitability. We also include the level of the property, plants, and equipment a firm has. Our prior is that firms with higher fixed assets, and thereby potentially higher direct emissions, are more likely to react to environmental concerns (Azar et al. 2021). We also include time trends because firms have become increasingly more aware of the impact of their operations on the climate over the sample period. We include time dummies to control for this secular trend. In the linear specification, we also condition on unobservable firm fixed effects. As mentioned earlier, this allows us to hold constant time-invariant firm unobservables when estimating the conditional probability.

We refrain from adding too many control variables for three reasons. First, adding more controls makes the non-parametric models difficult to converge. Second, more controls would likely violate the overlap assumption, as it becomes likely that a particular covariate does not have "similar" values for the treatment and the control groups. Third, and arguably most important, adding too many controls might induce 'collider' bias in our estimand of interest and render them inconsistent (Elwert and Winship 2014).

[Insert Table 3 here]

In Table 3, we report the estimates of the effect of downstream customer pressure on firms'

[18] Estimating equation 3 with time-invariant firm level unobservables (i.e. firm fixed effects) requires additional functional form assumptions that will be applicable only in the linear estimator.

[19] In the linear approach we don't need to estimate the two probability functions separately, as we can back out the estimand, ρ, from a single estimating equation. For the logistic and non-parametric approaches, we estimate the two probability functions separately and calculate the average difference between the fitted probabilities.

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probability of having climate-adaptive policies. We find that downstream pressure increases the probability of making climate change a key factor in their business strategy by 5 to 10 percentage points. The estimates are robust to several estimation approaches and do not appear to be sensitive to functional form assumptions. An average impact of 5 to 10 p.p. change in probability is a reasonable estimate since utility-maximizing suppliers will likely evaluate the incremental costs of adapting their business strategy with the costs of remaining a 'brown' supplier.

We also report the results of the effect of downstream customer pressure on incentives, oversight, and actions on climate-related issues of a firm. First, when a customer has an emission reduction target, the probability of a supplier having incentives for the management of climate-related issues increases by around 10 percentage points (column (2)). These incentives include monetary incentives for managers to meet emission reduction targets or energy consumption reduction targets. Incentives also include non-monetary awards such as recognition in the performance evaluation metrics of managers. Second, we find that downstream pressure is associated with an increased probability of having board oversight on climate issues. A firm is 6 to 13 percentage points more likely to have board oversight on projects/endeavours dealing with climate change (column (3)). Board oversight entails, for example, board-level committees which oversee climate-related projects or building business plans and strategies to tackle climate-related risks. Both these pieces of evidence point towards a significant impact of customers' climate awareness on their suppliers' incentives and oversight of climate-related issues. The natural follow-up question is: do these governance policies lead to explicit firm-level policies on emission reduction?

Finally, in columns (4) and (5) of Table 3, we explore how downstream pressure impacts firms' commitment to reducing emissions. We first explore whether a firm is more likely to institute an emissions reduction target. We find that a firm is 6 to 8 percentage points more likely to have an emission reduction target if a customer also has an emissions reduction target. Relatedly, a firm is around 5 percentage points more likely to have firm-level initiatives to reduce emissions. These initiatives include, for example, instituting energy-efficient processes, installing low-carbon equipment, carbon offsetting, etc. Therefore, it seems that firms adopt both climate-action and climate-governance policies in response to customer pressure.

In the following analyses, we stick to the linear functional form of the probability functions. We do this for several reasons. First, noticing that the estimates are stable across various functional forms makes us feel comfortable in making the linearity assumption. Second, the linear form allows for more robust estimation, using varying combinations of fixed effects. Third, we later make use of the instrumental variable estimation method, where we are forced to make a functional form assumption (no pure non-parametric estimation is possible), and we choose the linear form.

We now drop the restrictive assumption that the effect of downstream pressure on outcome variables is constant over time. To do this, we utilize the estimation framework of staggered difference-in-differences.[20] We create cohorts of firms based on when they *first* received downstream

[20]The key identifying assumption now changes from *ignorability* to the *common trends* assumption, where we

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pressure. We aim to estimate the treatment effects based on the intensity of treatment. That is, we assume the treatment effects change over time based on how long a firm has remained exposed to treatment. To use a stable number of firms to estimate these time-varying treatment effects, we only consider those firms that first received treatment on or after 2015.[21]. This also allows us to estimate pre-treatment trends (in a separate estimation) with a suitable sample size of firms up to 4 years prior to treatment.

[Insert Table 4 here]

We report the time-varying estimates of the treatment effects in Table 4. We estimate treatment effects up to 5 years post-treatment for the five climate policy variables described earlier. We note that downstream pressure increased the probability of suppliers adopting a climate-aware business strategy by 5.8 percentage points (p.p) in the first year of downstream pressure. The effect increases to about 10 percentage points in years 2 and 3. The effect subsides thereafter. On climate policies such as incentivizing management and having board-level oversight, downstream has an increasing effect over time. For example, downstream pressure increases the probability of suppliers incentivizing their management by 10 p.p. in the first year of pressure. The effect increases to about 23 p.p in year 5. On climate policies such as having emissions reduction initiatives and targets, we also note an increasing impact of downstream pressure over time. Finally, we also test for pre-trends in Table 4. We report the coefficients for the pre-trend estimates up to 4 years prior to treatment. We do not find any evidence of a statistically significant pre-trend on any of the five climate policy variables.

3.2 Do customers reconfigure supply chains?

An alternative explanation to the above results could be that customer firms reconfigure their supply-chains and switch to 'greener' suppliers. It is possible that customer firms, rather than pressurizing their suppliers to become more climate-conscious, find it more efficient to move to new 'greener' suppliers. We explore this possibility of customer firms restructuring their supply chains and moving towards firms which are already more climate aware. To examine this possibility, we explore all the *new* customer-supplier connections that were formed and test whether customers having an emission target impacts the probability of acquiring a 'green' supplier. A 'green' supplier is defined as a supplier who responds positively to the 5 questions in Table 1 in the year the new connection was formed. Specifically, we estimate the following probability function:

$$Prob(GS_{it} == 1) = \alpha_i + \rho_j + \gamma_t + \beta ET_{jt} + \mathbf{\Omega X_{it}} + \epsilon_{ijt}. \tag{5}$$

where i indexes suppliers, j customers, and t time. GS is an indicator which equals 1 if the supplier responds positively to each of the environmental questions. ET is an indicator which equals 1 if

assume that the *trend* of the potential outcomes will be mean independent of the treatment status.

[21]Note in Figure 3 that more than 30% of the firms were already treated at the beginning of the sample and hence are not useful in the difference-in-differences setting, as we do not observe any change in their treatment status.

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a customer has set an emissions target. Note that the sample here is only new customer-supplier pairs formed (during the sample period), and the corresponding data are from those years when this new connection was formed. Within this sample, we aim to analyze whether a customer having an emissions target influences the probability of the new supplier being 'green'. We report the results in Table 5.

[Insert Table 5 here]

We first note that the number of new relationships formed during our sample period is around 4600. This is relatively small number given the possible combinations customer-supplier-year. Thus switching suppliers or customers is costly. We further note that the probability of acquiring a new 'green' supplier is not influenced by whether the customer has an emissions target, no matter how we define 'green'. The coefficients are not significant, neither statistically nor in economic magnitude. The coefficient on *Oversight* (implying that the new supplier is likely to have board oversight on environmental issues already) is slightly bigger, at 1.4%, but it is not statistically significant. Overall the evidence suggests that customers do not shift towards new 'greener' suppliers once they become more climate-conscious.

3.3 Transmission Mechanisms

The results of the previous sections show an increased probability of supplier firms adopting climate actions and climate governance in response to downstream pressure and not supply chain reconfiguration. There are three possible mechanisms that can drive such transmission along the supply chain networks.

First, customer firms can exert influence on the suppliers through feedback on the products (Manso 2011). When customer firms adopt emission targets, they can send feedback to their suppliers on the need for climate-responsible products. Increasingly, customers seem to involve suppliers in innovation projects, and it can be the case for green innovation too (Prahalad and Ramaswamy 2004). This feedback effect is likely to be stronger when the customer firm has greater bargaining power over the supplier (Chu, Tian, and Wang 2019). For example, if the customer firm has a wide range of suppliers to choose from, but suppliers need to compete among themselves for purchase contracts, then customer firms will likely have higher bargaining power. On the other hand, if there are a limited number of suppliers for a particular product, customers will have less bargaining power to push for the adoption of climate policies. Therefore, we examine whether suppliers in less competitive industries are less likely to adopt climate policies following customer pressure. In Table 6, we report the regression results where we allow the estimates to vary by the HHI index of the suppliers. We show that the impact of customer pressure on supplier climate choices is decreasing in the concentration of market power of the supplier in its own industry. This result indicates that bargaining power plays an important role in the customer-to-supplier

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transmission of climate policies.[22].

[Insert Table 6 here]

Another concern with our empirical analysis is that suppliers and customers that are geographically proximate may share intermediate input sources, human and natural resources (Orlando 2004, Chu, Tian, and Wang 2019). In our context, such spatial agglomeration of customer and supplier firms can affect adopting climate-responsible practices, *independent* of supply chain linkages. For example, some states can have a higher regulatory focus on the climate impact of firms. Therefore, all firms located there will be more likely to adopt climate-responsible practices. If so, the effects we document can be artefacts of suppliers and customers being located in states (or regulatory regimes) where there is a concerted push towards better climate-responsible business practices. Additionally, spatial agglomeration can lead to the transference of climate responsibility through the social connection between managers in the supplier and customer firms (Dasgupta, Zhang, and Zhu 2021).

[Insert Table 7 here]

To address this concern, we re-estimate the regressions but add an additional variable controlling for a fraction of customers that are from the same state. For this analysis, we restrict our sample to customers and suppliers based in the United States. We report the results in Table 7. We note that the coefficients on Customer Pressure are similar to the estimates of Table 3 after additionally controlling for the fraction of customer firms that are from the same state. Therefore, spatial agglomeration of customer and supplier firms does not seem to drive our baseline results.

3.4 Policy-Outcome Gap

In this section, we examine the effect of suppliers' adoption of climate policies following customer pressure on their climate-related *outcomes*. We use models analogous to section 3.1, first estimating a constant effect of downstream pressure and then switching to the staggered difference-in-differences framework. In Table 8, we report the estimates of the effect of downstream customer pressure on firms' climate-related outcomes. Specifically, we focus on GHG emissions and expenditure on energy as short-term impacts and CapEx and R&D as leading indicators of a firm's climate impact. We do not find a statistically significant impact of downstream customer pressure on any of these 'real' outcome variables.

[Insert Table 8 here]

In Table 9, we report the pre and post-treatment effects of downstream pressure on the out-

[22] In unreported results, we use the difference between customers and suppliers (in terms of total assets) as an alternate measure of bargaining power: a larger difference signifies the higher bargaining power of customers over suppliers. We find that a larger size difference increases the likelihood of supplier firms' adoption of climate policies following customer pressure

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come variables. Here too, we do not find any statistically significant impact of treatment. *Prima facie*, these results show a policy-outcome gap and provide evidence consistent with green-washing motives. Suppliers seem to adopt customers' policies symbolically without addressing their climate outcomes.

[Insert Table 9 here]

We further investigate the origins of the policy-outcome gap. We perform three main tests. First, we examine the climate outcomes of a supplier who adopts climate policies following customer pressure, conditional on the supplier's financial margins.[23] Our estimand of interest is the triple interaction of customer pressure, supplier's adoption of climate policies and an indicator of high gross margin. *High Gross Margin* is an indicator equals 1 if the gross margin of a firm is above the 80^{th} percentile of the gross profit distribution within the sample, zero otherwise.[24] In Table 10, we find that suppliers with high gross margins increase capital investments when they adopt emission targets following customer pressure. Suppliers with higher gross margin *and* an emission reduction target had 1.3 percentage points (p.p) higher capital expenditure (as a fraction of total assets) than the rest. Therefore, even though we find no effect of high gross margins on short-term climate outcomes, these results indicate that the policy-outcome gap we observe in aggregate may be a function of the low financial margins of suppliers.

[Insert Table 10 here]

Next, we investigate the role of monitoring by the customer firms in explaining the policy-outcome gap. We examine the climate outcomes of supplier firms that adopt emission targets following customer pressure that are geographically proximate. We measure the geographic proximity of customer-supplier pairs as the linear distance between the headquarters of these two firms.[25] We show the triple-interaction results in Table 11. find that these suppliers increase their capital investments. Suppliers with proximate customers *and* an emission reduction target had 0.3 p.p higher capital expenditure (as a fraction of total assets) than the rest. Additionally, we find no statistically significant effect on emissions, but energy expenses increase when suppliers adopt emission targets following pressures from geographically proximate customers. Since the per unit cost of green energy inputs is generally higher than that of traditional sources of energy, the increase in energy expenses could be driven by suppliers transitioning to green energy sources. Therefore, these results indicate that customer monitoring, or the threat of it, can mitigate the policy-outcome

[23] A more direct measure will be to examine if customers commit to guaranteed above-market prices to support suppliers' emission reduction initiatives. However, supply chain contracts are not systematically disclosed by companies.

[24] In the baseline models, we use suppliers' adoption of emission targets. The results are qualitatively similar to other climate policies.

[25] A direct test for monitoring will be to examine whether the frequency of environmental audits by customer firms reduces the policy-outcome gap. However, environmental audit information is not readily available. In fact, only one supplier reports in the CDP survey to have environmental audits from a US customer.

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gap.

[Insert Table 11 here]

Finally, we focus on the role of climate change beliefs in explaining the policy-outcome gap. We use the political donations of all employees of a firm as a proxy for the firm's beliefs on climate change: Democrat-leaning suppliers are more likely to take climate action than Republican-leaning suppliers (Di Giuli and Kostovetsky 2014, Goldberg et al. 2021, Coley and Hess 2012, Antonio and Brulle 2011). We merge political donations data from OpenSecrets with Factset to create an indicator *Democrat Leaning Suppliers* which equals 1 if the donations of all employees of a firm to the Democratic Party are at least 20% greater than that to the Republicans, zero otherwise.[26] In Table 12, we find no statistically significant effect of political ideology on climate outcomes. Therefore, we find no evidence that beliefs about climate change are associated with the policy-outcome gap.

[Insert Table 12 here]

Together, these results indicate that more favourable financial terms for suppliers in supply chain contracts and better monitoring by customers can be effective in aiding suppliers in transitioning from symbolic adoption of climate policies to real investments towards climate-responsible practices.

4 Alternative Estimations & Additional Tests

4.1 Unobservable Supplier-Customer Heterogeneity

In the analysis thus far, we have aggregated the downstream pressure measure at the supplier level. This aggregation is possibly missing out on specific dynamics of customer-supplier pairs. In this section, we analyze the effect of individual customers on suppliers' environmental actions. More specifically, we evaluate when any specific customer sets itself a GHG-emission reduction target and what impact it has on its suppliers' propensity to adapt to climate change. This approach is different because it allows us to condition on supplier-customer (time-invariant) unobservables. For example, there could be a long-standing relationship between any particular pair which drives the supplier's decisions.

To estimate the effect of individual customers on suppliers, we estimate the following equation:

$$Prob(Y_{it} = 1) = \alpha_{ij} + \gamma_t + \rho P_{jt} + \mathbf{\Omega X_{it}} + \epsilon_{ijt}. \tag{6}$$

where i indexes suppliers, j customers, and t time. The outcomes variables are the five climate policy variables and the four climate related outcome variables as described in previous sections.

[26]We use donations from the Presidential election years within our sample to construct this measure

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The sample consists of a complete panel of all pairs of customers and suppliers. A customer is defined as any firm which was a customer at any point during the sample period.

The main independent variable of interest, P_{jt}, is now measured at the customer level. It is a dummy variable which equals 1 if a customer, j, has an emissions reduction target in year t, *and* is a current customer of i. The estimation of equation 6, given its linear form, allows us to condition on supplier-customer pair unobservables, α_{ij}.

[Insert Table 13 here]

We report the estimation results for climate policy variables in Table 13. We note that the magnitudes of the effects are smaller than the aggregate effects estimated earlier. For example, we note the probability of a firm having an emission reduction target increases by 3.1 percentage points, as compared to the aggregate effect of approximately 6 percentage points estimated in Table **??**. This is expected because we are estimating the average effect of downstream pressure from a single customer. The influence of a single customer on supplier outcomes is likely to be weaker than the combined influence of all (or a subset of) customers together.

[Insert Table 14 here]

We report the estimation results for climate outcome variables in Table 14. Here too, we do not find any statistically significant effect of individual customer pressure on any of the outcome variables.

4.2 Estimation with an Instrumental Variable

The statistical association that we document in the previous section points towards the possibility of a strong causal mechanism. However, to interpret them as causal, we had to make a couple of strong assumptions. In this section, we estimate the effects using a different set of assumptions. We use an instrumental variable (IV) to estimate the effects of downstream customer pressure on firms' environmental actions.

In our setting, the desirable attribute of an instrument is that it should impact suppliers' choice of environmental action only via the customers' choice of setting emission reduction targets. More specifically, we need something that 'exogenously' impacts a customer firm's choice of setting emission reduction targets, *and* that it impacts supplier firms' environmental decisions only via the customers' decision on emission targets. We choose shareholder proposals on environmental issues at customers' peer firms as our instrument.

We compute our instrumental variable as follows. We create a dummy variable which equals 1 if a firm (i.e., a customer firm) is from an industry (defined by the firm's 4-digit GICS code) where a shareholder proposal on climate change was introduced (in any other firm) in the past, during the sample period. We then collapse this variable for each supplier, much like the way we compute

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our pressure variable in section 2.3. These shareholder proposals include proposals such as creating a feasibility plan for net-zero GHG emissions.

Our identifying assumption of *exclusion restriction* is based on established results on peer effects in corporate sustainable policies (Flammer, Hong, and Minor 2019, He, Kahraman, and Lowry 2023). When the shareholders of a customer firm's peers initiate proposals that deal with climate change within the peer firm, this puts the focal firm 'on notice' on their climate performance. These focal customer firms then are more likely to act on reducing their emissions by setting themselves a target. Shareholder proposals, even when they fail, can be informative about the socio-environmental preference of the investors (He, Kahraman, and Lowry 2023). For the focal firm, this is a plausibly exogenous shock for the focal firms' suppliers as shareholder proposals in peer firms should not directly affect the focal firm.[27] The impact of these shareholder proposals would impact supplier firms only via the actions of customer firms on climate change.

As mentioned earlier, we make a linear functional form assumption to execute the IV estimation. The main estimating equations are as follow:

$$P_{it} = G(\mathbf{X_i}, Z_{it}, \gamma_t) + \epsilon_{it} \tag{7}$$

$$Y_{it} = \alpha_i + \gamma_t + \rho \hat{P}_{it} + \mathbf{\Omega} \hat{P}_{it}(\mathbf{X_i} - \bar{\mathbf{X}}) + \epsilon_{it} \tag{8}$$

where Z_{it} is a dummy variable which equals 1 if firm i at time t has any customer that had a shareholder proposal initiated by its industry peers. The function G is estimated using either a logit, probit, or LPM regression. The fitted values are then used in the second stage. The linearity assumption in the second stage allows us to incorporate more complex fixed effects structures, such as firm fixed effects and/or industry-year fixed effects. Note we allow the treatment effects to vary with the pre-treatment covariates. We centre the covariates around their respective means such that we can interpret the ρs as the average treatment effects.

[Insert Table 15 here]

In Table15, we report the results of our IV estimation. The top panel reports the first stage (equation 7) and the bottom panel reports the second stage (equation 8). We first note that shareholder proposals in peer firms have a huge impact on the probability of customer firms instituting emissions reduction targets. A firm is 43 percentage points more likely to have an emission reduction target when shareholder proposals on climate change are proposed in peer firms.[28] The F-Statistics of the excluded instruments is approximately 240. We are, therefore, fairly confident we do not have an issue with weak instruments.

[27]There could, however, be industry-specific reasons which cause both shareholder proposals in peer firms and the focal firm to set emission reduction targets simultaneously. We deal with this with industry-year fixed effects in the estimation, such that any observable factor in the industry-year level will not influence our estimates. We report these results in the appendix.

[28]The slight differences in the estimates across the 5 columns of the 1st stage is because of differences in sample arising from missing values of the dependent variables in each of the different estimations.

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The bottom panel reports the results of the 2nd stage regressions. We find that downstream pressure is likely to increase managerial incentives by 8.5 percentage points and board-level oversight by 5 percentage points. The estimated effects are very similar to the estimates of the previous section. On environmental actions such as emission reduction initiatives and emission reduction targets, we estimate downstream pressure to increase the likelihood by 6 percentage points and 17 percentage points, respectively. Our estimate of the effect of downstream pressure on adopting a climate-conscious business strategy is, however, insignificant in magnitude. This differs from our 5 to 10 p.p. estimates using a reduced form and non-parametric approaches.

The estimates using this different approach are, by and large, similar to the reduced form approach in the previous section. The standard errors are however higher than before, and some of the coefficients, even though economically meaningful, are not statistically significant.[29]

In the instrumental variable estimation, our exclusion restriction assumption is that our instrument impacts suppliers' climate choice outcomes only via customer pressure (i.e., customers having an emission reduction target). It is possible that our instrument, shareholder climate proposals in peer firms of customers, impact supplier climate outcomes via other mechanisms. One relevant mechanism would be that shareholder pressure on customers induces shareholder pressure in supplier firms. That is, shareholders of suppliers are more likely to introduce proposals on climate change because of shareholder proposals brought in by the customer. This channel would violate the exclusion restriction as the chain of association does not flow through our endogenous variable (i.e., customer emission targets).

[Insert Table 16 here]

We test whether this alternative channel, which violates our exclusion restriction, is active. We test this by checking whether shareholders' proposals by customers make similar proposals by suppliers' shareholders more likely. We report the results in Table 16. We note that the probability of shareholder proposals in supplier firms is almost unaffected by shareholder proposals in customer firms. The coefficient is approximately -0.004 and not statistically significant. This evidence allows us to rule out this alternative channel and supports our exclusion restrictions.

4.3 Other Robustness Tests

In our baseline models, we focus on the total emissions of suppliers. However, supplier firms in our sample may not have adequate resources to gather emission data from their suppliers, which are typically small, geographically distant firms (Villena and Gioia 2020). Therefore, we examine the robustness of our baseline results using only scope 1 emissions of suppliers. Our results remain qualitatively unchanged.

[29] We perform the same IV estimation on the climate-related outcome variables. We do not find any impact using the IV estimation as well. We purposes of brevity, we report these results in the online appendix.

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Further, we use emission targets as a measure of customer pressure. However, customers often adopt emission-reduction initiatives either prior to or instead of setting an explicit emission-reduction target. In alternate specifications, we use customers' adoption of emission-reduction initiatives as a measure of pressure on suppliers. We find qualitatively similar results to the baseline estimates.

Finally, we use suppliers' adoption of emission targets following customer pressure to examine the policy-outcome gap. However, suppliers adopt a range of climate action and climate governance practices following customer pressure. We test the robustness of the policy-outcome gap results, conditional on other climate policy adoption of suppliers. We find similar effects on emissions, energy expenses and the leading indicators. Therefore, these empirical choices do not seem to affect our baseline estimates materially. We report these results in online appendices.

5 Conclusion

Corporations are increasingly facing scrutiny about the climate impact of their operations, including that of their supply chain. In this paper, we examine whether customer firms transmit climate-responsible practices along the supply chain. Using staggered difference-in-differences models, we show that suppliers are more likely to adopt climate action and climate governance practices following the adoption of emission targets by their customers. The effects are economically meaningful and increase with the relative bargaining power of the customer firm over its suppliers and cannot be explained by the replacement of 'brown' with 'green' suppliers. However, we find no evidence that adopting climate policies following customer pressure, on average, changes supplier firms' climate outcomes (emissions and energy expenses) and leading indicators of emission abatement (capital investments and R&D expenses). We go on to provide evidence on the possible origins of this gap in the suppliers' adoption of climate policies and their climate outcomes. Suppliers with higher gross margins and closely located to customers increase their capital investment when they adopt climate policies following customer pressure.

Our results highlight the effectiveness and the limitations of private regulation of environmental standards in the supply chain and have important implications for public policies on corporate sustainability practices. Regulators around the world are introducing regulations that hold large firms responsible for the climate impacts of their supply chains. Some studies show that firms, especially in the developed world, shift away from suppliers in emerging markets where climate risks are high (Bisetti, She, and Žaldokas 2023, Pankratz and Schiller 2021). This is likely to be economically costly for both customer and supplier firms due to foregone relationship-specific investments and the search cost of new supply chain partners. It also risks widening the international wealth gap since a large fraction of suppliers are in developing countries where the climate risks are also higher. On the other hand, private regulations of suppliers' climate-responsible practices by customer firms can be a pathway to more sustainable supply chains at lower economic costs. However, the effectiveness of these arrangements can be hindered if suppliers face unfavourable commercial

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terms and customer firms cannot incur the cost of monitoring suppliers' climate-responsible practices. Therefore, discussing green-washing concerns in the supply chains seems important in light of the suppliers' financial constraints. Our results highlight the requirements to consider commercial terms of supply chain contracts in designing public policies on environmental due diligence in the supply chain. With strong incentives to offer better prices to suppliers and monitor their climate-responsible practices, large firms' adoption of climate-responsible practices can trigger multiplier effects in the decarbonization process.

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Tables & Figures

Table 1

Selected questions from the 2019 survey

This table reports the selection of questions from the 2019 survey that we focus on. *No.* is the question number in the survey (in 2019). *Year First* indicates the first year of the survey where the question (or a similar one) was first asked. *Unchanged* implies if the operative wordings of the question remained unchanged in the past 10 years of the survey.

No.	**Question**	**Year First**	**Unchanged**
C 1.1	*Is there board-level oversight of climate-related issues within your organization?*	2010	No
C 1.3	*Do you provide incentives for the management of climate-related issues, including the attainment of targets?*	2010	Yes
C 3.1	*Are climate-related issues integrated into your business strategy?*	2010	Yes
C 4.1	*Did you have an emissions target that was active in the reporting year?*	2010	Yes
C 4.3	*Did you have emissions reduction initiatives that were active within the reporting year? Note that this can include those in the planning and/or implementation phases.*	2010	Yes

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Table 2

Summary statistics

This table reports the summary statistics of the supplier firms in our sample. **Panel A** reports the summary statistics of the response of these supplier firms to the survey questions listed in Table 1. *Max Switched* denotes the year in which the maximum number of firms responded 'Yes' the first time. *Unchanged* denotes the number of firms which never responded 'Yes' during the sample period. **Panel B** reports the summary statistics of these firms' financial statements and their downstream customers. Variable definitions are provided in the appendix.

Panel A: Firm Climate Governance

	N	Firms	Mean	Std. Dev	Median	Min	Max	Max Switched	Unchanged
Business Strategy (0/1)	6880	688	0.56	0.50	1	0	1	2017	138
Emission Target (0/1)	6880	688	0.44	0.50	0	0	1	2017	240
Emission Initiative (0/1)	6900	690	0.59	0.49	1	0	1	2016	145
Management Incentive (0/1)	6930	693	0.46	0.50	0	0	1	2019	237
Board Oversight (0/1)	6940	694	0.42	0.49	0	0	1	2018	160

Panel B: Supplier Financials & Supply Chains

	N	Firms	Mean	Std. Dev	Median	Min	Max
Firm Size ($ billion)	6355	699	51.9	200.3	7.34	0.004	3386.1
Return on Assets	6378	699	0.038	0.11	0.042	-2.47	1.49
Gross Margin (EBITDA/Sale)	6170	699	0.20	0.19	0.18	-2.67	0.88
High Gross Margin (0/1)	6170	699	0.20	0.40	0	0	1
PP&E over Assets	6228	699	0.27	0.25	0.18	0.00	0.95
CAPX over Assets	6286	699	0.04	0.04	0.03	-0.19	0.45
R&D over Assets	3690	699	0.05	0.07	0.02	0.00	1.11
OpExp on Energy (%)	3180	699	7.8	12.6	2.5	0.00	97.5
Emissions over Assets (CO2e mts/$ million)	3482	699	188.7	477.3	34.9	0.0	9836
HHI Supplier Index	647	647	0.017	0.022	0.011	0.000	0.202
Democrat Supplier (1/0)	660	660	0.41	0.49	0	0	1
Customer Pressure (0/1)	6990	699	0.65	0.48	1	0	1
No. of Customers in *Factset*	699	699	61.4	94.3	37	1	1037
No. of Customers in *CDP*	699	699	11.7	13.4	8	1	128
Size of Customers in *CDP* ($ billion)	7281	708	55.3	212.1	8.2	0.005	3386.1
Suppliers - Customers ($ billion)	79,818	1326	-73.0	368.3	-13.0	-3386	3381

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Figure 1

Firms' climate goals and incentives

This figure plots the fraction of firms which respond affirmatively to the survey questions (questions C3.1, C1.3, C1.1, C4.1, C4.3, in that order). We plot the fraction of firms which responded with a 'Yes' in a given year.

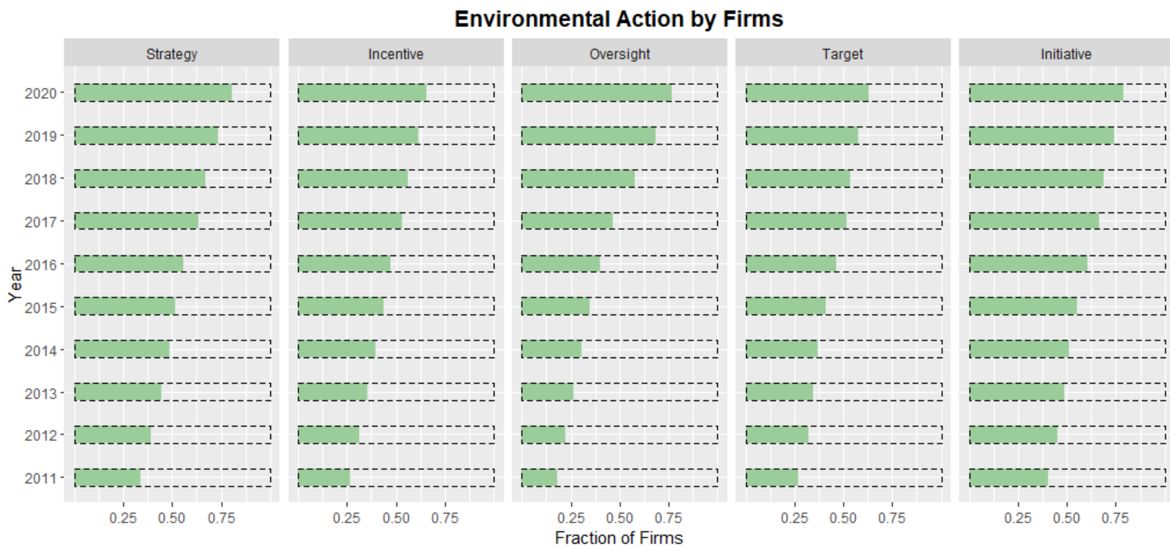

Figure 2

Industry variation in Firms' climate goals and incentives

This figure plots the fraction of firms, across different industries, which respond affirmatively to the survey questions (questions C3.1, C1.3, C1.1, C4.1, C4.3, in that order). We heat code the the fraction of firms, in a given industry, which responded with a 'Yes' in a given year.

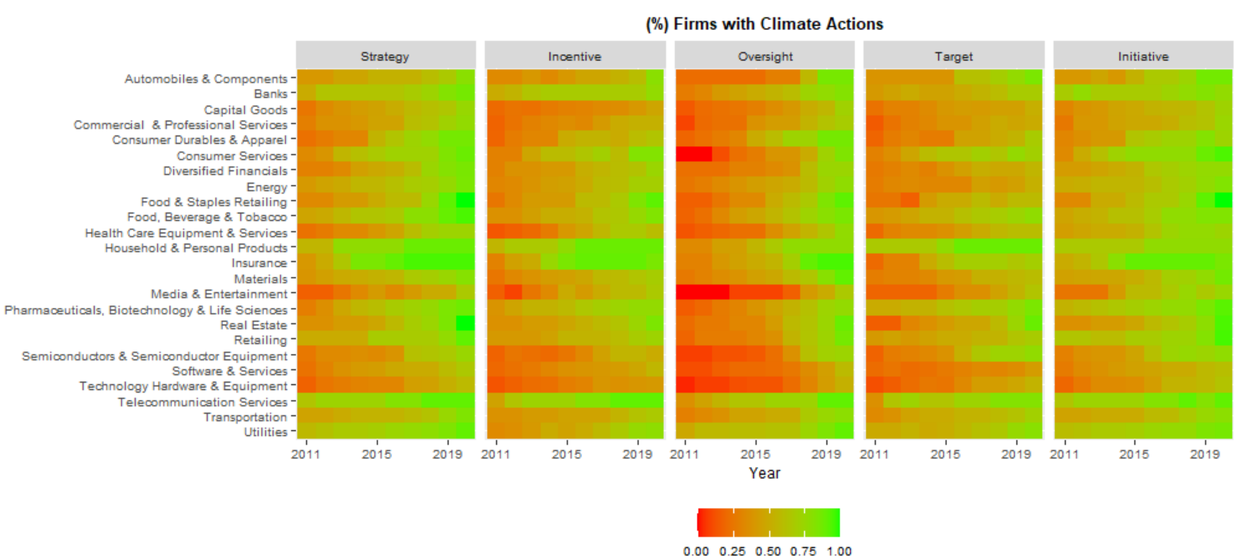

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Figure 3

Customer pressure on supplier firms

This figure plots the fraction of supplier firms which face downstream pressure from customer firms. *Customer Pressure* is defined as having *any* customer which has set itself a GHG emission reduction target. We plot the fraction of supplier firms which faced customer pressure in a given year.

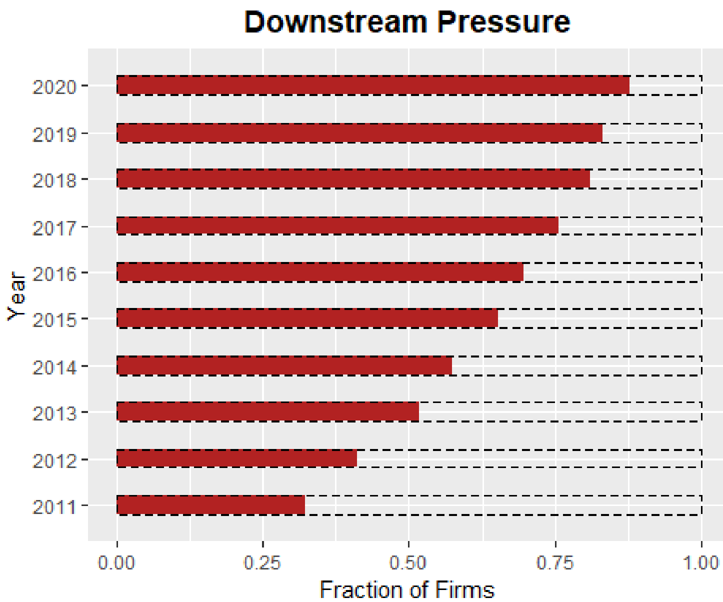

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Table 3

Impact of Customer Pressure on Climate Policy Adoption of Suppliers

This table reports the estimate of the effect of downstream customer pressure on supplier firms' climate policies. The dependent variables are *Strategy*, which equals 1 if the firm integrates climate-related issues into their business strategy (Question C 3.1). *Incentives*, which equals 1 if the firm has put in place incentives for the management of climate-related issues (Question C 1.3). *Oversight*, which equals 1 if the firm has board level oversight on climate-related issues (Question C 1.1). *Target*, which equals 1 if the firm has an emission reduction target (Question 4.1). *Initiative*, which equals 1 if the firm has emission reduction initiatives (Question 4.3). The estimation uses three approaches: linear, logistic, & non-parametric. We first estimate the two probability functions in equation 3. Next, to estimate the average treatment effects, we compute the difference between the average fitted values of the two probability functions. The non-parametric approach uses a bootstrap method to estimate standard errors. Standard errors are clustered at the firm level.

		Linear Estimation			
	Strategy (1)	Incentives (2)	Oversight (3)	Target (4)	Initiative (5)
Effect of Customer Pressure	0.047**	0.103***	0.074***	0.057**	0.040*
	(0.022)	(0.022)	(0.022)	(0.023)	(0.022)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes
Pre-treatment Covariates	Yes	Yes	Yes	Yes	Yes
Observations	6140	6190	6190	6140	6160
Adjusted R^2	0.708	0.720	0.684	0.697	0.715
		Logistic Estimation			
	Strategy (1)	Incentives (2)	Oversight (3)	Target (4)	Initiative (5)
Effect of Customer Pressure	0.082***	0.095***	0.072***	0.06**	0.040
	(0.028)	(0.027)	(0.026)	(0.029)	(0.03)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effect	No	No	No	No	No
Pre-treatment Covariates	Yes	Yes	Yes	Yes	Yes
Observations	6140	6190	6190	6140	6160
		Non-Parametric Estimation			
	Strategy (1)	Incentives (2)	Oversight (3)	Target (4)	Initiative (5)
Effect of Customer Pressure	0.10***	0.091***	0.122***	0.078***	0.065**
	(0.028)	(0.028)	(0.027)	(0.029)	(0.03)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effect	No	No	No	No	No
Pre-treatment Covariates	Yes	Yes	Yes	Yes	Yes
Observations	6140	6190	6190	6140	6160

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Table 4

Impact on Climate Policies using Staggered Difference-in-Differences

This table reports the estimate of the effect of customer pressure on supplier environmental policies using staggered difference-in-differences estimation. The dependent variables, as in the previous tables, are the environmental policies of suppliers. We consider only those firms that received treatment (i.e., customer pressure) after 2014. The testing for pre-trends and the estimation of treatment effects are done using separate estimations but are reported together here. Standard errors are clustered at the cohort level and reported in parenthesis.

	Strategy (1)	Incentives (2)	Oversight (3)	Target (4)	Initiative (5)
T-4	0.029	0.004	0.026	0.040	0.036
	(0.028)	(0.028)	(0.025)	(0.030)	(0.027)
T-3	0.018	-0.010	0.036	0.025	0.024
	(0.034)	(0.035)	(0.034)	(0.035)	(0.032)
T-2	0.033	0.023	0.053	0.044	0.037
	(0.040)	(0.043)	(0.041)	(0.041)	(0.038)
T-1	0.061	0.060	0.042	0.065	0.048
	(0.045)	(0.049)	(0.046)	(0.047)	(0.043)
Observations	2135	2138	2142	2138	2134
F-Stat	1.272	1.910	0.600	1.203	0.852
T	0.058**	0.100***	0.028	0.053*	0.062**
	(0.027)	(0.027)	(0.026)	(0.027)	(0.026)
T+1	0.089**	0.131***	0.056	0.068*	0.058*
	(0.035)	(0.034)	(0.037)	(0.037)	(0.033)
T+2	0.103**	0.170***	0.075*	0.095**	0.073*
	(0.043)	(0.042)	(0.045)	(0.045)	(0.043)
T+3	0.099*	0.191***	0.128**	0.134**	0.107**
	(0.052)	(0.051)	(0.054)	(0.055)	(0.051)
T+4	0.052	0.194***	0.118*	0.103	0.044
	(0.061)	(0.059)	(0.064)	(0.064)	(0.058)
T+5	0.031	0.234***	0.124	0.150*	0.136*
	(0.079)	(0.072)	(0.077)	(0.080)	(0.074)
Observations	2950	2960	2960	2950	2950
F-Stat	20.429	8.373	14.682	188.872	111.087
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes

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Table 5

Probability of Customers Choosing New 'Green' Suppliers

This table reports the estimate of the effect of customers' climate adaptions on the choice of new suppliers. The dependent variables are the responses of a supplier to each of the policy questions in the year the new customer-supplier pair is formed. The main independent variable, *Customer with Emission Target*, is a dummy variable which equals 1 if a customer has an emissions reduction target in that given year. Standard errors are double clustered at the supplier and customer level and reported in parenthesis.

	Strategy (1)	Incentives (2)	Oversight (3)	Target (4)	Initiative (5)
Customer with Emission Target	0.007	-0.004	0.014	0.001	0.005
	(0.016)	(0.017)	(0.017)	(0.014)	(0.015)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Supplier Fixed Effect	Yes	Yes	Yes	Yes	Yes
Customer Fixed Effect	Yes	Yes	Yes	Yes	Yes
Customer Controls	Yes	Yes	Yes	Yes	Yes
Observations	4658	4667	4680	4626	4654
Adjusted R^2	0.790	0.830	0.784	0.803	0.808

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Table 6

Supplier Bargaining Power and Climate Policy Adoption

This table reports the estimate of the effect of bargaining power on the environmental actions of suppliers. The 5 dependent variables are the suppliers' responses to the climate policy questions. *Supplier HHI Index* is the Herfindahl Index value of the supplier industry, based on 3 digit naic code. Standard errors are clustered at the firm level and reported in parenthesis.

	Strategy (1)	Incentives (2)	Oversight (3)	Target (4)	Initiative (5)
Customer Pressure	0.054**	0.105***	0.063***	0.057**	0.060***
	(0.021)	(0.021)	(0.021)	(0.022)	(0.021)
Customer Pressure × Supplier HHI Index	-2.127***	-0.606	0.041	-1.794*	-1.804***
	(0.544)	(0.949)	(1.094)	(1.025)	(0.564)
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	5889	5942	5940	5888	5928
Adjusted R^2	0.693	0.707	0.675	0.688	0.702

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Table 7

Spatial Agglomeration and Suppliers' Climate Policy Adoption

This table reports the estimate of the effect of downstream pressure on the environmental actions of suppliers, controlling for agglomeration effects. his table reports the estimate of the effect of bargaining power on the environmental actions of suppliers. The 5 dependent variables are the suppliers' responses to the climate policy questions. *Customers in State* is the fraction of customers that are from the same state of the supplier. Standard errors are clustered at the firm level and reported in parenthesis.

	Strategy (1)	Incentives (2)	Oversight (3)	Target (4)	Initiative (5)
Customer Pressure	0.043**	0.103***	0.058***	0.061***	0.051**
	(0.020)	(0.021)	(0.021)	(0.022)	(0.020)
Customers in State (%)	0.000	-0.025	0.018	-0.017	0.009
	(0.026)	(0.028)	(0.025)	(0.028)	(0.036)
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes
Observations	6105	6144	6152	6100	6121
Adjusted R^2	0.700	0.711	0.679	0.694	0.709

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Table 8

Customer Pressure and Climate-Related Outcomes of Suppliers

This table reports the estimate of the effect of customer pressure on climate-related outcomes of the supplier. The 4 dependent variables are as follows: *Emissions*, which is the ratio of total emissions (in CO2e metric tons) over assets of a company. *OpExp Energy* is the percentage of operating expenditure that is spent on energy. *Capex*, is the capital expenditure over assets. *R&D*, is the expenditure on research and development scaled by total assets. Standard errors are clustered at the firm level and reported in parenthesis.

	Emissions (1)	OpExp Energy (2)	Capex (3)	R&D (4)
Customer Pressure	5.484	-0.065	0.000	0.002
	(16.519)	(0.648)	(0.002)	(0.002)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes
Pre-treatment Covariates	Yes	Yes	Yes	Yes
Observations	3205	2830	5705	3291
Adjusted R^2	0.904	0.294	0.740	0.883

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Table 9

Suppliers' Climate-Related Outcomes using Staggered Difference-in-Differences

This table reports the estimate of the effect of customer pressure on supplier climate-related outcomes using staggered difference-in-differences estimation. The dependent variables, as in the previous tables, are the climate-related outcomes of suppliers. We consider only those firms that received treatment (i.e., customer pressure) after 2014. The testing for pre-trends and the estimation of treatment effects are done using separate estimations but are reported together here. Standard errors are clustered at the cohort level and reported in parenthesis.

	Emissions (1)	OpExp Energy (2)	Capex (3)	R&D (4)
T-4	3.454	0.517	0.001	-0.005
	(18.782)	(1.139)	(0.003)	(0.004)
T-3	-0.805	-1.075	-0.005	-0.005
	(27.079)	(0.959)	(0.003)	(0.005)
T-2	25.745	-0.732	-0.001	-0.004
	(30.289)	(1.041)	(0.004)	(0.005)
T-1	15.260	-1.299	-0.003	-0.010*
	(36.468)	(1.253)	(0.004)	(0.005)
Observations	1031	877	1904	884
F	1.140	0.931	2.941	1.226
T	16.850	0.163	-0.000	-0.005**
	(15.978)	(1.037)	(0.002)	(0.002)
T+1	21.610	0.914	0.003	-0.007*
	(21.559)	(1.279)	(0.003)	(0.004)
T+2	30.829	0.496	0.000	-0.007
	(25.164)	(1.245)	(0.003)	(0.005)
T+3	31.407	-0.261	-0.004	-0.007
	(39.173)	(1.819)	(0.004)	(0.005)
T+4	55.336	0.793	-0.001	-0.011
	(46.464)	(2.504)	(0.004)	(0.007)
T+5	71.411	-0.670	0.004	-0.012
	(59.276)	(2.401)	(0.005)	(0.008)
Observations	1509	1343	2616	1263
F-Stat	0.852	0.345	0.835	1.237
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes

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Table 10

Climate-Related Outcomes of Suppliers with High Gross Margins

This table reports the estimate of the effect of customer pressure on suppliers' climate-related outcomes. The main independent variable is the triple interaction between customer pressure (*Pressure*), an indicator variable for a supplier having an emissions reduction target (*Target*), and an indicator variable of a supplier being in the top quintile of the gross margin distribution (*High Gross Margin*). Standard errors are clustered at the firm level and reported in parenthesis.

	Emissions (1)	Energy Exp (2)	Capex (3)	R&D (4)
Pressure × High Gross Margin × Target	9.110	1.674	0.013**	0.003
	(44.826)	(2.126)	(0.007)	(0.008)
Pressure × High Gross Margin	-23.321	-1.699	-0.012**	-0.011
	(39.500)	(1.823)	(0.006)	(0.007)
Pressure × Target	9.238	-1.596	-0.001	0.000
	(20.192)	(1.589)	(0.002)	(0.003)
Target × High Gross Margin	5.816	0.376	-0.009*	-0.000
	(38.138)	(1.553)	(0.005)	(0.008)
Pressure	-3.644	1.709	0.001	-0.001
	(21.085)	(1.591)	(0.002)	(0.003)
High Gross Margin	-80.645**	-0.402	0.011**	-0.006
	(36.138)	(1.272)	(0.005)	(0.005)
Target	-4.300	0.375	0.003	-0.001
	(19.538)	(1.213)	(0.002)	(0.002)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Observations	3361	2927	6050	3575
Adjusted R^2	0.913	0.582	0.737	0.886

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Table 11

Climate-Related Outcomes of Suppliers Closely Located to Customers

This table reports the estimate of the effect of customer pressure on suppliers' climate-related outcomes. The main independent variable is the triple interaction between customer pressure (*Pressure*), an indicator variable for a supplier having an emissions reduction target (*Target*), and an indicator variable of a customer being in the bottom quintile of the distance distribution (*Proximate Customer*). Standard errors are clustered at the firm level and reported in parenthesis.

	Emissions (1)	OpExp Energy (2)	Capex (3)	R&D (4)
Pressure × Proximate Customer × Target	-7.311	1.505**	0.003**	0.001
	(12.472)	(0.730)	(0.001)	(0.002)
Pressure × Proximate Customer	5.662	-0.837	-0.001	-0.002
	(10.625)	(0.642)	(0.001)	(0.002)
Pressure × Target	0.517	-0.489	0.001	-0.002
	(7.808)	(0.464)	(0.001)	(0.001)
Target × Proximate Customer	8.086	0.346	-0.001	-0.000
	(7.312)	(0.440)	(0.001)	(0.002)
Pressure	-4.836	0.414	-0.000	0.001
	(9.386)	(0.474)	(0.001)	(0.001)
Year Fixed Effects	Yes	Yes	Yes	Yes
Supplier x Customer Fixed Effect	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	26084	22956	46974	33758
Adjusted R^2	0.948	0.672	0.809	0.915

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Table 12

Climate-Related Outcomes of Democrat Leaning Suppliers

This table reports the estimate of the effect of customer pressure on suppliers' climate-related outcomes. The main independent variable is the triple interaction between customer pressure (*Pressure*), an indicator variable for a supplier having an emissions reduction target (*Target*), and an indicator variable of a supplier being a majority Democrat donor (*Democrat Supplier*). Standard errors are clustered at the firm level and reported in parenthesis.

	Emissions (1)	OpExp Energy (2)	Capex (3)	R&D (4)
Pressure × Democrat Supplier × Target	42.590	-0.098	0.000	-0.010
	(77.437)	(2.512)	(0.006)	(0.016)
Pressure × Democrat Supplier	-2.149	1.542	-0.000	0.017
	(56.764)	(2.208)	(0.004)	(0.013)
Pressure × Target	0.812	-0.196	0.003	-0.005
	(62.801)	(2.155)	(0.004)	(0.011)
Target × Democrat Supplier	-102.947*	-0.165	0.002	-0.010
	(59.291)	(2.236)	(0.005)	(0.013)
Pressure	36.069	0.028	-0.001	0.009
	(47.432)	(1.875)	(0.003)	(0.008)
Democrat Supplier	-17.010	-2.538	0.000	0.012
	(44.361)	(1.989)	(0.004)	(0.011)
Target	78.763	0.621	-0.003	0.020**
	(53.996)	(1.990)	(0.003)	(0.009)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effect	No	No	No	No
Firm Controls	Yes	Yes	Yes	Yes
Observations	3207	2896	5718	3378
Adjusted R^2	0.266	0.177	0.499	0.248

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Table 13

Estimating the Effect of Individual Customers on Climate Policies

This table reports the estimate of the effect of individual customers' climate adaptions on suppliers' climate policies. The sample is at the supplier-customer-year level. The main independent variable is a dummy variable which equals 1 if a customer has an emissions reduction target in a given year. Standard errors are double clustered at the supplier and customer level and reported in parenthesis.

	Strategy (1)	Incentives (2)	Oversight (3)	Target (4)	Initiative (5)
Customer Pressure	0.035^{**}	0.042^{***}	0.032^{**}	0.035^{**}	0.027^{*}
	(0.016)	(0.016)	(0.014)	(0.016)	(0.016)
Pre-Treatment Covariates	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Supplier x Customer Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	73980	74620	74500	73880	74200
Adjusted R^2	0.711	0.744	0.678	0.723	0.731

Table 14

Estimating the effect of individual customers on climate-related outcomes

This table reports the estimate of the effect of individual customers' climate adaptions on suppliers' climate-related outcomes. The sample is at the supplier-customer-year level. The main independent variable is a dummy variable which equals 1 if a customer has an emissions reduction target in a given year. Standard errors are double clustered at the supplier and customer level and reported in parenthesis.

	Emissions (1)	Energy Exp (2)	Capex (3)	R&D (4)
Customer Pressure	4.025	0.055	0.000	0.001
	(4.084)	(0.250)	(0.000)	(0.001)
Pre-Treatment Covariates	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Supplier x Customer Fixed Effect	Yes	Yes	Yes	Yes
Observations	38295	34776	69417	45948
Adjusted R^2	0.916	0.316	0.743	0.878

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Table 15

Suppliers' Climate Policy Adoption using Instrumental Variable Approach

This table reports the estimate of the effect of downstream customer pressure on supplier firms' climate policies using an instrumental variable. The panel on the top reports the first stage of the regressions. The instrument, *Shareholder Proposals*, equals 1 if the focal firm is from an industry where a shareholder proposal on climate change was raised. The panel below reports the second-stage estimates. The 5 dependent variables are the suppliers responses to the 5 climate policy questions. Standard errors are clustered at the firm level and reported in parenthesis.

	Instrumental Variable - First Stage				
	Strategy (1)	Incentives (2)	Oversight (3)	Target (4)	Initiative (5)
Shareholder Proposals	0.430***	0.432***	0.403***	0.429***	0.432***
	(0.025)	(0.025)	(0.026)	(0.025)	(0.025)
Firm Controls	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	6659	6705	6762	6655	6678
F-Test (Excluded Instruments)	239.53	244.56	243.47	241.07	244.01

	Instrumental Variable - Second Stage				
	Strategy (1)	Incentives (2)	Oversight (3)	Target (4)	Initiative (5)
Customer Pressure	0.003	0.085*	0.052	0.169***	0.064
	(0.047)	(0.048)	(0.052)	(0.052)	(0.046)
Firm Controls	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	6659	6705	6762	6655	6678
Adjusted R^2	0.132	0.092	0.262	0.052	0.093

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Table 16

Testing Exclusion Restriction

This table reports the results of regression shareholder proposals at the supplier firm on shareholder peer pressure on customer firms. *Supplier Proposals* is a binary variable which equals 1 if the shareholder of a supplier had introduced proposals on climate change anywhere in the past. *Shareholder Proposals*, equals 1 if any customer firm (of the focal supplier firm) is from an industry where a shareholder proposal on climate change was raised anytime in the past. Standard errors are clustered at the firm level and reported in parenthesis.

	Supplier Proposals	
	(1)	(2)
Shareholder Proposals	-0.004	-0.003
	(0.009)	(0.010)
Firm Fixed Effect	Yes	Yes
Year Fixed Effect	Yes	Yes
Firm Controls	No	Yes
Observations	6940	6152
Adjusted R^2	0.818	0.809

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Appendix

Appendix A Variable Definitions

Table A1

Definition of variables

Variable	Source	Definition
Strategy	CDP	Table 1 question C3.1
Incentive	CDP	Table 1 question C1.3
Oversight	CDP	Table 1 question C1.1
Target	CDP	Table 1 question C4.1
Initiative	CDP	Table 1 question C4.3
Customer Pressure	CDP	Indicator variable equals 1 if any existing customer of a supplier responds 'Yes' to question C4.1 any time in the past while remaining a customer
Log(Firm Assets)	Compustat	Natural logarithm of the total assets (at) of a supplier
Return on Assets	Compustat	Ratio of Net Income (ni) to Assets (at)
Gross Margin	Compustat	Ratio of EBITDA (ebitda) to Sales (sale)
High Gross Margin	Compustat	Indicator variable equal to 1 if gross margin above 80th percentile
PP&E over Asset	Compustat	Ratio of Gross Property Plant & Equipment (ppegt) to Assets (at)
CAPX over Asset	Compustat	Ratio of Capital Expenditure (capex) to Assets (at)
R&D over Asset	Compustat	Ratio of R&D Expenditure (xrd) to Assets (at)
Emissions over Asset	Asset 4 & Compustat	Ratio of Total Emissions to Assets (at)
OpEx on Energy	CDP	Mid-point of the categorical response to the CDP question: *"What percentage of your total operational spend in the reporting year was on energy?"*
Supplier HHI Index	Keil (2017)	Herfindahl Index at the 3 digit NAIC code for each supplier firm
Democrat Supplier	OpenSecrets	Indicator variable equal to 1 if donations of all employees of a firm to the Democratic Party are at least 20% larger than donations to the Republican party.
Proximate Customer	R Library (zipcodeR)	Indicator variable equals 1 if the distance between the zip codes of a pair of customer and supplier is less than than the 20th percentile of the distribution of the distances

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Variable	**Source**	**Definition**
Shareholder Proposals	Voting Analytics	Indicator variable equals 1 a firm had a peer (defined by *gsubind*) which had a climate-related shareholder proposal.

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Appendix B Construction of climate response variables

CDP provides us with two data sets, one in which the respondents were asked to participate in the survey by their investors, and another in which they were asked by their suppliers. By merging the two data sets, we obtain an unbalanced panel which contains all firms in the CDP dataset and their yearly responses to five environmental actions (EA) questions: *Strategy*, *Incentive*, *Oversight*, *Target*, and *Initiative*. The unbalanced panel contains 10,776 unique firms. In order to match the CDP dataset to the *FactSet* and *Compustat* data sets, we removed all firms in the CDP data set for which the GVKEY and/or CUSIP cannot be identified, reducing the number of firms to 1,326. Furthermore, we removed all firms that cannot be identified as either a customer or a supplier in the *FactSet* database, reducing the number of firms to 793.

If we only keep the *FactSet* data for which the customer or supplier is one of the 793 remaining firms, we are left with 8,262 unique customer-supplier relationships. Of the 793 firms in the CDP dataset, 705 firms are suppliers and 718 are customers. For each supplier, we are now able to observe their EAs on a yearly basis, the EAs of their customers on a yearly basis and in which years the customer relationship was active. Note that this panel is highly unbalanced since the vast majority of suppliers and customers did not respond to the CDP survey each year. In order to overcome this challenge posed by the data we employ a set of assumptions/imputations to guess what firms' response to EA questions would have been. We describe the assumptions below.

Assumption 1 : First response is "No"

During the sample period if a firm's first response to any EA question is a "No", then we assume that in all prior years (during the sample period) the firm did not undertake that particular EA. That is, their response in prior years to that specific EA question would be a "No".

Assumption 2 : Last response is "Yes"

During the sample period, if the last response that a firm gives implies that they did undertake a certain EA in that year, we assume that in all following years, they also did undertake that EA. That is, their response in following years to that specific EA question would be a "Yes".

Assumptions 1 and 2 are fairly innocuous assumptions. This is because the nature of the responses is such that they are "sticky" over time. For instance, if a firm sets itself an emissions reduction target, or introduces incentives for the management of climate-related issues, the firm is very likely to stick with these choices for several years. Therefore we can impute what the firm's response would be to some environmental-related questions even if they did not respond to the CDP survey in a given year.

Assumption 3 : Gaps between two "No's"

If there is a gap between two values where the pre-gap value is a "No" and the post-gap value is also a "No", we fill up the gap years with No's

Assumption 4 : Gaps between two "Yes's"

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If there is a gap between two values where the pre-gap value is a "Yes" and the post-gap value is also a "Yes", we fill up the gap years with Yes's

Assumptions 3 and 4 are also fairly mild assumptions and follows the same principle as assumptions 1 and 2.

Assumption 5 : Gaps between a "No" and a "Yes"

If there is a gap between two values where the pre-gap value is a "No" and the post-gap value is a "Yes", we fill up the gap with "No's". The basis for this assumption is that the firm would have responded to a CDP survey as soon as it started taking actions related to climate change. We use this assumption for less than 5% of the sample.

Assumption 6 : Last Response is a "No"

During the sample period if a firm's last response to any EA question is a "No", then we assume that in all following years (during the sample period) the firm did not undertake that particular EA. That is, their response in following years to that specific EA question would be a "No".

Assumption 7 : First Response is "Yes"

During the sample period, if the first response that a firm gives implies that they did undertake a certain EA in that year, we assume that in all prior years, they did not undertake that EA. That is, their response in all prior years, during the sample period, to that specific EA question would be a "No".

Assumptions 6 and 7 are the strongest assumptions in our sample construction process. Our reasoning in applying these assumptions are as follows: If a firm did indeed undertake steps to integrate climate-related issues within their business, they would be eager to disclose this to the outside stakeholders. Therefore, if the last publicly disclosed response to any of the survey questions is a "No", then we assume that the response would be the same for future undisclosed survey years till the end of the sample period. Because if the firm's answer had been a "Yes" it has no incentive not to disclose so. A similar logic applies to the case where the first response is a "Yes". If, in the previous years, the response had been a "Yes", the firm had no incentive not to disclose so.

The only possible combination left is when a firm has gap years in survey responses, and the pre-gap value is a "Yes", and the post-gap value is a "No". This is not logically consistent with our reasoning, and therefore we drop these firms for that specific EA question. Less than 1 per cent of the sample exhibits this characteristic, and we cannot attribute a specific reason for such patterns in the CDP surveys.

We also had to make an additional adjustment to the question regarding board-level oversight (C 1.1) because the question was modified in 2018. If a firm responded that it did not have board-level oversight in 2018, we assume that it did not have board-level oversight anywhere in the past. This is required because, from 2010-2017, the C 1.1 question was framed as inquiring about the highest level of direct responsibility for climate change within the firm. From 2018 onwards, this was changed to the current formulation. For this reason, there is a possibility that firms could

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be misclassified between 2010-2017, and the responses can be misconstrued as having board-level oversight before 2018 but not after. Hence, to deal with this logical inconsistency, we made the above-described adjustment.

Appendix C Construction of Customer Pressure Variable

In this section, we provide the minute details of the construction of the Customer Pressure variable, P, used in many of the tests. For each supplier, P is equal to one if *any* of the customers has set an emissions reduction target while the relationship was active, anywhere in the past. For this, we first define $Pressure$ for *each* individual customer. The procedure goes as follows: For each customer-supplier relationship, we check for two things each year: 1) if the relationship was active the previous year and 2) if the customer said yes to the emissions reduction question the previous year. If both are true, we set an indicator variable $Pressure$ to one. Thereafter, in order to ensure that any influence in the past remains present, we say that $Pressure$ gets a value of one if any of the $Pressure$'s in the previous years for this supplier-customer relationship has been one.

Below we provide an example of a complicated scenario where a supplier and a customer have business relations that switch on and off during the sample period. Consider the following supplier-customer pair:

Supplier ID	Customer ID	Year	Active Relation?	Cust Emission Target?	Pressure
123456	987654	2010	no	no	0
123456	987654	2011	yes	no	0
123456	987654	2012	yes	no	0
123456	987654	2013	yes	yes	0
123456	987654	2014	no	yes	1
123456	987654	2015	no	yes	1
123456	987654	2016	yes	yes	1
123456	987654	2017	yes	yes	1
123456	987654	2018	yes	yes	1
123456	987654	2019	no	yes	1
123456	987654	2020	no	yes	1

Firstly, $Pressure$ is always zero in 2010 since we cannot observe any data before this year. Secondly, $Pressure$ is zero in 2011-2013 since only one of the two conditions as described above is met, and the value of $Pressure$ has always been zero in the past. In 2013, we saw that the relationship was active and that the customer said yes to having an emissions reduction target. This implies that in 2014, the two conditions were met for the first time. Thereafter, from 2014 onward, all $Pressure$'s will be given the value of one.

The logic of such an empirical construction is the following. Our goal is to create a variable which reliably captures whether a customer is likely to put pressure on the supplier. For this to happen, we believe two conditions need to be met, whatever the scenario. First, the customer needs to be a firm that is acting on climate change. Second, *when* the customer firm changes its outlook on climate change, the supplier needs to have been an *active* supplier. More specifically,

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we want to avoid considering scenarios where a customer changes its behaviour, but the supplier is no longer an active supplier. We argue this supplier is unlikely to be facing pressure. But, we want to include scenarios where when a customer changes its climate behaviour, then all active suppliers face pressure, *and continue to do so even if the relationship ceases to exist in the future.* The reason to incorporate such stickiness is that once a supplier has faced pressure and potentially 'invested' in changing its behaviour, it is unlikely to switch directions (regarding climate change) even if the forcing customer no longer has a business relationship with the supplier.

Finally, we compute the aggregated *Customer Pressure* variable, P, by aggregating the number of individual pressure per year for each supplier. That is, if this value is above zero, for any customer, we assign the value of one to the aggregated pressure variable.

Appendix D Construction of the Instrumental Variable

In order to control for the endogeneity issues that arise from the original setting, we create the variable *Shareholder Proposals*, which we use as an instrumental variable. This variable gets the value 1 if *any* of the customers of a supplier firm is from an industry where shareholders have brought in climate-related proposals while the relationship was active anywhere in the past. Climate related shareholder proposal are proposals which are filtered by a list of keywords (e.g., "GHG", "Climate", "Environment", "Carbon", "Emission", etc.) on the agenda description. We describe below how we construct this variable. The procedure goes as follows: Firstly, we check for each *customer* if they have experienced industry shareholder proposals. For this, we look at how many shareholder proposals have been handed in each year in *other firms* in the same industry (defined by *gsubind*). We say that there is shareholder pressure when at least one proposal has been handed in by another firm in the same industry. For each customer, we check if there have been shareholder proposals in peer firms anywhere in the past.

Thereafter, for each customer-supplier relationship, we check for two things in each year: 1) if the relationship was active in the previous year and 2) if the customer has been exposed to any peer-firm shareholder proposal (as described earlier) in the previous year. If both are true, we set an indicator variable to one. This indicator remains one once it switches to one. Finally, in order to get the combined *Shareholder Proposal* for each supplier, we aggregate the *Shareholder Proposals* per year for all customers, of a supplier, by setting them to one if *any* customer has the value one.

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