Shareholder value implications of supply chain ESG: Evidence from negative incidents*

Xuanpu Lin
University of Hong Kong
u3514070@connect.hku.hk

Guoman She
University of Hong Kong
gshe@hku.hk

Aaron Yoon
Northwestern University
aaron.yoon@kellogg.northwestern.edu

Haoran Zhu
Southern University of Science and Technology
zhuhr@sustech.edu.cn

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Abstract

We examine the value implications of supply chain ESG. We find that firms with fewer supply chain ESG incidents exhibit superior future accounting performance (i.e., profit, sales, and inventory efficiency) and that the relationship is stronger in the presence of pro-social stakeholders and a more volatile supply chain environment. We also find that the focal firms' stock price reacts negatively to supplier ESG incidents, and that firms that better manage supply chain ESG exhibit higher future stock returns. The excess future stock return persists for at least three years and is more salient among firms with a more complex and opaque supply chain. Overall, we highlight the benefits of supply chain ESG and the decision usefulness of the relevant disclosure.

Keywords: Supply Chain ESG, Accounting Performance, Stock Returns, Information Frictions

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1. Introduction

Supply chain ESG issues have been receiving an increased amount of attention as they account for a significant portion of a firm's overall ESG impact. For example, Scope 3 emissions, which supply chain emissions are a part of, contribute over 70% of the total greenhouse gas emissions by corporate issuers (Bloomberg 2023). Given the salience, an increasing number of policymakers have been requiring firms to disclose supply chain ESG-related information including Scope 3 emissions and the measures that firms are taking to address supplier labor abuse (UK, 2015; EC, 2022; SEC, 2022). However, such disclosure requirements pose potential burdens on companies, escalating compliance costs, and raising concerns regarding the proprietary nature of this information (Healy and Palepu 1993; Leuz and Wysocki 2016). Therefore, it is important to understand whether supply chain ESG information is useful to investors, and what potential information externalities exist along the supply chain (Pandit, Wasley, and Zach, 2011; Christensen, 2022).

Against this backdrop, we provide large-scale evidence on the link between supply chain ESG and accounting performance as well as stock market performance. For the purpose of our analysis and following the existing literature that viewed ESG as a tool to mitigate downside risk (Krüger 2015; Diemont et al. 2016; Hoepner et al. 2022; Sautner and Starks 2023), we define supply chain ESG as "endeavors to *mitigate* environmental, social, and/or governance aspects of suppliers' operations that could potentially cause a reduction in actual or expected value and reputation of the focal firm." We aim to deepen our understanding of the net effects of supply chain ESG from the focal firm's shareholders' perspective and inform regulators and investors about the potential impact of supply chain ESG disclosures.

We start by noting that the value implication of supply chain ESG efforts is ex-ante unclear. On the one hand, supply chain ESG might be value-enhancing for at least two reasons. First, superior supply chain ESG reduces the odds of supplier ESG adversities that result in negative externalities on local communities and create downstream brand and reputation damage beyond pure business risk, which may lead to stakeholder backlash against the focal firm. In fact, maintaining a positive image was ranked by managers as the most important reason for socially responsible sourcing (Lee, O'Marah, John, and Blake, 2012). If this is true, downstream consumers may distance themselves from the focal firm following supplier ESG incidents (Houston, Lin, Shan, and Shen, 2022; Christensen, de George, Joffre, and Macciocchi, 2023). In sum, strong supply chain ESG could help focal firms attract socially conscious stakeholders.

Second, ESG adversities of suppliers might destabilize supply chains, as focal firms would be under stakeholder pressure to disassociate from suppliers following heightened ESG risk (Bisetti, She, and Zaldokas, 2022; Pankratz and Schiller, 2022; Darendeli, Fiechter, Hitz, and Lehmann, 2022). This not only results in substantial costs to adapt supply chains, but also impairs the ability to procure inputs to fulfill purchase orders in time.[1] The enforcement of supply chain ESG-related regulation also exposes focal firms with irresponsible sourcing to significant supply chain adaptation costs (Hsu, Li, and Tsou, 2022; Dai, Duan, Liang, and Ng, 2022).[2] In essence, good supply chain ESG can help firms not only reduce operational costs but also increase revenue.

On the other hand, there are several reasons to expect a weak link between supply chain ESG and value creation. Responsible sourcing requires firms to undertake costly investments in

[1] For instance, Lefevre, Pelle, Abedi, Martinez, and Thaler (2010) conducted a small sample study on responsibility violations at suppliers and found that the direct operation-related costs (e.g., product recalls and inspection costs) borne by focal firms amount to 0.7% of revenue.

[2] For example, the 2008 amendments to the Lacey Act prohibits import of illegal timber. The 2010 California Transparency Act requires firms to disclose how they conduct due diligence to combat suppliers' human right abuse, inducing firms to move away from suppliers with poor human right records (She, 2022).

the supply chain to monitor suppliers' adherence to ESG standards (e.g., through supplier certification and audit). This would increase operational costs at least in the short run (Chen and Lee, 2017). Moreover, imposing higher ESG standards may raise suppliers' manufacturing costs, which would translate to higher input costs for the focal firm (Guo, Lee, and Swinney, 2016). Therefore, high operational and input costs due to responsible sourcing could erode a firm's competitive advantage if consumers are unwilling to pay the premium (FT 2021). Lastly, given that the value relevance of ESG efforts at the focal firm is still debated, it is uncertain whether supply chain ESG will pay off for the focal firm (see Di Giuli and Kostovetsky 2014; Khan, Serafeim, and Yoon 2016; Ahn, Patatoukas, and Skiadopoulos 2024).

To test these predictions, we create an outcome-based measure that captures the realized performance of supply chain ESG for the years 2009 to 2020. This measure overcomes two important empirical challenges in existing literature. The first is that suppliers' identities are often difficult to identify, and the second is the lack of a credible measure of supplier ESG, especially when suppliers are private. We overcome the first challenge by using the FactSet Revere Relationship database, which to our knowledge contains the most comprehensive information about supply chain networks (Bae, Elkamhi, and Simutin, 2019; Gofman, Segal, and Wu, 2020). We overcome the second challenge by using RepRisk, which collects negative ESG incidents for both public and private firms. This news-based measure of actual negative incidents has advantages over ESG ratings (e.g., MSCI), which are often a weighted average of various categories and based only on publicly available, and primarily firm-initiated, disclosure (Chen, Li, Mao, and Yoon, 2022; Park, Yoon, and Zach, 2022).

Our final product is the number of ESG incidents involving the firm's suppliers over a 12-month window preceding the focal year, which is then divided by the number of suppliers to

control for the scale of the supply chain network. This measure essentially assumes that supply chain ESG performance is a production of both the inherent supply chain ESG risk and supply chain ESG risk management endeavors. In this regard, a firm can achieve better performance—reducing the frequency of supplier incidents—by disassociating themselves from risky supply chains and/or by enhancing their investment to monitor and discipline suppliers.

We begin our analyses by examining the relationship between supply chain ESG and various measures of future accounting performance. We find a robust negative relation between the frequency of supply chain ESG incidents and subsequent profitability. The inference is robust even when we include firm fixed effects to control for slowly moving latent firm characteristics (e.g., operational strategies). Next, we find that supply chain ESG affects both the sales generation (downstream impact) and input management (upstream impact) capacities of the focal firm. Specifically, consistent with supply chain ESG empowering revenue expansion, we find that the frequency of supply chain ESG incidents is negatively associated with future sales. Moreover, the frequency of supply chain ESG incidents is associated with reduced inventory levels and diminished capacity to convert purchase orders into future revenue, suggesting that supply chain ESG stabilizes supply chains.

Next, we provide additional evidence to further shed light on potential mechanisms underlying the positive supply chain ESG-future profitability relation. We find that this positive relation is more pronounced when (i) customers are socially conscious, (ii) investors have a stronger preference for ESG, and (iii) supply chain is more volatile (i.e., incidents likely have real consequences on supply chain stability). Results suggest that value is created in the presence of a stable supply chain and pro-ESG stakeholders. The heterogeneity in customer and investment ESG preferences also supports the notion that our findings capture the ESG aspects of suppliers'

operations that diminish the valuation and reputation of focal firms, rather than being solely driven by non-ESG business risk.

We then examine the stock market reaction to supply chain ESG incidents. First, we find that the focal firm exhibits negative abnormal market reactions to suppliers' ESG incidents during the three-day window around the incident being public news. This suggests that investors perceive supplier ESG incidents to be value-destroying in the short term. Second, we find that firms with fewer supplier ESG incidents exhibit higher stock returns during the subsequent year. Specifically, a high-minus-low strategy that takes a long position in the group of firms with the least supply chain ESG incidents and a short position in the group of firms with the most supply chain ESG incidents earned a statistically significant alpha of 6.77% per year (t = 3.030).

Further analyses suggest that the results are not driven by correlations between supply chain ESG and other prominent signals that explain cross-sectional stock returns (e.g., those suggested in Green, Hand, and Zhang (2013)), hold in Fama and MacBeth (1973) and panel regressions with the inclusion of firm characteristics, and firm and time fixed effects, and use alternative asset pricing factor models (e.g., Q-factor from Hou, Xue, and Zhang, 2015). Overall, these results suggest that robust supply chain ESG creates value for the firm in the longer-term.

The observed relationship between supply chain ESG and future stock returns raises the question of why the stock market fails to fully incorporate the potential value creation effects of supply chain ESG, which would otherwise result in negligible abnormal returns in the future. We provide evidence that information frictions hinder the timely incorporation of the signal for supply chain ESG. Specifically, we find that firms with more frequent supply chain ESG incidents tend to have larger negative earnings announcement returns, suggesting that the delayed market reaction could be due to investors facing challenges in promptly evaluating the benefits of robust supply

chain ESG. Further, we find that stock prices are less likely to incorporate the signal of supply chain ESG when focal firms have low supply chain transparency, a larger proportion of suppliers are located outside the United States, and firms with greater retail investor ownership. In sum, information friction and the lack of investor sophistication create an impediment to the timely pricing of supply chain ESG information. Finally, we find that the return spread led by supply chain ESG declines gradually over time and becomes insignificant starting from the fourth year following portfolio formation.

A natural question that follows the results presented so far is whether and how firms undertake actions to adapt their supply chains following negative incidents. Prior studies suggest that firms can enhance supply chain ESG by either managing supplier portfolios or engaging with suppliers (Pankratz and Schiller, 2022; Darendeli et al., 2022; She, 2022; Bisetti et al., 2022). Consistent with the findings of prior literature, we find that firms with a greater number of supplier ESG incidents switch from suppliers with poor ESG records to those with strong ESG performance, and appear to increase endeavors to monitor suppliers, as evidenced by an improvement in ESG ratings of suppliers which continue to work with the focal firms. These results suggest that firms do manage supply chain ESG risk following adverse supply chain ESG shocks, and corroborate our argument that upstream ESG adversities induce significant supply chain adaptation costs.

Our paper contributes to several areas of the literature. First, we extend the literature that links firm ESG efforts and shareholder value. For example, whether firm ESG efforts generate shareholder value has been debated, and papers have presented channels that could potentially increase shareholder value (Edmans 2011; Khan et al. 2016; Bolton and Kacperczyk, 2021a, 2021b; Derrien, Krueger, Landier and Yao, 2022; Hsu et al., 2022; Welch and Yoon 2022; Ahn et al. 2024). We extend this literature, which mainly focused on the focal firms' ESG efforts, by

highlighting that robust supply chain ESG generates value for the focal firm. Further, our results suggest that these supply chain transparency initiatives would facilitate more timely incorporation of supply chain news into stock prices, which has important policy implications for the recent development of regulations targeting supply chain ESG.

Second, we extend the literature that studies supply chain ESG (e.g., Guo et al., 2016; Dai et al., 2022). The supply chain is now recognized as an important ESG issue that has a large impact on our society. For example, Scope 3 emissions account for the majority of carbon emissions from corporate issuers. While the supply chain can be an important transmission channel of positive ESG practices (Schiller, 2018; Dai, Liang, and Ng, 2021; She, 2022; Darendeli et al., 2022; Chen, Su, Tian, Xu, and Zuo, 2023), Dai et al. (2022) and Lu, Peng, Shin, and Yu (2023) found that supply chain can also be used as a channel to outsource toxic practices. We add to this stream of papers by showing the net benefits of having a robust supply chain ESG.

Finally, we extend the literature that measures supply chain risk, which, despite being a well-developed theoretical concept, has been difficult to quantify (Ho, Zheng, Yildiz, and Talluri, 2015; Pournader, Kach, and Talluri, 2020). Researchers used various proxies to measure supply chain risks (e.g., Hendricks and Singhal, 2003, 2005; Patatoukas 2012; Wu and Birge, 2014; Bray, Serpa, and Colak, 2019; Wu, 2022) and linked supply chain shocks to negative short-term market reactions (Hendricks and Singhal, 2003; Liu, Sarkar, Kumar, and Jin, 2018; Kim, Wagner, and Colicchia, 2019; Hendricks, Jacobs, and Singhal, 2020). Also, a small group of researchers has highlighted the long-term value implications of global sourcing strategies and supply chain networks (i.e., Wu and Birge 2014; Jain and Wu, 2020). We add this literature by constructing a new measure that captures a firm's supply chain ESG and extending our understanding of the value implications for shareholders and the mechanisms driving the phenomenon.

2. Sample, measurement, and descriptive statistics

2.1. Signal of supply chain ESG

We measure the performance of supply chain ESG using the frequency of ESG-related incidents that suppliers experience. This measure follows the spirit that supply chain ESG is the production of the fundamental ESG risk inherent in supply chains and firms' investment in supply chain ESG risk management. Therefore, a higher frequency of supplier incidents suggests that firms fail to disassociate themselves from risky supply chains and/or implement their monitor measures to discipline suppliers.

We obtain the list of tier-1 suppliers from the FactSet Revere database, which provides the most comprehensive coverage of supplier-customer relationships (Gofman et al., 2020). This dataset identifies a firm's suppliers from various sources, including firm disclosure, analyst reports, investor presentations, supply contracts, and press releases. For each supplier-customer relationship, FactSet Revere collects and verifies the starting and ending dates of the relationship, which allows us to track the point-in-time supplier list (Pankratz and Schiller, 2022). We note that our measure has advantages over supply chain ESG performance scores from major ESG data vendors (e.g., MSCI, Sustainalytics, etc.). Supply chain ESG related subscores are often not populated, because ESG data vendors use key performance indicator approach and rate firm supply chain ESG performance only when they deem the issue as material for the industry that the focal firm operates in (Welch and Yoon 2022; Chen, Li, Mao, Yoon 2022).

Next, we gather ESG incidents data during the 2009-2020 period from RepRisk.[3] RepRisk collects ESG incidents for over 220,000 private and public companies by screening over 100,000

[3] RepRisk started collecting news article in 2007. However, the coverage in 2007 and 2008 is less complete. We thus start the analyses from 2009 to mitigate concerns about measurement errors. Focusing on the period after 2009 also allows us to alleviate the confounding effects of the 2008 financial crisis on supply chains and stock price.

public sources including media, regulatory, and commercial documents (Gantchev, Giannetti, and Li, 2022). After extracting incidents from these sources, the analyst team manually conducts quality checks and regulatory reviews, identifies the affected firms, and records the novelty (i.e., newness) of each incident.[4] RepRisk classifies these incidents into 28 ESG-related issues (see Appendix B for more details) within the scope of environmental, social, and governance: environmental incidents encompass issues such as climate change and pollution; social incidents involve community (e.g., social discrimination) and employee relations issues (e.g., forced labor); governance incidents include issues related to corruption and bribery. Cross-cutting incidents refer to issues that encompass more than one category (e.g., social and governance) and include issues such as the violation of national legislation, among others.

We merge RepRisk and FactSet Revere using a two-step approach. For public suppliers, we rely on the International Securities Identification Number (ISIN) to link RepRisk firms to FactSet Revere suppliers. For private suppliers (i.e., cases where an ISIN is unavailable), we rely on a fuzzy name-matching algorithm. We then measure the realized performance of supply chain ESG (*SuppESG Incident*) for each firm-year using the total number of suppliers' ESG incidents during a 12-month window preceding the year, which is then scaled by the number of suppliers to account for the size of the supply chain network. A higher value of the *SuppESG Incident* indicates weaker supply chain ESG.

2.2. Sample construction and distribution

Our sample selection procedure starts with all U.S. firms covered by both the CRSP and Compustat databases during the period from 2009 to 2020. We additionally require firms to be

[4] For the purpose of our study, we only keep the new incidents (i.e., Novelty = 2).

covered by the FactSet Revere database to identify their supplier lists. Next, we exclude utility firms (i.e., SIC between 4900 and 4999), financial firms (i.e., SIC between 6000 and 6999), and firms without a Fama-French 49 classification. We also require firms to have sales larger than $1 million and exclude observations with missing control variables. Finally, we gather monthly stock return data from CRSP. As the measure of supply chain ESG spans from 2009 to 2020, the sample for our return analyses is from July 2010 to June 2022. Panel A of Table 1 outlines the sample selection procedures. These sample selection procedures leave us a final sample of 15,133 (194,565) firm-year (firm-month) observations used in our Fama-MacBeth and panel regressions.

Panel B of Table 1 reports the distribution of the topics of supplier ESG incidents. The majority of environmental incidents are related to local landscape (7.87%) and pollution (7.62%), whereas social incidents are concentrated in impacts on the community (8.72%), human rights (10.08%), and employment (8.78%). We also observe a large number of incidents related to violations of regulations (14.46%). Panel C displays the distribution of our sample by industry. The industries with the most observations include Computer Software (10.72%), Pharmaceuticals (9.03%), Electronic (8.38%), Retail (7.06%), Business Services (5.63%), and Wholesale (5.29%).

2.3. Descriptive statistics

Panel A of Table 2 presents the summary statistics about the signal of supply chain ESG and firm characteristics. The mean (median) value of *SuppESG Incident* is 1.161 (0.167), indicating that, on average, a supplier experiences 1.161 (0.167) ESG incidents in a year. Panel B of Table 2 further displays the distribution of *SuppESG Incident* across Fama-French 49 industries. The top five industries with the most supply chain ESG incidents include Candy & Soda, Computer

Software, Shipbuilding, Rubber and Plastic Products, and Chemicals, partly because their upstream industries are labor and/or pollution intensive.

We also report summary statistics for a series of firm characteristics (see Appendix A for detailed definitions). The average *Firm Incident* is 0.769, suggesting that focal firms on average experience 0.769 ESG incidents in a year. A median firm has a market capitalization of \$1,146 (= $e^{7.044}$) million and a book-to-market ratio of 0.556. On average, a firm spends 8.2% of sales on research and development, 1.2% on advertising, and 30.9% on selling, general, and admin related issues. The sample firms on average have a return on assets ratio of 9.7%. These statistics are largely consistent with those reported in prior studies (e.g., Dai et al., 2021).

3. Research design and results

3.1. Future accounting performance

To study the effect of supply chain ESG on future accounting performance, we estimate the following regression on a firm-year panel:

$$Dep\ Var_{it+1} = \beta_0 + \beta_1 Log\ SuppESG\ Incident_{it-1} + \beta_2 Z_{it-1} + \varepsilon_{it} \quad (1)$$

where *i* and *t* index firm and year, respectively. *Dep Var* is proxies of accounting performance in year t+1.[5] They include return on assets ratio (*ROA*), which is the ratio of operating income to average total assets; asset turnover ratio (*AssetTurnover*), which is the natural logarithm of the ratio of net sales to average total assets (e.g., Li, Qiu, and Shen, 2018); and *Inventory*, which is inventory scaled by sales and captures focal firms' ability to procure inputs to support revenue generations (e.g., Belo and Lin, 2012; Jain, Girotra, and Netessine, 2014). *Log SuppESG Incident* is the natural logarithm of one plus the intensity of supplier ESG incident. We use log

[5] In untabulated analyses, we document similar results when we examine the accounting performance in t+2.

transformation to normalize the skewness of *SuppESG Incident*, though our inferences are robust without the transformation.

Following prior literature on valuation and asset pricing (e.g., Hirshleifer, Hsu, and Li, 2013; Bolton and Kacperczyk, 2021a; Hsu et al., 2022), the vector of firm characteristics, *Z*, includes the natural logarithm of market capitalization (*Size*), the book-to-market ratio (*BM*), the natural logarithm of stock returns (*Return*), the natural logarithm of average stock price (*PRC*), the natural logarithm of average trading volume (*Vol*), capital expenditure divided by sales (*CAPX*), tangibility ratio (*TANT*), advertisement expenditure (*Adv Exp*), and the natural logarithm of one plus the frequency of ESG incidents of the focal firm (*Firm Incident*). All the control variables are measured in year t-1. We further include year fixed effects and industry or firm fixed effects to control for time-varying macro factors and time-invariant industry or firm characteristics, respectively. Our prediction is that strong supply chain ESG allows firms to achieve superior accounting performance by insulating themselves from adverse upstream shocks.

Our primary analyses focus on the association between the frequency of supply chain ESG incidents and future profitability. We estimate Eq. (1) using *ROA* as the dependent variable and report the results in Panel A of Table 3. Column (1) uses *Log SuppESG Incident* and industry and year fixed effects as the only independent variables. The coefficient of *Log SuppESG Incident* is −0.013 and statistically significant at the 1% level. The results remain robust with the inclusion of firm level controls in column (2). In column (3), we further include firm fixed effects to control for slowly moving latent firm characteristics (e.g., supply chain network). *Log SuppESG Incident* continues to load significantly negatively. A standard deviation increase in *Log SuppESG Incident* reduces return on asset ratio by 0.002 (= −0.003×0.642), which corresponds to 3.0% of its within-

firm standard deviation (i.e., 0.067).[6] The result suggests that strong supply chain ESG empowers firms to achieve superior future performance.

In Panel B of Table 3, we investigate the effect of supply chain ESG incidents on focal firms' sales generation (downstream impact) and input management (upstream impact). To study the effect on sales generation, we estimate Eq. (1) using *AssetTurnover* as the dependent variable, controlling for firm and year fixed effects. As shown in column (1) of Table 3 Panel B, *Log SuppESG Incident* is negatively related to the asset turnover ratio and is significant at the 5% level. The estimates suggest that a standard deviation increase in *Log SuppESG Incident* reduces asset turnover ratio by 0.008 (= −0.012×0.642), which corresponds to 3.2% of its within-firm standard deviation (i.e., 0.251).

To study the impact on input management, we conduct two sets of analyses. First, we estimate Eq. (1) using *Inventory* as the dependent variable. Column (2) of Table 3 Panel B shows that *Log SuppESG Incident* is negatively related to *Inventory*, suggesting that supplier ESG incidents cause supply chain disruption and lead to inventory shortage. On average, a standard deviation increase in *Log SuppESG Incident* reduces the inventory ratio by 5% relative to its within-firm standard deviation (= −0.003×0.642/0.042).

Furthermore, we investigate whether the inventory shortage impairs focal firms' ability to fulfill purchase orders. Following prior studies, we use change in order backlogs as the proxy for purchase order and examine its heterogenous ability to predict future sales conditional on supply chain ESG performance (Rajgopal, Shevlin, and Venkatachalam, 2003). To this end, we use *AssetTurnover* as the dependent variable and augment Eq. (1) with the change in order backlogs (*ΔPO*) and the interaction term between *ΔPO* and *Log SuppESG Incident*, and (Rajgopal et al.,

[6] Following the suggestion of Breuer and deHaan (2023), we use the with-firm variation of profitability as the benchmark to assess the economic significance of the effect of supply chain ESG.

2003; Chang, Chen, Hsu, and Mashruwala, 2018). Column (3) of Table 3 Panel B reports the regression results. We find a significantly positive coefficient on *ΔPO*, which is consistent with the prediction that purchase order leads to greater future revenue. However, *Log SuppESG Incident*× *ΔPO* is negative and significant at the 5% level, suggesting that supply chain ESG incidents impair focal firms' ability to fulfill purchase order and thus weaken the positive purchase order-future sale relation.

3.2. Exploring the potential mechanisms

In this subsection, we examine the channels in which supply chain ESG is linked to firm value. We propose two channels: (i) enabling firms to attract pro-social stakeholders; and (ii) allowing firms to lower operational costs by insulating themselves from supply chain ESG adverse shocks. The results presented in Section 3.1 suggest that supply chain ESG is positively associated with sales growth and inventory efficiency, which offer initial evidence supporting both channels.

To lend further credence to these two channels, we explore the heterogeneity in the association based on stakeholder ESG preference and supply chain stability by modifying the regression model (1) as follows:

$$ROA_{it+1} = \beta_0 + \beta_1 Log\ SuppESG\ Incident_{it-1} + \beta_2 Partitioning\ Var_{it-1} + \beta_3 Log\ SuppESG\ Incident_{it-1} \times Partitioning\ Var_{it-1} + \beta_4 Z_{it-1} + \varepsilon_{it} \quad (2)$$

where the dependent variable is ROA_{it+1}.[7] *Partitioning Var* is a binary variable indicating firms with greater exposure to pro-social stakeholders or with more volatile supply chains.

[7] We focus on *ROA* because the impact of supplier incidents on profitability is predicted to vary across both stakeholder ESG preference and supply chain stability. In contrast, it is less clear ex-ante whether the impact of supplier incidents on asset turnover (inventory) is a function of supply chain stability (stakeholder preference).

We report the results in Table 4. We first explore the role of customer ESG preference. We attempt to capture corporate customers' ESG preferences using the median ESG performance (i.e., RepRisk Rating) of focal firms' customers identified by FactSet Revere. We create a binary variable, *High Customer ESG*, to indicate the firms with customer ESG performance above the median. Column (1) reports the results. Despite the sample size reduction due to the availability of customer information, the coefficient on *Log SuppESG Incident* × *High Customer ESG* is significantly negative, suggesting that supply chain ESG has a greater impact on future profitability when customers are more ESG conscious.

In column (2), we delve into the variations in investor ESG preference, with the conjecture that investors would exert greater pressure on firms to incur adaptation costs and to disassociate themselves from suppliers with poor ESG records. Following Gantchev et al. (2022), we first identify ESG-conscious investors based on Refinitiv's E&S ratings (i.e., the average environmental and social score) of their portfolio holdings in the previous two years: investors with average portfolio ratings in the top tercile are classified as ESG-conscious investors. We then create a binary variable called *High Investor ESG*, which equals one if the proportion of the focal firms' average outstanding shares owned by ESG-conscious investors from year t−3 to year t−1 is greater than the median. The coefficient of *Log SuppESG Incident* × *High Investor ESG* is significantly negative (*coef.* = −0.006; t = −2.757). The results suggest that supply chain ESG adversities has stronger value destroying effects in the presence of more ESG-conscious investors.

In column (3), we study the role of supply chain stability with the prediction that the effect of supply chain ESG on profitability would be stronger when it influences supply chain stability to a greater extent. For this purpose, we measure supplier turnover rate with the fraction of

suppliers in year t−1 that stop dealing with the focal firm in year t+1.[8] We then establish a binary variable *High Supplier Turnover*, which equals one if the turnover rate is above the median. The coefficient of *Log SuppESG Incident* × *High Supplier Turnover* is significantly negative (*coef.* = −0.005; $t = -2.159$), suggesting that supply chain ESG adversities erodes profitability by reducing supply chain stability.

3.3. Stock market reaction

3.3.1. Short term reaction

In this section, we examine the stock term market reaction to focal firms when supplier ESG incidents become public. We start with all supplier ESG incidents in our sample. To mitigate confounding effects, we remove incidents occurring in the week before or after focal firms' earnings announcement. This leads us to a sample that consists of 25,728 supplier ESG incidents. For each incident, we estimate the cumulative abnormal returns (CARs) in a three-day (i.e., [−1,+1]) window around the supplier incident for the focal firm.

Panel A of Table 5 reports the results. We report the CARs computed based on the market model, Fama-French three-factor model, and Fama-French-Carhart factor model, respectively. The factor loadings are estimated over a 260-day period ending 30 days before the earnings announcement. The results suggest that supplier ESG incidents trigger a significant but mild negative market reaction. For example, the results based on Fama-French-Carhart factor model suggest that the focal firm experiences an average of −6 basis points of CAR during the three-day window around the supplier ESG incident. The modest economic magnitude may not be surprising given that supply chain networks are complex and often invisible to the public, and the majority

[8] The sample size decreases because we require a firm to have suppliers and their ESG rating information from year t−1 to year t+1.

of supplier ESG incidents are reported in foreign news outlets using non-English languages. Nonetheless, the significant results suggest that investors perceive supplier ESG incidents to be value-destroying for the focal firm

3.3.2. Long term returns

An important question that remains is whether the stock market fully incorporates supply chain ESG related information in a timely manner. Because it is costly to acquire supply chain ESG information, (e.g., to obtain the FactSet and RepRisk databases and process these databases to create the signal of supply chain ESG), we posit that the market exhibits a delayed response to supplier incidents, leading to a detectable association between supply chain ESG and future stock returns.

To test this prediction, we construct quartile portfolios based on the measure of supply chain ESG. Because the fundamental ESG risk of supply chain can vary considerably across industries, we sort firms within their corresponding Fama-French 49 industry (e.g., as in Hsu et al., 2022). We construct portfolios at the end of June annually using *SuppESG Incident* measured in the base year and hold the portfolios for twelve months. The low (high) portfolio contains firms with the least (most) supply chain ESG incidents in a 12-month window preceding the base year.[9] We then perform the following time-series regression to examine whether firms in the low portfolio outperform those in the high portfolio:

$$R_{it} = \alpha_{it} + \beta_{MKT} MKT_t + \beta_{SMB} SMB_t + \beta_{HML} HML_t + \beta_{RMW} RMW_t + \beta_{CMA} CMA_t + \varepsilon_{it} \quad (3)$$

[9] To ensure within-industry variation in supplier ESG risk management and achieve meaningful portfolio sorting, we remove industry-years (about 12.7% of the observations) where we are unable to sort firms into four portfolios based on the frequency of supplier incidents (i.e., the 25th percentile equals the 75th percentile). The most common case is that the industry consists of fewer than four public firms, or over 75% of firms in an industry-year do not have supplier incident in the past 12 months, for which we would only be able to classify firms into the Low and High groups. Our results are not sensitive to this sample restriction.

where *R* is the portfolio *i*'s value-weighted return in month *t* in excess of the risk-free rate; *MKT* is the market excess return in month *t*; *SMB* and *HML* are the Fama and French (1993) size and book-to-market factors, respectively; *RMW* and *CMA* are the Fama and French (2015) profitability and investment factors, respectively; α is the intercept that captures the abnormal risk-adjusted return. Standard errors are estimated following Newey and West (1987), which allows ε to be heteroskedastic and serially correlated.

Panel B of Table 5 reports the average firm characteristics across the quartile portfolios. Firms in the high portfolio on average experience 3.575 incidents per supplier, while firms in the low portfolio on average exhibit 0.005 incidents per supplier. Firms in the low portfolio also tend to have fewer ESG incidents, which is consistent with the assortative matching between supplier and customer (Dai et al., 2021). Interestingly, we find that firms in the low and high portfolios are similar in terms of size (6.341 vs. 6.925), book-to-market ratio (0.578 vs. 0.580), research and development (*R&D*) expenditures (0.099 vs. 0.110), capital expenditure (0.249 vs. 0.248), and tangibility (0.226 vs. 0.234).

Panel C of Table 5 reports the results from portfolio return test. We find that firms with the best supply chain ESG (i.e., firms with the least supplier incidents) significantly outperform those with weaker supply chain ESG (i.e., firms with the most supplier incidents). To be specific, holding the low portfolio (i.e., our long portfolio, the group of firms with the fewest supplier incidents) yields an annualized alpha of 3.804% (t = 3.194).[10] In contrast, holding the high portfolio (i.e., our short portfolio, the group of firms with the most supply chain incidents) yields an annualized alpha of −2.952% (t = −2.087). In sum, taking a long/short position earns an annualized alpha of 6.768 %

[10] We calculate the annualized alpha by multiplying the monthly alpha by 12.

(t = 3.030). These results are consistent with the notion that strong supply chain ESG predicts future stock returns.

We further supplement the factor model approach using both Fama-MacBeth and panel regressions, which allow us to control for firm-level characteristics that could potentially be correlated with both future returns and supply chain ESG. Specifically, we estimate the following value-weighted Fama-MacBeth (1973) regression (Hou, Xue, and Zhang, 2020):

$$R_{it} = \beta_0 + \beta_1 \, Log\ SuppESG\ Incident_{it-1} + \beta_2 \, Z_{it-1} + \varepsilon_{it} \quad (4)$$

where R is the excess monthly return for firm i measured as in the quartile portfolios for each month beginning from July of the base year to June of the next year. We use *Log SuppESG Incident* to introduce richer cross-sectional and time-series variations in supply chain ESG. Our inference is both quantitatively and qualitatively similar if we replace *Log SuppESG Incident* with two indicator variables for high and low portfolios, respectively. The vector of firm characteristics, Z, resembles that in Eq. (1), except that in Eq. (4) we further control for return *ROA* to control for firms' past accounting performance.

In column (1) of Table 6, we report the results of value-weighted Fama-MacBeth regression. The coefficient on *Log SuppESG Incident* is significantly negative (*coef.* = −0.586; t = −2.054), which is consistent with the results presented in Table 5 Panel C. In columns (2) and (3), we employ panel regressions and include industry and year-month fixed effects to control for industry and macro-level factors or firm and year-month fixed effects to control for firm and macro-level factors. The coefficients on *Log SuppESG Incident* continue to be significantly negative in both columns (*coef.* = −1.804; t = −3.151; *coef.* = −2.498; t = −2.321, respectively). Overall, our results suggest that the excess return of firms better managing supply chain ESG risk cannot be attributed to its correlation with firm characteristics and confirm that having a robust supply chain ESG

predicts future stock returns.

3.4 Why does the market fail to fully price supply chain ESG?

We next explore two non-mutually exclusive explanations for the delayed market responses. The first is that investors may be unable to evaluate the benefits of positive supply chain ESG because of the ambiguous effects of responsible sourcing on shareholder value from a theoretical standpoint. The second is that even when investors understand the benefits of supply chain ESG, the combination of information frictions and lack of investor sophistication prevents investors from acquiring and integrating information about supply chain ESG.

3.4.1 Earnings announcement returns

To assess the first explanation, we examine the association between supply chain ESG and future quarterly earnings announcements. Following Edmans (2011), we hypothesize that if investors fail to fully anticipate the value creation effects of supply chain ESG, then the earnings announces of firms with stronger (weaker) supply chain ESG performance would trigger more positive (negative) market reactions. In column (1) of Table 7, we consider the market reaction to quarterly earnings announcements in year t+1. We compute the cumulative abnormal returns over a three-day window (CAR[−1, +1]) around the announcement date of quarterly earnings of year t+1, and regress it on *Log SuppESG Incident*, *Size*, *BM*, *Return*, *PRC*, *Vol*, *CAPX*, *TANT*, *Adv Exp*, *Log Firm Incidents*, and year fixed effects. We find that the coefficient on *Log SuppESG Incident* is significantly negative (*coef.* = −0.016; *t* = −3.352). In column (2), we consider the market reaction to quarterly earnings announcements in year t+2 and find that the coefficient on *Log SuppESG Incident* continues to be significantly negatively. The coefficient is smaller both

economically and statistically compared to column (1), which supports that notion that investors gradually learn and incorporate the value creation effects over time. These results suggest that firms with fewer supply chain ESG incidents exhibit a higher announcement return than those with more incidents, supporting the argument that investors fail to fully anticipate the value creation effects of supply chain ESG.

3.4.2. Information friction and investor sophistication

In this subsection, we examine the role of information friction and investor sophistication. Supply chains are inherently complex and opaque; the lack of supply chain transparency creates an impediment for investors to identify a firm's supply chain network and measure the performance of supply chain ESG. To test this idea, we leverage the FactSet Revere database to measure the extent of supply chain opacity. Specifically, FactSet Revere identifies a firm's suppliers from either the firm's public disclosure or the disclosures of their suppliers. Compared with the firm's disclosure, it is more costly for investors to acquire information from the disclosures provided by suppliers (especially foreign suppliers). The concealment of supplier identity also reflects focal firms' incentives to keep their supply chain opaque.

Following Shi, Wu, Zhang, and Zhou (2020), we measure supply chain opacity using the fraction of the firm's suppliers that are disclosed *only* by the suppliers. We find that on average 56% of suppliers are not disclosed by focal firms. We then employ the following double-sorting approach. We independently categorize the sample into two groups based on supply chain opacity and into quartile portfolios based on the frequency of supply chain ESG incidents. Table 8 Panel A reports the results. We find that the supply chain ESG-driven return spread is concentrated in the subsample of firms with more opaque supply chains.

Next, we measure the degree of supply chain complexity using the fraction of suppliers that are outside the United States. The presence of foreign suppliers increases the information acquisition and integration costs because it may be more costly for American investors to identify the suppliers and assess their ESG performance, especially when the news about these suppliers is not written in English. For each focal firm-year, we compute the fraction of foreign suppliers. We then independently categorize the sample into two groups based on supply chain complexity and into quartile portfolios based on the number of suppliers ESG incidents. Panel B reports the results. We find that the supply chain ESG-driven return spread is concentrated in the subsample of firms with more complex supply chains (i.e., foreign suppliers).

Last, we test the role of investor sophistication. To do this, we follow prior studies (e.g., Hsu et al., 2022) and assume that retail investors have a lower level of investor sophistication. If investors' lack of expertise to acquire and integrate related information impedes the pricing of supply chain ESG, we expect the supply chain ESG-return association to be concentrated in the subsample with higher retail ownership. We categorize the sample into two groups based on the percentage of retail ownership (i.e., one minus the percentage of institutional ownership) at the beginning of the portfolio formation, and into quartile portfolios based on *SuppESG Incident*. Panel C shows that the stock-market outperformance of firms with fewer supply chain ESG incidents is concentrated in firms with high retail ownership. Overall, the results suggest that information friction impedes the assessment and pricing of supply chain ESG.

3.4.3. Longevity test

Finally, we find that it takes time for the market to understand the benefits of supply chain ESG, and that the excess return decays over time. We show this by examining the portfolio alpha

across various time intervals after the formation of portfolios. Table 9 reports the results. Initially, the annualized alpha of the portfolio with the fewest supply chain ESG incidents stands at 6.768% in the first year after portfolio formation. It remains statistically significant in the second and third year following the portfolio formation (annualized alpha = 3.936%). The annualized alpha in the fourth and fifth year following the portfolio formation, however, declines to 2.508% and becomes statistically insignificant (t = 1.525). These results suggest that the market does not immediately and fully recognize the value implication of supply chain ESG.

4. Additional tests

4.1. Firm remediation actions

A natural question is whether and how firms take remediation actions following supplier ESG incidents to mitigate value losses. Following prior studies (e.g., Pankratz and Schiller, 2022; Darendeli et al., 2022; She, 2022), we posit that firms might either (i) change their supplier portfolio, and/or (ii) engage with their existing suppliers to improve their ESG policies.

To test the first possibility, we investigate whether firms are more likely to terminate (establish new) relationships with bad (good) suppliers that have weak (strong) ESG performance. We construct a binary variable, *End_BadSupplier*, to indicate that in year t+1 (or t+2), the firm terminates a supplier with below-the-median ESG performance, measured by the RepRisk Rating. We also create a binary variable, *Start_GoodSupplier*, that equals one if in year t+1 (or t+2), the firm enters a relationship with a new supplier with above-the-median ESG performance, measured by the RepRisk Rating. We rerun equation (1) using *End_BadSupplier* and *Start_GoodSupplier* as the dependent variable and tabulate results in Table 10. We include year and firm fixed effects throughout all the analyses as we are interested in the within-firm variations in sourcing policies,

though all of the results remain intact when we replace firm fixed effects with industry fixed effects. The result shows that *Log SuppESG Incident* is positively associated with bad supplier termination (columns (1) and (2)) and new relationships with good suppliers (columns (3) and (4)). To the extent that restructuring supply chains is costly, this result also supports our argument that supply chain ESG enhances supply chain stability and thereby operation efficiency.

Next, we investigate whether firms increase their efforts to discipline their existing suppliers. To isolate this engagement effect from the change in supplier portfolio, we focus on suppliers that continue the relationship with the firm from t−1 to t+1 (or t+2) and track the change in their ESG performance (She, 2022). We construct a variable, *Supplier ESG Improvement*, which is the fraction of suppliers that experience an improvement in ESG performance (i.e., RepRisk Rating) ranked in quartiles. Columns (5) and (6) of Table 10 present the results. We find that *Log SuppESG Incident* is significantly positively related to future supplier ESG improvement, suggesting that firms engage with suppliers to improve ESG policies following negative supply chain incidents. Overall, these results indicate that firms actively manage their supply chain ESG risk by terminating suppliers with poor ESG records, searching for good suppliers with strong ESG, and engaging with suppliers to enhance their ESG policies following adverse supplier incidents.

4.2. Robustness tests

4.2.1. Alternative signals of supply chain ESG

Our primary signal of supplier ESG is based on the equally weighted average of supplier ESG incidents. One possibility is that incidents involving a supplier that is more important to the focal firm may have a greater impact on value creation. We assess the robustness of our main findings by considering the importance of a relationship. Because the majority of transaction

information (i.e., sales from a supplier to a customer) is absent, we use the length of the relationship to proxy for the importance of a supplier to a customer. Specifically, we create an alternative measure using the length-weighted average supplier incidents in year t-1. We continue to find that the frequency of supply chain ESG is negatively associated with future profitability and future stock returns. Taking a long position of firms with the fewest length-weighted incidents and a short position in the group of firms with the most length-weighted incidents generates an annualized alpha of 5.99% (t = 2.699). We omit this set of tests for brevity.

Moreover, throughout the paper we use a 12-month window to measure the performance of supply chain ESG. We find that all of our results are robust when we investigate supply chain ESG using a two-year window, i.e., the average frequency of supplier incidents in year t-1 and year t-2. Lastly, in our sample, 7.32% of incidents are classified by RepRisk as supply chain issues. Because these incidents might be driven by focal firms' ESG adversities and thus may not reflect supply chain risk, we remove supplier incidents related to supply chain issues and find robust results. We also omit presenting these tests for brevity.

4.2.2. Controlling for other return predictive signals

One concern about the supply chain ESG-return relation is that it is driven by omitted return predictive signals (RPSs) that are correlated with the signal of supply chain ESG (Green et al., 2013). To alleviate this concern, we follow Green et al. (2013) and select 10 prominent RPSs that are most correlated with our signal of supply chain ESG.[11] We then regress the long-short spread of *SuppESG Incident* on the spread of these 10 selected RPSs. The untabulated results show that

[11] These RPSs are selected from the orthogonalizing regression wherein we regress the long-short returns based on supply chain ESG on the return of a pool of 70 RPS (Huang, Song, and Xiang, 2022). We select 10 RPSs that generate the highest adjusted R-squared.

the alpha remains significantly positive (annualized alpha = 4.824%; t = 3.230). This suggests that the relation between return and supply chain ESG is not driven by its correlation with other return predictive signals documented in prior studies.

In addition, we assess the robustness of our findings to alternative risk factor models, including the Q-factor model proposed by Hou et al. (2015), the Fama-French three factors model, and the Fama-French three factors model with Carhart (1997) momentum factor. We find the annualized alpha of the low-minus-high portfolio is similar (both economically and statistically) to that reported in Panel C of Table 5. We omit presenting these results for brevity.

4.2.3. Financial constraints and policy uncertainty

Finally, we assess two alternative explanations that could potentially drive our results. The first is that financially constrained firms are less capable of managing supply chain ESG matters, and the second is that firms confronting high political uncertainty devote more resources to managing their supply chain. We re-estimate our Fama and MacBeth (1973) analyses and panel regressions by augmenting the equation (4) with the WW index (Whited and Wu, 2006), a widely used proxy for financial constraints, and the *EPU Exposure* (Baker, Bloom, and Davis, 2016; Bali, Brown, and Tang, 2017), a measure of firm-level exposure to the political uncertainty index based on Bloom (2009) by using rolling window regressions, separately.[12] Untabulated results suggest that the negative relation between *Log SuppESG Incident* and future profitability and stock returns remains robust after controlling for these factors.[13]

[12] For each stock in each month, we estimate the uncertainty beta from the monthly regressions of excess returns on the political uncertainty index over a 60-month rolling window by controlling for risk factors, including the market (*MKT*), size (*SMB*), book-to-market (*HML*), momentum (*UMD*), liquidity (*LIQ*), investment (*IA*), and profitability (*ROE*) factors from Fama and French (1993), Carhart (1997), Pastor and Stambaugh (2003), and Hou et al. (2015).
[13] We use a double-sorting approach based on both *EPU Exposure* and supplier ESG incidents. We do not find that the significant return spread of low-minus-high portfolios is concentrated in the sample with high exposure to EPU.

5. Conclusion

In this paper, we examine the long-term value implications of supply chain ESG. To study this question, we create a novel measure (i.e., the number of ESG incidents involving the firm's suppliers over a 12-month window preceding the year, divided by the number of suppliers) as a signal. We provide evidence that is consistent with the notion that strong supply chain ESG creates firm value. Specifically, we find that robust supply chain ESG enables firms to achieve higher future profitability, as it empowers revenue generation and firms' ability to procure inputs to fulfill purchase orders. In addition, supply chain ESG triggers a (mild) negative market reaction to focal firms, and leads to long-term stock market outperformance. For example, a low-minus-high portfolio strategy that takes a long (short) position in the quartile portfolio of the lowest (highest) frequency of supply chain ESG incidents generates a statistically significant alpha of 6.77% per year. Further analyses suggest that this delayed stock market response is attributable to a lack of supply chain transparency and the presence of high information acquisition costs. Lastly, we find that firms undertake remediation actions following supply chain ESG incidents.

Supply chain is now being perceived as an important ESG issue that has a large impact on our society and ignoring issues such as Scope 3 emissions of the focal firm can significantly underestimate its climate impact (Kothari et al., 2023). In addition, an increasing number of countries are considering requiring firms to enhance and disclose their due diligence to monitor suppliers' ESG practices. To this end, our paper has important policy implications and suggests that such initiatives would provide valuable information to stakeholders and allow the market to timely and completely integrate supply chain ESG into stock prices.

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Table 1 Sample selection and distribution

This table describes the sample. Panel A presents the sample selection process. Panel B presents the distribution of supplier incidents by event type. Panel C presents the percentage of firm-year observations across Fama-French 49 Industries.

Panel A: Sample selection

Step	Monthly return observations	Firm-year observations
Merged sample between FactSet, RepRisk, Compustat and CRSP from 2009 to 2020 (corresponding monthly return is from 2010 to 2022)	229,734	19,556
(-) Observations without Fama-French 49 classification	(1,308)	(115)
(-) Observations with sales smaller than $1 million	(6,348)	(537)
(-) Observations with missing controls (and accounting performance)	(27,513)	(3,771)
Final sample	194,565	15,133

Panel B: Event types

Topic	Frequency	Percentage
Emission	30,315	3.89%
Pollution	59,423	7.62%
Landscape impacts	61,422	7.87%
Waste	23,697	3.04%
Animal mistreatments	3,557	0.46%
Human rights abuse	78,639	10.08%
Communities impacts	68,023	8.72%
Discrimination in employment	6,953	0.89%
Labor issue	20,698	2.65%
Freedom of association and bargaining	15,656	2.01%
Employment	68,502	8.78%
Product	53,745	6.89%
Supply chain	59,269	7.60%
Violation of Regulations	112,810	14.46%
Governance (corruption, fraud, and tax, etc.)	117,342	15.04%

Panel C: Distribution by Fama-French 49 industry

Industry	#Firm-Year	Industry	#Firm-Year
Agriculture	0.38%	Automobiles and Trucks	2.58%
Food Products	2.32%	Aircraft	0.97%
Candy & Soda	0.28%	Shipbuilding	0.45%
Beer & Liquor	0.61%	Defence	0.19%
Tobacco Products	0.06%	Precious Metals	0.29%
Recreation	0.62%	Mining	0.33%
Entertainment	1.67%	Coal	0.12%
Printing and Publishing	0.75%	Oil	3.89%
Consumer Goods	1.55%	Communication	2.79%
Apparel	1.54%	Personal Services	1.33%
Healthcare	1.40%	Business Services	5.74%
Medical Equipment	3.38%	Computers	2.35%
Pharmaceuticals	8.16%	Computer Software	10.16%
Chemicals	3.15%	Electronic	8.41%
Rubber and Plastic Products	0.69%	Lab Equipment	2.29%
Textiles	0.54%	Business Supplies	1.63%
Construction Materials	1.92%	Shipping Containers	0.36%
Construction	1.29%	Transportation	3.47%
Steel Works	1.98%	Wholesale	5.63%
Fabricated Products	0.22%	Retail	7.04%
Machinery	4.34%	Restaurants & Hotels	1.77%
Electrical Equipment	1.37%		

Table 2 Descriptive statistics

This table presents the descriptive statistics. Panel A reports the summary statistics of key variables. *Log SuppESG Incident* is the natural logarithm of one plus *SuppESG Incident*, which is the number of supplier incidents divided by the number of suppliers in year t-1. *Firm Incident* is the total firm RepRisk incidents over the past 12 months. *Size* is the log of market capitalization. *ROA* is the ratio of operating income to average total assets. *ATO* is the ratio of net sales to average total assets. *Inventory* is the ratio of inventory to sales. *ΔPO* is the change in the ratio of order backlog to total assets. *Size* is the natural logarithm of market value. *BM* is the book value of equity divided by the market value at the end of the calendar year. *Return* is the natural logarithm of stock returns. *PRC* is the natural logarithm of stock price. *Vol* is the natural logarithm of stock trading volume. *R&D* is the research and development expenditure divided by total sales. *Adv Exp* is the advertisement expenditure divided by total sales. *SG&A* is the selling, general, and administrative expenses divided by total sales. *ROA* is the operating income after depreciation divided by total assets. *CAPX* is the capital expenditure divided by net property, plant, and equipment. *TANT* is tangible assets divided by total assets. Panel B reports the average number of supply chain ESG incidents per supplier across the Fama-French 49 Industries. Detailed variable definitions are in Appendix A.

Panel A: Summary statistics of key variables

	Obs.	Mean	SD	P25	P50	P75
SuppESG Incident	15,133	1.161	2.584	0.000	0.167	1.200
Log SuppESG Incident	15,133	0.473	0.642	0.000	0.154	0.788
Firm Incident	15,133	0.769	2.237	0.000	0.000	0.000
ROA	15,133	0.097	0.138	0.063	0.114	0.163
AssetTurnover	15,133	-0.877	0.737	-1.288	-0.839	-0.383
Inventory	14,974	0.118	0.126	0.013	0.099	0.173
ΔPO	14,993	0.000	0.099	0.000	0.000	0.000
Size	15,133	7.044	2.004	5.675	7.072	8.365
BM	15,133	0.556	0.465	0.249	0.432	0.720
Return	15,133	0.104	0.410	-0.112	0.122	0.335
PRC	15,133	3.234	1.232	2.472	3.382	4.104
Vol	15,133	11.262	1.720	10.201	11.345	12.436
R&D	15,133	0.082	0.187	0.000	0.007	0.080
Adv Exp	15,133	0.012	0.028	0.000	0.000	0.010
SG&A	15,133	0.309	0.889	0.107	0.218	0.371
CAPX	15,133	0.237	0.166	0.120	0.194	0.308
TANT	15,133	0.237	0.220	0.074	0.160	0.334

Panel B: Supply chain ESG incidents across Fama-French 49 industries

Industry	*SuppESG Incident (Mean)*	Industry	*SuppESG Incident (Mean)*
Agriculture	1.714	Automobiles and Trucks	1.100
Food Products	0.955	Aircraft	0.616
Candy & Soda	3.235	Shipbuilding	2.054
Beer & Liquor	0.942	Defence	0.312
Tobacco Products	0.372	Precious Metals	0.640
Recreation	1.190	Mining	1.252
Entertainment	0.976	Coal	0.332
Printing and Publishing	0.906	Oil	0.563
Consumer Goods	0.921	Communication	1.765
Apparel	0.732	Personal Services	1.825
Healthcare	0.839	Business Services	1.217
Medical Equipment	0.683	Computers	0.803
Pharmaceutical	0.772	Computer Software	2.064
Chemicals	2.000	Electronic	0.675
Rubber and Plastic Products	2.093	Lab Equipment	0.499
Textiles	1.505	Business Supplies	0.517
Construction Materials	0.537	Shipping Containers	1.049
Construction	0.668	Transportation	1.670
Steel Works	1.132	Wholesale	1.344
Fabricated Products	0.885	Retail	1.758
Machinery	0.542	Restaurants & Hotels	1.266
Electrical Equipment	0.490		

Table 3 Supply chain ESG and future accounting performance

This table reports the regression results of the relation between supply chain ESG and future financial performance. In Panel A, the dependent variable is return on assets ratio (*ROA*), which is measured as operating income scaled by average total assets in year t+1. In Panel B, the dependent variables are *AssetTurnover* in Columns (1) and (3), which is measured as the natural logarithm of the ratio of net sales to average total assets in year t+1, and *Inventory* in Column (2), which is measured as inventory scaled by average sales in year t+1. *Log SuppESG Incident* is the natural logarithm of one plus *SuppESG Incident*, which is the number of supplier incidents divided by the number of suppliers in year t-1. *ΔPO* is the change in the ratio of order backlogs to total assets from year t-1 to year t. All variables are winsorized at the 1st and 99th percent and the detailed definitions are in Appendix A. Standard errors are robust to heteroskedasticity and clustered at the industry-year level, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% (two-sided) levels, respectively.

Panel A: Future return on assets

Dep. Var. =	ROA_{t+1}		
	(1)	(2)	(3)
Log SuppESG Incident	-0.013***	-0.011***	-0.003**
	(-7.610)	(-7.560)	(-2.296)
Size		0.010***	-0.030***
		(3.277)	(-7.145)
BM		-0.006	-0.014***
		(-1.322)	(-3.755)
Return		0.023***	0.022***
		(4.486)	(5.529)
PRC		0.037***	0.054***
		(13.902)	(15.796)
Vol		-0.009***	0.010***
		(-2.948)	(4.414)
CAPX		-0.035***	0.005
		(-3.072)	(0.629)
TANT		0.096***	-0.020
		(10.135)	(-0.927)
Adv Exp		0.206***	0.271***
		(3.489)	(2.922)
Log Firm Incident		-0.004	-0.003
		(-1.327)	(-1.288)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	No
Firm FE	No	No	Yes
Obs.	15,133	15,133	15,133
Adj. R-squared	0.143	0.327	0.756

Panel B: Future sales generation and input management

Dep. Var. =	$AssetTurnover_{t+1}$	$Inventory_{t+1}$	$AssetTurnover_{t+1}$
	(1)	(2)	(3)
Log SuppESG Incident	-0.012**	-0.003**	-0.011**
	(-2.270)	(-2.552)	(-1.983)
ΔPO			0.244***
			(9.106)
ΔPO×Log SuppESG Incident			-0.064**
			(-2.394)
Size	-0.133***	0.000	-0.135***
	(-8.342)	(0.089)	(-9.557)
BM	-0.090***	0.004**	-0.092***
	(-6.347)	(2.106)	(-6.538)
Return	0.089***	-0.002	0.086***
	(6.369)	(-1.346)	(6.155)
PRC	0.059***	0.002	0.062***
	(5.666)	(0.944)	(6.248)
Vol	-0.021***	-0.000	-0.019**
	(-2.755)	(-0.179)	(-2.584)
CAPX	0.087**	0.009	0.070**
	(2.386)	(1.423)	(2.010)
TANT	-0.076	-0.002	-0.069
	(-0.867)	(-0.150)	(-0.792)
Adv Exp	2.332***	-0.139*	2.208***
	(4.037)	(-1.773)	(3.980)
Log Firm Incident	-0.018**	-0.002*	-0.016**
	(-2.353)	(-1.768)	(-2.206)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Obs.	15,133	14,971	14,978
Adj. R-squared	0.885	0.877	0.887

Table 4 Heterogeneity in supply chain ESG-profitability relation

This table reports the regression results of the relation between supply chain ESG and future return on assets in year t+1. The sample size varies across columns due to the availability of the partition variables. The dependent variable is the return on assets ratio in year t+1. *Log SuppESG Incident* is the natural logarithm of one plus *SuppESG Incident*, which is the number of supplier incidents divided by the number of suppliers in year t-1. *High Customer ESG* is a binary variable that equals 1 if *Customer ESG* is greater than the sample median in year t-1. *Customer ESG* is the median RepRisk Rating of the focal firm's customers. *High Investor ESG* is a binary variable that equals one if the proportion of the focal firm's average outstanding shares owned by ESG-conscious investors from year t-3 to t-1 is greater than the sample median. Following Gantchev et al. (2022), investors with average portfolio Refinitiv E&S ratings in the top tercile are classified as ESG-conscious investors. *High Supplier Turnover* is a binary variable that equals 1 if the supplier turnover rate is greater than the sample median. *Supplier turnover rate* is the fraction of suppliers in year t-1 that stop dealing with the focal firm in year t+1. All columns control for *Size*, *BM*, *Return*, *PRC*, *VOL*, *CAPX*, *TANT*, *Adv Exp*, and *Log Firm Incident*. All variables are winsorized at the 1st and 99th percent and the detailed definitions are in Appendix A. Standard errors are robust to heteroskedasticity and clustered at the industry-year level, and t-statistics are reported in parentheses. ∗, ∗∗, and ∗∗∗ denote significance at the 10%, 5%, and 1% (two-sided) levels, respectively.

Dep. Var. =	ROA_{t+1}		
	(1)	(2)	(3)
Log SuppESG Incident	-0.002	-0.001	-0.001
	(-1.195)	(-0.456)	(-0.535)
High Customer ESG	-0.005*		
	(-1.736)		
Log SuppESG Incident×High Customer ESG	-0.004*		
	(-1.713)		
High Investor ESG		0.002	
		(0.825)	
Log SuppESG Incident×High Investor ESG		-0.006***	
		(-2.757)	
High Supplier Turnover			0.001
			(0.355)
Log SuppESG Incident×High Supplier Turnover			-0.005**
			(-2.159)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Obs.	10,839	15,133	10,752
Adj. R-squared	0.735	0.756	0.757

Table 5 Short- and long-term stock market responses

This table reports results of stock market responses. Panel A reports the average short term market reaction around the supplier incident for the focal firm. For each incident, we estimate the cumulative abnormal returns (CARs) in a three-day (i.e., [−1,+1]) window around the supplier incident for the focal firm. We report the CARs computed based on the market model, Fama-French three factor model, and Fama-French-Carhart factor model, respectively. Panel B presents the time-series average of firm characteristics for four portfolios sorted based on the intensity of supply chain ESG incidents. Firms with the best (worst) supply chain ESG are indicated as the Low (High) group. *Log SuppESG Incident* is the natural logarithm of one plus *SuppESG Incident*, which is the number of supplier incidents divided by the number of suppliers in year t-1. *Firm Incident* is the total firm RepRisk incidents over the past 12 months. *Size* is the log of market capitalization. *BM* is the book value of equity divided by the market value at the end of the calendar year. *R&D* is the research and development expenditure divided by total sales. *Adv Exp* is the advertisement expenditure divided by total sales. *SG&A* is the selling, general, and administrative expenses divided by total sales. *ROA* is the operating income after depreciation divided by total assets. *CAPX* is the capital expenditure divided by net property, plant, and equipment. *TANT* is tangible assets divided by total assets. Panel C reports alphas, factor loadings, and t-statistics from monthly calendar-time Fama-French regressions. The regressions are estimated from July 2010 to June 2022. *MKT* is the market excess return; *SMB* and *HML* are the Fama and French (1993) size and book-to-market factors; *RMW* and *CMA* are profitability and investment factors from Fama and French (2015). All variables are winsorized at the 1st and 99th percent and the detailed definitions are in Appendix A. Standard errors are estimated by Newey-West correction, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% (two-sided) levels, respectively.

Panel A: Short-term market reaction to supplier ESG incident

	MM	FF3	FF3 Plus Momentum
CAR (%)	-0.041**	-0.053***	-0.056***
[t]	(-2.225)	(-2.955)	(-3.055)

Panel B: Firm characteristics by portfolio

	Low	**2**	**3**	**High**
SuppESG Incident	0.005	0.531	0.964	3.575
Log SuppESG Incident	0.004	0.390	0.583	1.316
Firm Incident	0.245	1.896	1.544	0.640
Size	6.341	8.198	8.018	6.925
BM	0.578	0.476	0.491	0.580
R&D	0.099	0.056	0.091	0.110
Adv Exp	0.010	0.018	0.014	0.014
SG&A	0.296	0.255	0.271	0.308
ROA	0.083	0.119	0.102	0.074
CAPX	0.249	0.204	0.232	0.248
TANT	0.226	0.287	0.244	0.234

Panel C: Alphas from calendar time portfolio regression

	Low	**2**	**3**	**High**	**L−H**
Alpha	0.317***	-0.060	0.131	-0.246**	0.564***
	(3.194)	(-0.361)	(1.554)	(-2.087)	(3.030)
MKT	0.940***	1.131***	0.907***	1.144***	-0.204***
	(34.738)	(17.618)	(36.869)	(25.473)	(-3.269)
SMB	0.082	-0.089	0.016	0.066	0.016
	(1.590)	(-0.818)	(0.391)	(0.967)	(0.169)
HML	-0.073	-0.189**	-0.049	-0.140*	0.067
	(-1.173)	(-2.197)	(-1.455)	(-1.853)	(0.523)
RMW	0.057	-0.010	0.085	0.276**	-0.219
	(0.809)	(-0.074)	(1.611)	(2.014)	(-1.247)
CMA	-0.090	0.079	0.117*	0.105	-0.194
	(-1.017)	(0.631)	(1.924)	(1.111)	(-1.271)

Table 6 Fama-MacBeth and panel regressions

This table reports the results from value-weighted Fama-MacBeth and firm-level panel regressions. The dependent variable is the monthly stock return for each firm measured as in the calendar-time portfolios for every month beginning from July of year t to June of year t + 1. *Log SuppESG Incident* is the natural logarithm of one plus *SuppESG Incident*, which is the number of supplier incidents divided by the number of suppliers in year t-1. All columns control for *Size*, *BM*, *Return*, *PRC*, *VOL*, *CAPX*, *TANT*, *ROA*, *Adv Exp*, and *Log Firm Incident*. All variables are winsorized at the 1st and 99th percent and the detailed definitions are in Appendix A. Standard errors are robust to heteroskedasticity and estimated by Newey-West correction for Fama-MacBeth regression (Column (1)) and are clustered at the industry-month level for panel regression (Columns (2) and (3)), and t-statistics are reported in parentheses. ∗, ∗∗, and ∗∗∗ denote significance at the 10%, 5%, and 1% (two-sided) levels, respectively.

	Future Monthly Return		
	Fama-Macbeth	Panel Regression	Panel Regression
	(1)	(2)	(3)
Log SuppESG Incident	-0.586**	-1.804***	-2.498**
	(-2.054)	(-3.151)	(-2.321)
Controls	Yes	Yes	Yes
Industry FE	No	Yes	No
Firm FE	No	No	Yes
Year-Month FE	No	Yes	Yes
Obs.	194,565	194,565	194,559
Adj. R-squared	0.518	0.599	0.601

Table 7 Supply chain ESG and earnings announcement return

This table reports the regressions of market reaction to quarterly earnings announcements on supply chain ESG. The dependent variables in Columns (1) and (2) are the three-day cumulative abnormal returns (CAR) from day −1 to day +1 relative to quarterly earnings announcements in year t+1 and year t+2, respectively. *Log SuppESG Incident* is the natural logarithm of one plus *SuppESG Incident*, which is the number of supplier incidents divided by the number of suppliers in year t-1. All columns control for *Size*, *BM*, *Return*, *PRC*, *VOL*, *CAPX*, *TANT*, *Adv Exp*, and *Log Firm Incident*. Standard errors are robust to heteroskedasticity and clustered at the industry-year level, and t-statistics are reported in parentheses. ∗, ∗∗, and ∗∗∗ denote significance at the 10%, 5%, and 1% (two-sided) levels, respectively.

Dep. Var. =	*Quarterly EA* *CAR* in year t+1	*Quarterly EA* *CAR* in year t+2
	(1)	(2)
Log SuppESG Incident	-0.016***	-0.010*
	(-3.352)	(-1.827)
Controls	Yes	Yes
Year FE	Yes	Yes
Obs.	59,524	58,319
Adj. R-squared	0.054	0.056

Table 8 Double sorting on supply chain opacity, complexity and retail ownership

This table reports double sorting portfolio alphas. Panel A reports the alphas from calendar-time regressions of monthly return on the Fama and French (2015) five factors for eight portfolios, where stocks are independently sorted into two portfolios based on supply chain opacity (Low and High) and into four portfolios based on supply chain ESG (Low, 2, 3, and High). *Supply chain opacity* is measured as the fraction of suppliers that are disclosed only by the suppliers. Panel B reports the alphas from calendar-time regressions of monthly return on the Fama and French (2015) five factors for eight portfolios, where stocks are independently sorted into two portfolios based on supply chain complexity (Low and High) and into four portfolios based on supply chain ESG (Low, 2, 3, and High). *Supply chain complexity* is measured as the fraction of suppliers that are located outside of the United States. Panel C reports the alphas from calendar-time regressions of monthly return on the Fama and French (2015) five factors for eight portfolios, where stocks are independently sorted into two portfolios based on retail ownership (Low and High) and into four portfolios based on supply chain ESG (Low, 2, 3, and High). Firms with the best (worst) supply chain ESG are indicated as the Low (High) group. Standard errors are robust to heteroskedasticity and estimated by Newey-West correction, and t-statistics are reported in parentheses. ∗, ∗∗, and ∗∗∗ denote significance at the 10%, 5%, and 1% (two-sided) levels, respectively.

Panel A: Double sorting: Supply chain opacity and supply chain ESG

Supply Chain Opacity	**Low**	**2**	**3**	**High**	**L−H**
Low	0.029	-0.356	0.072	0.099	-0.070
	(0.164)	(-1.585)	(0.314)	(0.479)	(-0.260)
High	0.366***	-0.040	0.103	-0.276*	0.641***
	(3.349)	(-0.232)	(1.080)	(-1.872)	(3.374)

Panel B: Double sorting: Supply chain complexity and supply chain ESG

Supply Chain Complexity	**Low**	**2**	**3**	**High**	**L−H**
Low	0.216*	-0.205	0.373**	0.050	0.167
	(1.714)	(-1.049)	(2.453)	(0.342)	(0.952)
High	0.286**	0.104	-0.018	-0.354**	0.640***
	(2.084)	(0.496)	(-0.173)	(-2.524)	(2.761)

Panel C: Double sorting: Retail investor holding and supply chain ESG

Retail Ownership	**Low**	**2**	**3**	**High**	**L−H**
Low	0.058	-0.215	0.028	0.042	0.016
	(0.784)	(-0.918)	(0.283)	(0.321)	(0.110)
High	0.487***	0.118	0.204*	-0.427***	0.913***
	(3.082)	(0.664)	(1.692)	(-2.872)	(3.745)

Table 9 Longevity analysis

This table reports the alphas from calendar-time regressions of monthly returns on the Fama and French (2015) five factors for the portfolio of taking a long position for firms with the best supply chain ESG and a short position for the portfolio of firms with the worst supply chain ESG. Rows 1 to 3 report the alphas for the period of months 1 – 12, 13 – 36, and 37 – 60 after portfolio formation, respectively. Standard errors are robust to heteroskedasticity and estimated by Newey-West correction, and the corresponding t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% (two-sided) levels, respectively.

Month after portfolio formation	Alpha of Long-Short Portfolio
1-12	0.564***
	(3.030)
13-36	0.328**
	(2.027)
36-60	0.209
	(1.525)

Table 10 Firm remediation actions

This table reports the regression results of the relation between supply chain ESG incidents and firm remediation actions in year t+1 and year t+2. The dependent variables are *End_BadSupplier*, *Start_GoodSupplier*, and *Supplier ESG Improvement. End_BadSupplier* is an indicator that equals 1 if in year t+1 (or t+2), the firm terminates a supplier with below-the-median ESG performance (RepRisk Rating). *Start_GoodSupplier* is an indicator that equals 1 if in year t+1 (or t+2) the firm enters a relationship with a new supplier with above-the-median ESG performance (RepRisk Risk Rating). *Supplier ESG Improvement* is the fraction of the focal firm's existing suppliers whose ESG performance (RepRisk Rating) improves from t−1 to t+1 (or t+2) ranked in quartile. *Log SuppESG Incident* is the natural logarithm of one plus *SuppESG Incident,* which is the number of supplier incidents divided by the number of suppliers in year t-1. All columns control for *Size*, *BM*, *Return*, *PRC*, *VOL*, *CAPX*, *TANT*, *Adv Exp,* and *Log Firm Incident*. All variables are winsorized at the 1st and 99th percent and the detailed definitions are in Appendix A. Standard errors are robust to heteroskedasticity and clustered at the industry-year level, and t-statistics are reported in parentheses. ∗, ∗∗, and ∗∗∗ denote significance at the 10%, 5%, and 1% (two-sided) levels, respectively.

	End_BadSupplier		*Start_GoodSupplier*		*Supplier ESG Improvement*	
	t+1	t+2	t+1	t+2	t+1	t+2
	(1)	(2)	(3)	(4)	(5)	(6)
Log SuppESG Incident	0.781***	0.741***	0.254*	0.258**	0.541***	0.396*
	(7.891)	(6.044)	(1.929)	(2.416)	(3.107)	(1.776)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	15,133	13,974	15,133	13,974	6,911	5,660
Adj. R-squared	0.798	0.832	0.715	0.623	0.57	0.619

Appendix A Variable definitions

Variable	Definition
SuppESG Incident	The number of suppliers ESG incidents over the past 12 months, divided by the number of suppliers
Log SuppESG Incident	The natural logarithm of one plus *SuppESG Incident*, which is the number of supplier incidents divided by the number of suppliers in year t-1
ROA	Operating income after depreciation divided by average total assets in year t+1
AssetTurnover	Sales divided by average total assets in year t+1
Inventory	Inventory divided by average net sales in year t+1
ΔPO	Change in the ratio of purchase order backlog to total assets from year t-1 to year t
Firm Incident	The frequency of firm RepRisk incidents over the past 12 months
Size	The log of market capitalization deflated by CPI (measured in 2009 dollars (millions USD))
BM	The book value of equity divided by the market value at the end of the calendar year
Return	The natural log of stock return in year t-1 for the accounting performance test and during the last 12 months for the return test
PRC	The natural log of stock price in year t-1 for the accounting performance test and at the end of month t-2 for the return test
VOL	The natural log of stock trading volume in year t-1 for the accounting performance test and in month t-2 for the return test
R&D	Research and development expenditure divided by total sales in year t-1. Missing value of research and development expenditure is replaced by 0
Adv Exp	Advertisement expenditure divided by total sales in year t-1. Missing value of advertisement expenditure is replaced by 0
SG&A	Selling, General, and Administrative expenses divided by total sales in year t-1
CAPX	Capital expenditure divided by net property, plant, and equipment in year t-1
TANT	Tangible assets divided by total assets in year t-1
End_BadSupplier	An indicator that equals 1 if in year t+1 (or t+2), the firm terminates a supplier with below-the-median ESG performance (RepRisk Rating) in year t−1
Start_GoodSupplier	An indicator that equals 1 if in year t+1 (or t+2), the firm enters a relationship with a new supplier with above-the-median ESG performance (RepRisk Rating)
Supplier ESG Improvement	The fraction of the focal firm's suppliers whose ESG performance (RepRisk Rating) improves from t−1 to t+1 (or t+2) ranked in quartile. We focus on suppliers who have relationship with the focal firm in both t−1 and t+1 (or t+2) to identify the engagement effects
Customer ESG	The median ESG performance of the focal firm's customers in year t-1. ESG performance is the RepRisk Rating
Investor ESG	The percentage of outstanding shares owned by ESG-conscious investors in year t-1. To identify ESG-conscious investors, we follow Gantchev et al. (2022) and identify ESG-conscious investors based on the average Refinitiv E&S ratings (i.e., the average environmental and social score) of their portfolio holdings in the previous three years. We then classify investors with average portfolio ratings in the top tercile as ESG-conscious investors
Supplier Turnover	The fraction of suppliers that stop dealing with the focal firm from year t-1 to year t+1

Appendix B Topics of RepRisk incidents