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Configurational Analysis of ESG Factors and Eco-Innovation Impact on Financial and Market Performance in Scandinavian Manufacturing Firms

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ABSTRACT

Environmental, Social, and Governance (ESG) factors and eco-innovation have become increasingly important in the business landscape. Firms are expected to operate in a responsible and sustainable manner, while stakeholders demand greater transparency and accountability from corporations. This study investigates the complex relationships between Environmental, Social, and Governance factors and eco-innovation in driving firm performance among Scandinavian manufacturing companies. The research employs the fuzzy set Qualitative Comparative Analysis method to analyse the data from 104 manufacturing firms across Sweden, Norway, and Denmark to identify specific configurations leading to high and non-high firm performance outcomes. The findings reveal distinct pathways to achieving high financial and market performance. For financial performance, a pronounced emphasis on the environmental pillar, coupled with eco-innovation initiatives, emerges as the primary driver. For market performance, firms achieve superior performance either through environmental and governance practices or through environmental practices combined with eco-innovation. Conversely, the presence of all ESG dimensions without eco-innovation leads to non-high performance. These findings contribute to understanding how different combinations of ESG practices and eco-innovation can drive firm success in the Scandinavian manufacturing context.

1 | Introduction

In today's rapidly evolving business landscape, firms are increasingly eager to develop sustainable strategies that not only drive profitability but also address pressing global challenges (Kandpal et al. 2024). This shift toward responsible business practices has brought Environmental, Social, and Governance (ESG) factors and eco-innovation to the forefront of corporate agendas worldwide (Dicuonzo et al. 2022). As stakeholders demand greater accountability and transparency, companies are recognizing that their long-term success is inextricably linked to their ability to navigate complex environmental and social issues while maintaining robust governance structures (Khamisu et al. 2024). Effective implementation of ESG activities is crucial for improving corporate efficiency, financial performance, and market competitiveness (Xie et al. 2019).

Existing studies have extensively explored the performance effects of ESG practices. At the macro level, high ESG scores are considered instrumental in meeting stakeholder demands, facilitating long-term emission reductions, and enhancing organizational sustainability (Edmans 2023; Setiarini et al. 2023). At the micro level, proactive ESG practices can significantly improve investment efficiency, optimize

government-enterprise relations, and enhance performance metrics such as return on assets (ROA) by fostering green innovation (Zhang et al. 2023). However, the impact of ESG performance on corporate outcomes exhibits marked inconsistency across different contexts. For instance, research focusing on Chinese manufacturing firms has identified negative impacts of ESG (Khan and Liu 2023), while evidence from the Nordic financial sector reveals a dual nature of both positive and negative effects (Rahi et al. 2022). Eco-innovation, as another critical source of corporate competitive advantage, aims to mitigate environmental risks by improving products and processes (Larbi-Siaw et al. 2023; Mohd Daud et al. 2024). Existing literature indicates that effective eco-innovation can secure strategic resources and enhance customer trust (Oduro 2024). Nevertheless, the positive effect of eco-innovation on performance is not always direct or significant. The introduction of environmental management systems may lead to organizational rigidity (Valero-Gil et al. 2023), and due to lags in consumer perception, environmental investments often struggle to yield immediate financial returns in the short term (Nakamura 2011). The existence of these "strategic trade-offs" implies that firms must achieve synergy among various antecedent conditions to balance innovation investment with economic returns.

In summary, while existing literature has extensively acknowledged the value of ESG practices and eco-innovation for corporate performance and sustainability, several research gaps remain. First, most extant studies adopt a variable-centered perspective to examine the independent impacts of specific ESG dimensions and eco-innovation (e.g., Mohajan and Zhao 2026; Setiarini et al. 2023; Zhang et al. 2023), failing to integrate them into a unified framework for comprehensive consideration. Consequently, the potential non-linear interactions and synergistic complementarities between them (e.g., Friede et al. 2015; Wang et al. 2024) have been overlooked, leaving the mixed effects of both factors on performance inadequately explained. Second, although different types of organizational performance may rely on distinct combinations of resources and capabilities, the multiple pathways (equifinal configurations) to achieving financial and market performance have not been sufficiently explored. This limitation hinders in-depth insights into the configurational effects of ESG and eco-innovation, making it difficult for firms to flexibly select differentiated performance-enhancement paths under resource and institutional constraints. Finally, current research primarily focuses on multinational corporations or emerging economies, while studies targeting the Scandinavian manufacturing sector remain scarce. However, understanding how to recombine or substitute different capabilities to achieve performance goals is critical, particularly for manufacturing firms operating under stringent environmental regulations.

To address these limitations, this study integrates institutional theory and the "innovation offset" perspective to construct an integrated model examining the driving mechanisms of the synergistic configurations of ESG practices and eco-innovation on the financial and market performance of Scandinavian manufacturing firms. By employing the fuzzy-set qualitative comparative analysis (fsQCA) method, this study reveals multiple equifinal and asymmetric causal paths leading to high performance. The contributions of this research are first reflected in the theoretical perspective, providing an integrated view for understanding the causal complexity between sustainability practices and firm performance by elucidating the interdependent logic of external institutional pressure and internal eco-innovation drivers in value creation. Second, we shift the research focus from isolated "net effects" to the "synergistic effects" between factors, confirming that organizational success depends on specific contextual configurations of conditions rather than the independent drive of any single dimension. Finally, at the level of practical value, this study fills the empirical gap in the Scandinavian manufacturing sector, offering actionable path guidance for corporate leaders navigating "strategic trade-offs" among innovation investment, social responsibility, and economic returns, while providing empirical support for policymakers to design precise environmental incentive systems.

The remainder of this paper is organized as follows: Section 2 reviews the literature on ESG, eco-innovation, and corporate performance while identifying the limitations of existing research. Section 3 elaborates on the theoretical foundation of this study and proposes a conceptual framework. Section 4 describes the research methodology, including data collection, variable measurement, and the advantages of applying the fsQCA method. Section 5 presents the analysis process and empirical results in detail. Section 6 discusses the findings and their implications for theory and practice. Finally, in Section 7, we conclude the paper, summarize the main contributions, and point out the limitations of this study along with directions for future research.

2 | Literature Review

2.1 | ESG Practices and Firm Performance: From Linear to Complex Relations

Against the backdrop of increasingly severe global environmental and social challenges, ESG (Environmental, Social, and Governance) issues have emerged as a central focus of academic inquiry (Galletta and Mazzù 2023; Li, Tang, and Li 2024). As a critical framework for measuring non-financial performance, ESG has profoundly reshaped the interaction logic between firms, their stakeholders, and the natural environment (Buallay 2019; Drempetic et al. 2020).

Currently, research on the impact of ESG on firm value and sustainable development has experienced exponential growth (Bagh et al. 2024; Li, Tang, Liang, and Wang 2024; Wang et al. 2024; Duque-Grisales and Aguilera-Caracuel 2021; Seok et al. 2024), yet findings remain subject to significant debate. While one stream of research provides direct evidence that ESG promotes firm performance (Chen et al. 2023), another reveals the complexity and context-dependency of these effects. For instance, some scholars have found that the environmental (*E*) and social (*S*) dimensions contribute positively to firm value, whereas the impact of the governance (*G*) dimension remains insignificant (Kong et al. 2023; Zheng et al. 2022). Regional disparities further exacerbate these inconsistencies:

in the Brazilian market, high ESG scores help reduce the cost of capital (Possebon et al. 2024); conversely, in India, while ESG disclosure enhances market valuation (Tobin's *Q*), it may impair short-term profitability (ROA) due to resource diversion (Veeravel et al. 2024).

Such conflicting conclusions suggest that the relationship between ESG and performance is not a simple linear mapping but is profoundly influenced by synergies or conflicts among the various dimensions. From an external perspective, drawing on signaling theory, ESG disclosure mitigates information asymmetry and reduces investor risk perception, thereby significantly enhancing financing accessibility and lowering debt costs (Cheng et al. 2014; Eliwa et al. 2021; Reber et al. 2022). From an internal management perspective, ESG practices generate a premium effect on organizational capabilities, enhancing talent attraction and employee identification (Farooq et al. 2017; Weber 2014). Furthermore, a long-term bidirectional linkage exists between ESG performance and green innovation outputs; superior ESG performance can drive firms toward green innovation transformation (Zheng et al. 2023).

2.2 | The Role of Eco-Innovation in Enhancing Firm Performance

Eco-innovation has been identified as a source of competitive advantage globally, enhancing the understanding and investigation of eco-innovation strategy on sustainability and firm performance (Mohd Daud et al. 2024). Larbi-Siaw et al. (2023) argue that eco-innovation is the development of existing products, processes, organizational structures, and technologies to reduce pollution and related environmental risks. Multiple studies have demonstrated a positive relationship between eco-innovation and various aspects of corporate performance (Geng et al. 2021; Przychodzen and Przychodzen 2015).

For instance, effective eco-innovation practices not only provide firms with strategic developmental resources but also enhance customer trust and attract investor attention (Oduro 2024), contributing unique value to corporate sustainability. Typically, eco-innovative firms exhibit superior profitability (such as higher ROA and ROE) and capital operational efficiency (Przychodzen and Przychodzen 2015). Consequently, the literature suggests that firms should regularly update their business processes to respond to environmental trends through eco-innovation and optimize social and environmental efficiency, thereby driving performance improvements (Mohajan and Zhao 2026). This integration of strategic orientation helps firms achieve better performance while promoting long-term sustainable operations.

However, the impact of eco-innovation on performance is not always direct or linear. Some research has found that eco-innovation activities—for example, the introduction of Environmental Management Systems (EMS)—may generate organizational rigidities, which in turn weaken the link between eco-innovation and environmental performance (Gerged et al. 2023). This finding contradicts traditional expectations (Valero-Gil et al. 2023). Furthermore, environmental investments often struggle to yield immediate financial returns, primarily due to cognitive lags among consumers and shareholders; such investments may only show a significant enhancement of corporate performance over the long term (Nakamura 2011).

2.3 | The Interdependence Between ESG and Eco-Innovation: A Configurational Perspective

Extant literature has extensively confirmed the significant positive correlation between ESG initiatives, corporate innovation, and organizational value (Li and Li 2024; Wang and Esperança 2023). On one hand, robust ESG performance can enhance corporate innovation efficiency by reducing agency costs and mitigating financing constraints (Wang and Esperança 2023), thereby improving innovation quality and patent value (Li and Li 2024). On the other hand, as a core manifestation of digital and green transformation, eco-innovation serves not only as a driver for firms to achieve sustainable development goals but also as a strategic implementation that feeds back into and strengthens ESG performance, creating a positive dynamic feedback mechanism (Long et al. 2023; Toha et al. 2024).

However, this interdependence exhibits complex boundary conditions and potential inconsistencies at the empirical level. Research indicates that the driving effect of ESG on firm value is often deeply moderated by industry characteristics, ownership structures, and regional contexts (Chen and Zhang 2024). For instance, in heavy-polluting industries or contexts with high governmental environmental concern, the promotional effect of ESG on innovation is more pronounced (Wang and Wang 2024). Furthermore, the development of digital finance and the intervention of government subsidies have added to the non-linear characteristics of the "ESG–innovation–performance" nexus (Xue et al. 2023; Na et al. 2024). This implies that improvement in a single dimension does not necessarily guarantee performance growth; rather, the synergistic alignment among various elements is the key to value creation.

By reviewing existing research findings, we find that although current literature widely acknowledges the importance of ESG and eco-innovation and has explored their respective relationships with firm performance, several research gaps warrant attention. First, most studies overlook the causal complexity between the various dimensions of ESG and eco-innovation, failing to reveal the non-linear interactive logic of these elements in enhancing performance. Second, few studies have integrated ESG practices and eco-innovation into a unified framework to explore their hybrid configurational impact on firm performance. To date, there is a lack of direct evidence explaining how firms navigate complex strategic trade-offs through different combinations of pathways. Finally, current research primarily focuses on global multinational corporations or developing economies, leaving a significant gap in the context of the Scandinavian manufacturing sector. Understanding how ESG and eco-innovation influence firm performance and identifying the configurational paths to achieving high-level performance targets is crucial for the sustainable development of the manufacturing industry. In summary, these existing deficiencies limit the practical guidance value of current research conclusions,

highlighting the need to further explore how firms achieve optimal performance through differentiated pathway combinations under complex resource constraints and environmental pressures.

3 | Theoretical Foundation and Conceptual Model

Drawing on Institutional Theory, firms face multi-faceted pressures from government regulation, capital markets, and stakeholders, which typically manifest in coercive, normative, and mimetic forms (DiMaggio and Powell 1983). Consequently, corporate environmental strategic decisions are not based solely on efficiency considerations but are deeply embedded within an institutional environment composed of regulatory policies, industry norms, and social expectations (Aragòn-Correa et al. 2020). To respond to external expectations and secure as well as maintain organizational legitimacy, firms actively engage in various environmental investments or corporate social responsibility (CSR) practices, such as ESG initiatives (Meyer and Rowan 1977; Suchman 1995).

It is worth noting that while ESG is typically categorized as a non-financial factor, it has been widely recognized as a critical driver for managing financial risks. Through such practices, firms aim to mitigate compliance risks, institutional uncertainties, and potential financial volatility (Singhania and Gupta 2024). By enhancing corporate reputation and fostering trust, ESG practices improve a firm's ability to secure key resources such as capital and policy support, which in turn reduces risk premiums and strengthens financial stability (Campbell 2007).

In the Scandinavian context, firms similarly confront stringent environmental regulations and peer pressure; thus, proactively responding to environmental calls and increasing resource commitment is an inevitable choice to meet stakeholder expectations. While such external pressures impose a degree of institutional constraint, they also provide the impetus for firms to internalize environmental concerns into internal policies and strategic actions. Firms are expected to obtain a social license to operate by establishing a responsible social image, which helps mitigate financial risks while yielding benefits for performance improvement and sustainable development. Therefore, this theory provides a robust foundation for examining how ESG practices drive corporate performance.

Under increasing pressure from stringent environmental regulations, firms often face a trade-off between environmental compliance and economic competitiveness, which inevitably incurs significant compliance costs (Jaffe et al. 1995). However, well-designed environmental standards are not merely a cost burden; they can induce “innovation offsets” that enhance resource productivity (Porter and Linde 1995). This implies that if firms proactively respond to regulatory pressures through process improvements or technological innovations, they may offset or even exceed compliance expenditures, thereby achieving enhanced performance and sustainable development. This logic, which frames innovation as a compensatory mechanism, provides the core theoretical foundation for examining the value creation of eco-innovation in this study. Within this research, eco-innovation is defined as a dynamic process through which firms develop or improve green technologies, processes, and products to effectively mitigate environmental externalities and explore new market opportunities. From the perspective of innovation offsets, eco-innovation is not only a passive response to environmental regulations but also a strategic investment behavior aimed at overcoming constraints and pursuing green premiums through creative endeavors. Based on this theoretical framework, we investigate whether proactive eco-innovation, when complemented by corporate social responsibility practices, can jointly drive the improvement of corporate economic performance.

In summary, this study constructs a conceptual framework based on Institutional Theory and the Innovation Offset perspective. We explore different driving mechanisms for corporate performance enhancement from the perspectives of external institutional constraints and internal value transformation, respectively. This complementary lens provides solid theoretical support for understanding how ESG practices and eco-innovation jointly act on corporate performance, facilitating a deep analysis of the mixed effects of both on superior performance within the Scandinavian context. Furthermore, this complementary perspective aligns closely with the configurational logic of fsQCA: superior performance does not stem from the summation of single factors, but from the strategic alignment of institutional legitimacy (ESG practices) and innovation offset capabilities (Eco-Innovation). The conceptual logic of this study is illustrated in Figure 1.

4 | Research Design

4.1 | Sample and Data

This study focuses on manufacturing firms located in Scandinavian countries—Sweden, Norway, and Denmark—to investigate the relationship between ESG factors, eco-innovation, and firm performance. The data for the study was obtained from the Refinitiv Eikon database, a comprehensive source of ESG-related and financial performance data for publicly listed firms. The year 2023 was selected for analysis to ensure the data reflects the most current trends and practices.

The initial sample consisted of 205 manufacturing firms registered in the selected Scandinavian countries. These firms were screened based on their availability of ESG scores and financial performance data. To maintain consistency and rigor in the analysis, the study employed a “complete case” scenario approach (Hughes et al. 2019), which eliminates firms with missing data. This process resulted in a final sample size of 104 firms, encompassing 416 observations. The inclusion criteria ensured that the selected firms provided data across all key variables, including ESG dimensions, eco-innovation metrics, and financial performance indicators. Out of the 104 firms, the distribution by country is as follows: Sweden accounts for 67 firms, Norway for 21 firms, and Denmark for 16 firms. Table 1 shows the distribution of the firms by industry focus. The inclusion criteria ensured that the selected firms provided data across all key variables, including ESG

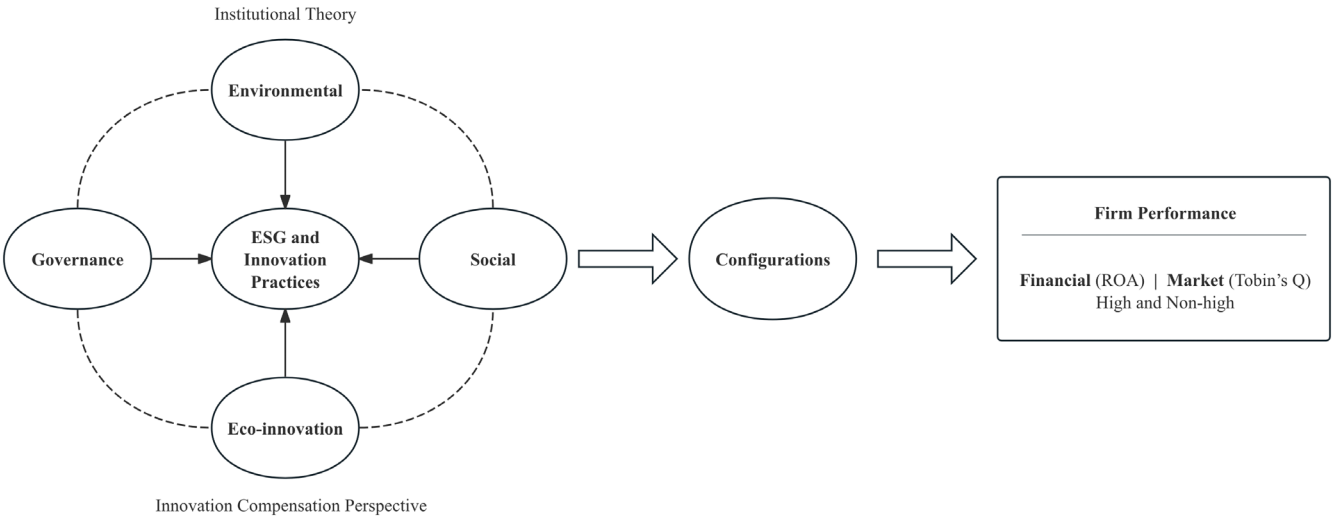

FIGURE 1 | A configuration model on ESG and Eco-innovation for firm performance. *Source:* Figure by authors.

dimensions, eco-innovation metrics, and financial performance indicators.

4.2 | Description of the Outcome and Antecedent Conditions

This section outlines the parameters employed in the current research. Table 2 provides an overview for the conditions used.

The key variables of interest in this study include environmental, social, and governance disclosure scores, eco-innovation, and two firm performance metrics: ROA and Tobin's *Q*. ESG disclosure scores, which represent the environmental, social, and governance dimensions, were sourced directly from the Refinitiv Eikon database. The environmental disclosure score measures the firm's environmental initiatives and transparency, while the social and governance scores capture the firm's contributions to social welfare and corporate governance practices, respectively. The Refinitiv Eikon eco-innovation score assesses how effectively a company lowers environmental costs for consumers and creates new market opportunities through innovative or improved green technologies, processes, or products (see Refinitiv Eikon). Previous studies often use surveys or questionnaires to assess eco-innovation (e.g., Eiadat et al. 2008; Peng and Liu 2016). However, these approaches can lack objectivity and verifiability, as responses may be shaped by personal biases (Arena et al. 2018; Zaman et al. 2024). In contrast, the eco-innovation score from Refinitiv Eikon provides a more objective measure. ROA was used as a proxy for financial performance, representing the ratio of earnings before interest and tax to total assets, while Tobin's *Q*, the ratio of the market value of equity plus total liabilities to total assets, served as a proxy for market performance.

4.3 | Method

A fsQCA method was employed to identify the ESG factors and eco-innovation that impact the performance of manufacturing companies (variables are defined in Table 2). fsQCA is a set-based methodology that uses Boolean algebra to determine the combinations of antecedent conditions that are likely to result in a specific outcome (Legewie 2013; Longest and Vaisey 2008). The tilde symbol (~) denotes the logical negation (absence) of a condition, calculated as 1 minus the original set membership score. For example, ~*S* represents the absence of the social dimension as a causal factor.

Compared to traditional regression analysis, which focuses on the net effects of individual variables, the methodological advantages of fsQCA in this study are primarily reflected in three aspects. First, grounded in configuration theory, fsQCA transcends linear regression's focus on the independent effects of single variables (Liu et al. 2022; Ragin 2009), effectively revealing the mixed driving effects of ESG practices and eco-innovation on corporate performance. Second, unlike regression analysis, which tends to seek a single optimal explanatory path, fsQCA acknowledges the existence of multiple equifinal paths leading to the same outcome (Zhu et al. 2026). This is consistent with the theoretical framework of this study, suggesting that firms can achieve equally high levels of financial or market performance through different institution-resource matching modes. Finally, while traditional regression methods typically rely on the assumption of linear symmetry—implying that the absence of factors leading to success necessarily leads to failure—fsQCA effectively overcomes this limitation (Fiss 2011). It accounts for the fundamental differences between configurations leading to high corporate performance and those leading to non-high performance, thereby enabling a more comprehensive exploration of the complex mechanisms driving corporate sustainability.

The application of fsQCA follows a specific step-by-step process, including data calibration, necessity analysis, sufficiency analysis of conditional configurations, and robustness testing. Initially, data must be calibrated, followed by an interpretation of causal relationships from the perspectives of both necessity and sufficiency. A condition is necessary for an outcome if the outcome cannot occur without that condition. A condition or configuration of conditions is sufficient for an outcome if the

TABLE 1 | Industry distribution of firms.

Industry	Firm numbers	Percentage (%)
Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	8	7.69
Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	8	7.69
Agriculture, Construction, and Mining Machinery Manufacturing	5	4.81
Motor Vehicle Parts Manufacturing	5	4.81
Pulp, Paper, and Paperboard Mills	5	4.81
Converted Paper Product Manufacturing	4	3.85
Communications Equipment Manufacturing	4	3.85
Basic Chemical Manufacturing	4	3.85
Semiconductor and Other Electronic Component Manufacturing	4	3.85
Seafood Product Preparation and Packaging	4	3.85
Medical Equipment and Supplies Manufacturing	4	3.85
Other General Purpose Machinery Manufacturing	4	3.85
Industrial Machinery Manufacturing	3	2.88
Alumina and Aluminum Production and Processing	3	2.88
Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing	2	1.92
Cut and Sew Apparel Manufacturing	2	1.92
Electrical Equipment Manufacturing	2	1.92
Household Appliance Manufacturing	2	1.92
Computer and Peripheral Equipment Manufacturing	2	1.92
Fabric Mills	2	1.92
Beverage Manufacturing	2	1.92
Aerospace Product and Parts Manufacturing	1	0.96
Animal Food Manufacturing	1	0.96
Other Fabricated Metal Product Manufacturing	1	0.96
Steel Product Manufacturing from Purchased Steel	1	0.96
Grain and Oilseed Milling	1	0.96
Rubber Product Manufacturing	1	0.96
Petroleum and Coal Products Manufacturing	1	0.96
Fruit and Vegetable Preserving and Specialty Food Manufacturing	1	0.96
Motor Vehicle Manufacturing	1	0.96
Motor Vehicle Body and Trailer Manufacturing	1	0.96
Engine, Turbine, and Power Transmission Equipment Manufacturing	1	0.96
Other Nonmetallic Mineral Product Manufacturing	1	0.96
Boiler, Tank, and Shipping Container Manufacturing	1	0.96
Household and Institutional Furniture and Kitchen Cabinet Manufacturing	1	0.96
Commercial and Service Industry Machinery Manufacturing	1	0.96
Other Food Manufacturing	1	0.96
Other Electrical Equipment and Component Manufacturing	1	0.96
Office Furniture (including Fixtures) Manufacturing	1	0.96
Other Wood Product Manufacturing	1	0.96

(Continues)

TABLE 1 | (Continued)

Industry	Firm numbers	Percentage (%)
Cement and Concrete Product Manufacturing	1	0.96
Paint, Coating, and Adhesive Manufacturing	1	0.96
Audio and Video Equipment Manufacturing	1	0.96
Pharmaceutical and Medicine Manufacturing	1	0.96
Spring and Wire Product Manufacturing	1	0.96
Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	1	0.96
Total	104	100.00

Source: Table by authors.

outcome occurs when the condition is present, even if other conditions are also present (Ragin 2009). The 3.0 version of the fsQCA software was used to conduct the analysis.

5 | Results

5.1 | Data Calibration

Variable calibration is a pivotal step in Qualitative Comparative Analysis (QCA) for converting raw data into fuzzy-set membership scores. This study adopts the direct calibration method proposed by Ragin (2009). Compared to direct assignment or indirect calibration methods that rely on subjective judgment (such as expert experience), this approach offers greater objectivity and replicability. Specifically, following the methodology of Fiss (2011), we calibrated the four antecedent conditions and two outcome variables.

In calibrating the fuzzy sets, this study adopts the direct method and sets the thresholds for full membership, the crossover point, and full non-membership at the 75th, 50th, and 25th percentiles of the sample distribution, respectively. This specification is motivated by the characteristics of the sample, which consists of Scandinavian manufacturing firms that generally exhibit high levels of performance in sustainability, resulting in relatively high and concentrated variable scores. The use of uniform absolute thresholds in such a context may obscure meaningful variation within high-performing cases and even misclassify relatively strong performers into lower membership categories, leading to a loss of information. By contrast, percentile-based anchors establish relative benchmarks within the sample, enabling clearer differentiation among cases while preserving variation and enhancing the explanatory power of the configurational analysis. This setting standard has been applied in existing literature (Lou et al. 2022), as it preserves sufficient contrast between cases while capturing more diverse strategic combinations.

Through the aforementioned calibration process, all variables were transformed into fuzzy-set membership scores ranging from 0 to 1 (Liu et al. 2022). Furthermore, to prevent cases from being excluded at the crossover point, we followed the recommendation of Crilly et al. (2012) and subtracted 0.001 from cases with a membership score of exactly 0.5. Table 3 presents the results of data calibration.

5.2 | Analysis of Necessary Conditions

We conducted necessary conditions analysis to examine whether ESG pillar and eco-innovation are necessary conditions for generating high or non-high firm performance (Tobin's *Q* and ROA). Consistency measures the degree to which cases sharing a given configuration reliably exhibit the outcome, with values closer to 1.0 indicating stronger empirical support. Necessary conditions analysis can answer whether a condition must be present when high or non-high firm performance occurs. When the consistency level exceeds 0.9, it can be preliminarily judged that the condition is a necessary condition for the outcome to occur. Furthermore, some literature suggests that the coverage rate of necessary conditions should ideally not be less than 0.5 (Liu et al. 2025). The results in Tables 4 and 5 indicate that the consistency of all conditions is below the threshold of 0.9.

5.3 | Sufficiency Analysis of Conditional Configuration

Configurational analysis answers which combinations of conditions are sufficient to produce a specific outcome by considering the combination of antecedent conditions that lead to the outcome. Raw coverage quantifies the proportion of the outcome explained by a specific configuration, analogous to explained variance in regression analysis. We conducted configurational analysis using fsQCA 3.0 software separately for ROA and Tobin's *Q* to generate high and non-high firm performance, with each configuration representing different pathways to achieving the same outcome. The parameter settings are as follows: First, considering that lower frequency thresholds can be set for small- and medium-sized samples, we set the frequency threshold to 1. Second, consistency measures the extent to which each configuration is a subset of the outcome set, and if the consistency score is below 0.75, imprecise subset relationships may be obtained (Ragin 2009). Therefore, we further increased the consistency threshold to 0.8. Finally, to avoid contradictory configurations, we set the PRI to 0.6.

Table 6 presents the configurations that lead to high levels of corporate performance. For financial performance (ROA), we identify one key pathway, H1 (~*S* * ~*G* * *E* * Eco-innovation), with a consistency of 0.783 (indicating a 78.3% reliability in producing the outcome) and a raw coverage of 0.140 (explaining 14% of high-performance cases), which indicates a reliable but specialized pathway toward achieving superior financial returns. This configuration suggests that high levels of environmental commitment (*E*) and eco-innovation are the core conditions driving financial returns, and notably, this objective can be attained even in contexts where social responsibility (*S*) and

TABLE 2 | Variables and definitions.

Conditions	Description	Source
Environment disclosure score	The environmental dimension of the ESG score	Eliwa et al. (2021), Houqe et al. (2020)
Social disclosure score	The social dimension of ESG score	Eliwa et al. (2021), Houqe et al. (2020)
Governance disclosure score	The governance dimension of ESG score	Eliwa et al. (2021), Houqe et al. (2020)
Eco-innovation	Company's ability to reduce environmental costs and burdens for its consumers	Issa and Bensalem (2023), Zaman et al. (2024)
ROA—Return on assets	The ratio of earnings before interest and tax to total assets	Al Amosh and Khatib (2023), Houqe et al. (2020)
Tobin's *Q*	The ratio of the market value of equity plus total liabilities to total assets	Ademi and Klungseth (2022), Boulhaga et al. (2023)

Source: Table by authors.

TABLE 3 | Data calibration of outcomes and conditions.

Outcomes and conditions	75%-Full membership	50%-Crossover point	25%-Full non-membership
ROA	0.120	0.083	0.049
Tobin's *Q*	2.084	1.371	0.892
E	71.277	59.417	43.270
S	76.889	64.524	49.635
G	75.843	61.002	40.136
Eco-innovation	73.608	50.000	30.680

Note: The choice of the 75th, 50th, and 25th percentiles as anchors follows established methodological precedents in management research (Lou et al. 2022), ensuring that the calibration process remains objective and grounded in the empirical distribution of the sample.
Source: Table by authors.

TABLE 4 | Analysis of necessary conditions for financial performance measured by ROA.

	High financial performance		Non-high financial performance	
Conditions	**Consistency**	**Coverage**	**Consistency**	**Coverage**
E	0.545	0.547	0.531	0.535
~*E*	0.537	0.533	0.550	0.548
S	0.513	0.500	0.594	0.580
~*S*	0.569	0.583	0.488	0.501
G	0.503	0.505	0.588	0.591
~*G*	0.592	0.589	0.507	0.506
Eco-innovation	0.575	0.568	0.525	0.520
~Eco-innovation	0.513	0.519	0.563	0.571

Note: The notation ~ indicates the absence/negation of a condition.
Source: Table by authors.

corporate governance (*G*) are relatively absent, implying a strategic logic among Scandinavian manufacturing firms to achieve cost offsets and efficiency gains by focusing on green technology premiums.

Regarding the configurations that lead to high levels of market performance (Tobin's *Q*), two equifinal pathways were identified: H2 (*E* * ~*S* * *G*) and H3 (*E* * ~*S* * Eco-innovation). H2 exhibits a strong consistency of 0.791 and a raw coverage of 0.156, where

TABLE 5 | Analysis of necessary conditions for financial performance measured by Tobin′ *Q*.

	High financial performance		Non-high financial performance	
Conditions	**Consistency**	**Coverage**	**Consistency**	**Coverage**
E	0.516	0.520	0.565	0.567
~*E*	0.570	0.568	0.522	0.518
S	0.478	0.468	0.635	0.619
~*S*	0.610	0.626	0.454	0.464
G	0.515	0.518	0.578	0.579
~*G*	0.581	0.580	0.519	0.516
Eco-innovation	0.538	0.533	0.553	0.546
~Eco-innovation	0.541	0.548	0.527	0.532

Note: The notation ~ indicates the absence/negation of a condition.
Source: Table by authors.

TABLE 6 | Configurations for generating high levels of financial and market performance.

	For ROA	For Tobin′*Q*	
Configuration	**H1**	**H2**	**H3**
E	●	●	●
S	⊗	⊗	⊗
G	⊗	●	
Eco-innovation	●		●
Consistency	0.783	0.791	0.752
Raw coverage	0.140	0.156	0.202
Unique coverage	0.140	0.034	0.079
Overall solution coverage	0.140	0.235	
Overall solution consistency	0.783	0.754	

Source: Table by authors.

TABLE 7 | Configurations for generating non-high levels of firm performance.

	For ~ ROA	For ~ Tobin′ *Q*
Configuration	**N1**	**N2**
E	●	●
S	●	●
G	⊗	●
Eco-innovation	⊗	⊗
Consistency	0.751	0.800
Raw coverage	0.130	0.159
Unique coverage	0.130	0.159
Overall solution coverage	0.130	0.159
Overall solution consistency	0.751	0.800

Source: Table by authors.

the synergy between environmental commitment and corporate governance forms the core of market recognition, reflecting the capital market's preference for firms that balance regulatory governance with environmental responsibility. H3, with a consistency of 0.752 and the highest raw coverage of 0.202 (accounting for 20.2% of market performance cases), represents the more empirically relevant pathway, highlighting the status of environmental performance and active eco-innovation as core conditions for eliciting positive feedback from markets and investors.

In summary, across all identified pathways, environmental performance (*E*) consistently emerges as a core condition, underscoring its role as a necessary antecedent for high performance, while the consistent absence of the social dimension (*S*) reveals the prevalence of strategic trade-offs and resource crowding-out effects within the context of resource constraints.

Table 7 presents the configurations leading to non-high levels of corporate performance, further substantiating the causal asymmetry within our framework. For non-high financial performance (ROA), configuration N1 (*E* * *S* * ~ *G* * ~Eco-innovation) exhibits a consistency of 0.751 and raw coverage of 0.130. This pathway suggests that in the absence of effective corporate governance and eco-innovation, mere investment in environmental and social pillars fails to translate into financial gains. Instead, firms may fall into a "compliance cost trap," where high ESG expenditures without innovative offsets lead to a resource crowding-out effect that compromises profitability.

For non-high market performance (Tobin's *Q*), configuration N2 (*E* * *S* * *G* * ~Eco-innovation) reveals an even more noteworthy phenomenon: even with high performance across all three ESG dimensions, the absence of eco-innovation leads to suboptimal market valuation (consistency = 0.800; raw coverage = 0.159). This configuration of "high compliance, low innovation" implies that capital markets perceive firms that neglect the core driver of eco-innovation as conservative and lacking dynamic competitive capabilities. Without the transformative potential of innovation, an excellent ESG profile alone is insufficient to secure a valuation premium above the industry average.

TABLE 8 | Robustness test of high-performance configurations using increased frequency threshold of 2.

	For ROA	For Tobin′ *Q*	
Configuration	**R1_1**	**R2_1**	**R3_1**
E	●	●	●
S	⊗	⊗	⊗
G	⊗	●	
Eco-innovation	●		●
Consistency	0.783	0.791	0.752
Raw coverage	0.140	0.156	0.202
Unique coverage	0.140	0.034	0.079
Overall solution coverage	0.140	0.235	
Overall solution consistency	0.783	0.754	

Source: Table by authors.

TABLE 9 | Robustness test of high-performance configurations using adjusted PRI consistency threshold of 0.65.

	For ROA	For Tobin′ *Q*	
Configuration	**R1_2**	**R2_2**	**R3_2**
E	●	●	●
S	⊗	⊗	⊗
G	⊗	●	
Eco-innovation	●		●
Consistency	0.783	0.791	0.752
Raw coverage	0.140	0.156	0.202
Unique coverage	0.140	0.034	0.079
Overall solution coverage	0.140	0.235	
Overall solution consistency	0.783	0.754	

Source: Table by authors.

5.4 | Robustness Test

To ensure the reliability of the research conclusions, this study conducted rigorous robustness tests on the empirical results through two key measures. First, we increased the case frequency threshold from 1 to 2 to exclude the influence of extreme or isolated cases on the configurational paths. As shown in Table 8, under these stricter screening criteria, the driving paths, consistency, and coverage for both financial performance (R1_1) and market performance (R2_1, R3_1) remained highly stable. This demonstrates that the identified configurations possess strong generalizability.

Secondly, we further examined the sensitivity of the results by adjusting the Proportional Reduction in Inconsistency (PRI) consistency threshold. When the PRI threshold was raised from 0.6 to 0.65, as shown in Table 9, the logical structures of all configurations were entirely consistent with the original analysis, and the overall solution consistency remained at a high level above 0.75. Together, these two measures confirm that the complex causal conclusions regarding ESG practices, eco-innovation, and corporate performance in this study exhibit significant technical robustness and are not dependent on specific parameter settings. Consequently, the empirical results meet the requirements of robustness test (Schneider and Wagemann 2012).

6 | Discussion

Drawing on institutional theory and the innovation offset perspective, this study employs the fsQCA method to unravel the complex logic underlying how Scandinavian manufacturing firms balance ESG practices with eco-innovation. The identified three high-performance pathways (H1, H2, H3) and two non-high-performance pathways (N1, N2) provide a configurational theoretical foundation for the manufacturing sector to enhance corporate performance and sustain competitive advantages in sustainable development.

First, the high-performance configurations (H1 and H3) identified in this study provide an in-depth explanation of the synergistic driving effect between environmental performance (*E*) and eco-innovation. The results indicate that for proactive investment in the environmental dimension to translate into substantial performance outcomes, it must be supplemented by strategic efforts in eco-innovation. This confirms and extends the work of Zhang et al. (2023) and Lian et al. (2023), demonstrating that environmental investment and innovation play a critical hybrid role in enhancing corporate performance and sustainability. It also echoes the assertion that ESG performance and green innovation share a mutually reinforcing relationship (Wang et al. 2024) and supports the view of green innovation as a risk-buffering mechanism, whereby firms can hedge against potential risks associated with ESG rating fluctuations through innovative means (Zhou et al. 2024). These findings can be understood through the logic of "innovation offsets," which suggests that firms can effectively counteract the compliance costs incurred by environmental regulations through eco-innovation, thereby maintaining and strengthening their competitive advantage while establishing legitimacy. These configurational insights transcend the conventional single-causality theoretical perspective and provide significant evidence for understanding sustainable development: in the highly regulated context of Scandinavia, environmental actions do not function in isolation; rather, the synergistic alignment between these actions and eco-innovation serves as the core driver for achieving superior financial returns and market premiums.

In the analysis of market performance, pathway H2 ($E * \sim S * G$) reveals that the configurational synergy between environmental commitment (*E*) and corporate governance (*G*), along with the core absence of social responsibility (*S*), constitutes a driving path toward high market performance. This finding suggests that the capital market's recognition of corporate sustainability does not depend solely on isolated environmental performance but rather on the institutional safeguards provided by a sound governance structure for environmental strategies. This confirms the view of Li, Tang, Liang, and Wang (2024) that efficient internal control and governance mechanisms are prerequisites

for translating environmental investment into long-term market value. However, it is noteworthy that the conclusions of this study contrast with the perspective of Kong et al. (2023) and Zheng et al. (2022), which argue that "environmental and social performance affect firm value, while governance performance has no significant effect." This discrepancy may stem from the contextual characteristics of the research samples; for instance, the arguments of Kong et al. (2023) are based on developing and least developed countries, whereas this study provides contrary evidence from Scandinavian countries. This indicates that in the highly regulated and institutionally mature context of Scandinavia, the integration of internal governance mechanisms with external environmental strategies is an effective path to enhancing corporate performance. This conclusion also indirectly suggests a logic of institutional complementarity: only when environmental commitment is nested within a robust governance framework can it effectively reduce organizational uncertainty by enhancing strategic transparency, thereby gaining the trust of capital markets. This implies that corporate governance currently still plays a more significant role in corporate management than environmental and social issues. To enhance market competitiveness, firms should lean toward disclosing more governance information (Xie et al. 2019).

Notably, this study finds that the social dimension (*S*) is consistently characterized by the "absence of a core condition" (~*S*) across all high-performance pathways. This finding modifies the idealized assumption in existing literature regarding the balanced synergy among the three ESG dimensions (Tian et al. 2025), revealing a logic of "strategic trade-offs" inherent in the sustainability practices of manufacturing firms. From the perspective of institutional theory, corporate social responsibility has increasingly evolved into a "legitimacy baseline" or a threshold requirement for enhancing corporate reputation (Lim and Zhang 2025), rather than a primary driver of differentiated competitive advantage (Campbell 2007; Coelho et al. 2023). While previous research suggests that socially responsible firms possess the potential for higher financial returns (Dam and Scholtens 2015), firms under resource constraints often find it challenging to maintain uniform high-intensity investment across all ESG dimensions. In this context, excessive investment in the social dimension may trigger a "resource crowding-out" effect, thereby undermining resource allocation toward core environmental technologies and governance optimization. This finding fundamentally reflects the trade-offs firms must navigate during sustainable transitions, aligning with the prevailing discourse in contemporary sustainability literature (Adebayo and Ackers 2024; Lu et al. 2026). Furthermore, it offers critical insights for practitioners: the key to enhancing performance lies not in an "all-encompassing" distribution of resources, but in identifying key driving factors within specific institutional boundaries and achieving optimal resource allocation efficiency through strategic focus.

The configurational analysis of non-high corporate performance reveals the potential risks associated with the absence of specific strategic elements. The results for pathways N1 and N2 indicate that proactive investment in the environmental (*E*) and social (*S*) dimensions cannot independently guarantee high-level performance. If a firm lacks the transformative capacity of eco-innovation or simultaneously faces deficiencies at the governance (*G*) level, it may still result in non-high performance outcomes despite excellent environmental and social records.

This finding aligns with existing assertions regarding the core roles of governance mechanisms and eco-innovation in performance enhancement (Alshdaifat et al. 2025; Geng et al. 2021; Przychodzen and Przychodzen 2015). It also echoes perspectives suggesting that the pressure encouraging manufacturing firms to actively adopt eco-innovation to improve operations should involve multi-level efforts—ranging from external compliance and communication to internal technological and managerial innovation—to boost performance (Geng et al. 2021). In summary, firms should regularly update their business processes and utilize eco-innovation to respond to environmental trends while optimizing social and environmental efficiency, thereby driving performance improvements (Mohajan and Zhao 2026).

Analyzing the underlying mechanism further, the aforementioned results suggest that firms may fall into a "compliance cost trap." Although proactive engagement in ESG practices can secure external dividends—such as mitigating regulatory risks and attracting investment (Edmans 2023; Zhang et al. 2023)—this process is inevitably accompanied by significant expenditures. If strategic investments, such as process optimization and energy conservation, cannot be effectively converted into productivity through internal innovation, it becomes difficult to drive substantial improvements in financial or market performance. This logic aligns closely with the innovation offset perspective: investments in environmental and social responsibility do not automatically translate into economic gains; rather, their value creation depends on the firm's capacity to transform institutional pressure into innovative momentum. Based on this, the study provides a fresh perspective on sustainable development: firms should view eco-innovation as the core means of responding to environmental trends. When fulfilling ESG responsibilities, they must carefully weigh the returns against the potential risks across various dimensions to ensure that ESG pressures act as a catalyst for organizational transformation rather than merely evolving into a heavy cost burden.

7 | Conclusion

This study provides an in-depth exploration of the roles of ESG factors and eco-innovation in influencing the financial and market performance of Scandinavian manufacturing firms. By employing the fsQCA method, we identified multiple configurations of ESG and eco-innovation practices that contribute to high-performance outcomes. These findings offer a theoretical foundation and actionable practical insights for firms aiming to drive financial performance through optimal ESG practices and eco-innovation.

7.1 | Theoretical Contributions

This study makes several theoretical contributions to the fields of organizational performance improvement and sustainable development by elucidating the interactive relationships between ESG practices, eco-innovation, and corporate performance.

First, although existing literature has confirmed the independent contributions of ESG or eco-innovation to performance, this study breaks through the limitations of evaluating single factors in isolation. It clarifies how different combinations of elements, through configurational synergy, collectively drive high levels of financial and market performance. We constructed a conceptual framework based on institutional theory and the innovation offset perspective to examine the configuration of various variables. This integrated perspective accurately captures the causal complexity of sustainability issues within modern institutional environments, responding to calls from scholars to explore the multi-dimensional antecedents of corporate performance in real-world contexts. Our findings suggest that the key to achieving performance targets lies not merely in obtaining high ESG scores, but more importantly, in the strategic alignment of ESG practices with eco-innovation capabilities to enhance organizational adaptability and foresight.

Second, unlike previous literature that predominantly adopted linear thinking to explore the impacts of ESG or innovation (e.g., Setiarini et al. 2023; Zhang et al. 2023), this study introduces the fsQCA method to identify multiple equifinal pathways leading to superior performance. In doing so, it provides a configurational paradigm for analyzing the sustainability strategies of Scandinavian manufacturing firms. The application of this methodology is not only a direct response to calls for more context-sensitive sustainability research (Friede et al. 2015; Indrasuci and Rokhim 2023), but more importantly, the study refines the oversimplified idealized assumptions regarding the synergistic effects of the three ESG pillars by revealing the core absence of the social (*S*) dimension. This further elucidates the strategic trade-offs that the manufacturing industry must confront under complex resource constraints and institutional pressures. Consequently, by deepening the understanding of causal complexity in sustainable development, this study provides critical empirical evidence for manufacturing firms to identify optimal strategic paths under environmental regulations.

7.2 | Managerial and Policy Implications

The multiple equifinal pathways identified in this study offer critical insights for manufacturing firms seeking to create sustainable competitive advantages by integrating ESG practices and eco-innovation within complex institutional environments. These distinct configurational pathways reflect the differentiated strategic choices and trade-off mechanisms adopted by firms across ESG dimensions and eco-innovation. Specifically, pathways oriented toward financial performance emphasize the direct synergy between environmental investment and eco-innovation, suggesting that firms enhance resource efficiency through technological advancement to achieve cost optimization and revenue growth. In contrast, pathways oriented toward market performance rely more heavily on the synergy between environmental investment and corporate governance, bolstering investor confidence and market recognition by improving governance quality and information transparency. This divergence indicates that different performance objectives correspond to distinct resource allocation logics.

Viewed from a holistic configurational perspective, manufacturing firms should leverage the logic of equifinality to identify and construct synergistic pathways that best align with their specific resource endowments. The findings suggest that the key to enhancing performance lies not in a balanced distribution of investment across all three ESG dimensions, but in the deep synergy between environmental performance and eco-innovation. This study further reveals that the effective integration of environmental investment and innovation serves as a vital mechanism for overcoming compliance cost constraints and triggering innovation offset effects. This implies that, provided basic institutional legitimacy is maintained, firms should utilize strategic focus to prioritize resource allocation toward environmental technological breakthroughs and governance optimization, thereby achieving superior strategic outcomes under resource-constrained conditions.

Finally, regarding policy guidance, policy design could consider focusing on guiding firms to transform ESG investments into actual eco-innovation capabilities, easing the cost pressure during the initial stages of compliance through fiscal subsidies, technical R&D support, or differentiated credit policies. Additionally, regulatory authorities could further refine classified disclosure standards to help capital markets identify manufacturing firms with environmental responsibility and innovation potential. By lowering financing costs through the differential pricing of green financial instruments, the industrial sector can be encouraged to transition toward sustainable development.

7.3 | Limitations and Future Research

This research acknowledges several limitations. First, the sample is confined to Scandinavian manufacturing firms. Given the region's exceptionally high institutional maturity and social responsibility benchmarks, the social dimension has evolved into a ubiquitous "legitimacy threshold." This specific geographical context limits the generalizability of the findings to emerging markets with weaker environmental regulations or to non-manufacturing sectors. Second, constrained by the use of cross-sectional data from 2023, the analysis captures resource allocation logic at a specific point in time, thereby limiting its ability to uncover the dynamic evolution and potential time-lag effects of ESG practices and eco-innovation over the long term. Finally, the research model does not yet encompass boundary variables such as digital transformation that may influence strategic configurations, and the fsQCA method remains limited in its ability to quantify the marginal contributions and relative weights of individual antecedent conditions.

Based on the aforementioned limitations, we offer several directions for future research. First, future studies should expand the sample coverage across different regions and industries to enhance external validity by comparing configurational differences under various institutional backgrounds. Second, we encourage the use of longitudinal panel data to dynamically examine how firms adjust their "ESG + eco-innovation" configuration paths in response to evolving external pressures. Additionally, our study implies that eco-innovation can serve as an endogenous driver to offset the potential cost losses incurred by ESG practices, ensuring that performance remains unharmed during the process of

establishing legitimacy. Subsequent research could more meticulously consider the cost effects of ESG practices and explore how specific potential risks arise during the pursuit of legitimacy, along with corresponding countermeasures, to further refine the "input-transformation-output" causal chain. Finally, we suggest that researchers adopt hybrid research methods—such as combining fsQCA with structural equation modeling (SEM) or qualitative case studies—to enhance the scientific rigor and practical guidance value of research conclusions through the integration of quantitative weight analysis and qualitative verification.

Author Contributions

Qianqian Chen: conceptualization, investigation, formal analysis, writing – original draft. **Tarlan Ahmadov:** conceptualization, data curation, resources, writing – original draft, writing – review and editing, methodology, visualization. **Thi Thanh Nhan Do:** data curation, conceptualization, writing – original draft, project administration. **Baoying Zhu:** conceptualization, methodology, investigation, validation, supervision, writing – original draft, writing – review and editing. **Wolfgang Gerstlberger:** conceptualization, supervision, writing – review and editing, investigation.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available at Ahmadov (2024).

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