Supply Chain Disruptions: The Propagation and Economic Costs of ESG Shocks*

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Abstract: We provide evidence that unexpected negative Environmental and Social (E&S) news significantly impacts global supply chains, as downstream firms sever ties with affected suppliers. These terminations are primarily driven by input elasticity of substitution. Firms are more likely to end supplier relationships when input elasticity of substitution is high, particularly in sectors with low input specificity and lower upstream industry concentration, where alternative suppliers are easier to find. Additionally, firms with greater visibility are more likely to drop suppliers due to reputational risks, but this effect is evident only when input specificity is low. We also demonstrate that severing supplier relationships incurs short-term costs for downstream firms, leading to lower markups and reduced total factor productivity, indicating an inability to adjust prices in the short run.

Keywords: ESG, supply chain, markups, productivity

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1 Introduction

ESG news has gained significant importance, reflecting the growing emphasis on sustainability in business practices. Currently, more than 90% of S&P 500 companies publish ESG reports, 79% of investors consider a company's management of ESG risks and opportunities critical to their investment decisions, and 83% of consumers believe that companies should actively shape ESG best practices.[1] Extensive literature documents how ESG news impacts firms through the behavior of investors, financial institutions, and consumers.[2] This paper investigates whether negative ESG news extends beyond the implicated firm to disrupt global supply chains, thereby affecting downstream firms' operating costs, markups, and productivity. Additionally, we explore the trade-offs these downstream firms face between the costs of sourcing new suppliers and the reputational risks associated with maintaining relationships with a supplier involved in an ESG incident.

Recent policy developments have brought the impact of ESG considerations on supply chain configuration to the forefront of both policy and academic discussions.[3] However, significant gaps remain in our understanding of how ESG considerations affect supply chain networks, particularly regarding the trade-offs firms face when balancing potential reputational losses against the increased operating costs associated with changing suppliers. The consequences of supplier changes on firm output and productivity—especially when input complementarity leads to higher efficiency—remain ambiguous, as do the potential effects on consumer costs, which may rise due to increased firm markups. Baqaee et al. (2023) emphasize the crucial role of supplier churn in driving productivity growth, attributing approximately half of aggregate productivity gains to this phenomenon. Conversely, De Simone et al. (2024) demonstrate that emission-capping regulations compel manufacturing firms to transition to cleaner technologies, often leading them to shift toward higher-margin products to maintain profitability, resulting in reduced product variety and increased markups.

[1] See this website for more statistics on the growing importance of ESG news.

[2] For investor reactions, see Gantchev et al. (2022), Glossner (2021), Derrien et al. (2022), Krüger (2015), and Duchin et al. (2022); on access to credit through better ESG ratings, see Houston and Shan (2021); on the role of consumer awareness, see Servaes and Tamayo (2013).

[3] Examples of regulations with implications for supply chains include efforts on Scope 3 emissions disclosure and the implementation of mechanisms like the carbon border adjustment mechanism (CBAM).

Our findings indicate that negative Environmental and Social (E&S) news about suppliers increases the likelihood of downstream firms terminating their relationships with those suppliers and reorganizing their global supply network, incurring short-term real economic costs. Two primary factors drive this outcome. First, input elasticity of substitution in upstream sectors plays a crucial role. Customers are more likely to sever ties when there is higher input elasticity of substitution. This is particularly evident in cases of low input specificity and when supplying sectors exhibit lower industry concentration, facilitating the search for alternative suppliers. Second, the termination of supplier relationships is significantly influenced by the visibility of the downstream firm.[4] More visible firms are more likely to drop a supplier, presumably due to greater reputational risks associated with maintaining relationships with suppliers involved in negative ESG incidents. Despite the costs and time involved in finding new suppliers, firms may choose to do so in response to negative news about their suppliers due to potential spillover effects on their own ESG reputation. However, our analysis reveals that firm visibility is not the primary driver in these decisions when faced with low elasticity of substitution. In fact, highly visible firms are more likely to drop suppliers only when input specificity is low—that is, when finding a suitable alternative supplier is relatively easy. This suggests that the decision to sever ties with a supplier is primarily contingent on the feasibility of substitution and immediate production costs, rather than solely on brand considerations and potential lower long-run profits associated with reduced sales. Notably, we find no evidence that the length of the relationship, measured in years, between customer and supplier influences the decision to sever ties.

In the second part of the paper, we examine whether terminating relations with suppliers is indeed costly for downstream firms. Our findings confirm this hypothesis. On average, the cost share of firms more likely to drop suppliers after negative E&S news increases by 3.7%. This effect is more pronounced when input specificity is high, with no evidence of higher costs in cases of low input specificity. Moreover, the cost increase is greater when the downstream firm's visibility is high. These results support our intuition that while firms

[4]We measure visibility using several methods: a binary indicator of whether the company is public, the degree of international presence of the company, and the firm's advertising expenditure.

may sever ties with suppliers to mitigate reputational risks or align with sustainability goals, such decisions incur tangible short-term economic costs, particularly when finding alternative suppliers is challenging. Furthermore, we demonstrate that exposed downstream firms with higher costs generally exhibit lower markups, reflected in reduced Total Factor Productivity Revenue (TFPR). Due to the absence of firm-level price data, we cannot definitively distinguish between the part of the TFPR effect stemming from efficiency losses (such as those resulting from substituting with lower-quality inputs) and the part attributable to price changes. Nevertheless, the observed reduction in markups suggests that at least part of the decline in TFPR is driven by changes in prices rather than efficiency alone.

To conduct our analyses, we utilize two primary datasets. FactSet provides supply chain data, including detailed information on supplier-customer relationship dates and company financials. RepRisk identifies ESG risk incidents through a combination of artificial intelligence and human analysis, processing information from diverse sources such as media reports and stakeholder publications. These incidents refer to events or situations that can negatively impact a company's reputation, operations, and financial performance. RepRisk's objective is to enable investors, companies, and other stakeholders to identify, assess, and manage ESG risks.

The empirical strategy begins by estimating the impact of negative E&S news on terminated relationships. We present results using ordinary least squares (OLS) and Poisson regression to account for the many zeros in the dependent variable. We select E&S news of suppliers that are exogenous to downstream firms, and use the predicted terminated relationships from the first stage in a second stage to assess the impact of these terminations on the operating costs, markups, and productivity of downstream firms.

Empirically examining the impact of ESG news on the likelihood of terminated relationships presents a key challenge due to potential endogeneity, as the likelihood of an incident may correlate with supplier characteristics that could also influence relationship terminations. To address this concern, we focus on negative ESG news shocks provided by the RepRisk database, which categorizes incidents by severity and reach. We restrict our sample to first-time incidents marked as novel, and focus on medium to high severity, and medium to

high reach. This ensures that the incidents studied are unanticipated, have significant consequences and have broad impact. This approach also allows us to focus on Environmental and Social (E&S) incidents, which are more closely related to visibility, avoiding the "Governance (G)" component that could be more directly tied to financial performance.

We further mitigate endogeneity concerns by emphasizing *news-related* ESG data, which offers a cleaner identification of shock timing compared to ESG *ratings*. ESG ratings are often based on voluntary disclosures, tend to be inconsistent across rating agencies (see Berg et al. (2022) and Gibson Brandon et al. (2021)), and are highly persistent over time, making it difficult to capture significant changes. To account for the influence of customer characteristics on supplier selection, we include customer fixed effects in our regressions, controlling for firm-specific unobserved characteristics that remain constant over time and reducing the risk of omitted variable bias. To reinforce the robustness of our findings, we employ a stacked difference-in-differences analysis, which deals with concerns regarding the timing of treatment and potential confounding factors from not using "clean controls". Additionally, to ensure that the incidents are attributable to the suppliers and not downstream firms, we exclude cases where companies are held accountable for their suppliers' actions. Finally, we estimate the dynamic effects of E&S incidents on relationship termination over a nine-year window (four years before and after the event) and find no significant pre-trends, reinforcing our hypothesis that relationship terminations are driven by the incidents themselves, rather than other customer or supplier characteristics.

Our paper contributes to several strands of literature, primarily expanding the research on shock propagation along supply chains. The importance of firm networks and shock propagation is well-established across various domains. In trade literature, studies have examined the impact of tariff shocks, natural disasters, and geopolitical risks on supply chain disruptions (see Boehm et al. (2019), Carvalho et al. (2021), Korovkin et al. (2024), and Crosignani et al. (2024)). Financial shock propagation through supply chains has also been documented (see Adelino et al. (2022), Costello (2020), and Alfaro et al. (2021)). Recent research has further demonstrated how government fiscal shocks propagate across networks (see Barattieri et al. (2023) and Abad et al. (2023)). Our contribution to this body of work lies in examining

the propagation of E&S news shocks, an increasingly relevant type of supply chain risk. By focusing on E&S news shocks, we extend the understanding of shock propagation to encompass a broader range of factors affecting modern supply chains, particularly those related to sustainability and corporate responsibility.

In fact, there is limited evidence on the propagation of ESG shocks along the supply chain and the impact on real outcomes. In this area, one part of the recent existing literature shows how ESG improvements by customers improves the ESG performance of suppliers – upstream propagation of shocks (see Dai et al. (2021) and Schiller (2018)).[5] The second strand of this literature focuses on how ESG shocks to suppliers impacts customers – downstream propagation of shocks (see Tran and Coqueret (2023), Pankratz and Schiller (2023), Ersahin et al. (2024a) and Bisetti et al. (2024)). Our research directly contributes to the second strand of this literature and makes two key contributions. First, we document an increase in the likelihood of terminated relationships after suppliers are exposed to ESG shocks. Second, we explore economic outcomes beyond financial returns, demonstrating increasing operating costs and lower productivity gains following these terminated relationships.

Furthermore, we extend beyond merely documenting terminated relationships to identify which firms are more likely to terminate. This is significant given the ongoing discourse about the impact of ESG news and the assumption that firms will change suppliers due to investor and customer awareness to protect their brand, intangible capital, and future sales (see Akey et al. (2023)).[6] While we find this to be generally important, our research reveals that in the short run, for firms sourcing very specific inputs or from highly concentrated markets, the cost of changing suppliers is so high that ESG considerations and potential future impacts become less relevant.

Our paper also contributes to the literature examining the cost of changing suppliers. First, we confirm previous findings on the crucial role of input specificity, aligning with evidence that higher input specificity leads to greater propagation losses through the network

[5] One exception is Asgharian et al. (2023) that find effects on competing firms but no network propagation through customer-supplier links.

[6] This can be attributed to the importance of reputation for investors (see Bolton and Kacperczyk (2021) and Tran and Coqueret (2023)), competitors (see Ramadorai and Zeni (2024)) or customers (see Servaes and Tamayo (2013)).

(Barrot and Sauvagnat (2016)). This corroborates the trade literature's findings of greater-than-expected complementarity between domestic and foreign inputs (Boehm et al. (2019), Carvalho et al. (2021)). Second, we provide evidence that terminating relationships is costly: firms experience increased costs and decreased markups and productivity.

The rest of the paper is organized as follows. Section 2 describes the data and the construction of the main variables. Section 3 explains the empirical methodologies and specifications used in our analyses. Section 4 presents the results and Section 5 concludes.

2 Data

In this section, we describe the data sources used in this study and provide summary statistics. We combine data from five sources: RepRisk, FactSet, industry-level data on shares of differentiated goods from Barrot and Sauvagnat (2016), Refinitiv, and climate change exposure data from Sautner et al. (2023a).

2.1 Negative ESG News

We identify firm-level negative ESG news shocks using RepRisk incidents data.[7] Since 2006, RepRisk has employed artificial intelligence, machine learning, and human expertise to transform extensive data into actionable analytics and risk metrics. The platform collects and updates information daily in 23 languages, systematically identifying and tracking key ESG risks and breaches of international standards that could result in reputational, compliance, and financial challenges for companies. RepRisk's approach is event-driven, not firm-driven. The RepRisk ESG risk platform encompasses information on over 219,000 public and private companies. Each day, RepRisk evaluates more than 100,000 public sources and stakeholders, including print media, online media, social media, blogs, government entities, regulators, think tanks, newsletters, and other online platforms. These sources span international, regional, national, and local levels. RepRisk categorizes ESG incidents into Environmental, Social, and

[7]The use of RepRisk is standard in the literature to analyze ESG news, see for example Glossner (2021), Gantchev et al. (2022) or Derrien et al. (2022).

Governance issues, and based on severity, the reach of the information source, and novelty.[8] Additionally, various flags are used to further classify issues; for example, the supply-chain flag indicates if companies are held accountable for the actions of their suppliers.

Following Bisetti et al. (2024), Krüger (2015), Gantchev et al. (2022), and Dyck et al. (2019), we concentrate on *Environmental and Social (E&S)* incidents, excluding governance-related incidents from our main analysis. We drop the governance incidents, which ensures that the incidents we examine are associated solely with reputational effects, distinct from purely business-related risks. To ensure the exogeneity and relevance of the news shocks, we focus on E&S incidents that are novel and exclude those with low severity levels and low reach. Additionally, we exclude incidents related to supply-chain issues to ensure that customers are not responsible for their suppliers' incidents. Our analysis includes a total of 28,773 risk incidents involving 21,935 companies. Before merging RepRisk E&S data with other data, our sample shows that 43% of the incidents are related to environmental issues, and 81% are related to social issues.

The primary variable of interest from the RepRisk data, which serves as the key explanatory variable in our study, is the indicator for the occurrence of negative E&S news shocks among suppliers. This dummy variable is set to 1 if any supplier of a firm experienced an E&S news incident in the previous period.

2.2 Supply Chain and Firms' Fundamentals

We also use the FactSet database, an American financial data company that provides data solutions through different data feeds. In our analysis, we use supply chain data and company fundamentals.

[8] Severity and reach are categorized by RepRisk into low, medium, and high. The severity is assessed using a rule-based approach based on the impact of the incident, the scale of affected individuals, and the nature of its cause (accident, negligence, intent, or systematic). The reach indicator measures the influence or readership of the source where the risk incident was published. Novelty indicates whether the issue addressed is new or not.

2.2.1 Supply Chain Data

The FactSet Revere Supply Chain Relationships dataset categorizes the global business connections and interdependencies among companies. It sources information from primary public documents such as SEC 10-K annual reports, investor presentations, and press releases. The dataset organizes these relationships into four main categories—customer, supplier, partner, and competitor—and 13 sub-categories, providing a detailed classification from the perspective of either company involved. For our analysis, we concentrate on supplier-customer relationships. The dataset includes information on customer entity ID, supplier entity ID, the start and end times of the relationship, and the reporting company's entity ID. FactSet supply chain data has recently received considerable attention in the literature. Studies such as Pankratz and Schiller (2023), Ersahin et al. (2024a), Ersahin et al. (2024b), and Schiller (2018) have used this data to analyze relationships between suppliers and customers.

Before merging with other data, the dataset contains 750,542 unique relationships, involving 93,752 unique supplier entities and 147,394 unique customer entities from over 185 countries. This data spans from April 2003 to November 2021 and comprises 22,925,307 observations.

Our primary focus in analyzing supply-chain relationships is on the number of terminated supplier relationships, which serves as the main dependent variable in the first stage of our study.[9] To avoid skewing the results, we exclude terminated relationships for customers in their final year of panel participation. Furthermore, in the Appendix, we show that using the fraction of terminated relationships, rather than the number of terminated relationships, as the primary dependent variable does not alter the main results.

2.2.2 Firms' Fundamentals Data

We use firms' financial data from the FactSet Fundamentals dataset, which offers financial statement information dating back to 1979. This dataset covers data from both developed

[9]We define the number of terminated supplier relationships as the count of suppliers associated with customer i in year t who do not appear in the panel in period $t+1$. To ensure the accuracy of our analysis, we exclude terminated relationships for customer i if year t is the last year in which the customer appears in the panel.

and emerging markets globally. It includes over 86,000 companies—both active and inactive—across more than 115 countries.

Appendix A provides details on the merging process of the FactSet fundamentals and supply chain data. Following the methodology of Koijen et al. (2020), we select a single security for each entity. Before merging the fundamentals data with supply chain panels and other data, we identified 88,665 unique entities along with their primary securities' IDs in the fundamentals dataset, resulting in 1,161,309 observations from 1979 to 2021.

In our study we use various control variables from the Fundamentals panel, including total assets, trade credits, and other relevant financial metrics. Additionally, variables from the Fundamentals data are used to categorize customers into different samples, such as input specificity and customer visibility.

2.3 Input Specificity Data

The main input specificity variable is determined using data from Barrot and Sauvagnat (2016), who determined the share of differentiated goods produced at the 4-digit SIC industry level.[10] They build on the work of Rauch (1999), who classifies inputs as differentiated or homogeneous based on their sale through organized exchanges. This classification sorts inputs into industries according to the four-digit SITC Rev. 2 system, categorizing each as either traded on an exchange, reference priced, or homogeneous. Barrot and Sauvagnat (2016) then use a mapping between the SITC and SIC classifications, as outlined in Feenstra (1996), to determine the share of differentiated goods produced in each industry. We match the share of differentiated goods produced within the sector of each supplier for every customer. The main input specificity index is then derived as the average of these shares across all suppliers for each customer.

[10]We express our sincere gratitude to Jean-Noel Barrot and Julien Sauvagnat for sharing their data with us.

2.4 Additional Datasets

To further test the importance of customers' visibility in their supply-chain adjustment responses to negative news shocks, we incorporate Refinitiv ESG ratings and climate change exposure data from Sautner et al. (2023b) to assess firms' ESG reputation.

Refinitiv ESG scores, which have succeeded the ASSET4 ESG ratings, are widely used in academic and industry research. They provide comprehensive data on over 14,000 companies globally, covering around 90% of the world's market capitalization. These scores are based on 186 key metrics tailored to specific industries, categorized into environmental, social, and governance pillars. The overall ESG score is a weighted sum of these category scores, normalized on a scale from 0 to 100.

We merge Refinitiv ESG scores into our final panel through ISIN codes and fuzzy name matching. Although these ESG scores are not part of our baseline specifications, they are instrumental in some analyses to analyze variations in customers' supply-chain adjustment responses to negative E&S news shocks, serving as a proxy for the significance of reputation for these customers.

Additionally, we use climate change exposure data from Sautner et al. (2023a) and Sautner et al. (2023b), which introduces a method to quantify the attention that earnings call participants give to firms' climate change exposures. This method generates a firm-level climate change exposure index, which we merge with our final panels using ISIN codes. Similar to Refinitiv ESG scores, the climate change exposure index acts as a proxy for customer awareness and the importance of reputation, aiding in our analysis of how different customers respond to E&S news shocks from their suppliers.[11]

2.5 Summary Statistics

Table 1 presents summary statistics for our final dataset, which combines data from FactSet fundamentals, FactSet supply chain, RepRisk E&S news shocks, input specificity, Refinitiv and climate change exposure. The final sample we use includes only those customers that

[11] We use this proxy because Sautner et al. (2023b) demonstrate a significant positive correlation between firms' climate change exposure and their green-tech job postings and green patents.

appear in both FactSet fundamentals and supply chain data. Each observation is identified by customer and year. The final sample includes 112,825 customer-year observations from 21,568 customers, spanning from 2007 to 2020. It features customers from 116 countries and suppliers from 105 countries. We exclude firms with negative sales or assets, as well as those in the financial services industry (SIC codes 60–69) and government entities (SIC codes 90–99).

Panel (A) shows the summary statistics of the supply chain data for the main variable of interest, the number of terminated relationships with suppliers. We also include the fraction of terminated relationships with suppliers, and the total number of relationships with suppliers. On average, each customer annually works with 7.281 suppliers, of which 1.4 relationships are terminated, corresponding to an average fraction of terminated suppliers of 0.176.

Panel (B) presents summary statistics for the negative E&S news shocks indicator. This dummy variable takes a value of one if any of the suppliers of a company has experienced an environmental or social incident in the previous year. Approximately 24.1% of the observations show at least one E&S incident within a given year.

Panel (C) provides summary statistics for the key customer characteristics used to examine the determinants of supply-chain adjustment responses to negative E&S news shocks. These characteristics include input specificity, the Herfindahl-Hirschman Index (HHI) of suppliers,[12] the indicator of being publicly listed, the fraction of international suppliers,[13] adjusted Selling, General, and Administrative (SG&A) expenses over sales,[14] ESG scores, and the climate change exposure index. These metrics are used to categorize customers into different samples.

On average, customers exhibit an input specificity of 0.479, which is calculated based on the average share of differentiated goods provided by their suppliers. The Herfindahl-Hirschman Index (HHI) for firms' suppliers averages 993.06. Approximately 81% of customers in our panel are classified as public entities according to FactSet. The average proportion of

[12] HHI index is calculated as the sum of the squares of market shares at the 4-digit SIC level, using sales data from FactSet.

[13] A relationship is classified as international if the customer and supplier are based in different countries.

[14] Specifically, we use the FF_SGA_OTH variable from the FactSet Fundamentals panel. FF_SGA_OTH excludes foreign exchange gains/losses, IPO fees, hedge gains/losses, research and development expenses, and restructuring expenses, making it a more accurate proxy for advertising expenditures than FF_SGA, which includes these expenses.

international supplier relationships for these customers is 52.1%. If advertising expenditures is missing, we use adjusted SG&A expenditures over sales as a proxy for those customers, this is further discussed later in the paper. For customers in our panel with available ESG and climate exposure ratings, the average ESG score is 0.463, and the average climate exposure score is 0.001.

Panel (D) presents summary statistics for variables related to customers' real outcomes, including cost of goods sold relative to sales, revenue-based productivity measures (TFPR), and markups. The TFPR and markups are estimated using the residual method, applying a control function approach based on the methodologies of Olley and Pakes (1996), Ackerberg et al. (2015), and Rovigatti (2018) to estimate production function elasticities. Further details on the estimation methods for TFPR and markups are provided in Appendix A.4. The average values for cost of goods sold over sales, TFPR, and markups are 0.729, 0.517, and 1.427, respectively.

Panel (E) provides the summary statistics of our main control variables; including the logarithm of total assets, and normalized values of the following variables: cash and short term investments; net property plant and equipment; total current liabilities; accounts receivable; and accounts payable. All control variables are lagged one year and winsorized at the top and bottom 1%.

3 Empirical Methodology

In this section we detail the empirical methodologies used in our analysis. We start by examining the impact of negative E&S news shocks of suppliers on the termination of their relationships with downstream firms. This initial analysis serves as the first stage in the Two-Stage Least Squares (2SLS) approach employed in the later part of our study. In the second stage, we explore how the termination of these supplier relationships affects customers, with a particular emphasis on operating costs, firm markups and productivity.

Table 1: Summary Statistics

Variables	*Mean*	*Std.*	*p10*	*p25*	*p50*	*p75*	*p90*	*Obs.*
Panel (A): Supply-Chain Relationships								
Number of Terminated Suppliers; $Term_{i,t}^{Supp}$	1.400	3.991	0	0	0	1	3	94,952
Fraction of Terminated Suppliers; $\frac{Term_{i,t}^{Supp}}{N_{i,t}^{Supp}}$	0.176	0.280	0	0	0	0.25	0.5	94,952
Total number of Suppliers; $N_{i,t}^{Supp}$	7.281	19.822	1	1	2	6	15	112,825
Panel (B): Negative E&S News								
E&S Incidents Indicator; $D_{i,t-1}^{Inc,Supp}$	0.241	0.427	0	0	0	0	1	87,656
Panel (C): Customers' Differentiating Characteristics								
Input Specificity; $\overline{Spec}_{i,t-1}^{Supp}$	0.479	0.402	0	0	0.5	1	1	80,256
Suppliers' HHI; $\overline{HHI}_{i,t-1}^{Supp}$	993.06	897.68	199.059	418.56	781.457	1274.82	1943.63	87,656
Publicly listed customer indicator; D_i^{Pub}:	0.810	0.391	0	1	1	1	1	112,825
Ratio of international suppliers; $International_{i,t-1}^{Supp}$:	0.521	0.413	0	0	0.5	1	1	90,543
Scaled Adjusted SG&A Expenditure; $SG\&A^{Oth}/Sales_{i,t-1}$	0.256	0.490	0.040	0.076	0.146	0.265	0.439	84,873
ESG Score; $ESG_{i,t-1}^{Score}$	0.463	0.204	0.192	0.301	0.461	0.622	0.742	29,530
Climate Change Exposure; $Exposure_{i,t-1}^{Climate}$	0.001	0.002	0	0.0001	0.0003	0.0009	0.003	31,814
Panel (D): Customers' Real Performance Indicators								
Cost of Goods Sold over Sales; $\frac{Cogs_{i,t}}{Sales_{i,t}}$	0.729	0.238	0.429	0.604	0.752	0.860	0.936	111,185
Productivity; $log\left(TFPR_{i,t}\right)$	0.517	0.522	-0.003	0.201	0.448	0.772	1.206	105,859
Markup; $Markup_{i,t}$	1.427	0.808	0.956	1.055	1.208	1.486	2.028	105,859
Panel (E): Control Variables								
$log(Asset_{i,t-1})$	6.542	1.961	4.017	5.195	6.524	7.878	9.120	111,403
$Cash/Asset_{i,t-1}$	0.175	0.177	0.018	0.050	0.117	0.236	0.422	111,544
$Ppe/Asset_{i,t-1}$	0.288	0.229	0.033	0.096	0.234	0.436	0.644	111,532
$Liab/Asset_{i,t-1}$	0.299	0.181	0.101	0.164	0.263	0.396	0.548	111,087
$Receiv/Sales_{i,t-1}$	0.230	0.230	0.052	0.109	0.175	0.267	0.419	111,490
$Payab/Sales_{i,t-1}$	0.138	0.185	0.029	0.054	0.093	0.154	0.248	110,753

This table shows summary statistics for the firms in our sample. Panel (A) presents the summary statistics of the supply chain data for the main variables of interest: the number of terminated relationships with suppliers, the fraction of terminated relationships with suppliers, and the total number of relationships with suppliers. Panel (B) displays the summary statistics of the dummy variable for negative E&S news, indicating whether suppliers had an E&S incident in the previous year. Panel (C) details the summary statistics for the main customer characteristics used to study the drivers of supply-chain adjustments in response to negative E&S news shocks. These characteristics include lagged values of the customers' input specificity index from Barrot and Sauvagnat (2016), an indicator for whether the customer is publicly listed, the fraction of international suppliers, the Herfindahl-Hirschman Index (HHI) of suppliers, adjusted SG&A expenditures over sales, ESG scores, and the climate change exposure index from Sautner et al. (2023a). Panel (D) provides the summary statistics for the main real variables of interest, reflecting the customers' real outcomes, including their cost share, revenue-based productivity (logarithm of TFPR), and markup. Panel (E) provides the summary statistics of the main control variables.

3.1 Impact of Negative E&S News on Supplier Relationship Termination

In this subsection, we explore whether negative E&S news shocks among suppliers lead to the termination of relationships between customers and suppliers. To investigate this, we estimate the following equation:

$$Term_{i,t}^{Supp} = \beta_1 D_{i,t-1}^{Inc,Supp} + \Gamma X_{i,t-1} + \gamma_i + \tau_{s,t} + \lambda_{c,t} + \epsilon_{i,t} \quad (1)$$

where $Term_{i,t}^{Supp}$ represents the number of supplier relationships terminated by downstream firm i during year t. $D_{i,t-1}^{Inc,Supp}$ is a dummy variable that takes a value of one if there was at least one E&S incident among the suppliers of customer i in the previous period ($t-1$), and takes a value of zero otherwise. $X_{i,t-1}$ denotes the set of control variables for downstream firms, lagged by one period. Following the literature, we include the number of suppliers, the logarithm of total assets, and normalized values of cash and short-term investments, net property plant and equipment, total current liabilities, total accounts receivable, and accounts payables. To ensure that relationship termination is not driven by country-specific or sectoral trends–such as differences in business cycles across countries or underperformance in certain sectors–we include sector-year ($\tau_{s,t}$) and country-year ($\gamma_{c,t}$) fixed effects. In addition, we include downstream firm fixed effects (γ_i) to account for persistent differences across firms, such as management culture. This allows us to estimate the likelihood of relationship termination based on within-firm changes. The coefficient of interest, β_1, measures the impact of having at least one supplier with negative E&S news on the number of terminated relationships.

The main identification assumption is that E&S news about suppliers are orthogonal to the characteristics of downstream firms. To ensure this, we take several steps. First, we use a classification of news provided by an external partner (RepRisk) rather than relying on ESG ratings, which are often self-reported. Second, we focus on news classified by RepRisk as first-time and novel, and we confirm that there are no pre-trends, ruling out anticipation effects. We also exclude Governance news, as it tends to be more correlated with supplier financial performance. A major concern in establishing causality is whether relationship terminations are correlated with customer characteristics. To address this, in addition to including customer fixed effects and lagged controls, we exclude news related to supply-chain considerations and demonstrate that our results are robust to controlling for ESG news about the customer.

A significant identification concern in the recent Difference-in-Differences (DiD) literature is the estimation of treatment effects without "clean controls," which often arises when treatment events occur in different calendar years and the same firm can be treated multiple times. To address this, we build upon the methodologies outlined in Cengiz et al. (2019) and Callaway and Sant'Anna (2021), employing a Stacked Difference-in-Differences approach to

assess the impact of negative E&S news shocks among suppliers on the probability of relationship termination. We estimate the following equation:

$$Term_{i,t,k}^{Supp} = \beta_1 D_{i,k}^{Treat} \times D_{t,k}^{Post} + \Gamma X_{i,t-1,k} + \gamma_{i,k} + \tau_{s,t} + \lambda_{c,t} + \delta_{k,t} + \epsilon_{i,t} \quad (2)$$

In the stacked DiD specification, each cohort k consist of treated and control customers observed within a five-year window spanning from $k-2$ to $k+2$. A customer i is categorized into the treatment group for cohort k if at least one of its suppliers experiences an E&S incident during the cohort year k. Once a customer is assigned to the treatment group in cohort k, it will never be treated nor controlled in future cohorts $k' > k$. A customer i is assigned to the control group for cohort k if it has not been previously treated and has no incidents among its suppliers within the five-year window of cohort k.

$Term_{i,t,k}^{Supp}$ denotes the number of supplier relationships terminated by customer i in cohort k during year t. $D_{i,k}^{Treat}$ indicates whether customer i belongs to the treatment group in cohort k. $D_{t,k}^{Post}$ identifies the years following the event year in cohort k, in other words $k \leq t \leq k+2$. $X_{i,t-1,k}$ represents the set of control variables, $\gamma_{i,k}$ is the customer-cohort fixed effect, $\tau_{s,t}$ denotes the sector-time fixed effect, $\lambda_{c,t}$ indicates the country-time fixed effect, and $\delta_{k,t}$ captures the cohort-time fixed effect.

The aim of this first stage is twofold. First, we assess whether negative E&S news about suppliers reshape global supply chains by influencing relationship termination by customers. We further explore whether these effects are stronger for firms with low input specificity, high visibility, and in newer relationships. Second, we focus on the subsample of firms where E&S news on suppliers increases the likelihood of relationship terminations, quantifying the economic costs of severing ties. This analysis is conducted following the approach outlined in the next subsection.

3.2 Impact of Relationship Termination on Customer Outcomes

To estimate the impact of relationship termination on customer outcomes we estimate the following equation:

$$Y_{i,t} = \beta_1 Term_{i,t}^{Supp} + \Gamma X_{i,t-1} + \gamma_i + \tau_{s,t} + \lambda_{c,t} + \epsilon_{i,t} \tag{3}$$

where $Y_{i,t}$ represents the following outcome variables of customer i in year t: cost of goods sold over sales, markups and, the logarithm of total factor productivity (TFPR). The variable $Term_{i,t}^{Supp}$ denotes the number of terminated supplier relationships in year t. We also include controls for observable firm-level time-varying characteristics $X_{i,t-1}$ and customer fixed effects γ_i to account for time-invariant characteristics. As in equation 1, $\tau_{s,t}$ denotes sector-time fixed effects, and $\lambda_{c,t}$ captures country-time fixed effects. The coefficient β_1 captures the effect of supplier relationship terminations on customer outcomes. A major concern with the causal interpretation of β_1 is that the decision to drop a supplier might be influenced by time-varying unobservable characteristics of the downstream firm *i*. For example, a decrease in demand for the firm's products could lead to lower sales, affecting markups and productivity, and potentially resulting in the termination of supplier relationships. To address this potential endogeneity, we employ a 2SLS approach, using the predicted relationship terminations due to negative E&S news obtained in the first stage explained in Section 3.1. As previously argued, E&S news shocks do not directly affect the actual performance of customer i, but they can lead to the termination of supplier relationships. Therefore, $D_{i,t-1}^{Inc,Supp}$ serves as a valid instrument in our 2SLS specification, as it influences the number of terminated supplier relationships and indirectly impacts customer performance through these terminations.

4 Results

This section begins by examining the impact of suppliers' negative E&S news shocks on the termination of their relationships with customers. Next, we analyze the main drivers behind these terminations. Finally, we explore how the termination of these relationships affects

customers' production costs, markups and productivity.

4.1 Impact of Suppliers' Negative E&S News Shocks on Relationship Terminations

First, we examine whether negative E&S news shocks among suppliers prompt the termination of relationships with them. Following the specification in Equation (1), we present the results in Table 2. The findings confirm that negative E&S news shocks do, in fact, lead to the termination of supplier relationships. Columns (1) and (2) show the results from the OLS regressions. To ensure the robustness of the main result given the count-based nature of the dependent variable, which includes many zeros, we also estimate Equation (1) using a Poisson regression, as suggested by Bisetti et al. (2024) and Cohn et al. (2022). The results of this Poisson regression are provided in Column (3) of Table 2. In Column (1), we exclude firm control variables and include customer, sector-time, and country-time fixed effects. Columns (2) and (3) incorporate all firm control variables and fixed effects. The main specification result is presented in Column (2), where we find that negative E&S news shocks among suppliers increase the number of terminated relationships by 0.122 units, equivalent to 8.7% of the average number of terminations.

To analyze the dynamics and ensure that the results presented in Table 2 are not driven by pre-existing trends, we estimate the following equation:

$$Term_{i,t}^{Supp} = \sum_{j=t-4}^{t+4} \beta_j D_{i,j}^{Inc,Supp} + \Gamma X_{i,t-1} + \gamma_i + \tau_{s,t} + \lambda_{c,t} + \epsilon_{i,t} \tag{4}$$

where we estimate the dynamic effects of E&S incidents among suppliers on customers over a 9-year window. This approach helps to measure the duration of the impact of E&S incidents of suppliers on relationship termination, while accounting for any underlying trends.Figure 1 displays the estimated coefficients β_j along with their associated 95% confidence intervals. As illustrated, the supply-chain adjustment response to suppliers' incidents does not exhibit any pre-trend pattern and the impact is short-lived. The effect is largest on the first year and

Table 2: Upstream Negative E&S News Shocks and Relationship Terminations

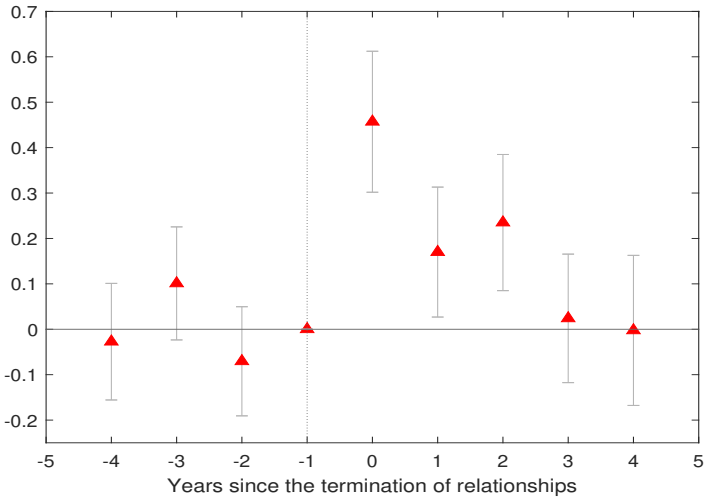
Variables	(1) $Term_{i,t}^{Supp}$	(2) $Term_{i,t}^{Supp}$	(3) $Term_{i,t}^{Supp}$
$D_{i,t-1}^{Inc,Supp}$	0.693***	0.122***	0.245***
	(0.0470)	(0.0289)	(0.0152)
$N_{i,t-1}^{Supp}$		0.194***	0.00394***
		(0.00473)	(0.000440)
$log(Asset_{i,t-1})$		0.0559**	0.278***
		(0.0284)	(0.0213)
$Cash/Asset_{i,t-1}$		0.0257	0.0231
		(0.107)	(0.0920)
$Ppe/Asset_{i,t-1}$		0.0436	0.285**
		(0.128)	(0.116)
$Liab/Asset_{i,t-1}$		-0.0350	0.177**
		(0.0936)	(0.0886)
$Receiv/Sales_{i,t-1}$		-0.0345	-0.0825
		(0.0645)	(0.0807)
$Payab/Sales_{i,t-1}$		0.161**	0.135
		(0.0677)	(0.0918)
R-squared	0.690	0.846	
Pseudo R-squared			0.562
Method	OLS	OLS	Poisson
Fixed Effects			
Firm	✓	✓	✓
Industry × Time	✓	✓	✓
Country × Time	✓	✓	✓
Observations	69,449	68,792	62,788

This table displays the impact of negative E&S news shocks among suppliers on the termination of relationships with them, using specification 1. Columns (1) and (2) use OLS estimation, while column (3) uses Poisson regression. The dependent variable is the number of terminated supplier relationships for customer i in year t. The key explanatory variable is a dummy variable for E&S incidents, which equals one if there was at least one E&S incident among suppliers of customer i in year $t-1$, and zero otherwise. Control variables include the number of suppliers, log(assets), and normalized values of cash, PPE, liabilities, receivables, and payables, all lagged by one year. Robust standard errors are provided in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.

disappears by the third year.

The recent DiD literature warns of estimation biases in empirical designs where units are treated at different times and previously treated units are used as controls. To confirm the robustness of our results against these potential biases, we present additional findings using the stacked DiD approach, as specified in Equation (2). The results from this stacked DiD

Figure 1: Dynamic Effects of Upstream Negative E&S News Shocks on Relationship Terminations



This figure illustrates the dynamic effects of suppliers' E&S incidents on the termination of relationships with them. Using event year $t-1$ as our baseline, we estimate the dynamic effects of negative E&S news shocks among suppliers on customers over a 9-year window. We plot the estimated coefficients β_js in specification 4 along with their associated 95% confidence intervals.

estimation are presented in Table 3. Columns (1) and (2) are estimated using OLS regression, while column (3) is estimated using Poisson regression.

In column (1), firm control variables are excluded and only customer-cohort, cohort-time, industry-time, and country-time fixed effects are included. In columns (2) and (3), all firm control variables and customer fixed effects are included. The main finding remains robust across the different specifications: treated customers (i.e., those with suppliers experiencing negative E&S news shocks) exhibit a significant increase in the number of terminated relationships with suppliers following these E&S incidents. The results from the stacked specification, presented in Column (2) of Table 3, closely align with the findings in Table 2.

Finally, as additional robustness checks, Table B.1 in the Appendix, shows that our main result remains robust to removing sector-time and country-time fixed effects, and especially, after controlling for the customer's own E&S incidents.

Table 3: Upstream Negative E&S News Shocks and Relationship Terminations – Stacked DiD

VARIABLES	(1) $Term^{Supp}_{i,t,k}$	(2) $Term^{Supp}_{i,t,k}$	(3) $Term^{Supp}_{i,t,k}$
$D^{Treat}_{i,t,k} \times D^{Post}_{i,t,k}$	0.807***	0.147***	0.128***
	(0.0368)	(0.0563)	(0.0328)
$N^{Supp}_{i,t-1,k}$		0.230***	0.0448***
		(0.0169)	(0.00563)
$log(Asset_{i,t-1,k})$		0.0177	0.0976***
		(0.0239)	(0.0333)
$Cash/Asset_{i,t-1,k}$		0.0696	0.0313
		(0.0813)	(0.128)
$Ppe/Asset_{i,t-1,k}$		0.199*	0.447**
		(0.107)	(0.187)
$Liab/Asset_{i,t-1,k}$		0.0744	0.177
		(0.0803)	(0.125)
$Reciv/Sales_{i,t-1,k}$		0.0602	0.0824
		(0.0480)	(0.0948)
$Payab/Sales_{i,t-1,k}$		0.0726	0.180
		(0.0578)	(0.112)
R-squared	0.523	0.632	
Pseudo R-squared			0.303
Method	OLS	OLS	Poisson
Fixed Effects			
Firm × Cohort	✓	✓	✓
Industry × Time	✓	✓	✓
Country × Time	✓	✓	✓
Cohort × Time	✓	✓	✓
Observations	182,780	122,959	98,133

This table illustrates the impact of negative E&S news shocks among suppliers on the termination of relationships with them, using the stacked DiD method. Columns (1) and (2) are estimated using OLS, while column (3) uses Poisson regression. The dependent variable is the number of terminated supplier relationships for customer i in cohort k at year t. The main explanatory variable is the interaction of two dummies: the treatment dummy, which indicates if firm i is treated in cohort k, and the post-incident dummy, which indicates if time t is after the E&S incident in year cohort k. Treatment groups in cohort k are those customers that have at least one incident among their suppliers in the cohort year k. Control variables include the number of suppliers, log(assets), and normalized values of cash, PPE, liabilities, receivables, and payables, all lagged by one year. All control variables, except the number of suppliers, are winsorized at the top and bottom 1%. Robust standard errors are provided in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.

4.2 Determinants of Relationship Terminations

The previous subsection establishes that negative E&S news shocks from suppliers lead to an increase in the termination of supplier relationships. In this subsection, we investigate the factors driving these terminations by examining different potential channels, such as input specificity and upstream market concentration, customer reputation sensitivity, and the age of supplier relationships. Our objective is to assess how these channels influence the stability of supply-chain relationships and their adjustment in response to E&S news shocks. To achieve this, we segment our sample according to the channels we want to explore, and apply equation (1) to the relevant samples.

4.2.1 Input Specificity and Upstream Market Concentration

An important factor influencing customers' decisions to terminate relationships with E&S violator suppliers is the ease of finding a replacement. We expect that customers who can more easily substitute suppliers will respond more strongly to E&S incident shocks. To test this hypothesis, we focus on the specificity of the intermediate inputs used.

We use data from Barrot and Sauvagnat (2016), which provides the proportion of differentiated goods produced in each industry at the 4-digit SIC level, based on Rauch (1999)'s classification. We calculate input specificity for each customer as the average share of differentiated goods produced in the sectors of its suppliers. Customers are then classified based on this average. If the average share of differentiated goods produced by their suppliers falls below the sector median, the customer is categorized as having low input specificity; if it is above the median, the customer is categorized as having high input specificity.

Table 4 shows that customers with suppliers in highly specific sectors do not react to suppliers' E&S incidents. However, when a customer can easily replace a supplier—particularly when suppliers are in low-specificity sectors—the customer responds significantly to these incidents. Furthermore, comparing the estimation results from Table 4 with the second column of Table 2 shows that the supply-chain adjustment response of customers with low input specificity is 36% greater than that of the entire sample.

Table 4: Upstream Negative E&S News Shocks and Relationship Terminations: The Role of Input Specificity

	(1)	(2)
Input Specificity	*High*	*Low*
VARIABLES	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$
$D_{i,t-1}^{Inc,Supp}$	0.0442	0.166***
	(0.0458)	(0.0453)
Controls	✓	✓
Fixed Effects		
Firm	✓	✓
Industry × Time	✓	✓
Country × Time	✓	✓
Observations	32,222	26,893
R-squared	0.836	0.876

This table shows the impact of negative E&S news shocks among suppliers on the termination of relationships with them, using specification 1, for customers connected to suppliers in sectors characterized by varying levels of input specificity, as defined by Barrot and Sauvagnat (2016). Column (1) displays the estimation results for customers whose lagged input specificity exceeds the median threshold within their sector, while column (2) presents results for customers below this threshold. Input specificity is defined as the average proportion of differentiated goods produced in the industries of each customer's suppliers. The main dependent variable is the number of terminated relationships with suppliers for firm i in year t. The primary explanatory variable is a dummy for E&S incidents, indicating if there was at least one E&S incident among suppliers of firm i in year $t-1$. Control variables include the number of suppliers, log(assets), and normalized values of cash, PPE (Property, Plant, and Equipment), liabilities, receivables, and payables, all lagged by one year. All control variables, except the number of suppliers, are winsorized at the top and bottom 1%. Robust standard errors are reported in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.

We can also use the number of suppliers and average upstream market concentration, estimated by the Herfindahl-Hirschman Index (HHI), as proxies for the ease of terminating relationships and finding substitutes. We anticipate that customers with a larger number of suppliers and those with suppliers from sectors with lower concentration will find it easier to terminate relationships with suppliers affected by E&S incidents and replace them with new ones. Table B.2 in the Appendix supports this expectation, showing that customers with a higher-than-median number of suppliers and a lower-than-median average suppliers' HHI are more likely to terminate relationships with suppliers involved in E&S incidents. All these findings suggest that input specificity and the ease of finding substitutes for suppliers are crucial factors in the supply-chain adjustment response to negative E&S news shocks.

4.2.2 Reputation, Visibility and Awareness

Reputation and visibility are crucial factors influencing customers' responses to suppliers' misconduct, particularly concerning negative news on their ESG behavior. We hypothesize that customers who prioritize their visibility and reputation will react more severely to their suppliers' misbehavior. To test this, we use various proxies for customers' awareness and the importance of reputation and visibility to them.

A key factor in determining the importance of visibility for customers is whether they are publicly listed companies. Column (1) in Table 5 demonstrates that publicly listed customers significantly respond to their suppliers' E&S incidents. This indicates that public companies, which are under greater scrutiny from investors and the public, place a higher value on maintaining their reputations and are more inclined to terminate relationships with suppliers following negative E&S news.

Another proxy for assessing the importance of reputation and visibility to customers is the international scope of their supplier relationships. Specifically, we examine the fraction of suppliers located in foreign countries. Customers with a high proportion of international suppliers are likely to place greater emphasis on their reputation and visibility. To explore how internationality influences the termination of supplier relationships in response to E&S news shocks, we categorize customers into two groups: those with predominantly international relationships and those with primarily domestic ones. As shown in Column (2) of Table 5, customers with a higher proportion of international suppliers are significantly likely to terminate relationships in response to negative E&S news from their suppliers.

Additionally, we use corporate advertising expenditures as a third proxy to evaluate customers' concern for reputation and visibility, following the methodologies of Servaes and Tamayo (2013) and Derrien et al. (2022). For firms where advertising expenditure data is missing, we use adjusted Selling, General, and Administrative (SG&A) expenditures relative to sales.[15] Customers with positive and non-missing lagged advertising expenditures, or with lagged adjusted SG&A relative to sales above the median value in their sector are considered

[15] In cases where advertising expenditure data is available, we observe a strong correlation of 0.93 between adjusted SG&A and advertising expenditures.

to be image-conscious, suggesting that reputation and visibility are more important to them. Column (3) in Table 5 presents the estimation results for these image-conscious customers, showing that they significantly react to their suppliers' E&S incidents by terminating the relationship. Similarly, Column (4) in Table 5 confirms this finding for customers with high advertising expenditures (not scaled by sales).

Finally, to provide further evidence, we examine corporate social responsibility (CSR) as an additional proxy for customers' awareness and the importance of reputation and visibility. We hypothesize that customers with high CSR ratings, who place significant emphasis on their visibility and reputation, will react more strongly to their suppliers' negative E&S news shocks by terminating their relationships. To test this hypothesis, we use customers' ESG score from Refinitiv, and climate change score from Sautner et al. (2023a) as indicators of CSR.

Using ESG and climate change exposure scores, we categorize customers. A customer is considered image-conscious if its lagged scores are higher than the median threshold in its sector. Columns (5) and (6) in Table 5 reveal that this sample of customers responds significantly to E&S incidents of their suppliers.

Interestingly, all coefficients in Table 5, which present the estimation results for customers with a high degree of visibility, are larger than our baseline first-stage result shown in the second column of Table 2, which is estimated using the whole sample of customers. These findings, using different proxies, indicate that customers' awareness and the importance of visibility and reputation play a significant role in the termination of relationships with suppliers in response to their negative E&S news shocks. Conversely, Table B.3 in the Appendix shows the estimation results for customers with low awareness. All coefficients in Table B.3 are smaller and less significant than their corresponding values for customers with high awareness in Table 5 or for the whole sample of customers in the second column of Table 2.

Our results are in line with those in Gantchev et al. (2022), which evidence divesting by responsible investors following negative environmental and social (E&S) incidents. They show that firms owned by more E&S-conscious investors experience larger reductions in valuations and react by subsequently improving their ESG performance. Our results are also in line with

Table 5: Upstream Negative E&S News Shocks and Relationship Terminations: The Role of Customer Visibility

	(1)	(2)	(3)	(4)	(5)	(6)
Characteristics	*Public*	*Internationality*	*Scaled Ads. Exp.*	*Ads. Exp.*	*ESG Score*	*Climate Exposure*
Degree	*Yes*	*High*	*High*	*High*	*High*	*High*
VARIABLES	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$
$D_{i,t-1}^{Inc,Supp}$	0.137***	0.147***	0.127***	0.117***	0.256***	0.188***
	(0.0326)	(0.0391)	(0.0371)	(0.0378)	(0.0690)	(0.0634)
Controls	✓	✓	✓	✓	✓	✓
Fixed Effects						
Firm	✓	✓	✓	✓	✓	✓
Industry × Time	✓	✓	✓	✓	✓	✓
Country × Time	✓	✓	✓	✓	✓	✓
Observations	57,392	35,060	36,700	39,626	12,100	12,386
R-squared	0.856	0.883	0.874	0.870	0.912	0.923

This table examines the impact of E&S incidents among suppliers on the termination of relationships with them for a sample of customers for whom visibility and reputation are important, using specification 1. Column (1) shows the estimation results for publicly listed customers in our sample. Column (2) presents the estimation results for customers whose suppliers are primarily international, where the lagged ratio of international relationships exceeds the median threshold in their sector. Columns (3) and (4) show the estimation results for customers with non-missing advertising expenditures or whose lagged adjusted SG&A expenditure over sales and adjusted SG&A expenditure (not scaled by sales), respectively, exceed the median threshold within their sector. Columns (5) and (6) display the estimation results for customers whose lagged Refinitiv ESG scores and climate change exposure index, based on data from Sautner et al. (2023b), respectively, exceed the median threshold within their sector. The main dependent variable is the number of terminated relationships with suppliers for firm i in year t. The primary explanatory variable is a dummy for E&S incidents, indicating whether there was at least one E&S incident among suppliers of firm i in year $t-1$. Control variables include the number of suppliers, log(assets), and normalized values of cash, Property, Plant, and Equipment (PPE), liabilities, receivables, and payables, all lagged by one year. All control variables, except the number of suppliers, are winsorized at the top and bottom 1%. Robust standard errors are reported in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.

Servaes and Tamayo (2013), who show that corporate social responsibility and firm value are positively related for firms with high customer awareness, but not for firms with low customer awareness.

Additionally, we examine whether the location of the customer influences the termination of relationships in response to E&S incidents among suppliers. We expect European customers to respond more significantly to negative E&S news shocks due to more restrictive regulations in the European Union, a higher degree of market pressure towards ESG, and the importance of reputation. Table 6 indicates that customers headquartered in Europe experience a more significant increase in terminated supplier relationships compared to customers located in the US or the global sample. In other words, supplier relationships for customers headquartered in the EU are more fragile compared to those in the US when it comes to terminating relationships in response to suppliers' E&S incidents.

Table 6: Upstream Negative E&S News Shocks and Relationship Terminations: Regional Differences

	(1)	(2)	(3)	(4)
Customer's Region	*Global*	*EU*	*US*	*Non EU and US*
VARIABLES	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$
$D_{i,t-1}^{Inc,Supp}$	0.122***	0.228***	0.0316	0.150***
	(0.0289)	(0.0860)	(0.0476)	(0.0409)
Controls	✓	✓	✓	✓
Fixed Effects				
Firm	✓	✓	✓	✓
Industry × Time	✓	✓	✓	✓
Country × Time	✓	✓	×	✓
R-squared	0.846	0.892	0.868	0.797
Observations	68,792	10,317	19,059	39,279

The table illustrates the impact of negative E&S news shocks among suppliers on the termination of relationships with them , using specification 1, across all customers, as well as specific breakdowns for customers headquartered in Europe, the United States, and regions outside the EU and the US. Column (1) presents estimation results for all customers, while columns (2), (3), and (4) display results for customers located in the EU, the US, and regions other than the EU and the US, respectively. The primary dependent variable is the number of terminated relationships with suppliers for customer i in year t. The main explanatory variable is a dummy variable for E&S incidents, indicating whether there was at least one incident among suppliers of customer i in year $t-1$. Control variables include the number of suppliers, log(assets), and lagged normalized values of cash, property, plant, and equipment (PPE), liabilities, receivables, and payables. All control variables, except the number of suppliers, are winsorized at the top and bottom 1%. Robust standard errors are reported in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.

4.2.3 Age of Relationships

Another factor we expect to influence customers' responses to E&S incidents of suppliers is the continuity and durability of relationships with suppliers. We define the age of a relationship as the number of years since the relationship first appeared in the panel. The average age of relationships for customer i in year t is defined as the mean age of all the relationships the customer has with its suppliers in year t. Customers are divided into two groups based on the value of their lagged average age of relationships relative to the median threshold in their sector: those with long-lasting suppliers and those with new suppliers.

Table 7 rejects our expectation regarding the impact of the age of relationships on the stability of the relationships. It shows that there is no significant difference between customers with long-lasting suppliers and those with new suppliers in terms of their supply-chain adjustment response to suppliers' E&S incidents.

Table 7: Upstream Negative E&S News Shocks and Relationship Terminations: The Role of Relationship Tenure

	(1)	(2)
Age of Relationships	*Long-Lasting Suppliers*	*New Suppliers*
VARIABLES	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$
$D_{i,t-1}^{Inc,Supp}$	0.0440	0.0302
	(0.0404)	(0.0577)
Controls	✓	✓
Fixed Effects		
Firm	✓	✓
Industry × Time	✓	✓
Country × Time	✓	✓
Observations	30,459	35,351
R-squared	0.894	0.673

This table presents the impact of E&S incidents among suppliers on the termination of relationships with them for customers with relatively young and old supplier networks. Column (1) shows the estimation result for customers whose lagged relationships' average age is higher than the median age threshold in their sector, and column (2) shows the estimation result for customers whose lagged relationships' average age is lower than the median age threshold in their sector. The main dependent variable is the number of terminated relationships with suppliers for firm i in year t, and the primary explanatory variable is a dummy for E&S incidents, indicating if there was at least one E&S incident among suppliers of firm i in year $t-1$. Control variables include the number of suppliers, log(assets), and normalized values of cash, PPE, liabilities, receivables, and payables, all lagged by one year. All control variables, except the number of suppliers, are winsorized at the top and bottom 1%. Robust standard errors are reported in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.

4.2.4 Disentangling the Importance of Input Specificity and Visibility

As shown in Tables 4, 5, B.2, and B.3, both input specificity and customers' awareness influence the supply-chain adjustment response to negative E&S news shocks among suppliers. Which factor is more important? Specifically, is input specificity or customers' awareness more dominant in driving customers' responses to negative news shocks? To address these questions, we use specification 1 and segment our samples to examine how input specificity and customer awareness interact in determining relationship termination after negative E&S news shocks.

We begin by restricting our sample to firms with high customer visibility, and examine how varying levels of input specificity influence relationship termination. If customer visibility is a significant factor in relationship termination, we anticipate notable reactions from both low and high input specificity firms. Conversely, if input specificity is the primary driver, we expect to observe significant results only within the low input specificity group. Next, we

focus on firms with high input specificity and investigate the effect of different levels of customer visibility on relationship termination. Should customer visibility prove to be a crucial factor, we expect to find significant results within the high visibility subsample.

Table 8 shows the impact of E&S incidents on termination responses for customers with high awareness and varying input specificity. Here, we observe that, even when restricting the sample to high awareness firms, customers with low input specificity still respond more strongly to negative E&S news shocks. Indeed, we do not observe significant responses for customers with high input specificity.

These findings suggest that input specificity is the dominant factor. Customers with high awareness who prioritize visibility and reputation will terminate relationships in response to negative news if it is not costly and if they can easily find an alternative supplier. Conversely, when input specificity is very high and finding a new supplier is difficult, customers will not terminate relationships, even if visibility and reputation are highly important to them.

Table 8: Input Specificity and High Customer Visibility

	Public		*High Internationality*		*High Scaled Ads. Exp.*	
	(1)	(2)	(3)	(4)	(5)	(6)
Input Specificity	*High*	*Low*	*High*	*Low*	*High*	*Low*
VARIABLES	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$
$D_{i,t-1}^{Inc,Supp}$	0.0514	0.196***	-0.0158	0.180**	0.0838	0.112*
	(0.0532)	(0.0514)	(0.0657)	(0.0733)	(0.0614)	(0.0611)
Controls	✓	✓	✓	✓	✓	✓
Fixed Effects						
Firm	✓	✓	✓	✓	✓	✓
Industry × Time	✓	✓	✓	✓	✓	✓
Country × Time	✓	✓	✓	✓	✓	✓
Observations	27,004	22,041	17,456	12,492	17,108	14,311
R-squared	0.847	0.883	0.869	0.914	0.842	0.909

This table investigates the impact of E&S incidents among suppliers on the termination of relationships with them for customers with a high degree of awareness and varying input specificity, using specification 1. Columns (1), (3), and (5) display the estimation results for customers with input specificity exceeding the median threshold within their sector. Columns (2), (4), and (6) show the estimation results for customers with with input specificity below the median threshold within their sector. The main dependent variable is the number of terminated relationships with suppliers for firm i in year t. The primary explanatory variable is a dummy for E&S incidents, indicating whether there was at least one E&S incident among suppliers of firm i in year $t-1$. Control variables include the number of suppliers, log(assets), and normalized values of cash, Property, Plant, and Equipment (PPE), liabilities, receivables, and payables, all lagged by one year. All control variables, except the number of suppliers, are winsorized at the top and bottom 1%. Robust standard errors are reported in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.

Table 9 highlights the impact of E&S incidents on the termination of relationships for customers with high input specificity and different levels of awareness. The findings indicate no significant difference in responses between customers with high and low awareness. This suggests that when input specificity is high, visibility and reputation do not play a significant role in shaping customers' reactions to negative E&S news shocks. Instead, input specificity emerges as the primary factor driving supply-chain adjustments in response to such incidents.

Table 9: Customer Visibility and High Input Specificity

	Public		*Internationality*		*Scaled Ads. Exp.*	
	Yes	*No*	*High*	*Low*	*High*	*Low*
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$
$D_{i,t-1}^{Inc,Supp}$	0.0514	-0.119	-0.0158	0.0504	0.0838	0.0233
	(0.0532)	(0.0989)	(0.0657)	(0.0628)	(0.0614)	(0.0912)
Controls	✓	✓	✓	✓	✓	✓
Fixed Effects						
Firm	✓	✓	✓	✓	✓	✓
Industry × Time	✓	✓	✓	✓	✓	✓
Country × Time	✓	✓	✓	✓	✓	✓
Observations	27,004	4,890	17,456	13,559	17,108	12,664
R-squared	0.847	0.720	0.869	0.809	0.842	0.851

This table shows the impact of E&S incidents among suppliers on the termination of relationships with them for customers with a high degree of input specificity and varying levels of awareness, using specification 1. Columns (1), (3), and (5) display the estimation results for public customers, customers with a lagged fraction of international relationships exceeding the median threshold within their sector, and customers with non-missing advertising expenditures or lagged adjusted SG&A expenditures over sales exceeding the median threshold within their sector, respectively. Columns (2), (4), and (6) show the estimation results for non-public customers, customers with a lagged fraction of international relationships below the median threshold within their sector, and customers with with missing advertising expenditures and lagged adjusted SG&A expenditures over sales below the median threshold within their sector, respectively. The main dependent variable is the number of terminated relationships with suppliers for firm i in year t. The primary explanatory variable is a dummy for E&S incidents, indicating whether there was at least one E&S incident among suppliers of firm i in year $t-1$. Control variables include the number of suppliers, log(assets), and normalized values of cash, Property, Plant, and Equipment (PPE), liabilities, receivables, and payables, all lagged by one year. All control variables, except the number of suppliers, are winsorized at the top and bottom 1%. Robust standard errors are reported in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.

4.3 The Economic Costs of Terminating Relationships for Customers

We established that negative E&S news shocks of suppliers lead to an increase in the termination of relationships. Here, we explore the costs associated with these terminations for customers, specifically examining whether losing suppliers impacts their operating cost, markups and productivity. The first three columns of Table 10 show the effects of terminating supplier

relationships on customers' cost of goods sold (COGS) relative to sales, markup, and the logarithm of a revenue-based productivity measure, estimating the OLS regression presented in equation (3).

The OLS estimates of equation (3) may be biased due to omitted variables that could simultaneously affect both the number of terminated supplier relationships and firm outcomes. To mitigate this issue, we implement an instrumental variable (IV) strategy. Our instrumental variable is a dummy variable, $D_{i,t-1}^{Inc,Supp}$, which indicates whether negative E&S news shocks affected the suppliers of customer i in the previous year. While these shocks do not directly influence customer outcomes, they can lead to supplier terminations, thereby indirectly affecting the customer. The last three columns of Table 10 present the second stage regression results. The Cragg-Donald Wald F statistics in Table 10 indicate that our estimation is not subject to weak instrument bias.

Both OLS and 2SLS approaches reveal that terminating supplier relationships significantly reduces customers' markup and productivity while increasing their cost share. The 2SLS results show a notably larger impact, which may be due to several factors. These include the local average treatment effect, as outlined by Card (2001) and Imbens and Angrist (1994), and a potential positive correlation between the number of terminated relationships (the endogenous regressor) and the error term in the OLS estimation. Additionally, attenuation bias resulting from measurement error could also contribute to the observed discrepancy.

In the 2SLS specifications, A one-unit increase in the number of terminated supplier relationships—equivalent to approximately 13.73% of the total number of suppliers—results in a 0.0275 unit increase in COGS over sales (about 3.7% of the average cost share), a 0.1 unit decrease in markup (approximately 7% of the average markup), and a 3.5% reduction in Total Factor Productivity (TFPR).[16]

We also demonstrate that the results are robust when using a continuous variable – the predicted share of terminated relationships – as an IV. Up to this point, our analysis has focused on the number of terminated supplier relationships ($Term_{i,t}^{Supp}$) as the primary depen-

[16] We further examine whether terminating relationships with suppliers in response to negative E&S news shocks affects customers' future sales. The results, presented in Table B.4 in the appendix, indicate that there is no significant impact on customers' sales due to the termination of these relationships.

Table 10: Supplier Loss and Customer Outcomes

VARIABLES	(1) $\frac{Cogs_{i,t}}{Sales_{i,t}}$	(2) $Markup_{i,t}$	(3) $log\,(TFPR_{i,t})$	(4) $\frac{Cogs_{i,t}}{Sales_{i,t}}$	(5) $Markup_{i,t}$	(6) $log\,(TFPR_{i,t})$
$Term_{i,t}^{Supp}$	0.000345**	-0.00128**	-0.000665***	0.0275**	-0.100**	-0.0356**
	(0.000135)	(0.000546)	(0.000208)	(0.0121)	(0.0429)	(0.0176)
$N_{i,t-1}^{Supp}$	-2.06e-05	5.18e-05	8.14e-05	-0.00528**	0.0192**	0.00685**
	(5.08e-05)	(0.000150)	(7.35e-05)	(0.00236)	(0.00838)	(0.00344)
$log(Asset_{i,t-1})$	0.0134***	-0.0474***	-0.00723	0.0132***	-0.0422***	-0.00685
	(0.00322)	(0.0110)	(0.00524)	(0.00360)	(0.0117)	(0.00551)
$Cash/Asset_{i,t-1}$	-0.0805***	0.416***	0.123***	-0.0831***	0.431***	0.130***
	(0.0134)	(0.0511)	(0.0221)	(0.0142)	(0.0516)	(0.0226)
$Ppe/Asset_{i,t-1}$	0.0364**	-0.0156	-0.182***	0.0356**	0.00937	-0.176***
	(0.0169)	(0.0447)	(0.0258)	(0.0178)	(0.0458)	(0.0258)
$Liab/Asset_{i,t-1}$	-0.00924	0.125***	0.0743***	-0.00505	0.120***	0.0632***
	(0.0121)	(0.0391)	(0.0200)	(0.0123)	(0.0388)	(0.0192)
$Receiv/Sales_{i,t-1}$	-0.0299*	0.0992*	0.0275	-0.0310*	0.0894*	0.0232
	(0.0164)	(0.0516)	(0.0275)	(0.0162)	(0.0496)	(0.0257)
$Payab/Sales_{i,t-1}$	0.154***	-0.252***	-0.256***	0.144***	-0.269***	-0.255***
	(0.0238)	(0.0740)	(0.0396)	(0.0241)	(0.0679)	(0.0387)
Method	OLS	OLS	OLS	2SLS	2SLS	2SLS
IV				$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$
Cragg-Donald Wald F statistic				28.307	27.812	27.812
Kleibergen-Paap rk LM statistic				17.873	17.504	17.504
Hansen J statistic				0.000	0.000	0.000
Fixed Effects						
Firm	✓	✓	✓	✓	✓	✓
Industry × Time	✓	✓	✓	✓	✓	✓
Country × Time	✓	✓	✓	✓	✓	✓
Observations	70,610	70,488	70,488	68,054	67,751	67,751

This table presents the impact of losing suppliers on customers' cost of goods sold (COGS) over sales, markup, and a revenue-based measure of productivity, estimated using specification 3. The main explanatory variable is the number of terminated relationships with suppliers. Columns (1) to (3) report the results from OLS estimations, while columns (4) to (6) present the results from 2SLS estimations. In the 2SLS specification, the main instrument is a dummy variable for negative E&S news shocks, indicating whether there was a negative E&S incident among the suppliers. All estimations include firm, sector-time, and country-time fixed effects. The control variables, which are lagged by one year, include the number of suppliers, log(assets), and normalized values of cash, PPE, liabilities, receivables, and payables. Except for the number of suppliers, these control variables are winsorized at the top and bottom 1%. Robust standard errors are reported in parentheses. Coefficients are marked with ***, **, or * to denote significance at the 1%, 5%, or 10% levels, respectively.

dent variable. This variable was employed in the first-stage estimation of specification (1) and subsequently assessed for its impact on customer outcomes in specification (3). As detailed in the Appendix, the findings indicate that using the fraction of terminated relationships ($\frac{Term_{i,t}^{Supp}}{N_{i,t}^{Supp}}$) yields similar results in both the first and second stages. Specifically, Table B.5 demonstrates that negative E&S news shocks involving suppliers lead to an increase in the fraction of supplier relationships that are terminated. Furthermore, Table B.6 shows that this increase in the fraction of terminated supplier relationships adversely affects customer outcomes.

4.3.1 Heterogeneous Impact of Losing Suppliers on Customer Outcomes

Here, we investigate whether the results discussed in Table 10 on the cost of severing ties with suppliers are driven by customer visibility or input specificity. We expect that firms with high visibility will experience significant economic costs when losing suppliers. However, we expect these costs to be lower if input specificity is low and it is easy to find alternative suppliers.

We estimate equation (3) using the 2SLS approach, with $D_{i,t-1}^{Inc,Supp}$ as the instrumental variable, for the sample of high visible firms. We can only conduct analyses for the specific customer samples that respond significantly to E&S news shocks in the first stage. It is important to emphasize that in this section, we can not examine the impact of terminating supplier relationships on customer outcomes for samples of customers where results were insignificant in the first stage. This specifically applies to customers with a high degree of input specificity, customers with low visibility, and customers with varying ages of relationships. For these customer samples, $D_{i,t-1}^{Inc,Supp}$ serves as a weak instrument. It does not satisfy the relevance condition because it does not significantly influence the variable $Term_{i,t}^{Supp}$ in the first stage.

To evaluate the costs associated with terminating relationships for customers with high visibility and awareness, we apply the same categorization criteria discussed earlier. Specifically, we focus on public firms, those with a high proportion of international relationships, and firms with high advertising expenditures. The estimation results, presented in Table 11, show that termination costs for high visible firms are indeed significant. These results may be expected after the findings shown in Table 10. There is no reason why more visible firms should not experience significant economic costs after losing suppliers.

However, we now refine our analysis and also focus on firms with low input specificity. These are firms for which switching suppliers could come at a lower cost. Thus, in Table 12 we restrict our analysis to high-visibility customers with low input specificity. We find that all the coefficients are insignificant, and the magnitude of the coefficients is considerably smaller. These results suggest that the costs are negligible, since suppliers can easily be substituted. This finding aligns with the results discussed in subsection 4.2.4, which suggest that high

visible firms only switch suppliers if the cost is low.

Table 11: Supplier Loss and Customer Outcomes: High Customer Visibility

	Public			*High Internationality*			*High Scaled Ads. Exp.*		
VARIABLES	(1) $\frac{Cogs_{i,t}}{Sales_{i,t}}$	(2) $Markup_{i,t}$	(3) $log\,(TFPR_{i,t})$	(4) $\frac{Cogs_{i,t}}{Sales_{i,t}}$	(5) $Markup_{i,t}$	(6) $log\,(TFPR_{i,t})$	(7) $\frac{Cogs_{i,t}}{Sales_{i,t}}$	(8) $Markup_{i,t}$	(9) $log\,(TFPR_{i,t})$
$Term_{i,t}^{Supp}$	0.0245**	-0.0732*	-0.0289*	0.0312**	-0.0856*	-0.0494**	0.0331*	-0.132*	-0.0545*
	(0.0112)	(0.0375)	(0.0160)	(0.0153)	(0.0482)	(0.0237)	(0.0187)	(0.0706)	(0.0299)
Method	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
IV	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fixed Effects									
Firm	✓	✓	✓	✓	✓	✓	✓	✓	✓
Industry × Time	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country × Time	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	56,861	56,624	56,624	34,703	34,537	34,537	36,057	35,845	35,845

This table examines the impact of losing suppliers on various performance metrics—specifically, cost of goods sold over sales, markup, and revenue-based productivity measures—for customers with relatively high awareness. The primary explanatory variable is the number of terminated supplier relationships. All estimates are derived using a 2SLS approach, with E&S incidents as the main instrument variable, indicating whether there was a negative E&S news shock among the suppliers of customer i in year $t-1$. Control variables include the number of suppliers, log(assets), and normalized values of cash, PPE (Property, Plant, and Equipment), liabilities, receivables, and payables, all lagged by one year. All control variables, except the number of suppliers, are winsorized at the top and bottom 1%. Robust standard errors are reported in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.

Table 12: Supplier Loss and Customer Outcomes: High Customer Visibility and Low Input Specificity

	Public *Low Input Specificity*			*High Internationality* *Low Input Specificity*			*High Scaled Ads. Exp.* *Low Input Specificity*		
VARIABLES	(1) $\frac{Cogs_{i,t}}{Sales_{i,t}}$	(2) $Markup_{i,t}$	(3) $log\,(TFPR_{i,t})$	(4) $\frac{Cogs_{i,t}}{Sales_{i,t}}$	(5) $Markup_{i,t}$	(6) $log\,(TFPR_{i,t})$	(7) $\frac{Cogs_{i,t}}{Sales_{i,t}}$	(8) $Markup_{i,t}$	(9) $log\,(TFPR_{i,t})$
$Term_{i,t}^{Supp}$	0.00364	-0.0182	0.00196	0.00580	0.0144	-0.00273	0.00649	-0.0670	-0.00376
	(0.00913)	(0.0369)	(0.0140)	(0.0148)	(0.0535)	(0.0206)	(0.0238)	(0.109)	(0.0359)
Method	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
IV	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fixed Effects									
Firm	✓	✓	✓	✓	✓	✓	✓	✓	✓
Industry × Time	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country × Time	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	21,931	21,845	21,845	12,404	12,348	12,348	14,158	14,087	14,087

This table examines the impact of losing suppliers on various performance metrics—specifically, cost of goods sold over sales, markup, and revenue-based productivity measures—for customers with relatively high visibility and low input specificity. The primary explanatory variable is the number of terminated supplier relationships. All estimates are derived using a 2SLS approach, with E&S incidents as the main instrument variable, indicating whether there was a negative E&S news shock among the suppliers of customer i in year $t-1$. Control variables include the number of suppliers, log(assets), and normalized values of cash, PPE (Property, Plant, and Equipment), liabilities, receivables, and payables, all lagged by one year. All control variables, except the number of suppliers, are winsorized at the top and bottom 1%. Robust standard errors are reported in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.

In summary, our analysis reveals that the costs associated with terminating supplier relationships vary significantly based on customer visibility and input specificity. While high visibility firms face substantial termination costs, those with low input specificity experience negligible costs, highlighting the ease of supplier substitution. These findings underscore the importance of understanding customer characteristics when evaluating the costs of losing

suppliers. As firms navigate E&S news shocks, recognizing these dynamics can inform strategic decisions, ensuring that they balance the need for flexibility with the potential costs of supplier disengagement.

5 Conclusion

This study highlights the significant impact of negative E&S news on global supply chain configurations, particularly focusing on the termination of supplier relationships by downstream firms. Our analysis reveals that such terminations are predominantly driven by the input elasticity of substitution. Specifically, firms are more likely to sever ties with suppliers when input elasticity of substitution is high, particularly in sectors with low input specificity and lower upstream industry concentration, where alternative suppliers are easier to find. Additionally, highly visible firms, driven by reputational concerns, are more inclined to drop suppliers, but only when finding substitutes is relatively straightforward.

Our findings also underscore the short-term economic costs associated with these decisions. Severing supplier relationships leads to increased operating costs, lower markups, and reduced total factor productivity for downstream firms, particularly when input specificity is high. These costs are more pronounced for highly visible firms, indicating that while reputational management is crucial, it comes at a tangible economic cost.

Methodologically, we addressed potential endogeneity concerns by using news-related ESG data, focusing on first-time, novel, and significant incidents, and employing a stacked difference-in-differences approach. This empirical strategy allows to isolate the impact of E&S incidents on relationship terminations and assess their subsequent effects on firm performance. Our results reinforce the importance of considering both the economic and reputational dimensions in supply chain decisions, particularly in the context of increasing regulatory emphasis on ESG considerations.

Overall, this study contributes to the growing literature on the intersection of ESG considerations and supply chain management, providing new insights into the trade-offs firms face when balancing reputational risks against the economic costs of supply chain reconfiguration.

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Supply Chain Disruptions: The Propagation and Economic Costs of ESG Shocks

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Online Appendix

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A Data

This section starts by describing the procedure for assigning a unique security ID to each FactSet entity ID. It then details the steps taken to clean and merge the FactSet data with the RepRisk data. Finally, it discusses the estimation of revenue-based productivity measures (TFPR) and markup using the residual approach.

A.1 Selecting Unique Security for Each Entity

FactSet fundamental data is in security level and each security is identified by FSYM-ID, while supply chain data is in entity level and each entity is identified by FACTSET-ENTITY-ID. Some companies have different listed securities. To merge supply chain data with fundamentals, following Koijen et al. (2020), we select a unique primary security (FSYM-ID) for each entity (FACTSET-ENTITY-ID). We select a security for each company which meets the following criteria:

- Only keep securities for which FF-ISCOMP is 1 in *ff-sec-coverage* table.[17]
- That security is identified as primary by FSYM-PRIMARY-EQUITY-ID in *sym-coverage* table.
- Drop all securities (FSYM-IDs) which have the same or missing FSYM-PRIMARY-EQUITY-ID. In another word, drop all securities that are not uniquely identified by FSYM-PRIMARY-EQUITY-ID.
- Using FSYM-PRIMARY-EQUITY-ID find the equivalent FACTSET-ENTITY-ID in *ff-sec-entity* table.

Now we have matching table between entities (FACTSET-ENTITY-ID), securities (FSYM-ID) and its primary equity (FSYM-PRIMARY-EQUITY-ID).

A.2 Merging FactSet Fundamentals and Supply Chain Data

We merge the supply chain and fundamentals data to create a unified dataset encompassing information on firms' fundamentals and their supply chain relationships. Initially, we

[17] FF-ISCOMP is 1 if the security is a primary issue; and is 0 if it is a secondary issue.

reshape the supply chain data into a format similar to the fundamentals panel. This involves transforming the dataset into a vertical long panel structure, where each row contains details about the supplier entity ID, customer entity ID, start date of the relationship, end date of the relationship, and the corresponding time (expressed as year-month). We retain only those observations for which the time falls within the start and end dates of the relationship. Subsequently, we merge the supply chain data with fundamentals using the customer entity ID and time.

A.3 Merging FactSet and RepRisk Data

Given the utilization of yearly data, we first aggregate information within RepRisk incidents data at the yearly granularity. This involves calculating the total number of incidents for each RepRisk ID in each year. Subsequently, we proceed with merging RepRisk and FactSet data. Initially, we merge the datasets using the ISIN code and year as the key identifiers. For entities that cannot be matched using the ISIN code, we employ fuzzy merging based on company names. To enhance the accuracy of fuzzy merging, we refine the process by excluding merged entities with discrepancies in ISO countries and website URLs between the FactSet and RepRisk datasets. This iterative approach ensures a more precise matching process.

A.4 Estimating Firm-Level Productivity and Markup

Markup and productivity play a pivotal role in understanding firm behavior, its market power and dynamics. One approach to analyzing these factors is through the residual method, which isolates certain elements to discern their impact on economic outcomes.

In firm-level panels like FactSet, we have data on firms' revenues and expenditures instead of quantities. Therefore, we focus on the revenue-based measure of total factor productivity (TFPR) rather than the quantity-based measure of total factor productivity (TFPQ). We estimate TFPR using the residual approach. Assume firm i at time t produces good $Y_{i,t}$ according

to a standard Cobb-Douglas production function:

$$Y_{i,t} = \widetilde{A}_{i,t} K_{i,t}^{\alpha_K^s} \left(LM_{i,t}\right)^{\alpha_L^s}$$

where $\widetilde{A}_{i,t}$ represents firm i's TFPQ during time t, $LM_{i,t}$ denotes the labor and materials used in production, both having the same elasticity α_L^s, and $K_{i,t}$ is the stock of capital with the corresponding elasticity α_K^s. The elasticities α_L^s and α_K^s are sector-specific and assumed to be the same for all firms within the two-digit SIC sector s. The firm's TFPR can be extracted from the following residual:

$$z_{i,t} = \log\left(A_{i,t}\right) = \log(Sales_{i,t}) - \alpha_L^s \log(LM_{i,t}) - \alpha_K^s \log(K_{i,t})$$

Here, $A_{i,t}$ represents firm i's revenue-based measure of total factor productivity at time t. $Sales_{i,t}$ is firm i's sales revenue at time t. After converting all variables to the same currency, we use the item `SALES` from FactSet for $Sales_{i,t}$, the item `COGS` for $LM_{i,t}$, and the constructed capital stock for $K_{i,t}$.[18] We estimate the production elasticities α_K^s and α_L^s using the control function approach following Olley and Pakes (1996), Rovigatti (2018), and Ackerberg et al. (2015). Finally, following De Loecker et al. (2020), we estimate markups using the following equation:

$$Markup_{i,t} = \alpha_L^s \frac{Sales_{i,t}}{LM_{i,t}}$$

[18] The capital stock is constructed using the perpetual inventory method following Ottonello and Winberry (2020) and Jeenas (2023).

B Tables

B.1 Upstream Negative E&S News Shocks and Relationship Terminations

VARIABLES	(1) $Term_{i,t}^{Supp}$	(2) $Term_{i,t}^{Supp}$	(3) $Term_{i,t}^{Supp}$	(4) $Term_{i,t}^{Supp}$
$D_{i,t-1}^{Inc,Supp}$	1.207***	0.146***	0.146***	0.123***
	(0.0559)	(0.0298)	(0.0302)	(0.0295)
$N_{i,t-1}^{Supp}$		0.193***	0.194***	0.195***
		(0.00411)	(0.00418)	(0.00483)
$log(Asset_{i,t-1})$		0.142***	0.133***	0.0515*
		(0.0304)	(0.0315)	(0.0298)
$Cash/Asset_{i,t-1}$		0.130	0.127	0.0109
		(0.106)	(0.110)	(0.111)
$Ppe/Asset_{i,t-1}$		-0.0376	-0.0408	0.0248
		(0.129)	(0.133)	(0.132)
$Liab/Asset_{i,t-1}$		0.0119	0.00871	-0.0211
		(0.0920)	(0.0952)	(0.0967)
$Receiv/Sales_{i,t-1}$		-0.00935	-0.0164	-0.0348
		(0.0630)	(0.0658)	(0.0675)
$Payab/Sales_{i,t-1}$		0.192***	0.188***	0.166**
		(0.0676)	(0.0695)	(0.0702)
$D_{i,t-1}^{OwnInc,Cust}$			0.116	0.104
			(0.0774)	(0.0775)
R-squared	0.624	0.835	0.834	0.845
Method	OLS	OLS	OLS	OLS
Fixed Effects				
Firm	✓	✓	✓	✓
Industry × Time	×	×	×	✓
Country × Time	×	×	×	✓
Observations	69,686	69,019	66,273	66,050

This table presents the impact of E&S incidents among suppliers on the termination of relationships with them, estimated using Equation 1 with OLS. The results here ensures the robustness of the main first stage results provided in Table 2. Columns (1) to (3) do not include sector-time and country-time fixed effects. Column (1) omits control variables entirely. Columns (3) and (4) include controls for the occurrence of E&S incidents affecting the customer itself. The primary dependent variable is the number of supplier relationships terminated by customer i in year t, while the main explanatory variable is a dummy indicating whether there was at least one E&S incident among the suppliers of customer i in year $t-1$. Control variables include the number of suppliers, log(assets), and normalized values of cash, PPE, liabilities, receivables, and payables, all lagged by one year. Except for the number of suppliers, these control variables are winsorized at the top and bottom 1%. Robust standard errors are shown in parentheses. Coefficients are marked with ***, **, or * to denote significance at the 1%, 5%, or 10% level, respectively.

B.2 Upstream Negative E&S News Shocks and Relationship Terminations: The Role of Upstream Market Concentration

	Number of Suppliers		*Suppliers' HHI*	
	High	*Low*	*High*	*Low*
	(1)	(2)	(3)	(4)
VARIABLES	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$
$D_{i,t-1}^{Inc,Supp}$	0.0861**	0.0231	0.0877**	0.143***
	(0.0356)	(0.0226)	(0.0440)	(0.0384)
Controls	✓	✓	✓	✓
Fixed Effects				
Firm	✓	✓	✓	✓
Industry × Time	✓	✓	✓	✓
Country × Time	✓	✓	✓	✓
Observations	41,738	23,458	33,844	31,938
R-squared	0.853	0.418	0.863	0.843

This table examines the impact of E&S incidents among suppliers on the termination of relationships with them for customers with varying levels of supplier numbers and average Herfindahl-Hirschman Index (HHI) among their suppliers, using specification 1. Column (1) presents the estimation results for customers whose number of suppliers is higher than the median in their sector, while Column (2) shows the results for customers with fewer suppliers than the sector median. Column (3) provides the estimation results for customers whose average suppliers' HHI is higher than the sector median threshold, and Column (4) shows the results for those below this threshold. The main dependent variable is the number of terminated relationships with suppliers for firm i in year t. The primary explanatory variable is a dummy for E&S incidents, indicating whether there was at least one E&S incident among suppliers of firm i in year $t-1$. Control variables include the number of suppliers, log(assets), and normalized values of cash, Property, Plant, and Equipment (PPE), liabilities, receivables, and payables, all lagged by one year. All control variables, except the number of suppliers, are winsorized at the top and bottom 1%. Robust standard errors are provided in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.

B.3 Upstream Negative E&S News Shocks and Relationship Terminations: The Role of Customer Visibility

	(1)	(2)	(3)	(4)	(5)	(6)
Characteristics	*Public*	*Internationality*	*Scaled Ads. Exp.*	*Ads. Exp.*	*Refinitiv Score*	*Climate Exposure*
Degree	*No*	*Low*	*Low*	*Low*	*Low*	*Low*
VARIABLES	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$	$Term_{i,t}^{Supp}$
$D_{i,t-1}^{Inc,Supp}$	-0.0176	0.0177	0.0836*	0.00181	0.00427	0.0861
	(0.0615)	(0.0415)	(0.0496)	(0.0426)	(0.0618)	(0.0641)
Controls	✓	✓	✓	✓	✓	✓
Fixed Effects						
Firm	✓	✓	✓	✓	✓	✓
Industry × Time	✓	✓	✓	✓	✓	✓
Country × Time	✓	✓	✓	✓	✓	✓
Observations	11,161	31,749	28,046	25,642	11,349	12,532
R-squared	0.702	0.793	0.826	0.523	0.681	0.885

This table examines the impact of E&S incidents among suppliers on the termination of relationships with them for a sample of customers for whom visibility and reputation are not important, using specification 1. Column (1) shows the estimation results for customers that are not publicly-listed in our sample. Column (2) presents the estimation results for customers whose suppliers are primarily domestic, where the lagged ratio of international relationships is lower than the median threshold in their sector. Columns (3) and (4) show the estimation results for customers with missing advertising expenditures whose lagged adjusted SG&A expenditure over sales and adjusted SG&A expenditure (not scaled by sales), respectively, are lower than the median threshold within their sector. Columns (5) and (6) display the estimation results for customers whose lagged Refinitiv ESG scores and climate change exposure index, based on data from Sautner et al. (2023b), respectively, are lower than the median threshold within their sector. The main dependent variable is the number of terminated relationships with suppliers for firm i in year t. The primary explanatory variable is a dummy for E&S incidents, indicating whether there was at least one E&S incident among suppliers of firm i in year $t-1$. Control variables include the number of suppliers, log(assets), and normalized values of cash, Property, Plant, and Equipment (PPE), liabilities, receivables, and payables, all lagged by one year. All control variables, except the number of suppliers, are winsorized at the top and bottom 1%. Robust standard errors are reported in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.

B.4 Supplier Loss and Customer Sales

VARIABLES	(1) $log(Sales_{i,t})$	(2) $log(Sales_{i,t+1})$	(3) $log(Sales_{i,t+2})$
$Term_{i,t}^{Supp}$	-0.0289	-0.0298	0.0239
	(0.0334)	(0.0439)	(0.0511)
Method	2SLS	2SLS	2SLS
IV	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$
Controls	✓	✓	✓
Fixed Effects			
Firm	✓	✓	✓
Industry × Time	✓	✓	✓
Country × Time	✓	✓	✓
Observations	68,789	62,731	49,079

This table presents the impact of terminating relationships with suppliers on customers' sales. The dependent variable is the customers' sales during the year of termination and the two subsequent years. The primary explanatory variable is the number of terminated supplier relationships, and the main instrument is a dummy variable for negative E&S news shocks, indicating whether there was an E&S incident among the suppliers. All estimations include firm, sector-time, and country-time fixed effects. Control variables include the number of suppliers, log(assets), and normalized values of cash, PPE, liabilities, receivables, and payables, all lagged by one year. Except for the number of suppliers, these control variables are winsorized at the top and bottom 1%. Robust standard errors are shown in parentheses. Coefficients are marked with ***, **, or * to denote significance at the 1%, 5%, or 10% levels, respectively.

B.5 Upstream Negative E&S News Shocks and Relationship Terminations – Fraction of Terminated Relationships

VARIABLES	(1) $\frac{Term_{i,t}^{Supp}}{N_{i,t}^{Supp}}$	(2) $\frac{Term_{i,t}^{Supp}}{N_{i,t}^{Supp}}$	(3) $\frac{Term_{i,t}^{Supp}}{N_{i,t}^{Supp}}$
$D_{i,t-1}^{Inc,Supp}$	0.0264***	0.0262***	0.125***
	(0.00299)	(0.00300)	(0.0142)
$log(Asset_{i,t-1})$		0.000157	-0.00175
		(0.00421)	(0.0198)
$Cash/Asset_{i,t-1}$		-0.0142	-0.105
		(0.0190)	(0.0915)
$Ppe/Asset_{i,t-1}$		0.0342	0.135
		(0.0231)	(0.113)
$Liab/Asset_{i,t-1}$		-0.0250	-0.135
		(0.0173)	(0.0825)
$Receiv/Sales_{i,t-1}$		-0.00733	-0.0235
		(0.0148)	(0.0718)
$Payab/Sales_{i,t-1}$		0.0458**	0.216**
		(0.0180)	(0.0847)
R-squared	0.297	0.297	
Pseudo R-squared			0.0855
Method	OLS	OLS	Poisson
Fixed Effects			
Firm	✓	✓	✓
Industry × Time	✓	✓	✓
Country × Time	✓	✓	✓
Observations	69,449	68,792	62,788

This table shows the impact of negative E&S news shocks among suppliers on losing relationships with them. Columns (1) and (2) are estimated using OLS, column (3) is estimated by Poission regression. The main dependent variable is the fraction of relationships with suppliers that are terminated for customer i in year t and the main explanatory variable is dummy of E&S incidents which indicates if there was at least one E&S incident among suppliers of firm i in year $t-1$. Control variables are log(assets), normalized values of cash, PPE, liabilities, receivables and payables. All control variables are lagged by 1 year and winsorized at the top and bottom 1%. Robust standard errors are provided in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.

B.6 Supplier Loss and Customer Outcomes – Fraction of Terminated Relationships

VARIABLES	(1) $\frac{Cogs_{i,t}}{Sales_{i,t}}$	(2) $Markup_{i,t}$	(3) $log\,(TFPR_{i,t})$	(4) $\frac{Cogs_{i,t}}{Sales_{i,t}}$	(5) $Markup_{i,t}$	(6) $log\,(TFPR_{i,t})$
$\frac{Term_{i,t}^{Supp}}{N_{i,t}^{Supp}}$	0.00198	-0.00513	-0.00433**	0.132***	-0.483***	-0.170**
	(0.00137)	(0.00460)	(0.00212)	(0.0500)	(0.176)	(0.0750)
$log(Asset_{i,t-1})$	0.0133***	-0.0470***	-0.00596	0.0147***	-0.0480***	-0.00893*
	(0.00276)	(0.00929)	(0.00449)	(0.00348)	(0.0113)	(0.00542)
$Cash/Asset_{i,t-1}$	-0.0715***	0.384***	0.110***	-0.0805***	0.420***	0.126***
	(0.0115)	(0.0427)	(0.0186)	(0.0142)	(0.0509)	(0.0224)
$Ppe/Asset_{i,t-1}$	0.0355**	-0.00621	-0.184***	0.0318*	0.0227	-0.171***
	(0.0148)	(0.0382)	(0.0223)	(0.0177)	(0.0456)	(0.0256)
$Liab/Asset_{i,t-1}$	-0.0177	0.144***	0.0877***	-0.00350	0.115***	0.0614***
	(0.0110)	(0.0349)	(0.0179)	(0.0123)	(0.0385)	(0.0191)
$Receiv/Sales_{i,t-1}$	-0.0139	0.0659	-0.00167	-0.0311*	0.0881*	0.0228
	(0.0133)	(0.0408)	(0.0216)	(0.0162)	(0.0495)	(0.0257)
$Payab/Sales_{i,t-1}$	0.158***	-0.239***	-0.256***	0.144***	-0.266***	-0.254***
	(0.0199)	(0.0574)	(0.0318)	(0.0242)	(0.0686)	(0.0389)
Method	OLS	OLS	OLS	2SLS	2SLS	2SLS
IV				$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$	$D_{i,t-1}^{Inc,Supp}$
Cragg-Donald Wald F statistic				75.664	74.417	74.417
Kleibergen-Paap rk LM statistic				76.320	75.012	75.012
Hansen J statistic				0.000	0.000	0.000
Fixed Effects						
Firm	✓	✓	✓	✓	✓	✓
Industry × Time	✓	✓	✓	✓	✓	✓
Country × Time	✓	✓	✓	✓	✓	✓
Observations	88,233	88,040	88,040	68,054	67,751	67,751

This table shows the impact of losing suppliers on customers' cost of goods sold over sales, markup, and revenue-based measure of productivity. The main explanatory variable is the fraction of relationships with suppliers that are terminated. Columns (1) to (3) are estimated by OLS while columns (4) to (6) are estimated by 2SLS. The main instrument variable is dummy of E&S incidents which indicates if there was a negative E&S news shocks among suppliers. All estimations have firm, sector-time and country-time fixed effects. Control variables are log(assets), normalized values of cash, PPE, liabilities, receivables and payables. All control variables are lagged by 1 year and winsorized at the top and bottom 1%. Robust standard errors are provided in parentheses. ***, ** or * indicates that the coefficient is significant at the 1%, 5%, or 10% level, respectively.