

The Impact of Corporate ESG Performance on Total Factor Productivity: From the Perspective of Supply Chain Transmission

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Abstract: Corporate ESG (Environmental, Social, and Governance) practices are crucial for promoting high-quality development and achieving green transformation. Using matched data from Chinese A-share listed companies and tax surveys from 2009 to 2022, this study empirically examines the impact of corporate ESG performance on total factor productivity (TFP) and its transmission mechanism within supply chain networks. The research finds that improved ESG performance not only significantly boosts a firm's own TFP growth but also generates asymmetric spillover effects through the supply chain: the positive impact of midstream enterprises on downstream customer firms is significantly stronger than on upstream suppliers. Mechanism analysis reveals that ESG practices enhance efficiency through three pathways: reducing intermediate input costs, optimizing resource allocation efficiency, and promoting innovation spillovers. Heterogeneity analysis shows that these spillover effects are more pronounced in state-owned enterprises, listed companies, and larger firms. Further research indicates that the efficiency-enhancing role of ESG in supply chains is more significant in industries with strict environmental regulations and is not significantly affected by firms' dual roles as both suppliers and customers. The findings provide new evidence on the network externalities of ESG practices and offer important insights for improving green supply chain policies and driving high-quality economic development.

Keywords: Corporate ESG Performance, Supply Chain Transmission, Total Factor Productivity, TFP

1. Introduction

The Report to the 20th National Congress of the Communist Party of China emphasizes that "high-quality development is the primary task for building a modern socialist country in all respects." Corporate high-quality development, as the micro-foundation of macroeconomic growth, is not only critical to individual competitiveness but also the core driver of economic transformation and upgrading. Against the backdrop of the global sustainable development trend and China's deepening "1+N" strategy for carbon peaking and carbon neutrality, the ESG concept has become a key dimension for measuring corporate high-quality development. Existing studies show that good ESG performance can significantly influence a firm's TFP by optimizing resource allocation, alleviating financing constraints, and enhancing innovation efficiency. However, most literature focuses on the

"direct effects" of ESG on a firm's own economic outcomes, neglecting the "network externalities" of corporate ESG behavior in the modern industrial chain division system—whether ESG practices affect the TFP of upstream and downstream firms through supply chain linkages.

With the deepening of industrial chain division, economic and technical connections between firms have become increasingly close. ESG practices can influence not only a firm's own operational performance but also generate significant spillover effects on upstream and downstream firms through supply chain transmission mechanisms. Specifically, the ESG performance of upstream suppliers may affect downstream firms' production efficiency and resource allocation through channels such as green procurement and environmental standard transmission, while downstream firms' ESG demands may urge upstream suppliers to improve environmental governance and social responsibility. This two-way interaction forms a "ripple effect" in supply chain networks, profoundly impacting TFP improvement across the entire industrial chain. Additionally, the supply chain externalities of ESG practices may amplify their economic effects through mechanisms such as knowledge spillover, technological collaboration, and risk sharing. Therefore, an in-depth analysis of how ESG performance affects TFP through supply chain networks enriches the research perspective on ESG's economic consequences and provides a theoretical basis for constructing a collaborative green supply chain development mechanism.

While existing literature has established a rich theoretical framework for the relationship between ESG and TFP, focusing on micro-level direct effects (e.g., improving investment efficiency, enhancing green technology innovation) and macro-level transitions from factor-driven to efficiency-driven growth, it has paid insufficient attention to spillover mechanisms in supply chain networks. Few studies have explored how the externalities of ESG, as a non-technical institutional arrangement, transmit through supply chains, and the lack of a heterogeneous perspective limits the generalizability of conclusions. This study addresses these gaps by using matched data from listed companies and tax surveys, constructing a supply chain network identification system, and empirically testing the multi-dimensional spillover effects of ESG practices.

2. Literature review and hypothesis development

2.1. Literature review

2.1.1. Internal mechanisms of ESG performance on firm efficiency

Research on how ESG performance affects firm production efficiency spans environmental economics and strategic management. From the resource-based view, ESG practices are seen as heterogeneous resources for firms to gain sustainable competitive advantages [1]. Environmental management systems drive technological innovation through the "innovation compensation effect," such as cleaner production technologies reducing energy consumption and production losses [2]. Social responsibility practices reduce transaction costs by enhancing stakeholder trust, while sound corporate governance optimizes decision-making processes and resource allocation efficiency. Porter's hypothesis suggests that strict environmental regulations can compel firms to improve production processes and achieve efficiency gains through technological innovation [3].

2.1.2. ESG spillover effects in supply chain networks

Supply chains, as core carriers of inter-firm technology diffusion and institutional coordination, provide a theoretical basis for cross-organizational transmission of ESG practices. Knowledge spillover theory indicates that technological innovations by core firms can spread through upstream and downstream supply chains, leading to efficiency improvements [4]. Empirical studies find that technological spillovers from digitally transformed firms significantly enhance downstream firms'

TFP. In green supply chain management, core firms enforce environmental standards on suppliers through institutional isomorphism, driving production process upgrades [5]. However, existing research mainly focuses on technological innovation spillovers, lacking analysis of ESG's non-technical strategic spillovers and their TFP transmission pathways.

2.2. Hypothesis development

Hypothesis 1 (H₁): Corporate ESG performance has a significant positive impact on its own total factor productivity. Based on the innovation compensation theory and resource-based view, ESG practices can optimize internal resource allocation through technological innovation and organizational change. Environmental management promotes cleaner technology adoption, social responsibility reduces transaction costs, and good governance improves decision-making efficiency, all contributing to TFP growth [1].

Hypothesis 2 (H₂): Corporate ESG performance has positive spillover effects on the total factor productivity of upstream and downstream firms. ESG spillover effects in supply chains can occur through multiple mechanisms: cost synergy (joint R&D and green procurement sharing environmental governance costs), information diffusion (standardized ESG disclosure sharing management experience), and institutional pressure (regulatory requirements or core firms' green procurement mandates driving compliance technology adoption) [6,7]

3. Empirical research

3.1. Empirical models

To explore the impact of manufacturing firms' ESG performance on their TFP and supply chain spillovers, we construct two models:

Model for Direct Effect:

$$y_{it} = \beta_0 + \beta_1 esg_{it} + CV\gamma_1 + \mu_i + \delta_t + \varepsilon_{it} \quad (1)$$

where y_{it} is TFP, esg_{it} is ESG rating, and CV includes control variables (firm size, leverage, profitability, etc.), with firm (μ_i) and year (δ_t) fixed effects.

Model for Spillover Effect:

$$y_{jt} = \alpha_0 + \alpha_1 esg_{it} + CV_i\gamma_1 + CV_j\gamma_2 + \mu_i + \mu_j + \delta_t + \varepsilon_{ijt} \quad (2)$$

where y_{it} is the TFP of upstream/downstream firms (j), and esg_{it} is the ESG rating of midstream firms (i).

3.2. Data description

Data Source: Matched data from A-share listed companies (2009–2022) and China Tax Survey Database (2009–2016 for non-listed firms). ESG ratings from Huazheng Index, TFP measured using the LP method (to reduce endogeneity), with controls for firm size, leverage, etc.

Variables: TFP (LP method as baseline), ESG (scored 1–9 from Huazheng), and control variables.

4. Empirical results

4.1. Direct effect of ESG on firm's own TFP

Table 1 shows that ESG performance significantly enhances a firm's TFP. A 1-unit increase in ESG rating boosts TFP by 1.49% ($p < 0.01$), supporting H₁.

Table 1: Direct effect of ESG on firm's TFP

	(1)	(2)
	TFP LP	TFP LP
ESG	0.0397*** (0.0036)	0.0149*** (0.0031)
Size		0.4367*** (0.0058)
Lev		0.4238*** (0.0229)
ROA		0.8647*** (0.0472)
Cashflow		0.4133*** (0.0374)
Fixed		-0.6162*** (0.0287)
Controls	NO	YES
Firm FE	YES	YES
Year FE	YES	YES
N	32122	30579
Adj.R2	0.8616	0.9081

4.2. Spillover effects on upstream and downstream firms

Table 2 reveals asymmetric spillover effects: ESG positively impacts downstream firms' TFP (coefficient=0.0397, $p<0.1$) but not upstream suppliers, supporting the non-symmetric hypothesis.

Table 2: Spillover effects on upstream/downstream firms

	(1)	(2)
	TFP LP	TFP LP
ESG	0.0143 (0.0195)	0.0397* (0.0225)
Controls	YES	YES
Firm/Year FE	YES	YES
N	2258	4131
Adj.R2	0.9117	0.6321
_cons	5.6121	11.5302

4.3. Robustness tests

Using alternative TFP measures (OP, OLS, FE, GMM) and clustering methods, results remain significant, confirming the reliability of spillover effects on downstream firms.

5. Heterogeneity analysis

5.1. Firm ownership and scale

State-owned enterprises (SOEs) and larger firms exhibit stronger spillover effects (Table 3). SOEs, under policy guidance, have more systematic ESG practices, while larger firms possess better resources to absorb ESG spillovers.

Table 3: Heterogeneity analysis by ownership and scale

Variables	(1) Non-SOEs	(2) SOEs	(3) Small Firms	(4) Large Firms
ESG	0.0896*** (0.0243)	0.1034** (0.0451)	0.0451 (0.0297)	0.0864*** (0.0258)
Controls	YES	YES	YES	YES
Firm/Year FE	YES	YES	YES	YES
Adj.R2	0.6063	0.7457	0.5383	0.7503
cons	11.3227	11.2959	11.7651	10.9003
N	3,432	538	1,538	2,196

5.2. Regulatory environment

In industries with strict environmental regulations, ESG spillover effects are more pronounced, as regulatory pressure enhances ESG compliance and technology adoption.

6. Mechanism analysis

6.1. Cost reduction

ESG improvements reduce firms' operational costs (coefficient=-0.0406, $p<0.1$), lowering intermediate input prices for downstream firms and improving their resource efficiency.

6.2. Resource allocation optimization

ESG performance decreases TFP dispersion among downstream firms (coefficient=-0.0059, $p<0.1$), indicating reduced resource misallocation through standardized management and technology diffusion.

6.3. Innovation spillover

Higher ESG ratings correlate with more invention patents in downstream firms (coefficient=3.5326, $p<0.1$), reflecting green technology transfer and collaborative innovation [8].

Table 4: Mechanism analysis

	(1) Cost	(2) Resource Allocation Optimization	(3) Innovation Spillover
ESG	-0.0406* (0.2347)	-0.0059* (0.0032)	3.5326* (1.8400)
Controls	YES	YES	YES
Firm/Year FE	YES	YES	YES
N	6823	3146	1373
Adj.R ²	0.0443	0.6128	0.9383
cons	-21.0106	-0.1169	-59.2992

7. Conclusions and policy implications

7.1. Research conclusions

Direct Effect: ESG performance significantly boosts a firm's own TFP through innovation and resource optimization.

Spillover Effect: Asymmetric impact with stronger effects on downstream firms via cost reduction, resource allocation, and innovation spillovers.

Heterogeneity: SOEs, listed firms, and larger firms exhibit more pronounced spillover effects, with regulatory intensity enhancing ESG's efficiency role.

7.2. Policy recommendations

Enhance Supply Chain ESG Governance: Develop industry-specific ESG standards, innovative financial tools (e.g., ESG-linked loans), and a data platform for transparent ESG information sharing.

Incentivize Green Innovation: Expand green technology banks, establish patent pools, and pilot carbon emission collaboration mechanisms to facilitate technology transfer in supply chains.

Build ESG Capabilities: Integrate ESG into corporate training and education, create demonstration zones for ESG collaboration, and participate in global sustainable supply chain standard-setting.

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