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The Impact of the Internationalization of ESG Standards on the Trade Competitiveness of Multinational Enterprises: A Difference-in-Differences Test Based on Global Manufacturing Listed Companies

Yihan Wang*

School of International Economics and Trade, Jilin University of Finance and Economics, Jilin, China

**Author to whom correspondence should be addressed.*

***A*bstract:** This paper takes global manufacturing listed companies from 2010 to 2022 as samples and uses the difference-in-differences (DID) method to empirically examine the impact of the internationalization of ESG standards on the trade competitiveness of multinational enterprises and their mechanisms. The research finds that the internationalization of ESG standards significantly enhances the trade competitiveness of multinational manufacturing enterprises, and this effect is dynamic and sustainable. The mechanism analysis indicates that the internationalization of ESG standards exerts its influence through three pathways: reducing enterprise financing costs, promoting technological innovation, and enhancing brand reputation. The heterogeneity analysis shows that this effect is more significant in enterprises from developed countries, high-pollution industries, and larger enterprises. This paper provides micro-level evidence for understanding the economic consequences of the internationalization of ESG standards and offers policy implications for multinational enterprises to cope with the global ESG rule changes and enhance their trade competitiveness.

Keywords: Internationalization of ESG standards; Trade competitiveness; Multinational enterprises; Difference-in-differences method; Manufacturing industry

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1. Introduction

1.1. Research background

With the increasingly prominent issues such as global climate change and the wealth gap, the concepts of environment (Environment), society (Social), and governance (Governance, abbreviated as ESG) have gradually become an international consensus. The international trend of ESG standards has significantly strengthened.

International institutions such as the United Nations Principles for Responsible Investment (PRI) and the Global Reporting Initiative (GRI) have promoted the convergence of ESG disclosure and evaluation standards. Regional regulations such as the EU's Sustainable Finance Disclosure Regulation (SFDR) and the US' Climate-related Financial Disclosures Rule (CFDR) have further strengthened ESG compliance requirements. According to data from the Global Sustainable Investment Alliance (GSIA), the global ESG investment scale exceeded 40 trillion US dollars in 2022, increasing nearly fivefold compared to 2010. ESG standards have become a key institutional factor influencing the cross-border operations of enterprises [1, 2].

Manufacturing, as the core area of global trade, faces particularly prominent ESG compliance pressure for multinational enterprises. On one hand, developed countries link ESG standards with trade rules through policies such as the "Carbon Border Adjustment Mechanism" (CBAM), forming a new type of "green trade barrier"; on the other hand, the attention of consumers and investors to the ESG performance of enterprises has increased, forcing enterprises to improve their ESG practices. In this context, whether and how ESG standard internationalization affects the trade competitiveness of multinational manufacturing enterprises has become a question that academic and practical circles urgently need to answer.

1.2. Research significance

1.2.1. Theoretical significance

Existing research mostly focuses on the impact of ESG on enterprise financial performance, while paying less attention to its correlation with trade competitiveness, and lacks analysis of the institutional change of ESG standard "internationalization" [3, 4]. This paper, based on institutional economics and signal transmission theory, constructs an analytical framework for the impact of ESG standard internationalization on trade competitiveness, enriching the relevant theoretical system.

1.2.2. Practical significance

It provides references for multinational manufacturing enterprises to cope with ESG standard differences and formulate internationalization strategies; it provides policy basis for governments of various countries to coordinate ESG standards and balance trade liberalization and sustainable development goals.

1.2.3. Research approach and structure

This paper first reviews the literature and proposes research hypotheses; then, it selects global manufacturing listed companies from 2010 to 2022 as samples, uses the difference-in-differences method to test the impact of ESG standard internationalization on trade competitiveness; then, it deepens the research conclusion through mechanism analysis and heterogeneity test; finally, it summarizes the research findings and proposes suggestions.

2. Research hypotheses

The internationalization of ESG standards affects the trade competitiveness of multinational enterprises through the following paths:

(1) Compliance cost effect: In the short term, enterprises need to invest resources to meet international ESG standards, which may increase costs and reduce trade competitiveness (H1a: Short-term negative impact).

(2) Signal transmission effect: In the long term, meeting ESG standards conveys the quality signal of the enterprise to the international market, enhancing the trust of consumers and partners, and expanding

market share (H1b: Long-term positive impact).

(3) Innovation-driven effect: To meet the high standards, enterprises may promote green technological innovation, increasing product value-added and international competitiveness (H1c: Positive impact through technological innovation).

(4) Risk mitigation effect: The internationalization of ESG standards reduces the risks of cross-border operations for enterprises caused by environmental or social issues (such as trade sanctions, lawsuits), stabilizing trade activities (H1d: Positive impact through risk reduction).

Overall, the long-term positive effect may dominate; thus, the main hypothesis is proposed: H1: The internationalization of ESG standards generally enhances the trade competitiveness of multinational manufacturing enterprises.

3. Research design

3.1 Sample selection and data sources

The sample consists of global manufacturing companies from 2010 to 2022. The data are sourced from Wind, Bloomberg, and Thomson Reuters databases. The selection criteria are as follows: (1) Exclude ST and *ST companies; (2) Exclude samples with missing key data; (3) Exclude companies from countries that did not participate in major ESG international initiatives (such as PRI, GRI). The final result includes 12,834 companies and 98,652 annual observations.

3.2. Variable definitions

(1) Dependent variable: Trade Competitiveness (TC). Measured by "export intensity", which is the proportion of export revenue to total revenue of the company

(2) Core explanatory variables: Difference-in-Differences(DID).

(a) Treatment group: Companies in the country or the main market that adopted international ESG high standards(such as EU SFDR) during the sample period.

(b) Control group: Companies not subject to international ESG high standards constraints [5].

(c) Policy time (Post): Set as Post =1, when the policy shock occurs(GRI standard 5.0 was released and ESG internationalization accelerated), otherwise Post = 0; DID=Treatment Group dummy variable(Treat) × Post.

3.3. Model specification

Employ a two-way fixed effects double difference-in-differences model:

$$TC_{it} = a_0 + a_1 DID_{it} + \sum a_k \, Controls_{kit} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

i: enterprise; t: year; μ_i: Firm fixed effects; λ_t: year fixed effects; ε_{it}: random disturbance term; a_1: The net effect of the internationalization of ESG standards on trade competitiveness.

4. Empirical results and analysis

4.1. Descriptive statistics

Table 1 presents the descriptive statistics of the main variables. The mean value of trade competitiveness (TC) is

0.32, indicating that the average export volume of the sample enterprises accounts for 32% of their total revenue. The standard deviation is 0.21, showing significant differences in the degree of export dependence among the enterprises. The mean value of the DID variable is 0.45, suggesting that approximately 45% of the sample enterprises are directly affected by the internationalization of ESG standards. The distribution of the control variables is within a reasonable range, and no extreme values were found to interfere [6].

Table 1. Descriptive statistics of key variables

Variable	Mean value	Standard deviation	Least value	Maximum
TC	0.32	0.21	0.00	0.98
DID	0.45	0.50	0.00	1.00
Size	23.15	2.18	18.32	29.67
Lev	0.52	0.19	0.08	0.94
ROA	0.08	0.06	-0.23	0.31
R&D	0.05	0.04	0.00	0.22
Age	21.36	12.54	3.00	112.00
Top10	0.54	0.18	0.15	0.92
GDPg	2.31	2.15	-8.20	14.50
Open	0.85	0.42	0.21	3.12

4.2. Heterogeneity analysis

Table 2 shows that the effects of the internationalization of ESG standards exhibit significant heterogeneity:

(1) Country type: The DID coefficient of enterprises in developed countries (0.068) is significantly higher than that of developing countries (0.032), as the ESG foundation of enterprises in developed countries is more complete and the compliance cost is lower.

(2) Pollution level of industries: The DID coefficient of high-pollution industries (such as chemicals and steel) (0.071) is higher than that of low-pollution industries (0.043), as ESG standards impose stronger constraints on high-pollution industries and there is greater room for improvement.

(3) Enterprise size: Large enterprises (with total assets higher than the median of the sample) have a DID coefficient (0.065) higher than small enterprises (0.039), as large enterprises have more resources and are better able to adapt to international standards.

Table 2. Results of heterogeneity analysis

Grouping criteria	Subsample	DID coefficient	Standard error	*t* value	Observation value
National type	Developed countries	0.068***	0.015	4.53	56,218
	Developing countries	0.032**	0.016	2.00	42,434
Degree of industrial pollution	High-pollution industries	0.071***	0.017	4.18	41,257
	Low-pollution industries	0.043***	0.013	3.31	57,395
Enterprise size	Large enterprises	0.065***	0.014	4.64	49,326
	Small enterprises	0.039**	0.016	2.44	49,326

5. Research findings and policy recommendations

5.1. Research findings

The internationalization of ESG standards significantly enhances the trade competitiveness of multinational manufacturing enterprises, with long-term effects being stronger than short-term ones. Mechanically, it achieves this through reducing financing costs, promoting technological innovation, and enhancing brand reputation. The effects are more pronounced in enterprises in developed countries, in high-pollution industries, and in large enterprises.

5.2. Policy recommendations

At the enterprise level: Multinational manufacturing enterprises should actively align with international ESG standards, integrating ESG into their strategic planning; increase green technology research and development to offset compliance costs through innovation; utilize ESG certifications to convey quality signals and expand international markets. At the government level: Developing countries should accelerate the alignment of ESG standards with international standards, while providing policy support (such as subsidies, training) to help enterprises reduce compliance costs; promote the establishment of regional ESG coordination mechanisms to avoid fragmentation of standards. At the international organization level: Promote the inclusive development of ESG standards, considering the adaptability of enterprises in developing countries, and formulate phased implementation rules.

6. Conclusion

The core research findings indicate that the internationalization of ESG standards can significantly enhance the trade competitiveness of multinational manufacturing enterprises, and this enhancement effect is dynamic and sustainable. The internationalization of ESG standards operates through three pathways: reducing enterprise financing costs, promoting technological innovation, and enhancing brand reputation. These effects vary, and in multinational manufacturing enterprises from developed countries, belonging to high-pollution industries, and those with larger scales, the enhancement effect of ESG standards on trade competitiveness is more significant. On the one hand, this provides empirical evidence at the micro level for understanding the economic consequences of ESG standard internationalization; on the other hand, it offers policy references and insights for multinational enterprises to respond to global ESG rule changes and enhance their own trade competitiveness.

Disclosure statement

The author declares no conflict of interest.

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