

Supply Chain Concentration and ESG Performance: Evidence from Chinese Listed Companies

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Abstract. This study explores the impact of supply chain concentration on corporate ESG performance within the context of globalization and increasing sustainability disclosure standards. Based on data from Chinese listed firms, the empirical results demonstrate a significant negative relationship between supplier concentration and ESG ratings, implying that excessive dependence on a limited number of suppliers or customers weakens firms' environmental, social, and governance performance. Such concentration restricts resource flexibility, reduces risk management capacity, and constrains long-term sustainability strategies. Robustness tests using alternative indicators confirm the stability of the findings, and heterogeneity analysis reveals that the negative effect is more pronounced among state-owned and large enterprises. Overall, the study highlights that supply chain structure plays a crucial role in shaping corporate sustainability outcomes, suggesting that diversifying supplier and customer relationships can enhance ESG performance, reduce operational risks, and promote resilient and sustainable corporate growth.

Keywords: ESG ratings, Supply chain concentration, Empirical

1. Introduction

With the deepening of globalization, the connections among countries in economic, political, cultural and other fields have become increasingly close. However, behind this thriving economic development, pressing environmental challenges have arisen. Barbier, E. B. argued that the expansion of global market demand has driven the rapid exploitation of resource-based economies [1]. However, enterprises have failed to consider environmental damage and the non-renewability of resources in their development strategies. To prevent the endless exploitation of non-renewable resources, the European Union has proposed the EU Taxonomy Regulation to guide enterprises to engage in sustainable economic activities and enhance the quality of ESG reports of enterprises. Furthermore, the research of Cristea, A. D. et al. pointed out that the extension of the enterprise supply chain would lead to an increase in transportation distance, thereby significantly increasing carbon emissions [2]. Consequently, as global production pressures and transportation contribute to increased carbon emissions and resource consumption, the complexity and vulnerability of enterprise supply chains are increasingly attracting public attention. Therefore, international organizations have introduced the concept of Supply Chain Due Diligence, prompting countries to strengthen the requirements for enterprises to disclose supply chain information and helping

investors assess the environment of upstream and downstream enterprises as well as potential social risks.

2. Literature review

In 2004, UNEP first introduced the concept of ESG and established a corporate governance framework anchored in risk management and long-term value creation. Under this framework, it is emphasized that an enterprise's strategy should not solely prioritize economic benefits, but also take into account environmental sustainability, social responsibility, and transparent and open corporate governance to achieve the long-term stable development of the enterprise.

In 2024, nine central ministries and commissions of China, including the Ministry of Finance, jointly promulgated the "Enterprise Sustainability Disclosure Standards - Basic Standards (Trial)". Notably, this document mentions that the "value chain" of enterprises should be included as one of the basic concepts in the scope of sustainable information disclosure, emphasizing that the supply chain management of enterprises needs to meet sustainable standards. However, as previously noted, in the context of globalization, corporate supply chains often exhibit complexity and vulnerability, posing a significant challenge to their high-quality development. Miroudot, S. pointed out that the globalized supply chain has promoted the maximization of efficiency, but overly centralized supply chain relationships have weakened enterprises' ability to withstand external shocks and greatly increased their management risks [3].

The existing literature mainly focuses on exploring the ESG performance of enterprises from the perspectives of suppliers and customers. Pour-Akbari, K. et.al pointed out that a high level of supplier or customer concentration is usually associated with increased bargaining power and operational risks, which may force companies to prioritize short-term financial goals at the expense of sustainability initiatives [4]. This indicates that overly concentrated customer-supplier relationships may lead to business dependencies that reduce a firm's risk resilience. Based on different theoretical foundations, an increase in supplier concentration may have completely different effects on a company's ESG performance. Therefore, this article will explore from the perspective of the supply chain how the concentration of suppliers affects the ESG performance of enterprises.

3. Data and methodology

3.1. Sample selection and data sources

This study selects A-share listed companies in China from 2009 to 2024 as research samples, which are screened according to the following criteria: Firstly, enterprises in special industries such as finance and insurance, as well as those marked as ST or *ST, which indicate abnormal business conditions, are excluded. Secondly, samples lacking key variable data are excluded. Finally, to mitigate the impact of outliers on the research results, all continuous variables are winsorized at the 1% and 99% levels. After processing, a total of 10,155 sample observations were finally obtained. The data of this study mainly comes from the CSMAR database.

3.2. Variable definition

Based on existing research, this paper employs the Huazheng ESG Rating (CSI ESG Rating) as the explanatory variable to measure corporate ESG performance. This rating system covers nearly all A-share listed companies, featuring comprehensive data and high authority. It has been widely applied

in academic research. Huazheng ESG rating is divided into nine levels, so this article will convert these levels into a numerical scale of 1 to 9 for quantitative analysis.

According to Porter's definition of supply chain concentration, this paper selects supply chain concentration (SPC) as the explanatory variable [5]. First, it calculates supplier concentration and customer concentration as the proportion of purchases from the top N suppliers or sales to the top N customers relative to total purchases or sales. Then, based on the supply chain centralization measurement standard of Fang, H. et al., the data of the top five suppliers and the top five customers of each enterprise were selected to calculate the average value. Thus, indicators for measuring the degree of supply chain centralization can be obtained [6].

This paper includes a series of key corporate financial and governance indicators as control variables to ensure the accuracy and reliability of the results. These control variables include: growth potential (GO), debt-to-asset ratio (Lev), cash flow (CF), company age (AGE), company size (SIZE), proportion of independent directors (IDR), company ownership structure (NATURE), and equity concentration (TOP1). In addition, to further control potential interfering factors, this paper also accounts for industry and year fixed effects.

3.3. Descriptive statistics

Table 1 shows the descriptive statistical results of the main variables. The average ESG performance of listed companies is 3.934. The standard deviation of the ESG score is 1.174, indicating substantial variations in ESG performance across enterprises. The mean value of the supply chain concentration (SPC) is 0.312, the minimum value is 0.0278, the maximum value is 0.857, and the standard deviation is 0.176. This indicates that supply chain concentration among Chinese A-share listed companies is relatively high, with considerable heterogeneity.

Table 1. Descriptive statistics

VARIABLES	N	Mean	S.D.	Min	Max
ESGrating	10,155	3.934	1.174	1	9
SPC	10,155	0.312	0.176	0.0278	0.857
GO	10,155	1.988	1.416	0	9.384
Lev	10,155	0.466	0.210	0.0694	0.975
CF	10,155	0.0503	0.0810	-0.205	0.303
AGE	10,155	13.94	7.710	0	33
SIZE	10,155	22.35	1.299	19.50	26.18
IDR	10,155	37.41	5.476	30	57.14
NATURE	10,155	5.639	2.437	1	9
TOP1	10,155	15.84	10.85	0.01000	37.30

3.4. Model setup

To examine the impact of supply chain concentration on corporate ESG performance, this study constructs the following model, drawing on Zhang, B. et al. [7].

$$ESG_{i,t} = \alpha_0 + \alpha_1 SPC_{i,t} + \sum \beta_s Control_{s,i,t} + \epsilon_i + \epsilon_t + \mu_{i,t} \quad (1)$$

In the above model, $ESG_{i,t}$ represents the ESG performance of enterprise i in Year t , $SC_{i,t}$ represents the concentration of suppliers, $Control$ is a set of control variables. ϵ_i and ϵ_t respectively represent the fixed effects of the industry and the year, $\mu_{i,t}$ represents the random error term.

4. Empirical results

4.1. Baseline regression

Table 2 reports the baseline regression results regarding the relationship between supply chain concentration and corporate ESG performance. Columns (1) to (3) in the table respectively examine the impact of the total supply chain concentration (SPC), customer concentration (CLIENT), and SUPPLIER concentration (SUPPLIER) on the ESG rating of enterprises. The regression results show that the regression coefficient of supply chain concentration (SPC) is -0.698, which is significantly negative at the 1% level, indicating that a higher overall supply chain concentration is associated with poorer corporate ESG performance. This means that when enterprises rely on a few counterparties in their supply chain relationships, they may face higher bargaining risks and external dependence, thereby eroding their autonomy and resource allocation to social responsibility and environmental governance.

Further subdividing the supply chain concentration into customer concentration and supplier concentration, it can be found that the customer concentration coefficient (CLIENT) is -0.098, showing a significant negative correlation at the 10% significance level. This indicates that the higher a company's reliance on a few core customers corresponds to a lower ESG rating. The SUPPLIER concentration coefficient (SUPPLIER) is 0.039, which is not statistically significant, indicating that the concentration between the enterprise and its upstream suppliers has no significant impact on the enterprise's ESG performance. This difference reflects a significant asymmetry in the roles of customer concentration and supplier concentration in the ESG decision-making of enterprises in the context of Chinese listed companies. Enterprises with high customer concentration often rely on a few major customers in the downstream market (such as state-owned enterprises or large manufacturing groups). These clients typically possess strong bargaining power and leverage for cost reduction, which makes enterprises more inclined to maintain business relationships and price competition in resource allocation, while neglecting ESG investments.

Meanwhile, (4) to (6) are the regression results of supply chain concentration under the three individual dimensions of E, S, and G, and the regression coefficients are all significant at the 1% level.

Table 2. Baseline regression results

	(1)	(2)	(3)	(4)	(5)	(6)
	ESGrating	ESGrating	ESGrating	E	S	G
SPC	-0.698*** (0.0628)			-1.576*** (0.432)	-7.053*** (0.570)	-2.315*** (0.414)
CLIENT		-0.0980* (0.0553)				
SUPPLIER			0.0393 (0.0556)			
GO	0.0170* (0.00867)	0.0128 (0.00871)	0.0126 (0.00872)	0.0530 (0.0584)	0.0896 (0.0771)	-0.0371 (0.0560)
Lev	-1.508*** (0.0567)	-1.506*** (0.0570)	-1.506*** (0.0570)	-0.381 (0.393)	-2.361*** (0.518)	-14.11*** (0.377)
CF	0.342** (0.137)	0.407*** (0.138)	0.406*** (0.138)	2.899*** (0.932)	-1.045 (1.230)	4.430*** (0.894)
AGE	-0.0202*** (0.00169)	-0.0210*** (0.00170)	-0.0210*** (0.00170)	-0.126*** (0.0120)	-0.190*** (0.0159)	-0.0214* (0.0115)
SIZE	0.379*** (0.0107)	0.400*** (0.0106)	0.400*** (0.0106)	1.868*** (0.0746)	1.829*** (0.0984)	1.421*** (0.0715)
IDR	0.0119*** (0.00191)	0.0123*** (0.00192)	0.0123*** (0.00192)	0.0254* (0.0131)	0.000210 (0.0173)	0.142*** (0.0126)
NATURE	-0.0141*** (0.00470)	-0.00999** (0.00471)	-0.00988** (0.00471)	0.0252 (0.0327)	0.153*** (0.0432)	-0.162*** (0.0314)
TOP1	0.00563*** (0.00103)	0.00516*** (0.00103)	0.00516*** (0.00104)	-0.00525 (0.00708)	-0.0199** (0.00934)	0.0771*** (0.00679)
Constant	-3.848*** (0.249)	-4.502*** (0.244)	-4.545*** (0.244)	19.90*** (1.733)	37.92*** (2.286)	47.89*** (1.661)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs	10,155	10,155	10,155	10,155	10,155	10,155
R-squared	0.230	0.221	0.221	0.178	0.162	0.278

Note: Standard errors in parentheses;*** p<0.01, ** p<0.05, * p<0.1

4.2. Robustness test

4.2.1. Replace explanatory variable

To verify the robustness of the benchmark regression results, this study employs alternative measurement indicators of supply chain concentration. Specifically, Column (1) in Table 3 uses the concentration of the largest supplier (TOP1SPC) to replace the supply chain concentration Index of

the benchmark model, and (2) uses the Herfindahl-Hirschman Index (SPCHHI) of supplier concentration as the concentration substitution variable.

The results in the table show that regardless of the alternative measure used, the regression coefficient of supply chain concentration remains significantly negative at the 1% level, confirming the robustness of the findings. This result is consistent with the direction and significance of the principal regression, indicating that the model and its conclusion have strong robustness.

4.2.2. Change explained variable

Currently, there is no unified measurement standard for ESG ratings, and evaluation criteria and coverage vary substantially across different rating agencies. To avoid the impact of different ESG rating agency choices on the benchmark regression results, this paper alters the measurement of ESG performance, selecting Bloomberg ratings as the dependent variable, denoted as BESG. The results are shown in column (3) of Table 3. The regression coefficient is negative at the significance level of 1%, again verifying that increasing the concentration of suppliers will significantly reduces the ESG performance of enterprises.

Table 3. Robustness test results

	(1)	(2)	(3)
VARIABLES	ESGrating	ESGrating	BESG
SPCHHI	-1.041*** (0.128)		
TOP1SPC		-0.845*** (0.0963)	
SPC			-3.885*** (0.697)
Constant	-4.326*** (0.275)	-4.184*** (0.277)	29.58*** (0.227)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Observations	8,597	8,597	2,989
R-squared	0.225	0.226	0.558

4.3. Heterogeneity analysis

In 2024, China's three major stock exchanges jointly issued the Guidelines on Self-Regulation of Listed Companies - Sustainability Reporting (Trial). Therefore, this paper performs a heterogeneity analysis using 2024 as the time threshold.

From columns (1) and (2) in Table 4, it can be seen that supply chain concentration (SPC) has a significantly negative impact on corporate ESG performance both before and after the policy implementation. However, the absolute value of the coefficient increases substantially following policy implementation. This indicates that after the ESG information disclosure policy was introduced, the inhibitory effect of supply chain concentration on the ESG performance of enterprises has been further strengthened, reflecting that in an environment with enhanced

information transparency, enterprises face stricter external supervision and greater social responsibility pressure.

Columns (3) and (4) distinguish between state-owned enterprises and non-state-owned enterprises. The results show that the coefficient of state-owned enterprises is significantly negative (-0.820), while that of non-state-owned enterprises shows a positive relationship (1.350). This indicates that for state-owned enterprises, a relatively high concentration of the supply chain may lead to rigid resource allocation and sluggish market response, hindering ESG performance. In contrast, facing market competition, non-SOEs may enhance their ESG performance by improving resource utilization efficiency or fulfilling social responsibilities through centralized supply chain relationships.

Columns (5) and (6) are group firms by size. The results show that for both large and small enterprises, supply chain concentration has a significant negative impact on ESG performance (-0.764 and -0.585, respectively). However, the magnitude of the impact is more pronounced for large firms, indicating that for larger enterprises with higher public attention, the risk of supply chain concentration is more likely to be magnified by the market, thereby having a greater negative impact on their ESG performance.

Table 4. Heterogeneity analysis results

	(1)	(2)	(3)	(4)	(5)	(6)
	After	Before	SOE	Non-SOE	Big	Small
SPC	-1.635*** (0.322)	-0.645*** (0.0611)	-0.820*** (0.0901)	1.350** (0.678)	-0.764*** (0.0917)	-0.585*** (0.0860)
GO	0.166*** (0.0624)	0.00486 (0.00826)	0.0356** (0.0150)	-0.00276 (0.0833)	0.107*** (0.0201)	-0.0187* (0.0105)
Lev	-3.010*** (0.271)	-1.349*** (0.0556)	-1.489*** (0.0905)	0.366 (0.667)	-1.358*** (0.0944)	-1.481*** (0.0716)
CF	1.215 (0.798)	0.336** (0.132)	-0.0466 (0.226)	3.151** (1.537)	0.535** (0.211)	0.125 (0.182)
AGE	-0.0416*** (0.00788)	-0.0186*** (0.00170)	-0.0112*** (0.00304)	-0.0451** (0.0191)	-0.0129*** (0.00257)	-0.0219*** (0.00216)
SIZE	0.807*** (0.0515)	0.329*** (0.0105)	0.363*** (0.0159)	0.468*** (0.0989)	0.406*** (0.0182)	0.291*** (0.0273)
IDR	-0.00363 (0.00961)	0.0136*** (0.00186)	0.00624** (0.00290)	0.0197 (0.0153)	0.0136*** (0.00269)	0.00818*** (0.00275)
NATURE	-0.0935*** (0.0223)	-0.00899* (0.00463)			-0.0117 (0.00772)	-0.0186*** (0.00601)
TOP1	0.00554 (0.00523)	0.00529*** (0.00100)	0.000116 (0.00171)	0.00929 (0.00915)	0.00298** (0.00143)	0.00700*** (0.00143)
Constant	-11.62*** (1.213)	-2.882*** (0.245)	-3.260*** (0.366)	-7.704*** (2.239)	-4.889*** (0.418)	-1.837*** (0.609)
Obs	871	9,267	3,911	164	5,039	5,060
R-squared	0.398	0.217	0.223	0.572	0.190	0.249

5. Conclusion

This study investigates the impact of supply chain concentration on corporate ESG performance utilizing data from Chinese A-share listed companies. The baseline regression results show that supply chain concentration has a significant negative impact on the ESG rating of enterprises. Specifically, enterprises with higher supply chain concentration are more likely to demonstrate inferior ESG performance. This suggests that excessive dependence on a limited number of key suppliers or customers may restrict enterprises' flexibility in supply chain risk management, social responsibility fulfillment, and governance transparency maintenance. To test the robustness of these findings, several alternative measures of supply chain concentration were adopted. These findings confirm the robustness and reliability of the main results. Also, the heterogeneity analysis reveals that the negative effect is more pronounced after the policy pilot, for state-owned enterprises (SOEs) and large enterprises.

Overall, the empirical evidence highlights the crucial role of supply chain structure in shaping firms' sustainable development practices. To enhance ESG performance, firms should avoid over-reliance on a small number of trading partners and instead pursue diversification in supplier and customer networks. Such diversification not only mitigates potential operational and reputational risks but also facilitates long-term sustainable growth that aligns with ESG goals.

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