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RESEARCH NOTE

Small worlds within global supply chains: implications for multinational enterprises' environmental, social, and governance controversies

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Abstract
With increasing public attention to corporate sustainability, environmental, social, and governance (ESG) controversies emerging in global supply chains present a growing problem for multinational enterprises (MNEs). This paper investigates whether MNEs with geographically dispersed suppliers are more likely to be exposed to supplier-related ESG controversies. It also explores structural characteristics of global supply chains that can mitigate MNEs' exposure to such controversies. Building on the literature on supply chain complexity and small-world networks, we suggest that the small-worldness of an MNE's supply chain network can mitigate the impact of the geographical dispersion of suppliers on supplier-induced ESG controversies. Our analysis of the Fortune 500 largest U.S. companies from 2010 to 2019 reveals that MNEs with geographically dispersed suppliers suffer from more supplier-induced ESG controversies, while small-worldness attenuates such impact. Our findings contribute to the international business literature by highlighting small-worldness as a network structural characteristic that can be deployed by MNEs to mitigate the negative impacts of supply chain spatial complexity.

Keywords ESG controversies · Supplier geographical dispersion · Small-world networks · Global supply chain · Network analysis

Introduction

The globalization of business activities combined with technological advancements has accelerated the growth of global supply chains (Fortanier et al., 2020; Kano et al., 2020). Global supply chains refer to the networks of firms that trade products or services across multiple countries (Marano et al., 2024). Multinational enterprises (MNEs) are increasingly moving from internalizing their cross-border activities to adopting a global supply chain approach, which offers key benefits such as greater cost efficiency and innovation (Kano, 2018; Turkina & Assche, 2018). International business (IB) research argues that this shift has led to a growing complexity of supply chains associated with geographically dispersed business activities involving multiple suppliers and subcontractors, with offshore production sites in low-cost countries linked to MNEs from the U.S., Europe, and other developed regions (Fortanier et al., 2020; Kano et al., 2020; Sharma et al., 2022; Strange & Humphrey, 2019).

IB scholars have explored the impact of supply chain complexity on the MNE's economic performance (e.g., Bode & Wagner, 2015; Sharma et al., 2019, 2022) and innovation

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(Sharma et al., 2020). However, there is very little research on how this growing complexity and geographical dispersion of global supply chains may pose significant challenges for MNEs in ensuring environmental, social, and governance (ESG) standards among suppliers worldwide. These challenges are critical, as ESG controversies involving major MNEs, such as toxic waste spills, child labor, and modern slavery, often stem from their suppliers, leading to potential reputational and, ultimately, financial damage to the focal MNE (Asmussen et al., 2023; Li & Cuervo-Cazurra, 2024). These supplier-induced controversies arise when ESG incidents are publicized in the media and subsequently used by "information aggregators", such as *RepRisk* and *Refinitiv ESG*, among many others (Chen & Lee, 2017). For example, the U.S. giant Apple is facing continuous criminal complaints from the Democratic Republic of Congo for using conflict minerals, or minerals mined in dangerous conditions and using child labor, in its supply chain. Although Apple strongly disputes the allegations, these supply chain controversies continue to present significant reputational problems for the company (Rolley, 2024).

Our focus is on a key challenge for MNEs in managing ESG standards in global supply chains associated with the geographical dispersion of suppliers (Goerzen & Beamish, 2003; Jiang et al., 2010; Mol & Lee, 2024). While the IB literature highlights the difficulty of managing global supply chains, there is a paucity of studies on the possible link between the geographical dispersion of suppliers and supplier-induced ESG controversies (Wang et al., 2024). We build on prior research grounded within the supply chain complexity perspective that explores information exchange and practice diffusion in global supply chains (Kim & Davis, 2016; Sharma et al., 2020, 2022). Specifically, we argue that the locational heterogeneity of suppliers significantly affects MNEs' control over the diffusion of ESG practices due to the burden of coordination and communication challenges in a spatially complex supply chain. Therefore, our first research question is: *What is the relationship between an MNE's geographical dispersion of suppliers and ESG controversies stemming from its suppliers?*

We further explore how a structural characteristic of global supply chains, small-worldness, could moderate the adverse impact of the geographical dispersion of suppliers on ESG controversies. Small-worldness describes an MNE's global supply chain with high local clustering and short average path length to other MNEs, creating a network where information exchange and social norms around ESG practices are fostered (Uzzi et al., 2007). In such networks, MNEs can better monitor and regulate supplier behaviors, enhancing control over the diffusion and compliance of ESG practices (Fleming et al., 2007; Maksimov et al., 2022). This potential governance role of small-worldness raises our second question: *Does the small-worldness of an MNE's global supply chain mitigate the impact of the geographical dispersion of suppliers on ESG controversies stemming from its suppliers?* To answer these questions, we analyze ESG controversies among Fortune 500 U.S. firms from 2010 to 2019 using multiple data sources such as RepRisk, Refinitiv ESG, and FactSet. Our analysis suggests that MNEs with geographically dispersed suppliers experience more supplier-induced ESG controversies, while small-worldness reduces this effect.

Our study makes important contributions to the IB literature. First, although IB scholars have developed in-depth research on global supply chains, there is a dearth of studies on the impact of spatial complexity aspects of supply chains on a firm's ESG standing. We advance the literature by identifying the geographical dispersion of suppliers as a key driver of MNEs' ESG controversies. Second, we contribute to research on MNE business networks by investigating the structural characteristics of small-world networks. Specifically, the governance role of small-world networks within global supply chains has been largely overlooked in prior IB studies, and we aim to highlight its importance. Finally, we integrate research on supply chain complexity with prior studies on the MNE's supplier network characteristics by showing how small-world network structures can mitigate the adverse effects of spatial heterogeneity of supply chain participants in the context of ESG controversies. This, in turn, has important practical implications for managers of global companies who rely on ever-growing numbers of geographically dispersed suppliers.

Theoretical background

We define ESG controversies as environmental, social, and governance scandals that expose firms to reputational and financial risks (Aouadi & Marsat, 2018; Cai et al., 2012). Examples include human rights violations such as slave or child labor, environmental pollution, unsustainable use of natural resources affecting local communities, and corruption cases like bribery and kickbacks (Cho et al., 2019; Hardcopf et al., 2021). Recently, IB scholars have emphasized the importance of managing supplier-induced ESG controversies (Asmussen et al., 2023; Li & Cuervo-Cazurra, 2024; Wang et al., 2024), which refer to the scandals in which MNEs are held accountable for suppliers' actions (Kim et al., 2019). This research shifts the emphasis from the cost efficiency of global supply chains towards exploring potentially negative and economically significant reputational effects for the focal MNE associated with ESG malpractices among its multiple suppliers.

Although MNEs may set up high ESG standards at the headquarters level, they often rely on direct suppliers to ensure that ESG compliance is diffused throughout the

global supply chain (Narula, 2019; Wilhelm & Villena, 2021). Yet geographical dispersion of suppliers complicates coordination and interactions within the network, increasing the risk of ESG problems (Jiang et al., 2010; Villena & Gioia, 2020). However, the precise nature of the relationship between the geographical dispersion of suppliers and supplier-induced ESG controversies remains unclear as other factors such as the size of MNEs and the number of suppliers in their global supply chains could attract more stakeholder scrutiny and increase ESG controversies (Li & Cuervo-Cazurra, 2024; Villena & Gioia, 2020; Wang et al., 2024).

To address this theoretical void, we first examine whether the geographical dispersion of suppliers within an MNE's global supply chain is related to supplier-induced ESG controversies while controlling for the size of the MNE and the number of suppliers. The geographic dispersion of suppliers denotes the distribution of suppliers across various countries (Bode & Wagner, 2015; Sharma et al., 2022). To manage ESG issues within such a diverse global supply chain, MNEs may benefit from a spatial network structure that helps monitor member behavior and coordinates ESG initiatives (McKendall & Wagner, 1997; McKendall et al., 2002). While most research on global supply chain governance has focused on dyadic mechanisms like contracting, internalization, and relational norms (Chen & Lee, 2017), studies on network-level governance for ESG remain limited.

Building upon the literature on small-world networks (e.g., Uzzi & Spiro, 2005), we propose small-worldness as a structural network characteristic that can help mitigate MNEs' ESG risks in geographically dispersed global supply chains. The idea is that an MNE with a community-like supply chain structure can better access information on potential supplier misconduct and apply community-driven sanctions (Baldassarri, 2015; Coleman, 1988). Additionally, such connectedness fosters community governance, promoting shared norms of acceptable behavior across supply chain members (Coleman, 1988; DiMaggio & Powell, 1983; Vurro et al., 2009).

A small-world network refers to a network where the links among actors are highly clustered, and the average path length between two network members is relatively short (Fleming et al., 2007; Uzzi & Spiro, 2005; Uzzi et al., 2007). Such networks retain a high likelihood of connections between network members as well as a low average number of intermediaries needed to connect them, thereby conceptually representing an intermediate state between regular and random networks (Watts & Strogatz, 1998). Management scholars have found small-world network properties in various real-world network contexts such as inter-firm alliances (Schilling & Phelps, 2007) and board interlocks (Davis et al., 2003). Studies have operationalized small-worldness using network-level measures, capturing the overall structure of an entire network rather than an individual firm's position within it (Uzzi & Spiro, 2005; Watts & Strogatz, 1998). This operationalization is useful for assessing the systemic properties of multiple networks but does not directly reflect an MNE's ego network embeddedness. Therefore, we adopt the approach by Schilling and Phelps (2007), where the clustering measure focuses on an MNE's embeddedness in its ego network, as we focus on supplier-induced ESG controversies that affect the focal MNE. Figure 1 illustrates two MNEs with relatively high and low levels of small-worldness.

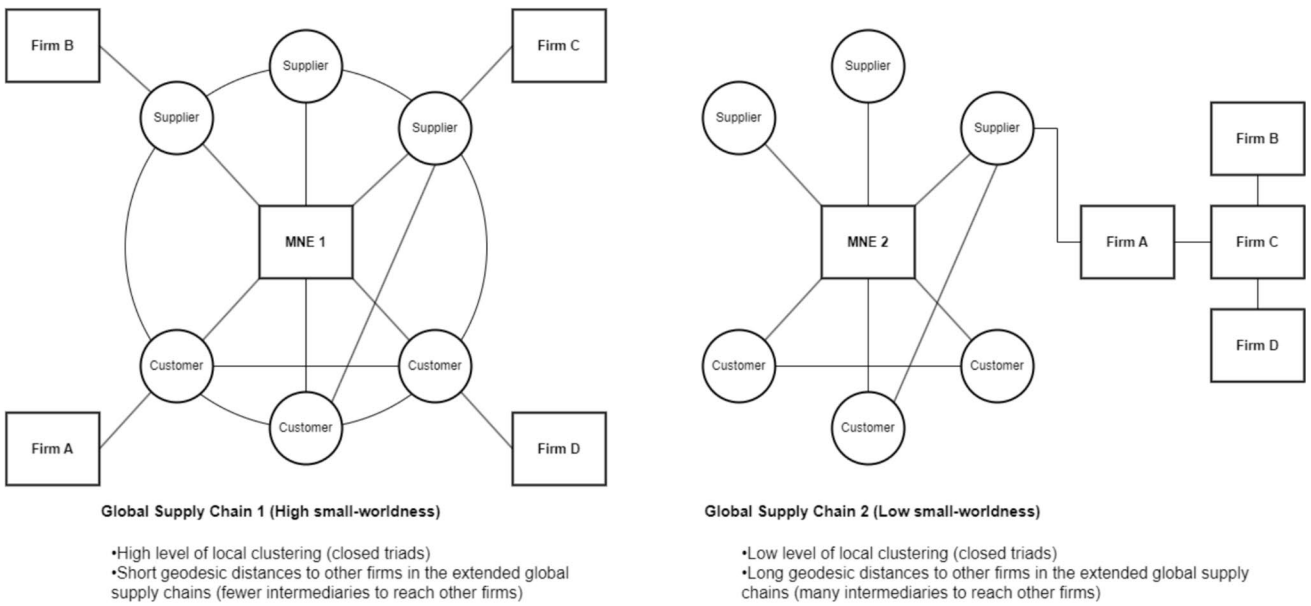

Fig. 1 MNE small-worldness

Hypotheses

IB studies point out that the complexity of global supply chains creates significant challenges for MNEs in regulating supplier behaviors (Casson & Li, 2022; Goerzen & Beamish, 2003, 2005; Narula, 2019). As Sharma et al. (2022) in their study of complexity in global supply chains point out, network complexity can create greater difficulties in collaboration and restrict information sharing, thereby raising the risks and costs related to acquiring and managing information. This argumentation is in line with research on problems with good practice adoption in the context of MNEs. For example, Kostova and Roth (2002: 227) emphasize that "units located in environments in which people knew a great deal about quality, and where many companies used quality practices, reported higher levels of implementation than units located in environments with relatively little social knowledge of quality." We extend this discussion by suggesting that geographically dispersed global supply chains tend to increase coordination complexity, which makes it difficult for an MNE to manage a supplier's adoption and compliance with its ESG best practices. While MNEs typically rely on formal control mechanisms such as supplier contracts (Caro et al., 2021; Poppo & Zenger, 2002), managing them across different jurisdictions can be complex (Li & Cuervo-Cazurra, 2024). As Filatotchev et al. (2022) indicate, our understanding of the constituent elements of E, S, and G constantly evolves and is framed by specific organizational contexts. Therefore, it may be difficult for the MNE to include all possible eventualities in a supplier contract.

Further, managing ESG practices across geographically dispersed supply chains becomes challenging due to complexities in communicating sustainability standards, regulatory requirements, and stakeholder expectations (Bode & Wagner, 2015; Sharma et al., 2022). These challenges can result in inconsistencies in ESG implementation. For example, as spatial distribution in supply chains increases, differences in languages, cultural norms, and values also grow, and this complexity can affect how suppliers interpret and implement best practices. In addition, geographical distance can make monitoring more difficult, potentially encouraging opportunistic behavior among lower-tier suppliers and undermining collaboration within the supply chain (Sharma et al., 2022). As a result, spatial complexity may hinder effective information exchange and knowledge sharing for managing ESG practices across the supply chain.

In summary, the geographical dispersion of suppliers leads to diminished MNE's capability for monitoring the diffusion of, and compliance with, ESG best practices within global supply chains, resulting in coordination and communication complexities (Casson & Li, 2022; Choi & Krause, 2006; Sharma et al., 2022). These challenges significantly undermine MNEs' ability to detect, monitor, and manage ESG malpractices among their suppliers (Asmussen et al., 2023; Caro et al., 2021). Therefore, we hypothesize that:

Hypothesis 1: The geographical dispersion of suppliers is positively related to the extent of an MNE's supplier-induced ESG controversies.

Our prior argument suggests that the geographical dispersion of suppliers may open MNEs to a new set of problems associated with ESG malpractices in their global supply chains and the associated reputational damage. One way to mitigate this threat is to reduce geographical dispersion albeit with losing some of its economic benefits. Another way is to adopt a "cascading compliance approach", which shifts the responsibility of supplier monitoring to first-tier suppliers (Narula, 2019). However, recent studies suggest the limited effect of this approach (e.g., Wilhelm, 2024; Wilhelm et al., 2021). Instead, we argue that another solution is to utilize the global supply chain's structural characteristics to minimize occurrences of supplier misbehavior.

We build on research on small-world networks indicating that their spatial properties enhance member performance and innovation by facilitating information exchange among members, thus granting greater access to collective knowledge (Fleming et al., 2007; Schilling & Phelps, 2007; Uzzi & Spiro, 2005; Uzzi et al., 2007). In addition to innovation benefits, we argue that small-worldness can also serve as a form of collective governance that regulates member behaviors. Frequent interactions within densely connected clusters foster cohesion and norms about acceptable behaviors (Coleman, 1988; DiMaggio & Powell, 1983; Vurro et al., 2009). In geographically dispersed global supply chains, small-worldness facilitates interactions that help members understand ESG-related best practices across different regions, thereby establishing network norms that guide ESG conduct. Moreover, small-worldness in global supply chains enhances the visibility of member behaviors among globally dispersed actors (Fleming et al., 2007; Phelps, 2010; Schilling & Phelps, 2007). This increased visibility exposes suppliers to greater peer scrutiny (Kim & Jin, 2017; Vurro et al., 2009), allowing for the swift identification of ESG malpractices and enabling collective sanctions such as terminating business relationships (Jones, Hesterly, & Borgatti, 1997; Vurro et al., 2009). Similarly, this increased visibility can enhance the effectiveness of MNEs' existing formal control mechanisms by improving their ability to detect contract breaches by suppliers (Teece, 1986).

Such enhanced information flows within small-world networks also support MNEs' coordination efforts in managing ESG standards. For instance, these networks can facilitate the dissemination of ESG initiatives to direct suppliers and beyond, helping MNEs mitigate challenges arising from the

geographical dispersion of suppliers and associated ESG controversies through proactive engagement (Goerzen & Beamish, 2003, 2005). Additionally, small-worldness can enable MNEs to learn innovative practices for managing ESG standards from one another (Maksimov et al., 2022; Schilling & Phelps, 2007). Hence, we hypothesize that:

Hypothesis 2: An MNE's supply chain small-worldness weakens the positive relationship between the geographical dispersion of its suppliers and supplier-induced ESG controversies.

Methodology

Sample and data

Our sample is drawn from the 2019 U.S. Fortune 500 companies list, encompassing data from 2010 to 2019. We selected this observation window purposefully to mitigate any supply chain disturbances stemming from the 2008–2009 financial crisis and the COVID-19 pandemic. We focus on Fortune 500 companies because large U.S. firms receive more scrutiny from stakeholders regarding their ESG activities and supply chain relationships and operate under the same regulatory regime. We created our unique data set using four major databases: FactSet Supply Chain Relationships (SCR), Refinitiv ESG, Refinitiv Eikon, and RepRisk.

We collected the buyer–supplier relationship network data from the FactSet SCR database, which archives buyer–supplier ties of over 20,000 firms using corporate annual reports, press releases, and other announcements such as investor presentations (FactSet, 2022). The data for the dependent variable, supplier-induced ESG controversies (henceforth, ESG controversies), was collected from RepRisk, which collects information from public sources and stakeholders to identify ESG-related incidents (RepRisk, 2024). The other ESG activities, financial information, industry classification, and supplier location data were collected from Refinitiv ESG and Refinitiv Eikon (Refinitiv, 2021). In addition, we used the United Nations Sustainable Development Goal Index (Sachs et al., 2022) as the source of country-level sustainability scores.

The unit of analysis of our study is each focal firm-year observation. Of the 2019 Fortune 500 companies, we excluded 28 private firms due to a lack of financial information. Among the remaining 472 firms, 54 firms were not identified in the Refinitiv ESG database and were thus removed from our sample. Out of the 418 remaining firms, one firm was not available in the FactSet SCR database, reducing our final sample to 417 firms. Table D.1 in the Online Appendix presents sample characteristics. Due to the incomplete availability of ESG, network, and financial data for these firms throughout the entire observation period, our final sample constitutes an unbalanced panel of 3033 firm-year observations. We used a 1-year lag between the dependent and independent variables.

Variables

Dependent variable

As our focus is on ESG controversies originating from suppliers, the dependent variable of our study is based on the RepRisk *supply chain issues* data field. It tracks unique ESG-related incidents each year where a company is held accountable for the actions of its suppliers, including vendors and subcontractors (RepRisk, 2023). RepRisk quantifies the extent of these controversies using three dimensions: *severity* (the magnitude of negative consequences for society), *reach* (the breadth of media coverage), and *novelty* (whether the incident is occurring for the first time). For our analysis, we calculated an average score of these three dimensions to represent the dependent variable.

Independent variables

We measured the independent variable, the geographical dispersion of suppliers, using the spatial complexity measure from the IB and supply chain literature (e.g., Bode & Wagner, 2015; Sharma et al., 2020, 2022). This measure is based on the distances between the headquarters countries of the MNE and its suppliers, accounting for the Earth's curvature. The formula is as follows:

$$\begin{aligned}&\textit{Geogrpahical dispersion of suppliers}\\&= \sum_{j=1}^{n} \frac{2\pi r}{360}[\arccos[coscos(lat_j)coscos(lon_j)coscos(lat_i)coscos(lon_i)\\&+ coscos(lat_j)sinsin(lon_j)coscos(lat_i)sinsin(lon_i)\\&+ sinsin(lat_j)sinsin(lat_i)]/1000\end{aligned}$$

where i and j represent the MNE's country and its suppliers' countries, respectively, and *lat* and *lon* are the latitude and longitude of the countries' capitals. r is the Earth's radius (6378 km). For interpretability, we scaled the measure by dividing it by 1000.

Moderator variable

For our moderator variable, small-worldness, we adopted the measure in which the local clustering coefficient is the numerator and average path length is the denominator (Fleming et al., 2007):

$$Small\ -\ worldness = \frac{Local\ clustering\ coefficient}{Average\ path\ length} \times 100$$

Unlike network-level measures of small-worldness (e.g., Uzzi & Spiro, 2005), our measure is a node-level measure that represents the extent to which an MNE's ego supply network is a tight-knit community, while the focal buying firm is also relatively close to all other firms in the extended supply chain network. The numerator—local clustering coefficient—quantifies the existence of triads among the alters (i.e., other nodes with ties with the focal node) in a node's ego network with the following formula (Watts & Strogatz, 1998):

$$Local\ clustering\ coefficient = \frac{\lambda_G(\nu)}{\tau_G(\nu)}$$

where $\lambda_G(\nu)$ is the number of closed triads in ego network G and $\tau_G(\nu)$ is the number of potential triads (i.e., triples) in ego network G. Hence, a higher local clustering coefficient means a higher proportion of closed triads in the ego network. The denominator—average path length—measures the average geodesic distance between the focal buying firm and all other firms in the entire network available in the FactSet SCR data in a given observation year. We used the following average path length formula (Watts & Strogatz, 1998):

$$Average\ path\ length = \frac{\sum_y d(y,x)}{N(N-1)}$$

Where $d(y, x)$ is the shortest path length (i.e., geodesic distance) between firm x and the focal MNE y in the entire network, and N is the number of firms in the entire network. Having average path length as the denominator of the small-worldness measure represents how closely the focal buying MNE is located to other firms in the entire network. Since the local clustering coefficient is a proportional measure, we multiplied it by 100 for the interpretability of the regression coefficient.

Control variables

We controlled for both supply base-level and focal firm-level variables. Supply base-level control variables include supply base average ESG performance, supply base ESG performance disparity, supply base country sustainability scores, and supply base industry diversity. Further, it may be argued that the design and effectiveness of management control systems that MNEs deploy to govern their supply chains may have a material impact on the occurrence of ESG controversies. Therefore, we incorporated MNE managerial control variables including supplier-targeted environmental policies and supplier-targeted social policies. Other controls include the focal firm's size, return on assets, debt to equity, market to book, foreign sales percentage, foreign assets percentage, firm age, number of suppliers, number of customers, incloseness centrality, outcloseness centrality, and betweenness centrality. Table B.1 in the Online Appendix provides a summary of all the variables used in our regression models, while Table B.3 presents the pairwise correlations and descriptive statistics for these variables.

Main statistical models and results

Considering the left-skewness and non-negative values of the continuous variable, ESG controversies, we employed Tobit regression models to address potential left-censoring issues (Amore & Murtinu, 2021; Wulff & Villadsen, 2020). To account for the panel structure of the data, we used random-effects Tobit models, as fixed-effects Tobit models tend to produce biased results (Li & Cuervo-Cazurra, 2024). We controlled for MNE industry and year effects by including the North American Industry Classification System (NAICS) 2-digit industry and year dummy variables. The maximum variance inflation factor (VIF) across all regression models is 4.43 with a mean of 1.98. The VIF of the interaction between geographical dispersion and small-worldness is 2.21. These values are all below the threshold of ten and indicate that multicollinearity is not a major concern within our models.

We estimated the random effects of Tobit regression as follows:

$$\begin{aligned} ESG\_controversies_{it+1} = {} & \beta_1 \cdot Geographical\_dispersion\_of\_suppliers_{it} \\ & + \beta_2 \cdot Small - worldness_{it} \\ & + \beta_3 \cdot Geographical\_dispersion\_of\_suppliers_{it} \\ & \cdot Small - worldness_{it} + \beta_k \cdot X_{k,it} + \alpha_i + \gamma_t + u_{it}, \end{aligned}$$

where $X_{k,it}$ is the vector of control variables for firm i at year t, α_i is firm random effects, γ_t is year fixed effects and u_{it} is the error term.

The significant and positive coefficient for geographical dispersion of suppliers ($\beta = 0.409$, $p < 0.001$) in Table 1 Model 3 provides support for H1. This result indicates that for each 1000 km increase in geographical dispersion of suppliers, there is a corresponding increase in the incidents of ESG controversies by 0.4. Additionally, the significant and negative coefficient for the interaction between the geographical dispersion of suppliers and small-worldness in Table 1 Model 4 ($\beta = -0.774$, $p < 0.001$) supports H2. Figure 2 further provides a visual representation of the moderation effect of small-worldness on the relationship between the geographical dispersion of suppliers and ESG controversies. In the figure, the solid line depicts the slope of the geographical dispersion of suppliers when the small-worldness value is one standard deviation above the mean. While the slope for the small-worldness value one standard deviation

Table 1 Tobit model estimates

	Model 1		Model 2		Model 3		Model 4	
Supply base ESG performance	−0.107	*0.138*	−0.094	*0.181*	−0.094	*0.182*	−0.101	*0.150*
	(0.072)		(0.071)		(0.071)		(0.070)	
Supply base ESG performance disparity	−0.143	*0.185*	−0.132	*0.211*	−0.128	*0.225*	−0.136	*0.195*
	(0.108)		(0.105)		(0.105)		(0.105)	
Supply base country sustainability	−0.337	*0.373*	−0.457	*0.218*	−0.440	*0.235*	−0.430	*0.243*
	(0.378)		(0.371)		(0.371)		(0.369)	
Supply base industry diversity	1.418	*0.000*	0.936	*0.000*	0.941	*0.000*	0.867	*0.000*
	(0.128)		(0.135)		(0.135)		(0.135)	
Supplier-targeted environmental policies	−0.232	*0.656*	0.050	*0.923*	0.031	*0.952*	0.087	*0.865*
	(0.522)		(0.512)		(0.512)		(0.509)	
Supplier-targeted social policies	0.616	*0.227*	0.658	*0.189*	0.631	*0.208*	0.613	*0.218*
	(0.510)		(0.501)		(0.501)		(0.498)	
Firm size	−0.344	*0.692*	−0.239	*0.777*	−0.185	*0.827*	0.081	*0.922*
	(0.868)		(0.844)		(0.844)		(0.834)	
Return on assets	0.190	*0.187*	0.195	*0.168*	0.199	*0.160*	0.201	*0.151*
	(0.144)		(0.141)		(0.141)		(0.140)	
Debt to equity	−0.016	*0.759*	−0.016	*0.767*	−0.016	*0.758*	−0.018	*0.737*
	(0.054)		(0.053)		(0.053)		(0.052)	
Market to book	−0.004	*0.919*	−0.000	*0.993*	−0.001	*0.976*	0.007	*0.862*
	(0.042)		(0.041)		(0.041)		(0.041)	
Foreign sales percentage	0.025	*0.545*	0.033	*0.397*	0.033	*0.402*	0.041	*0.300*
	(0.040)		(0.040)		(0.039)		(0.039)	
Foreign assets percentage	0.072	*0.073*	0.064	*0.104*	0.063	*0.107*	0.057	*0.146*
	(0.040)		(0.039)		(0.039)		(0.039)	
Firm age	−0.034	*0.412*	−0.032	*0.412*	−0.034	*0.394*	−0.035	*0.366*
	(0.041)		(0.039)		(0.039)		(0.039)	
Indegree centrality	3.149	*0.015*	2.614	*0.039*	2.409	*0.060*	2.892	*0.023*
	(1.297)		(1.268)		(1.281)		(1.275)	
Outdegree centrality	4.544	*0.000*	4.148	*0.000*	4.001	*0.000*	3.825	*0.000*
	(0.836)		(0.819)		(0.830)		(0.824)	
Incloseness centrality	5.495	*0.936*	42.799	*0.526*	52.695	*0.440*	54.335	*0.424*
	(68.352)		(67.551)		(68.245)		(67.893)	
Outcloseness centrality	−97.709	*0.000*	−90.451	*0.000*	−86.845	*0.000*	−83.230	*0.000*
	(21.300)		(20.911)		(21.168)		(21.039)	
Betweenness centrality	4008.13	*0.000*	3854.95	*0.000*	3861.08	*0.000*	3689.90	*0.000*
	(448.38)		(440.07)		(440.01)		(437.97)	
Geographical dispersion of suppliers			0.409	*0.000*	0.409	*0.000*	0.628	*0.000*
			(0.042)		(0.042)		(0.056)	
Small-worldness					– 1.034	*0.269*	– 0.352	*0.706*
					(0.936)		(0.936)	
Geographical dispersion × Small-worldness							– 0.774	*0.000*
							(0.131)	
Constant	22.416	*0.470*	29.288	*0.334*	27.526	*0.365*	21.984	*0.466*
	(31.028)		(30.346)		(30.374)		(30.138)	
Firm random effects	Yes	Yes	Yes	Yes				
Industry fixed effects (NAICS 2-digit)	Yes	Yes	Yes	Yes				
Year fixed effects	Yes		Yes		Yes		Yes	
Log likelihood	−10919.48		−10873.68		−10873.07		−10855.75	
Number of observations	3033		3033		3033		3033	

Standard errors in parentheses; *p* values in italics.

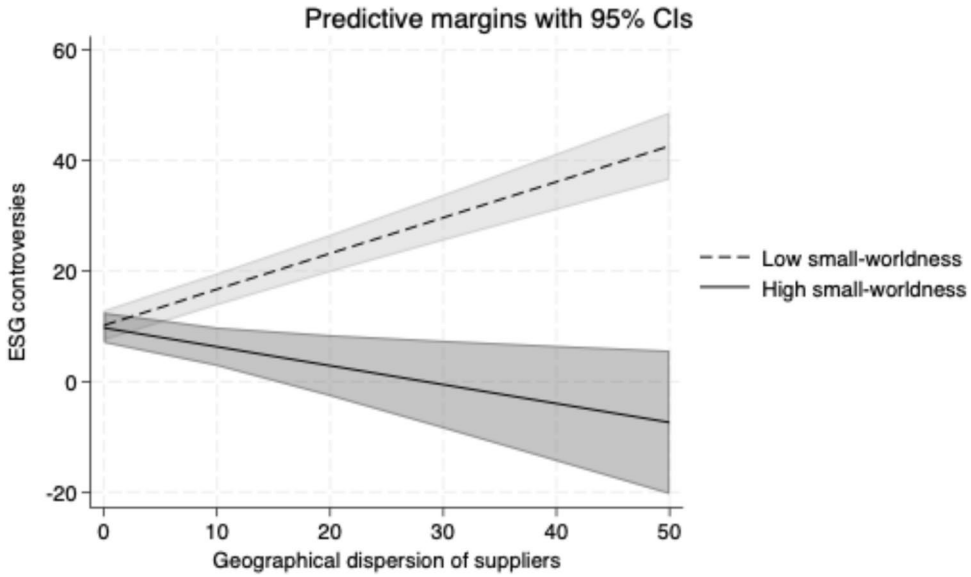

Fig. 2 Interaction between geographical dispersion of suppliers and small-worldness

below the mean (dashed line) is positive ($\beta = 0.648$, $p < 0.001$), the slope of the solid line is slightly negative ($\beta = -0.342$, $p = 0.011$). This observation indicates that small-worldness mitigates the impact of the geographical dispersion of suppliers on ESG controversies.

Robustness checks

To account for firm and industry heterogeneity more effectively, we conducted fixed effects ordinary least squares (OLS) regression, Tobit regression with NAICS 4-digit fixed effects, and industry split sample analysis (see Tables C.1-3 in the Online Appendix). To address concerns that ESG controversies may be rooted deeper within the tiers of the MNE's supply chain, we also tested our models with alternative measures of geographical dispersion of suppliers based on tier-2 suppliers and the combined set of tier-1 and tier-2 suppliers (see Table C.4 in the Online Appendix). The results from these models are highly consistent with those from the main models.

Furthermore, to address potential endogeneity, we employed fixed effects two-stage least squares (2SLS) models. We adopted the approaches used in recent studies with potentially endogenous supply base-level variables (e.g., Palit et al., 2022; Sharma et al., 2020, 2022) and used the average geographical dispersion of suppliers of the firms in the same industry based on the NAICS as an instrument. Firms often imitate the behaviors of their industry peers (DiMaggio & Powell, 1983), making the industry-average geographical dispersion a strong predictor of firm-level decisions. At the same time, it is less likely to be correlated with firm-specific omitted variables, thereby satisfying the exogeneity condition (Wang & Li, 2019). In addition, we used the natural log of capital expenditure of the MNE as an additional instrument to allow for the Sargan-Hansen over-identifying restrictions test. Table C.5 in the Online Appendix presents the results from the first-stage models. For moderation effects, we followed the approach suggested by Wooldridge (2010) and used the interaction term between small-worldness and the instrument for the geographical dispersion of suppliers in the first stage. The relevance condition proposed by Stock and Yogo (2002) is satisfied by the weak instrument test results based on the Cragg-Donald and Kleibergen-Paap F-statistics, while the Sargan-Hansen test outcome provides supporting evidence for the exclusion restriction (see Table C.6 in the Online Appendix). Collectively, these results affirm the validity of our instruments.

Table C.7 in the Online Appendix shows the results from the second stage fixed effects 2SLS models. Consistent with the results from the fixed effects OLS models, the support for our hypotheses holds in the fixed effects 2SLS models. Additionally, the Durbin-Wu-Hausman test result suggests that the estimates obtained from the 2SLS model are consistent with those derived from the OLS model (see Table C.6 in the Online Appendix), indicating that endogeneity may not be introducing bias into the estimates of our statistical models.

As additional robustness checks, Tables C.8–C.10 in the Online Appendix present the results for models that exclude the largest firms, analyze betweenness centrality, and incorporate an industry-adjusted dependent variable, following Wang and Li (2019).

Discussion

Theoretical implications

This study makes several theoretical contributions. First, it advances the IB literature on global supply chains and sustainability by linking geographically dispersed suppliers with supplier-induced ESG controversies. While previous research has suggested the importance of managing ESG malpractices within global supply chains (e.g., Asmussen et al., 2023; Li & Cuervo-Cazurra, 2024; for details, see Table A.1 in the Online Appendix), there is limited understanding of how the complexity of the global supply chain structure itself can pose ESG risks. Our findings expand the current literature by showing that the geographical dispersion of suppliers amplifies these ESG risks through greater coordination and communication complexities in global supply chains.

Furthermore, this study contributes to the IB literature on global supply chain governance by examining the role of small-worldness in mitigating supplier-induced ESG risks. As MNEs increasingly rely on external global suppliers, they face elevated risks related to supplier ESG issues (Benito et al., 2019; Gereffi et al., 2005; Strange & Humphrey, 2019). Unlike the more widely studied contractual governance, or the emerging cascading compliance model (Narula, 2019), small-world network structures offer peer-enforced governance through repeated interactions, lowering information barriers and fostering collective norms, ultimately reducing the incidence of ESG controversies (Jones et al., 1997; Vurro et al., 2009).

Finally, we provide a novel perspective on global supply chain governance by examining network-wide dynamics rather than focusing solely on dyadic relationships. This study contributes to the growing body of IB research using social network theory to explore global supply chain complexities (e.g., Sharma et al., 2019, 2022), particularly ESG-related issues, which have been less addressed in the literature (Wang et al., 2024). Our findings underscore that managing complex global supply chains requires understanding not only individual partner performance but also the broader network context.

While our findings suggest that small-worldness functions as a network-level governance mechanism for MNEs to manage supplier-induced ESG controversies, its potential downsides, in particular, the risks of over-embeddedness (Uzzi, 1997), cannot be overlooked. For example, a high level of clustering can reduce network agility in response to ESG-related external shocks, such as a sudden change in regulation. High levels of local clustering may also allow suppliers to coordinate collective resistance to MNEs' ESG initiatives, especially when these are perceived as financially burdensome (Fontana & Egels-Zandén, 2019). This means that further research is needed to explore the over-embeddedness of small-worldness in the context of global supply chains.

Managerial and societal implications

This study's results suggest that MNEs with more heterogeneous global supply chains in terms of their suppliers' geographical dispersion are more likely to face ESG controversies. However, considering the operational and market benefits of having suppliers globally (Allayannis et al., 2001; Pantzalis et al., 2001), simply reducing the geographical dispersion of suppliers to minimize the risk of ESG controversies may not be a pragmatic choice for MNEs. Given this backdrop, the findings on the governance role of small-worldness provide supply value chain managers with practical approaches to managing supplier-induced ESG controversies. As our empirical results suggest, MNEs with a high level of small-worldness outperform others in terms of mitigating the impact of their geographical dispersion of suppliers on ESG controversies.

To enhance the small-worldness of their firms, managers in MNEs may consider the following approaches. For example, MNEs could increase the number of closed buyer–supplier–supplier triads by establishing direct supply relationships with second-tier suppliers (Chae et al., 2019; Mena et al., 2013), promoting relationships between suppliers (Wu & Choi, 2005; Wu et al., 2010), or selecting suppliers that already have ties to other network members. In addition, they could shorten average path lengths in the buyer–supplier relationship network by creating supply chain ties with firms that have high levels of connectivity (i.e., closeness or betweenness centrality) (Kim et al., 2011; Shao et al., 2018).

Our study's implications extend to societal contexts, as ESG controversies within global supply chains can have adverse effects on both the MNE's home and the suppliers' countries, as exemplified by the Rana Plaza collapse (Narula, 2019). Local stakeholders in the suppliers' countries may lack information and power to address issues like forced labor, undermining their ESG efforts and impacting societies negatively (Kim et al., 2019; Nardella et al., 2023; Shevchenko et al., 2016). Our findings suggest that by fostering small-worldness within their networks, MNEs can gain economic benefits while helping local stakeholders by controlling supplier behavior.

Although our empirical context is based on the largest U.S. firms included in the Fortune 500, we believe that our findings are important when considering other corporate contexts outside the U.S. Prior studies suggest that similar ESG-related controversies present challenges to large MNEs based in Asia, Europe, and other regions which also rely on geographically dispersed supply chains (Asmussen et al.,

2023). Building on our research, future studies may consider the possible roles of the MNE's home country context when exploring an interface between supply chain complexity and the associated ESG challenges.

Conclusions

This study investigates the link between MNEs' geographical dispersion of suppliers and supplier-induced ESG controversies, indicating that MNEs with diverse global supply chains are more prone to such issues. While we focus on the MNEs based in the United States, similar governance challenges exist in other global contexts, where supplier chains are geographically dispersed. This susceptibility stems from the difficulties in upholding ESG standards across suppliers worldwide. Small-worldness, characterized by local clustering and short average path lengths, emerges as network governance capable of mitigating the impact of global supply chain heterogeneity on ESG controversies. By cultivating small-world characteristics within their networks, MNEs can effectively navigate the risks of ESG controversies while capitalizing on the advantages of global supply chains. This study advances our understanding of the dynamics within MNEs' global supply chains and calls for further insights from academia and industry in addressing sustainability challenges in an increasingly interconnected world.

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Data availability The dataset used in this study was compiled from four licensed sources: FactSet Supply Chain Relationships, Refinitiv ESG, Refinitiv Eikon, and RepRisk. Access to these databases is restricted and was obtained under institutional licenses granted to the authors' universities. The complete dataset can be made available by the corresponding author upon request and with permission from the respective data providers.

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