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Discussion on Paths to Enhance Supply Chain Resilience Based on ESG Concepts in Light of Global Value Chain Restructuring

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ABSTRACT

In recent years, the world's value chain has moved away from the pursuit of efficiency and is now paying more attention to security and resilience due to geopolitical risks, unstable trade policies, and extreme weather events. ESG has gone from being voluntary to required in the supply chain for governance. The European Union's Corporate Sustainability Due Diligence Directive is an example. According to the trend of value chain restructuring, this paper studies the inherent relationship between ESG and supply chain resilience, and proposes three paths for improvement in the dimensions of collaborative governance, digital empowerment and institutional transmission. Based on empirical evidence, ESG performance strengthens the resilience of the industrial chain and supply chain by improving information transparency and reducing financing constraints; the extraterritorial effects of regulations such as CSDDD are transmitted to Chinese export enterprises through procurement contracts and supplier guidelines. In order to continue to operate in the European market, Chinese enterprises have been required to integrate ESG standards into their supply chain management, and the capacity for ESG compliance is gradually becoming a condition for supplying major enterprises abroad. The company needs to integrate ESG into its daily operations of the supply chain, not just issue an annual report.

KEYWORDS

Global value chain restructuring; ESG; Supply chain resilience; Collaborative governance; Digital empowerment

1. INTRODUCTION

In recent years, based on the idea of maximising efficiency, the international division of labour system has moved production processes to areas with lower costs and built an extremely complex, multi-level global production network. The Model is changing at present. According to the WTO's "2025 Global Value Chain Development Report", around 46.3% of the world's trade is involved in global value chains, and this figure has been slightly decreasing from 48% in 2022. The value chain is not "de-globalising", but rather "restructuring rather than retreating", and is changing from "priority on efficiency" to "resilience, sustainability and inclusiveness", with significant strengthening of regionalisation, near-shoring, diversification and digitalisation [1]. Cai Jin, the president of the China Federation of Logistics & Purchasing (CFLP), noted at the 2026 Supply Chain Management Annual Conference that the essence of supply chain restructuring is to add safety, flexibility and resilience to the main considerations of cost and efficiency.

The state of ESG in global supply chain governance has also changed in kind. ESG was once considered a voluntary social responsibility for companies, but now it is required by many suppliers

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in the supply chain and necessary for market competition. The European Union's "Corporate Sustainability Due Diligence Directive" (CSDDD) entered into force on July 25, 2024, and established a legally binding enterprise supply chain human rights and environmental due diligence system; thus, enterprises are required to identify, prevent, mitigate and remedy human rights and environmental risks in their own operations, subsidiaries and the entire supply chain, as well as report on ESG data. MSCI has strengthened the risk assessment of supply chain labour standards and controversial sourcing in the update to its 2026 ESG rating model. ESG is no longer just about the company's image; it is also related to the stable operation of the supply chain and market access for enterprises.

Based on the above changes, this study aims to explore how to promote supply chain resilience through the lens of ESG. In light of the restructuring of the global value chain, this paper investigates how ESG influences the resilience of supply chains and puts forward operational implementation paths to offer a reference for enterprise practice and policy formulation.

2. DRIVING FACTORS AND CORE CHARACTERISTICS OF GLOBAL VALUE CHAIN RESTRUCTURING

The world's value chain restructuring is due to the joint impact of geopolitics, technological changes and climate change. The reason has not been found through study of how ESG impacts supply chain resilience.

The rise of geopolitical risks is the most direct cause. Cai Jin pointed out that international conflicts and the uncertainty of shipping routes have reduced the stability of global industrial and supply chains, weakened maritime power, and strengthened land power. The Director-General of the WTO, Ngozi Okonjo-Iweala, noted that policy-induced trade costs and uncertainty have risen sharply; however, as of December 2025, trade growth has been relatively strong. Uncertainty prompts supply chain adjustments: Enterprises accept the need for strategic redundancy and maintain surplus capacity and diversified supply for survival and recovery in times of crisis, at the cost of short-term efficiency.

The first reason is technological changes. Zhang Qi, Deputy Director of the Development Research Center for the State Council, stated at the Fourth Chain Expo that AI-related products have added over 40% to the growth of global trade, and although there has been no contraction in the global value chain, its restructuring has been intensifying. Digital technology has changed the working model of the supply chain and promoted various applications in post-disaster rescue and pre-disaster prediction [2]. According to the WTO report, there are multiple changes in the value chain at present, and technology is promoting digitalisation and automation, while environmental factors are also driving the transformation through green investment and carbon-pricing mechanisms. Gartner expects that by 2030, 60% of enterprises will apply AI in their supply chains, and Abhishek Sahay, an executive at SAP, noted that currently only 15% of enterprises have built the necessary data foundation; there are about 340 independent IT systems per enterprise, and data silos are very evident. This deficiency is a serious problem in the construction of supply chain resilience.

Climate Change Alters the Operating Environment of the Supply Chain. Cai Jin quoted a report from the World Meteorological Organization and noted that the period from 2015 to 2025 has been the 11 hottest years on record, thus climate risks are now one of the risks to supply chains [3]. Emission Trading Systems and Carbon Border Adjustment Mechanisms can reduce emissions; however, care should be taken in the design and international cooperation to avoid carbon leakage and trade fragmentation.

The main features of the restructuring of the global value chain are: a shift from efficiency-orientation to safety-and-resilience-orientation, a transition from simple globalisation to global-layout and regional-deepening globalisation, and a change from passive response to active construction. The characteristics of ESG are aligned with the above: environmental risk management, social

responsibility, and corporate governance. In addition to diversification and redundancy in the design of the supply chain, enterprises need to be able to identify, assess and respond to environmental and social risks.

3. THE INTRINSIC RELATIONSHIP BETWEEN ESG CONCEPTS AND SUPPLY CHAIN RESILIENCE

Therefore, it is reasonable to ask whether ESG can improve the resilience of the supply chain. Now, it has been converted into an observable phenomenon experimentally. Good ESG performance of the supply chain will help it resist external shocks and recover more quickly.

From the perspective of data, a study covering the period from 2012 to 2023 and involving 17,745 enterprise samples started with green innovation and found that ESG performance has a positive impact on supply chain resilience, mediated by green innovation. The above phenomenon is more severe in large-scale, state-owned and highly polluting enterprises. Another study of the Shanghai and Shenzhen A-share listed companies from 2010 to 2022 also found that ESG performance increases supply chain resilience by strengthening the stability of supply and demand relationships. Yao Zhenghai and others have found that high ESG performance can enhance the resilience of the supply chain by improving the reputation of the supply chain, reducing financing pressure and motivating salary incentives; however, information asymmetry has weakened this effect. The Effect of ESG on Supply Chain Resilience is Modified by Enterprise Size, Ownership and Industry Characteristics.

The three paths of ESG are: A relatively high ESG score will likely lead to a higher degree of disclosure by the company, and all parties in the supply chain will gain better risk awareness. In terms of the effect of relationships, ESG practice helps to build trust among supply chain partners and establish a long-term cooperative model for coordinated response to external shocks. In terms of the resource effect, enterprises with good ESG performance are more likely to obtain green financial support [4]. A typical case is the sustainable supply chain financing plan for ENN Natural Gas Co., Ltd. and MUFG Bank. It has introduced the CDP scoring system and adjusted the financing interest rate according to the environmental performance and transparency of suppliers.

The construction of the above mechanism is based on the reliability of ESG information. Differences in ESG ratings may reduce the resilience of the supply chain and will affect enterprises with low resilience more severely. Transparency of Information has a single-threshold effect. Therefore, the promotion of ESG will not be achieved automatically. There are no unified rating standards, and the quality of disclosure varies; thus, they are all ineffective. Enhance the quality and comparability of information disclosure for ESG promotion at the same time [5].

The above analysis shows the path of ESG's impact, but the presence of a mechanism does not guarantee that the effect will be achieved. The specific content of the resilience mechanism has not yet been specified. The three ways to advance the construction of resilient supply chains through ESG are collaborative governance, digital empowerment and institutional transmission. The content of the three paths is different: cooperative governance deals with the cooperation of parties; digital empowerment offers monitoring facilities; institutional transmission addresses the problem of rule dispersion.

4. COLLABORATIVE GOVERNANCE: TRANSFORMING ESG FROM CONTRACT CLAUSES INTO DAILY OPERATIONS

The former type of supply chain management has been contractual and price-based. The method is becoming less effective in the context of the restructuring of global value chains. The Stability of the supply chain depends more on how well partners work together. ESG can provide a general-purpose

basis for cooperation among all parties concerned. In accordance with the EU's CSDDD, companies need to identify and address human rights and environmental risks in their own operations, subsidiaries and the entire supply chain [6]. On February 26, 2026, the Omnibus Directive (EU) 2026/470 was issued and entered into force on March 18, 2026. The number of regulated enterprises fell by about 70%, and a "scope definition" mechanism was introduced. Identify high-risk links in the enterprise first, then focus on key follow-up actions.

The large buyer is increasing the scope of upstream due diligence through procurement contracts, supplier codes of conduct and audit clauses. Even if the Chinese suppliers are not directly subject to the directive, they may still be included in the compliance system via chain transmission [7]. The transmission mechanism is not symmetrical; the procurement power of the chain head is relatively high, so the selection and evaluation criteria for its suppliers will affect the ESG level of the entire supply chain. Changan Automobile has added necessary secondary suppliers to the APQP system, carried out audits of over 700 first-tier suppliers and 60 second-tier suppliers, and signed a "Supplementary Agreement for Sustainable Due Diligence" to strengthen supply chain transparency. BMW Brilliance Automotive has urged more than 300 first-tier suppliers to join the "Green Electricity Alliance" and aims to reduce about 1 million tonnes of CO2 equivalent emissions in the entire supply chain by 2025 compared with the 2019 baseline year. Although the two cases have different paths, the logic is the same: implement the ESG requirements in the contract in daily operations.

In collaboration, the concept of ESG has shifted from passive compliance to an active design principle for supply chain relationships. This change will not happen immediately. Chain leaders need to keep passing on ESG signals in procurement decisions, and at the same time, suppliers should start participating in capacity building. Through several communications, both sides have developed a general understanding; thus, the efficiency of coordination and risk resistance in the supply chain have increased. The cooperative relationship of ESG is, in fact, building an institutionalised trust system at the supply chain level to enable all parties to promptly agree on countermeasures to external shocks and avoid fragmented, independent responses. This cooperative ability itself is an irreplaceable advantage in the supply chain.

5. DIGITAL EMPOWERMENT: MAKING RISKS VISIBLE BEFORE TRANSMISSION

Collaborative governance can be used to distribute the responsibility among partners; however, the ability to cooperate will not eliminate the concealment and transmission of ESG risks. Institutional arrangements alone are not adequate for this purpose. If there are any environmental offences or labour issues in a particular link, it may be reported by the media, subject to regulatory penalties, and opposed by consumers; thus, the entire supply chain will be damaged. Annual audits and periodic observations cannot meet the current demand. The "AI Brain" model of Sinochem Holdings' procurement supply chain intelligent early warning has deployed 162 early warning models in the eight core scenarios of the procurement supply chain. Lenovo iChain's supply chain intelligent agent achieves end-to-end visibility through the intelligent control tower, has an accuracy rate of 85% for risk assessment, and has increased the speed of risk response by fourfold [8]. In 2026, MSCI improved the data-driven nature of its ESG rating model, and thus, the assessment of supply chain risks shifted from analysts' subjective evaluations to considering the cumulative exposure and risks at key links. Thus, the demand for enterprises has changed; they now need to consider the overall ESG performance of the entire supply chain and focus more on high-risk links in that chain.

Digital tools can be used to improve the speed of monitoring, and at the same time, new ways of risk management have also begun to emerge. In the past, the company could only base its decisions on the limited information provided by the supplier. The information was old and not very detailed. Now, with the help of technologies such as IoT sensors, satellite remote sensing and blockchain verification,

environmental data such as carbon emissions, water consumption and waste disposal can be collected and cross-verified in real time. Abnormal signals of labour rights can also be promptly detected by public opinion monitoring and reporting data [9]. Therefore, the transition from after-the-fact reports to before-the-fact alerts for supply chain ESG risks can now be supported by technology. However, the technical means themselves are also imperfect. Data quality is determined by the standardisation of the collection process, and the judgment power of the algorithm model depends on the representativeness of the training data. The more levels in the supply chain, the more difficult it is to obtain data. The top priority for Chinese enterprises is to embed ESG indicators into the daily operations of the supply chain information system and build a cross-departmental data collection mechanism, rather than compiling materials for the annual audit at the last minute. Only a solid data foundation can enable the digital tools to fulfill their purpose of early warning; otherwise, they will only be supplementary materials for post-incident investigation.

6. INSTITUTIONAL TRANSMISSION: PASSING THE RULES DOWN THE CHAIN

With the emergence of risks, the question of who will be responsible for governance comes next. The origin of many risks in a company is often related to its upstream suppliers. Therefore, the third way to transmit ESG standards is by inheritance. "Chain leader" enterprises in the global value chain promote the spread of ESG by making procurement decisions and contract terms that require it, thus leading the entire chain in a diffusion effect. ISO 20400: Sustainable Procurement Guidelines are overseas reference systems for this transmission. After Taiwan Mobile adopted ISO 20400, the amount of green procurement increased from NT$23.9 billion in 2023 to NT$27.8 billion in 2025, making up for almost 60% of the total procurement amount, and it also led 46 suppliers to establish carbon reduction goals based on the SBTi path. The Resilience of the supply chain is limited by the weakest link. In 2025, recycled materials made up 30% of all Apple products shipped, and all of its own-designed batteries used 100% recycled cobalt. Rational ESG construction reduces the risk of environmental violations and enhances adaptation to fluctuating resource prices and stricter carbon regulations.

The transmission effect of institutions will not be realised unless the leading enterprises in the chain can transform ESG requirements into actual and verifiable operating norms. In practice, the supplier guidelines of some enterprises are still at the level of principle statements and lack industry-specific implementation details and transitional arrangements; thus, it is difficult for suppliers to determine the standards for compliance and the direction of improvement [10]. There is also a capability asymmetry in the transmission: large suppliers have compliance teams and disclosure capabilities, but small and medium-sized suppliers do not have such resources; when the ESG threshold suddenly increases, they may be unable to comply and leave the supply chain, thus increasing supply chain instability. Effective institutional transmission should provide both pressure and support, and chain-leader enterprises can help suppliers strengthen their ESG capabilities by offering technical guidance, joint training and financing support to build resilience more effectively than a threat of withdrawal [11]. The institutional transmission mechanism will only be effective if the rules are strict; at the same time, they need to be clear and enforceable in the intergenerational transmission from one generation to the next. If, without the need for an external audit, the supplier voluntarily integrates ESG factors into its daily operations, it can be inferred that institutionalisation has taken place. In other words, chain-leading enterprises need to set up regular communication and feedback channels to have suppliers express their demands and receive support in the event of implementation difficulties, and the rules themselves should also be continuously revised and improved in practice.

7. CONCLUSION

Based on the above three paths, the function of ESG in promoting supply chain resilience can be classified as collaboration, risk observation and norm dissemination. In short, the restructuring of the world value chain is altering the working mode of the supply chain at the macro level. Efficiency is no longer the only objective; at the same time, safety and robustness have also increased in demand. ESG has changed from an idea of social responsibility to a system of supply chain governance. As a result, the impact of ESG on supply chain resilience has not been directly manifested but is transmitted through three channels: information openness, trust in partnerships, and resource access. The three mechanisms can only work together if enterprises incorporate ESG into their daily operations of supplier management, risk monitoring and rule transmission, and do not just report on this in their annual reports and compliance statements.

Literature review and case analysis will be employed in this paper to explore the mechanism and path of change. No econometric model was established to test the causal effect of ESG on supply chain resilience empirically. In terms of industry coverage, the selected cases are mainly from the automotive, chemical and electronic industries, and insufficient attention has been paid to industries with longer and more dispersed supply chains, such as textiles and agriculture. Test the actual application of the results in the industry. Although the negative impact of disagreements over ESG ratings on supply chain resilience has drawn the attention of scholars, it is still unclear how inconsistent rating standards and varying disclosure quality specifically weaken this effect and more empirical evidence is needed.

Restructuring of the global value chain is also leading to more than just compliance pressure for Chinese enterprises. The extraterritorial application of EU regulations, such as the CSDDD, may result in indirect compliance obligations for non-EU companies that are part of a supply chain network, even if they are not directly regulated in the EU. At the same time, China's strengths in renewable energy, electric vehicles and other areas can provide support for strengthening the depth of supply chain integration through ESG. According to a WTO report, the competitiveness of the world's value chains in the future will be more determined by "readiness", and digital infrastructure, stable clean energy supply, and institutional stability will be key factors. Further research can compare the different effects of ESG embedding paths in various industries and also track the international coordination issues of ESG rating standards. Companies that have turned ESG into a form of management ability rather than a cost of compliance will be better positioned for the next round of restructuring.

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