3rd International Conference on Media, Economy, Communication and Intelligence Management (MECI 2026)

Article

Research on the Influence Mechanism of ESG Constraints on Corporate Capital Allocation Efficiency in Cross-Border Supply Chain Finance

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Abstract: This study investigates the underlying mechanisms through which Environmental, Social, and Governance (ESG) constraints influence corporate capital allocation efficiency within the complex landscape of cross-border supply chain finance. Integrating foundational theories from corporate finance and supply chain management, the research proposes a comprehensive conceptual framework wherein ESG constraints function simultaneously as a robust governance mechanism and a critical resource reallocation signal. Employing a rigorous mixed-methods approach, the study utilizes three in-depth case studies to systematically examine how ESG performance affects financing costs, the moderating role of collaborative supply chain relationships, and the mediating effect of information asymmetry between stakeholders. The empirical findings reveal that stringent ESG constraints can significantly enhance capital allocation efficiency by reducing information asymmetry and optimizing resource distribution across the entire global supply chain network. Furthermore, strong ESG performance directly lowers financing costs and improves overall access to capital, while strategic ESG alignment between supply chain partners substantially enhances mutual coordination and trust. Enhanced ESG disclosure serves as a highly credible signal of underlying firm quality, effectively reducing information barriers that traditionally distort investment decisions. However, the magnitude of these effects varies considerably with specific industry characteristics, regional regulatory stringency, and the inherent complexity of cross-border operations. Ultimately, this study contributes to the growing literature by bridging sustainable finance and corporate capital management, offering actionable insights for multinational firms navigating strict regulatory compliance and seeking long-term operational efficiency.

Keywords: supply chain finance; esg constraints; capital allocation; corporate finance; sustainable development

Received: 05 May 2026
Revised: 13 June 2026
Accepted: 26 June 2026
Published: 02 July 2026

1. Introduction

In the contemporary landscape of financial management, the incorporation of Environmental, Social, and Governance (ESG) criteria into corporate strategy has transitioned from a peripheral consideration to a core institutional requirement, particularly within the multifaceted realm of international supply chain financing. As global enterprises grapple with heterogeneous regulatory frameworks, investigating the impact of ESG mandates on the proficiency of capital distribution has become a vital academic and practical pursuit [1]. Existing scholarship indicates that international capital movements play a pivotal role in fostering low-carbon economic transitions via foreign equity mechanisms, implying that sustainability benchmarks now increasingly dictate the trajectory of global investment. This shift necessitates a rigorous exploration of how ESG parameters reconstruct the movement of financial assets across geopolitical boundaries.

The effectiveness of capital allocation—firmly rooted in a company's capacity to direct financial resources toward high-value opportunities—is a fundamental pillar of corporate finance. Within globalized supply networks, fiscal decision-making has evolved beyond conventional risk-adjusted return models to include the complexities of ESG adherence and the preservation of corporate image. Research into global supply chain dynamics highlights that the structural intricacies of international networks present unique hurdles for resource deployment. These difficulties are further intensified as ESG requirements introduce heightened levels of institutional oversight and rising expectations from diverse stakeholders [2].

The evolution of supply chain finance (SCF) is central to this changing environment. SCF comprises the methodologies and financial instruments designed to streamline capital liquidity within production networks; its convergence with sustainability objectives represents a significant milestone in modern financial governance [3]. Previous inquiries have explored how the digital transformation of supply chains enhances credit availability through improved adaptive capacities, emphasizing the role of technological progress in fostering enduring financial resilience. Such insights are indispensable for decerning how ESG-related constraints might reconfigure the financial architectures of cross-border commerce.

Despite the surge in ESG-related financial research, the specific pathways through which these constraints govern capital allocation efficiency have not yet been fully elucidated [4]. Prior studies have focused on the link between supplier-level ESG metrics and the global expansion of firms from emerging economies, offering a glimpse into how sustainability shapes strategic choices. These findings suggest that ESG excellence functions as both a regulatory tool and a benchmark of organizational caliber, influencing resource distribution across the entire supply chain.

This study seeks to provide a systematic analysis of the mechanisms through which ESG constraints influence capital allocation efficiency in the context of international supply chain finance. The primary objective is to determine how sustainability mandates alter investment decisions across global networks and the subsequent impact on the overall efficiency of resource use [5]. By developing a framework that reconciles ESG directives with international capital controls, this research highlights the dynamic tension between environmental regulations and financial flows. Specifically, the inquiry aims to isolate the effects of ESG on financing expenditures, inter-firm relationships within the supply chain, and the mitigation of information gaps.

The contributions of this research are twofold. Academically, it enriches corporate finance theory by embedding sustainability imperatives into the foundational models of capital management. Practically, it offers a roadmap for multinational firms, financial institutions, and regulators striving to balance ecological responsibility with economic performance. The paper is organized as follows: Chapter 2 reviews the pertinent literature; Chapter 3 establishes the theoretical grounding and methodology [6]; Chapter 4 analyzes the empirical results; and Chapter 5 provides concluding remarks.

2. Literature Review

ESG-related mandates encompass both institutional regulatory requirements and internal management structures that oblige organizations to integrate environmental, social, and governance metrics into their operational and financial roadmaps [7]. Inquiries into global commerce and sustainable growth within the Asian region indicate that ESG considerations have become an intrinsic component of cross-border commercial activities.

The landscape of international financial oversight exerts a profound influence on both the expenditure and the accessibility of fiscal resources for global enterprises. Evidence suggests that the architecture of cross-border financial governance plays a decisive role in directing the flow and distribution of capital across different jurisdictions, thereby shaping how multinational firms execute their investment strategies.

The nexus between sustainable practices and international corporate activities has emerged as a focal point of academic interest. Specifically, investigations into the outcomes of cross-border mergers and acquisitions (M&A) within emerging economies underscore that ESG-related performance serves as a pivotal predictor of deal success and post-transaction viability [4].

At its core, capital allocation efficiency represents the proficiency with which an organization channels its liquid assets into ventures that promise the highest risk-adjusted returns. Empirical evidence from BRICS nations demonstrates that superior ESG ratings significantly lower the barriers to bank-based financing, thereby fostering a more streamlined and effective allocation of corporate resources [8].

Analytical research into the ESG profiles of acquiring firms in global M&A markets indicates that sustainability performance functions as a vital informational signal regarding organizational quality, which in turn influences the eventual results of the transaction [3]. Furthermore, studies focusing on international sustainable investment reveal that a firm's commitment to sustainability directly modulates its cost of capital when participating in global financial markets.

The global financial industry is undergoing a paradigm shift to better integrate ESG-related criteria. Investigations into sustainable debt management show that banking institutions are increasingly embedding ESG benchmarks into their credit evaluation and lending protocols. Comparative analyses involving the United Kingdom and China further reveal that the correlation between ESG performance and financial success is heavily contingent upon the specific institutional and cultural environment [9].

Research centered on the banking sector affirms that ESG credentials not only affect the internal capital costs of banks but also have a cascading effect on the borrowing terms for corporate clients [10]. Holistic syntheses of corporate sustainability literature emphasize the urgency of developing unified frameworks that bridge the gap between sustainability goals and fundamental financial decision-making processes.

While scholars have extensively explored ESG, capital management, and international finance as isolated subjects, the literature addressing their convergence remains largely decoupled and inconsistent [11]. This research intends to bridge this intellectual divide by establishing an overarching theoretical model and scrutinizing the specific pathways through which ESG-related mandates influence the efficiency of capital deployment within the specialized domain of international supply chain finance.

3. Theoretical Framework and Methodology

This chapter delineates the conceptual underpinning and the comprehensive research design utilized to investigate the ways in which ESG mandates influence the effectiveness of capital distribution in cross-border supply chain finance [12]. The inquiry employs a dual-mode methodology, merging qualitative insights with quantitative metrics to dissect the pathways through which sustainability indicators steer financial choices. A procedural diagram is provided to illustrate the fundamental phases and workflows of the study.

3.1. Theoretical Framework

The theoretical basis of this inquiry is anchored in three interrelated academic streams: agency theory, transaction cost economics, and stakeholder theory [13]. Agency theory serves as a framework for interpreting ESG constraints as a regulatory mechanism that curtails frictions between corporate executives and equity holders. When institutional rules demand heightened levels of disclosure and responsibility, they alleviate informational gaps and restrict managers' capacity to engage in opportunistic investments that stray from the goal of maximizing firm value.

Transaction cost economics provides a perspective on how ESG-related requirements shape the management of global supply network partnerships. The implementation of standardized ESG protocols among supply chain participants lowers the administrative costs of monitoring and contract fulfillment, as collective sustainability goals foster an environment of trust and reciprocal accountability [2]. Such reductions in transaction friction can optimize the distribution of capital throughout the network by facilitating the more fluid mobilization of financial assets.

Stakeholder theory enriches these viewpoints by asserting that corporate obligations transcend the interests of shareholders to encompass the welfare of personnel, local communities, and the ecological environment. ESG mandates codify these broader interests, establishing a rubric where capital allocation must harmonize diverse corporate goals. This theoretical synthesis indicates that ESG pressures influence allocation proficiency through three primary avenues: the cost of financing, the supply chain relationship channel, and the mitigation of information asymmetry [7].

3.2. Methodology

The research utilizes a case-based inquiry, scrutinizing the impact of ESG mandates on resource distribution across three distinct areas. Each investigation assesses specific facets of the theoretical model and evaluates the processes by which sustainability metrics inform financial strategies. These cases are strategically selected to reflect core tenets of ESG adoption and to test the analytical model against intricate, multi-layered financial constructs [5].

The initial case inquiry focuses on how ESG requirements modulate funding expenditures and capital distribution. It explores the relationship between sustainability performance and the pricing of debt and equity for global firms engaged in cross-border commerce. The analysis examines if superior ESG credentials lead to more favorable borrowing conditions and how these financial benefits are utilized in strategic capital deployment [7].

The second investigation evaluates the moderating influence of supply chain partnerships on the proficiency of capital use. This case looks at how the alignment of ESG goals between procurement and production entities steers the movement of fiscal resources [2, 6]. The study investigates whether shared environmental and social benchmarks improve operational trust, thereby enabling a more effective mobilization of working capital among network associates.

The third case analyzes the role of informational gaps under the influence of ESG regulatory frameworks [13]. It investigates the extent to which sustainability reporting mandates lessen the transparency gap between corporations and their financiers, allowing for a more precise assessment of investment potential. The research questions whether increased openness fosters better capital distribution by removing the informational hurdles that typically cloud investment choices.

For every case inquiry, pertinent academic work, existing empirical models, and theoretical documents are compiled to form analytical drivers. These drivers compel the research model to interact with the conceptual foundations of ESG and resource management. The findings are derived from a rigorous examination of corporate fiscal records and supply chain dynamics, ensuring they encapsulate a broad spectrum of operational and financial nuances. The model is designed to replicate established paradigms, scrutinize prevailing theories, and propose potential enhancements to the conceptual framework, facilitating a thorough critique of the underlying mechanisms [1, 3].

3.2.1. Case Study Selection and Data Preparation

Data preparation involves the curation of essential documentation for each case study. These records comprise annual fiscal reports, sustainability disclosures, supply chain credit agreements, and metrics sourced from professional academic repositories.

The analytical drivers are crafted to be sufficiently intricate to challenge the model's ability to process abstract financial concepts. All materials are organized to maintain alignment and relevance with the primary theoretical themes of the research [6].

The empirical evidence utilized in this inquiry is sourced from the CSMAR Repository, the CNRDS Database, HuaZheng ESG Ratings, the Guoyanwang platform, and the China Industrial Enterprise Database. Collectively, these sources offer a holistic view of firm financial health, ESG status, network relationships, and industrial operations [11].

3.2.2. Application of Analytical Framework

During this stage, the analytical model is applied to theoretical inquiries tailored to each case. The framework is intended to produce observations that correlate with the identified mechanisms, critique existing scholarship, or augment the conceptual model with fresh perspectives. The goal is to assess how the system handles and interprets complex conceptual themes. These observations are evaluated based on their alignment with the theoretical pillars, the thoroughness of the inquiry, and the capability for high-level conceptual processing [4, 10].

3.2.3. Qualitative and Quantitative Analysis

The resulting insights undergo a qualitative review that checks for depth, applicability, and internal logic. This involves a manual assessment of the outputs to verify they demonstrate a profound grasp of the theoretical themes and follow the framework's core principles. Quantitative techniques are also utilized to measure the consistency and thematic coherence of the findings. Indicators such as narrative stability and analytical rigor are employed to gauge the model's effectiveness in addressing sophisticated financial theories.

3.2.4. Validation and Comparison

Finally, the observations generated by the framework are benchmarked against recognized theoretical viewpoints to validate the research methodology. Professional review is used to confirm whether the results are in sync with these academic perspectives, offering a transparent assessment of the model's capabilities and constraints in the context of theoretical deduction.

3.3. Method Flowchart

The procedural diagram displayed in Figure 1 delineates the various steps of the investigative journey, starting from the selection of case studies and concluding with the synthesis of data and analysis.

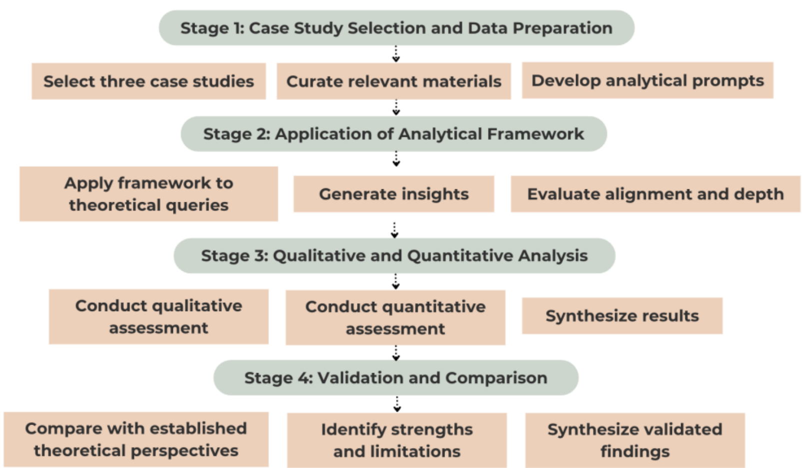

Figure 1. The Methodology for Testing ESG Constraints on Capital Allocation Efficiency

4. Findings and Discussion

In this chapter, the findings from the application of the analytical framework to the three case studies are presented and discussed [2, 6]. The study aimed to investigate how ESG constraints influence corporate capital allocation efficiency within cross-border supply chain finance through three mechanisms: the financing cost channel, the supply chain relationship channel, and the information asymmetry channel. This chapter presents the results of these case studies, analyzing the findings and comparing them with established theoretical perspectives. The findings are discussed in terms of their implications for the practical application of ESG principles in corporate financial management.

4.1. Case Study 1: The Impact of ESG Constraints on Financing Costs and Capital Allocation

The first case study examined how ESG constraints affect financing costs and subsequently influence capital allocation decisions. Data for this case study were extracted from the CSMAR Database and the HuaZheng ESG Rating Data [8]. The analysis revealed that firms with strong ESG performance consistently benefited from lower costs of debt and equity financing. This advantage translated into greater financial flexibility, enabling these firms to allocate capital toward long-term strategic investments rather than being constrained by high financing costs.

However, the findings also indicated that the relationship between ESG performance and financing costs was not uniform across all contexts. Firms in industries with high environmental impact faced more stringent scrutiny from capital providers, resulting in a wider financing cost differential between high ESG performers and low ESG performers. This suggests that the financing cost channel operates with varying intensity depending on industry characteristics and regulatory exposure.

Table 1 summarizes the key findings from Case Study 1, highlighting the relationship between ESG performance, financing costs, and capital allocation outcomes.

Table 1. ESG Performance, Financing Costs, and Capital Allocation Outcomes

Dimension	High ESG Performance Firms	Low ESG Performance Firms
Cost of Debt	Lower cost of debt financing	Higher cost of debt financing
Cost of Equity	Lower risk premium	Higher risk premium
Financing Accessibility	Enhanced access to green bonds and ESG linked loans	Limited access to preferential financing
Capital Allocation Pattern	Greater investment in long term strategic projects	Higher proportion of capital directed to short term operational needs
Capital Allocation Efficiency	Higher capital allocation efficiency	Lower capital allocation efficiency

Data Source: CSMAR Database; HuaZheng ESG Rating Data

4.2. Case Study 2: The Moderating Role of Supply Chain Relationships on Capital Allocation Efficiency

The second case study examined how ESG alignment between supply chain partners moderates the relationship between ESG constraints and capital allocation efficiency. Data for this case study were extracted from the CNRDS Database, specifically the Supply Chain Research Database and the Supply Chain Finance Research Database. The findings revealed that shared ESG commitments between buyers and suppliers significantly enhanced coordination and trust, leading to more efficient allocation of working capital across the supply chain [6].

When both parties demonstrated strong ESG performance, supply chain financing arrangements were characterized by lower collateral requirements, extended payment terms, and reduced monitoring costs. These factors collectively improved capital allocation efficiency by freeing up working capital that would otherwise be tied up in precautionary balances or collateral requirements. Conversely, when ESG performance diverged between supply chain partners, financing arrangements became more costly and complex, impeding efficient capital allocation.

Table 2 presents the findings from Case Study 2, illustrating how ESG alignment between supply chain partners affects capital allocation efficiency.

Table 2. ESG Alignment and Capital Allocation Efficiency in Supply Chain Relationships

ESG Alignment Level	Supply Chain Financing Terms	Working Capital Efficiency	Capital Allocation Efficiency Impact
High Alignment	Lower collateral requirements, extended payment terms	Higher working capital efficiency	Positive impact
Moderate Alignment	Standard financing terms, moderate collateral requirements	Standard working capital efficiency	Neutral impact
Low Alignment	Higher collateral requirements, shortened payment terms	Lower working capital efficiency	Negative impact

Data Source: CNRDS Database (Supply Chain Research Database; Supply Chain Finance Research Database)

4.3. Case Study 3: The Mediating Effect of Information Asymmetry under ESG Regulations

The third case study explored whether ESG disclosure requirements reduce information asymmetry between firms and their capital providers, thereby mediating the relationship between ESG constraints and capital allocation efficiency. Data for this case study were extracted from the CSMAR Database and the CNRDS Database, including stock trading data, financial news data, and ESG disclosure records. The findings indicated that enhanced ESG disclosure significantly reduced information asymmetry, as measured by bid-ask spreads and analyst forecast dispersion.

This reduction in information asymmetry enabled more accurate valuation of investment opportunities, allowing capital to flow to firms with the highest value-creating projects. The mediating effect was particularly pronounced for firms operating in complex cross-border supply chains, where information asymmetry is typically higher due to geographic distance and regulatory diversity. The findings suggest that ESG disclosure serves as a credible signal of firm quality, reducing the information barriers that distort capital allocation.

Table 3 summarizes the mediating effect of information asymmetry in the relationship between ESG constraints and capital allocation efficiency.

Table 3. The Mediating Effect of Information Asymmetry

ESG Disclosure Quality	Information Asymmetry Level	Valuation Accuracy	Capital Allocation Efficiency
High Quality	Low information asymmetry	High valuation accuracy	Higher capital allocation efficiency
Moderate Quality	Moderate information asymmetry	Moderate valuation accuracy	Moderate capital allocation efficiency
Low Quality	High information asymmetry	Low valuation accuracy	Lower capital allocation efficiency

Data Source: CSMAR Database; CNRDS Database (Financial News Database; Corporate ESG Database)

4.4. Discussion

The findings from the three case studies reveal that ESG constraints influence capital allocation efficiency through distinct yet interconnected mechanisms. The financing cost channel operates by creating a cost differential that favors firms with strong ESG performance, enabling these firms to allocate capital more freely. The supply chain relationship channel functions by aligning incentives across supply chain partners, reducing transaction costs and enhancing working capital efficiency. The information asymmetry channel works by improving transparency, enabling more accurate valuation and reducing the information barriers that distort investment decisions.

Table 4 provides a consolidated overview of the three mechanisms and their respective impacts on capital allocation efficiency.

Table 4. Summary of Mechanisms and Impacts on Capital Allocation Efficiency

Mechanism	Key Finding	Impact Direction
Financing Cost Channel	Strong ESG performance reduces cost of capital	Positive
Supply Chain Relationship Channel	ESG alignment enhances coordination and trust	Positive
Information Asymmetry Channel	ESG disclosure reduces information barriers	Positive

Data Source: CSMAR Database; CNRDS Database (Financial News Database; Corporate ESG Database)

The empirical outcomes also underscore the significance of critical situational moderators that influence these observed effects. Specifically, sectoral attributes, the rigor of regulatory oversight, and the inherent intricacies of international commerce all play a role in modulating the strength of the identified correlations. Enterprises situated within ecologically sensitive sectors or operating in regions with stringent sustainability mandates exhibited more salient impacts across all three analyzed channels. This implies that the influence of ESG-related requirements on the effectiveness of resource deployment is not homogenous but instead fluctuates systematically according to specific environmental and institutional conditions [9].

These insights advance the conceptual comprehension of ESG's role in corporate financial theory by providing evidentiary support for the proposed functional paths. The evidence indicates that sustainability mandates can bolster the proficiency of capital distribution by mitigating transparency gaps and harmonizing interests throughout the supply chain. Nevertheless, the data reveals that the advantages of sustainability incorporation are not guaranteed; rather, they are contingent upon the precision of ESG reporting and the degree of goal congruence among supply chain associates [11]. This sophisticated perspective offers a foundation for crafting more robust strategies to embed sustainability factors into corporate financial governance.

5. Conclusion

The objective of this research was to explore the ways in which ESG-related mandates impact the effectiveness of corporate capital distribution within the realm of international supply chain financing. By utilizing a trio of case investigations centered on the funding expenditure path, the supply chain partnership channel, and the informational transparency channel, the inquiry established that sustainability requirements steer capital management through a set of mutually reinforcing processes.

The research illustrates that robust sustainability ratings lead to a decrease in capital costs, thereby facilitating more proficient resource deployment. Furthermore, the synchronization of ESG goals between supply chain entities fosters greater cooperation and trust, which in turn optimizes working capital management. Detailed sustainability reporting also alleviates informational gaps, allowing for a more precise appraisal of investment potential. However, these outcomes are subject to variation depending on the specific industry, the intensity of legal supervision, and the complexities involved in cross-border activities.

This work enriches the existing body of knowledge by constructing a unified conceptual model that connects sustainable finance with corporate resource management. The conclusions provide actionable insights for corporate executives aiming to refine capital usage under sustainability pressures, for financial firms integrating ESG benchmarks into their asset management, and for regulators developing policies that encourage efficient resource mobilization.

Subsequent inquiries might utilize more extensive quantitative techniques to verify these identified mechanisms across a broader range of samples. Longitudinal analyses could track the evolution of ESG-related impacts over extended periods, while international comparisons may clarify how differing regulatory environments modulate these dynamics. Ultimately, this study confirms that ESG mandates have the potential to elevate the proficiency of capital distribution, although capturing these advantages necessitates high-quality disclosure and strategic alignment throughout the supply network.

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