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What Drives Sustainable Business Models? A Hierarchy of Pathways for SMEs

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Abstract

Institutional theory assumes that coercive, normative, and mimetic pressures operate as parallel forces driving organizational isomorphism. This study tests this assumption by exploring the impact of pressures on eco-innovation and environmental performance in manufacturing SMEs. A two-wave, time-lagged survey of 271 manufacturing SMEs in China was analyzed using structural equation modeling (SEM) using IBM SPSS Statistics 27 and AMOS 21.0. The findings demonstrate a significant impact of institutional forces. Specifically, mimetic pressure (competitive pressure) most strongly influences eco-innovation, while normative pressure (stakeholder pressure) most strongly influences environmental performance. Coercive pressure (environmental regulations) is relatively weak. This research advances institutional theory by measuring the mediation magnitudes, revealing that these pressures affect both direct and innovation-mediated pathways. Mimetic pressure is most dependent on eco-innovation for performance (32.5% mediated), while normative pressure mostly uses direct channels (10% mediated). The fsQCA results complement these findings by providing interchangeable pathways to achieve Environmental Performance. By considering all pressures together, this study establishes a hierarchy of influence where competition stimulates eco-innovation, and stakeholders stimulate performance. This study provides evidence that these pressures are not substitutes because they affect different degrees of reliance on eco-innovation. This study shows that, under fragmented enforcement, non-regulatory pressures may be more significant than regulatory ones.

Keywords: institutional theory; coercive; normative; and mimetic pressures; eco-innovation; environmental performance; small and medium-sized enterprises (SMEs)

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1. Introduction

Environmental sustainability has evolved from being a strategic option to an operational necessity, affecting firms worldwide [1]. According to the International Energy Agency [2], the industrial sector accounted for 37% of global energy use (166 Exajoules). Environmental problems are putting firms under intense pressure to change their operating models through ecological innovation, making eco-innovation a critical factor in achieving perpetual environmental sustainability.

According to García-Granero, et al. [3], large companies prioritize eco-innovation in strategic planning, driving considerable investment in unique green projects. On the other hand, SMEs face structural obstacles in implementing sustainable initiatives. Such

issues arise, particularly in developing nations, because SMEs are embedded in institutional environments characterized by financial limitations and regulatory uncertainty. An intriguing empirical setting for researching these phenomena is found in Chinese SMEs, as they account for 60% of GDP and account for 52.5% of the industrial carbon dioxide emitted [4]. This highlights the need for them to adopt innovative practices. The lessons learned from the Chinese experience can be generalized to other economies where similar trade-offs exist.

China's rapid development has significantly impacted the environmental regulations for carbon neutrality by 2060. A notably ambitious goal, as stated in the phased Five-Year Plan (2016–2020), was to reduce carbon dioxide (CO2) emissions by 18% per unit of GDP [5]. However, the identifiable efficiencies of this strategy at a national level have suffered from a variety of implementation issues in relation to the diverse types of industries. Deficiencies in regulatory enforcement became evident during the 14th Five-Year Plan (2021–2025), highlighting the need for targeted regulations and carbon ceilings for SMEs, whose environmental impact had previously been overlooked [6], a situation prevalent in many other emerging economies.

Institutional theory [7] suggests that firms are subject to three types of institutional pressures: normative (stakeholders), coercive (regulations), and mimetic (competitors), all of which are related to the achievement of legitimacy. These pressures can affect performance directly (via legitimacy) and indirectly (via eco-innovation), as suggested in the dual pathway framework [8,9]. Yet, institutional theory still does not indicate the extent to which each of these pressures uses innovation-related routes versus direct legitimacy routes. If each of the three pressures has the same reliance on eco-innovation, then the mechanisms are identical; otherwise, pressures are not interchangeable. This research fills this void by quantifying the extent to which each of these pressures uses the eco-innovation-related route. This is an advancement on the duality of institutional theory by measuring the different reliance of pressures on eco innovation, an idea refers to as mechanism differentiation.

Several recent studies show that green innovation and environmental performance are driven by coercive, normative, and mimetic pressures [10–13]. Together, these studies establish that all three institutional pressures can promote sustainability initiatives, but leave three key questions unanswered. Despite of past studies, three gaps are found in the literature: aggregation or isolation of pressures [13,14], implicit assumptions of homogeneity of mechanisms; no one quantifies proportions of specific mediating effect of each pressure, even in studies which consider all three pressures [11,12], no one calculates what percentage of effect of any one pressure works through eco innovation; and most evidence is on large listed companies.

To address these concerns, the study is designed to investigate in depth how eco-innovation and environmental performance are affected by coercive, normative, and mimetic pressure among manufacturing SMEs in the dual carbon agenda in China. The paper is a theory-testing study that employs a time-lagged design and integrates SEM and fsQCA to go beyond testing whether institutional pressures are important, and instead measures the extent to which each pressure depends on eco-innovation for environmental performance. In this way, this paper makes three important contributions. First, it will reveal the differentiation of institutional pressures by determining which pressure is more likely to stimulate eco-innovation and which pressure is more likely to directly impact environmental performance when a firm is exposed to multiple pressures. Second, it will quantify pressure-specific levels of mediation, providing fresh evidence on the extent to which each of the pressures relies on eco-innovation to achieve environmental performance. Third, by putting the study within a broader context of ambitious central policy

and widely varying local implementation, as in several emerging economies, it will be able to take institutional theory outside a developed country environment and show the relative significance of non-regulatory strategies like competitive benchmarking and stakeholder involvement. The contributions are also meant to be international in nature, providing insights to managers, policymakers, and researchers in the economies that encounter similar institutional complexities.

The rest of the paper is organized in the following way. Section 2 gives the theoretical background and development of the hypothesis. Section 3 presents the research methodology, sample, data collection, and measures. The empirical findings are reported in Section 4. Section 5 presents the findings, theoretical and practical implications, limitations, and future research directions. Section 6 concludes.

2. Theoretical Foundation and Hypothesis Development

2.1. Institutional Theory

Institutional theory explains how an organization responds to coercive, normative, and mimetic pressures, which make its actions legitimate [7]. These pressures are all related to one specific logic of legitimacy: regulatory, normative, and cognitive [15]. This has led to the assumption that all these pressures operate in parallel, hence promoting isomorphic practices that are green [16,17]. The assumption, however, mixes the source of pressure with the mechanism of pressure [9].

However, recent studies reveal the mechanisms. Marculetiu, et al. [18] reveal that normative pressures are the only origin affecting the symbolic and substantial sustainability strategies based on the coercive and mimetic pressures, which have no significant impact on the environmental performance. Ruiz-Blanco, et al. [19] reveal that normative pressure is the most influential in the control systems of sustainability. Zhang, Zhu and Lee [12] reveal that the impact of the regulatory, normative, and cognitive pressures on green innovation is positive, but the pathways differ in their strength. Thus, normative pressures operate through direct legitimacy signaling [18], mimetic pressures drive the eco-innovation adoption due to uncertainty [12], and the impact of coercive pressures is contingent [20].

From past literature, two significant gaps have been identified. First, most of the studies have analyzed each of the pressures separately, or as one construct, without the possibility of comparing all three of them [13,21]. Second, eco-innovation is recognized as a mediator, but not measured as to what degree it mediates each of the pressures' effects [12]. This has significant implications for theoretical development, as if all three pressures are equally based on eco-innovation, then the mechanism is homogenous; if, however, one of them attains its findings through direct legitimacy, and another one through innovation, then institutional theory should explain the differentiation of mechanisms, a phenomenon not predicted earlier [8,9].

These pressures are multidimensional, which is why the pathways vary [15]. Mechanisms for pressure-performance also differ because each legitimacy logic is conferred through different organizational activities, such as value, imitation, and compliance. Given that normative legitimacy relies on visible value alignment with stakeholders, it can be used to increase performance assessments without product or process changes; cognitive legitimacy, which is achieved by imitation under uncertainty, instead requires the adoption of observable and replicable eco-innovations, making the innovation-mediated path increasingly important for mimetic pressures. This gives rise to the two-pathways model for direct legitimacy routes and innovation-mediated routes [8,9]. Following this line of reasoning, the current study proposes a notion of mechanism differentiation: the idea that the three institutional pressures are not equivalent in their dependence on eco-innovation as a mediator, but differ in their dependence on the innovation-mediated path versus the

direct legitimacy path. This means that the relative importance of the innovation-mediated path versus the direct path is expected to differ between pressures. This expectation challenges the conventional view that coercive, normative, and mimetic pressures are parallel and equivalent institutional pressures [7]. By linking the degree of mediation to the legitimacy logic, mechanism differentiation extends the model by specifying which pressures rely more heavily on innovation and which rely more heavily on direct legitimacy. The contribution of this research to the institutional theory is two-fold: (1) the mediation level depends on the legitimacy logic (mechanism differentiation), and (2) the mediation level has been quantified empirically for the dual pathways model, placing the theory not in the broad isomorphic mode, but specifying the mechanisms. The hypotheses presented in the following sections operationalize this model.

2.2. Normative Pressures: Stakeholder Demands and Environmental Sustainability

Normative pressures are influenced by stakeholders who expect responsible behavior. For normative legitimacy, it is necessary to have alignment with stakeholders' values, and the environmental outcomes must be visible [7,15]. This alignment does not necessarily require innovating products and processes; instead, producing positive environmental outcomes (e.g., pollution reduction, community involvement) may be enough to secure stakeholder legitimacy. This implies that there is a direct link between stakeholders and environmental outcomes, and this link is dependent on normative pressures. De Giovanni and Vinzi [22] suggested that firms are assessed by stakeholders primarily based on their outcomes and statements. Baah, et al. [23] indicated that pressures from stakeholders enhance sustainability and better performance. This implies that pressure from stakeholders has a direct link to environmental outcomes.

At the same time, normative pressures can also work through eco-innovation as a substantive response to stakeholder demands. Stakeholder expectations for creative solutions to ongoing environmental issues may require firms to innovate products, processes and practices to gain legitimacy [24,25]. This approach provides a mediating role for normative pressures on environmental performance through eco-innovation, besides the direct approach. Flammer and Kacperczyk [26] prove that a stronger stakeholder approach will lead to more innovative practices in organizations because stakeholder demands require organizations to experiment. Xie, Abbass and Li [1] also prove that stakeholder demands lead to eco-innovation, which in turn leads to environmental performance. Thus, eco-innovation serves as a mediating mechanism through which normative pressure translates into environmental gains. Because normative legitimacy can be achieved through visible outcomes without substantive innovation, this study anticipates that stakeholder pressure will have a strong direct relationship with environmental performance, while also driving eco innovation.

H1. *Stakeholder pressure positively influences environmental performance through visible environmental practices.*

H2. *Stakeholder pressure positively influences eco-innovation innovative responses to stakeholder pressure for environmental solutions.*

2.3. Coercive Pressures: Environmental Regulations and Environmental Sustainability

The coercive pressures emanate from formal regulations and legal mandates that set out compliance obligations. For regulatory legitimacy, organizations have to comply with these mandates and hence need to obtain a "license to operate" [27]. This direct link suggests that environmental regulation can enhance performance through punishing non-

compliance and encouraging reductions in pollution, regardless of eco-innovation. Cross-national studies in Brazil [28], the EU [29], and the UK [30] all found that environmental regulation improves environmental performance. From an institutional theory perspective, this direct association assumes coercive pressure generates regulatory legitimacy through effective enforcement; in fragmented enforcement environments, this process is less reliable. Thus, coercive pressure is predicted to have a direct effect.

Regulatory pressure could also drive eco-innovation because organizations are motivated to look for cost-effective ways to comply. Severe policies increase environmental consciousness [31] and provide market pressure; investors prefer organizations that are less polluting, and this drives them to innovate [32,33]. Where regulatory pressure is not uniform, eco-innovation provides a strategic way to demonstrate regulatory compliance and gain a competitive edge. Han and Chen [34] demonstrate the role of regulations in driving eco-innovation in manufacturing industries, thereby supporting the argument that coercive pressure indirectly drives organizational performance by encouraging eco-innovation. But where regulatory legitimacy is not complemented by effective enforcement, the incentives to engage in eco-innovative compliance efforts are compromised. In an environment of fragmented enforcement, which many SMEs experience, the direct compliance-driven effect of regulation on environmental performance is likely to be weak, and its potential to drive eco-innovation is therefore weak as well.

H3. *Environmental regulations positively influence environmental performance through compliance and a "license to operate".*

H4. *Environmental regulations positively influence eco-innovation through cost-effective compliance measures.*

2.4. Mimetic Pressures: Competitors' Influence and Eco-Innovation

Mimetic pressures are driven by uncertain environmental demands, prompting imitation of successful competitors to achieve cognitive legitimacy [7]. Institutional theory suggests that cognitive legitimacy can be achieved by directly imitating the visible environmental practices of competitors, and this translates into direct performance effects. This implies that competitor pressures can affect environmental performance directly by encouraging imitation of competitors' sustainable practices. Bansal and Roth [35] posit that competition forces companies to adopt differentiation strategies by incorporating sustainability; Chung [36] and Xie, Abbass and Li [1] found that eco-friendly practices retain environmentally conscious customers, hence avoiding loss of market share. Therefore, competitor pressures are expected to have a direct positive effect on environmental performance.

Competition also spurs eco-innovation as a major driver of differentiation. Under conditions of uncertainty, imitation focuses on those practices that are easily replicable; in this context, eco-innovations are best examples [37]. This indirect effect is particularly important because it allows to differentiate mimetic pressure from normative and coercive pressure in terms of how they drive performance: whereas the latter two may do so directly via legitimacy effects, mimetic pressure likely does so indirectly via innovation effects. Wang, et al. [38] show that eco-competitions drive eco-innovation; Cornejo-Cañamares, et al. [39] show that industrial SMEs obtain a competitive advantage via eco-innovation under conditions of competitive pressure. Dai, et al. [40] report that organizations observe their competitors' green initiatives, and Baah, Opoku-Agyeman, Acquah, Issau and Moro Abdoulaye [23] show that competitor pressure indeed influences environmental performance via eco-innovation. Thus, mimetic pressure's direct incentive is to pursue eco-innovation because the signals that competitors send in an uncertain green

market are their innovation moves, the very visible, credible signals that firms seeking to be imitated must adopt to secure cognitive legitimacy.

H5. *Competitor pressure positively influences environmental performance through imitating visible environmental practices of competitors.*

H6. *Competitor pressure positively influences eco-innovation through the imitation of visible and replicable eco-innovations as signals under uncertainty.*

2.5. Eco-Innovation as a Pathway to Environmental Performance

Eco-innovation refers to new products, processes, and practices developed to address environmental issues. Eco-innovation in the dual pathway framework is included as a direct and mediating impact on environmental performance. The direct link is based on the idea that by adopting eco innovations, firms can decrease their emissions and increase their competitive advantage [41,42]. From an institutional theory view, eco innovation also generates visible, credible signals of substantive environmental practice, and thus enhances legitimacy and directly improves performance. It is important to understand eco innovations as attempts to enhance ecological sustainability and competitive advantage, rather than simply reacting to issues [43]. Thus, eco-innovation is expected to have a direct impact on environmental performance.

The major theoretical contribution of this study is in the quantification of the mediation effect of eco innovation. Institutional theory posits that there are multiple paths to achieve legitimacy, although the relative dependency of each pressure on innovation and direct compliance has not been explored. Eco innovation is an observable mediator of external pressure, where regulatory pressure drives innovation [44], which in turn boosts performance [45]; stakeholder pressure drives sustainable practices [1], and eco-innovation is a meaningful response; and competitive pressure drives differentiation through innovation [46], which is useful for differentiation and sustainability. By calculating the mediation effect of eco innovation for normative, coercive, and mimetic pressures, the study tests the idea of mechanism differentiation, in which mimetic pressure is most likely to rely on eco innovation, while normative and coercive pressures also rely on direct paths to legitimacy.

H7. *Eco-innovation positively influences environmental performance through emissions reduction and the conveyance of substantive effort.*

H8. *Eco-innovation mediates the relationships between (a) stakeholder pressure, (b) environmental regulations, (c) competitor pressure, and environmental performance.*

3. Methodology

3.1. Sample and Procedure

This study uses a quantitative research design to test theory-driven hypotheses to explore the direct and indirect influences of normative, coercive, and mimetic pressure on environmental performance through eco-innovation. The research sample is based on manufacturing SMEs registered in local industry directories and confirmed through HR departments to ensure SMEs' compliance. This sector was chosen due to its significant environmental impact and under competitive and regulatory pressures. Manufacturing SMEs are an essential key to achieving sustainability, making it an essential research context to understand eco-innovation adoption. Participants were chosen for their strategic perspectives on eco-innovation, derived from hands-on experience through operational

activities. They included supervisors and employees from different departments who are actively involved in manufacturing.

3.2. Data Collection

Data collection was challenging because contacting participants within manufacturing firms required persistent coordination to preserve the temporal ordering needed for causal inference. It was decided to collect 450 questionnaires in order to guarantee adequate statistical power and account for potential non-responses, in accordance with previous SEM investigations and suggestions that at least 200 genuine responses are necessary for robust analysis. A time-lagged design was used to reduce common method bias by separating predictor and outcome variable measurements [47].

3.2.1. Stage 1: Collecting Independent Variables

A sample size of 450 responses was fixed. Responses regarding pressures from stakeholders, regulations, and competitors were collected during (September–October 2025). Resistance, time constraints, and declining interest were encountered during collaboration. After discarding 120 negligent responses, the remaining responses totaled 330, leaving 330 valid responses.

3.2.2. Stage 2: Collecting the Mediator and Dependent Variable

Eco-innovation and environmental performance data collection took two months, from December to January 2026. A one-month gap was introduced to avoid common method bias. It was difficult to access the same employees. The last four digits of phone numbers were used to track the participants. A few employees were not accessible, had changed their jobs, or had provided incomplete responses. Despite the logistical obstacles, a total of 271 out of 450 questionnaires (60%) were matched. The sample size is much larger than the minimum recommended values used in structural equation modeling, which guarantees the stability of a model [48]. This time gap ensured the collection of reliable, valid, and bias-free data.

3.3. Measures

All items were assessed using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The constructs were measured as follows: normative pressure was measured using five items, reflecting stakeholders pressure [49], coercive pressure was measured using six items from [50] reflecting environmental regulations, mimetic pressure was measured using four items adapted from [51], capturing perceived competitors pressure, and eco-innovation was measured using three items adapted from [52]. Finally, the six items for Environmental Performance were borrowed from the studies of Gadenne, et al. [53], and their respective alpha (α) values are reported in (Appendix A). These scales were chosen as they have been used in previous institutional and environmental management research and have acceptable reliability ($\alpha > 0.70$ in previous studies) and directly capture the constructs of interest in this study.

3.4. Analytical Strategy

The direct and indirect relationships were simultaneously tested using structural equation modeling (SEM) in AMOS. SEM was used because it simultaneously estimates multiple latent variables while taking measurement error into account and provides model fit indices that are important characteristics of the complex model being applied in this study. The indirect effects were tested using bootstrapped confidence intervals as per mediation analysis standards. Descriptive statistics and data screening were conducted to

explore equifinality in terms of multiple configurations of antecedent conditions that lead to superior environmental performance.

4. Results

4.1. Sample Information

This study adjusted demographic data to prevent potential effects on key variables [54]. For example, older employees may experience fatigue that impacts performance [55]. Work experience and academic achievement influence the workplace differently [56]. The sample included 271 respondents, with 115 males and 156 females. Most employees were aged between 25 and 35 years (43.2%), since younger individuals tend to be more motivated and easier to train on new technologies. Regarding education, 138 respondents (50.9%) held a bachelor's degree, sufficient for operating and understanding complex systems. For work experience, the majority (43.9%) had between two and five years, indicating they were familiar with industry needs and the skills required to operate eco-innovations.

4.2. Measurement Model

Before proceeding with further research, some tests were conducted to examine construct-level reliability via the "composite reliability" and "α" measures. According to Hair, et al. [57], the criterion is supposed to fall within the range of 0.70–0.95. While the composite reliability ranged from 0.814 to 0.874, which is above 0.70 and indicates that the current study is within the criterion range of 0.70–0.95, the "α" values ranged from 0.781 to 0.871, which is above 0.70 [57].

To confirm the criterion requirement of convergent validity, we employed Average variance extraction (AVE) [57]. The AVE was found to be 0.506–0.593, over the cut-off value of 0.50, suggesting better convergent validity. This implies that the constructs have greater variation.

Discriminant validity, which is characterized by correlations between factors of less than 0.85 and $\sqrt{}$AVE > correlation between variables, is used to investigate if the items or measures of a factor load more on their factor than on other factors (Table 1). The five-factor model χ^2 = 229.734, df = 242, χ^2/df = 0.949, SRMR = 0.049, CFI = 1.000, GFI = 0.935, RMSEA = 0.000, shows a good fit, according to our analysis of model fitness indices using AMOS. Additionally, the variance inflation factor (VIF), whose threshold should be less than 3.0 [57], was examined in this study to determine the extent of multicollinearity. It ranged from 1.271 to 1.391, indicating no inconvenience of collinearity (Table 1).

Table 1. Descriptive Statistics and Correlation Coefficients.

Variables	Mean	S.D.	VIF	STP	ER	CP	Eco-Inn	EP
STP	3.17	0.85	1.37	**0.76**				
ER	3.08	0.85	1.27	0.438 **	**0.73**			
CP	3.32	0.91	1.30	0.298 **	0.222 **	**0.76**		
Eco-Inn	3.20	0.91	1.39	0.368 **	0.290 **	0.460 **	**0.77**	
EP	3.26	0.83	1.31	0.420 **	0.330 **	0.310 **	0.345 **	**0.71**

STP = Stakeholders pressure, ER = Environmental regulations, CP = Competitors pressure, Eco-Inn = Eco-Innovation, EP = Environmental performance. ** $p < 0.01$ Note: $\sqrt{}$AVE is depicted in bold.

4.3. Descriptive Statistics

The mean value of the constructs ranged from 3.08 to 3.32, whereas the Standard Deviation ranged from 0.83 to 0.91. The correlation analysis yields results that are satisfying such as STP and EP (r = 0.420 **), ER and EP (r = 0.330 **), CP and EP (r = 0.310 **), STP and EcoInno (r = 0.368 **), ER and Eco-Inn (r = 0.290 **), CP and EcoInno (r = 0.460 **) and EcoInn and EP (r = 0.345 **) in Table 1.

4.4. Hypothesis Testing

The structural equation model (as shown in Figure 1) strongly supports the hypothesis that institutional pressure has different effects. STP has a strong impact on EP (β = 0.264 ***), while ER has a lower effect (0.142 **), and CP has the lowest impact on EP (0.113 ***). In the case of eco-innovation, CP has a strong impact (0.373 **), followed by STP (0.205 **), and then ER (0.118 *).

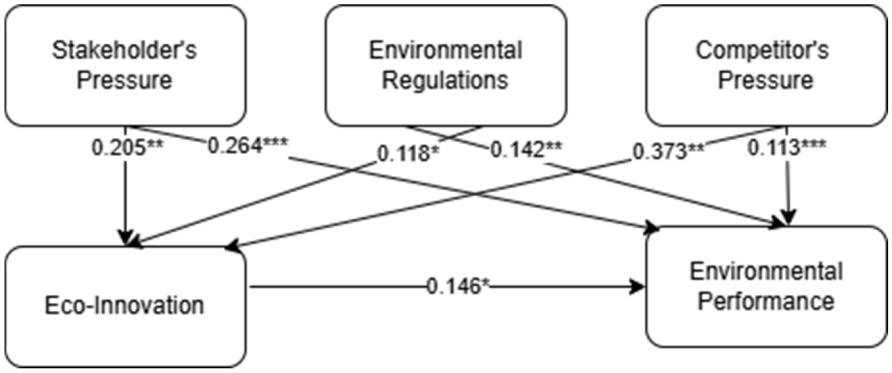


Figure 1. Conceptual path model with standardized SEM coefficients (Table 2). Note: *, **, and *** indicate $p < 0.05$, $p < 0.01$ and $p < 0.001$ respectively.

Table 2. Direct and Indirect Paths.

Paths	Effect Size	S.E.	LLCI-ULCI
STP → EP	0.264 ***	0.066	0.164–0.380
ER → EP	0.142 **	0.059	0.028–0.228
CP → EP	0.113 ***	0.064	0.018–0.238
STP → Eco-Inn	0.205 **	0.069	0.089–0.312
ER → Eco-Inn	0.118 *	0.053	0.006–0.188
CP → Eco-Inn	0.373 **	0.058	0.288–0.480
Eco-Inn → EP	0.146 *	0.081	0.006–0.287
STP → Eco-Inn → EP	0.030 *	0.021	0.002–0.072
ER → Eco-Inn → EP	0.017 *	0.012	0.000–0.038
CP → Eco-Inn → EP	0.054 *	0.031	0.003–0.107

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Eco-innovation also significantly influences EP (0.146 *). The indirect effects are significant for all three factors: stakeholder pressure (0.030 *), regulation (0.017 *), and competition (0.054 *). Eco-innovation transmits around 32.5% of the entire influence of competition on performance, whereas stakeholders and regulation transmit about 10%. Overall, these findings show that the institutional pressures are clearly differentiated, with competition most strongly influencing eco-innovation, stakeholder pressure most strongly influencing environmental performance, and regulation pressure being the least in both cases.

4.5. Fuzzy-Set Qualitative Comparative Analysis

4.5.1. Calibration

The objective of fsQCA is to find out the configurations of antecedent conditions that can cause high environmental performance (EP), which is the outcome condition. Antecedent conditions are STP, ER, CP, and Eco-Inn. While Eco-Inn acted as a mediator in the SEM model, it is considered an antecedent condition with the pressures, enabling fsQCA to examine the interaction between pressures and internal ability to generate EP. Following Ragin [58], the data is coded to fuzzy sets ranging from 0 to 1, where 1 indicates full membership, 0.5 indicates crossover, and 0 indicates full non-membership. A single index

is calculated for each construct by averaging the measurement items. The quartile method is used to establish the anchors at the 25th percentile, which indicates full non-membership, the 50th percentile or median, which indicates crossover, and the 75th percentile, which indicates full membership. Table 3 shows the calibration thresholds for each condition.

Table 3. Overview of the calibration rules.

Criteria	STP	ER	CP	Eco-Inn	EP
Full membership	3.8	4	4	4	4
Crossover point	3	3	3.5	3.33	3.17
Full non-membership	2.5	2.33	2.5	2.67	2.67

4.5.2. Analysis of Necessary Conditions

fsQCA is applied to examine whether any of the four antecedent conditions (STP, ER, CP, and Eco-Inn) are necessary for achieving a high level of EP. According to Ragin [58], raw data can be coded as a fuzzy set membership score ranging from 0 to 1 (full membership = 1, crossover = 0.5, full non-membership = 0). An index for each construct is created by taking the average of the measurement items for each construct before coding. The anchor points for each condition were determined by the quartile method: 25th percentile (full non-membership), 50th percentile or median (crossover), and 75th percentile (full membership), as shown in Table 4.

Table 4. Analysis of necessary conditions for high environmental performance.

Conditions	Consistency	Coverage
STP	0.678	0.685
~STP	0.429	0.455
ER	0.640	0.679
~ER	0.476	0.480
CP	0.660	0.666
~CP	0.434	0.461
Eco-Inn	0.682	0.766
~Eco-Inn	0.423	0.406

Note: "~" denotes the absence of a condition.

4.5.3. Analysis of Sufficient Conditions

Consistent with prior QCA studies [59], consistency and frequency thresholds need to be determined before performing a sufficient analysis. This study considered three practice criteria before determining the threshold: (1) The frequency threshold for large samples should be greater than 1; (2) The distribution of cases with 0 and 1 in the truth table should be covered and roughly balanced; (3) The number of observed cases should be not less than 75% of the total cases. The final consistency threshold is 0.84, and the frequency threshold is 6. fsQCA produces three solutions: complex, intermediate, and parsimonious. This paper mainly reports intermediate solutions and combines them with parsimonious solutions to distinguish between core conditions and peripheral conditions [59]. Table 5 shows the configuration for achieving a high level of environmental performance.

The results of the fsQCA indicate two sufficient conditions for high EP, thus confirming the equifinality of innovation outcomes. The overall solution consistency is 0.876, which is above 0.75, and coverage (0.444) indicates that the two sufficient conditions explain a large proportion of cases of high EP.

Solution 1a shows that the combination of STP, ER, and Eco-Inn is sufficient for high EP. This solution has the highest raw coverage (0.388), implying that firms under stakeholder

and regulatory pressure and those practicing eco-innovation can reach high levels of EP, complementing the results of SEM.

Table 5. Configuration for achieving high EP.

High Level of EP		
Configuration	1a	2a
STP_f (Stakeholder pressure)	●	●
ER_f (Environmental regulations)	●	
CP_f (Competitor's pressure)		⊗
Eco-Inn_f (Eco-innovation)	●	●
Consistency	0.873	0.862
Raw coverage	0.388	0.224
Unique coverage	0.220	0.056
Overall solution consistency	0.876	
Overall solution coverage	0.444	

● = core condition present; • = peripheral condition present; ⊗ = absence (negation); blank = condition not in the configuration.

Solution 2a indicates that high levels of EP can be reached without CP, but under conditions of STP and Eco-Inn. In the SEM results, CP has the strongest effect on Eco-Inn ($\beta = 0.373$) but a weak direct effect on EP ($\beta = 0.113$). This implies that CP is not a necessary condition for high EP but serves to enhance Eco-Inn to reach high levels of EP.

The robustness of these findings was verified across three different calibration choices (Appendix B). First, theoretical anchors (20, 50, 80) were applied, with frequency and consistency thresholds of 6 and 0.82, respectively. Second, anchors (2, 3, 4) were used with thresholds of 6 and 0.84. Third, the frequency threshold was increased to 8, with consistency at 0.86. In almost all robustness tests (Appendix B), eco-innovation is present in all configurations, reinforcing its importance for high EP.

5. Discussion

Earlier studies have addressed individual aspects (e.g., regulation [60] or stakeholder involvement [61]) or institutional factors as a construct [62]. This study clearly shows a differentiation of institutional pressures. Although the three pressures exhibit both direct and indirect effects, competition has the strongest influence on eco-innovation, stakeholder pressure has a relatively stronger influence on performance, and regulation is the weakest in both areas. This is in line with recent calls for a better understanding of the institutional mechanisms [63,64].

The results that coercive pressure is the least effective differ from studies of developed economies and large firms, where regulatory pressure is a driver of eco-innovation [30,44]. But it is in line with studies that demonstrate that regulatory impact is contingent on consistent enforcement practices [20]. In Chinese manufacturing SMEs, localized enforcement and resource constraints result in formal regulations that may not send a sufficiently strong signal to trigger innovation. Therefore, non-regulatory pressures, particularly competitor benchmarking and supply chain stakeholder pressures, become more influential drivers of environmental action [65]. This finding does not invalidate the role of regulation but highlights that the impact of regulatory pressure is contingent, especially in emerging markets where enforcement is weak.

A novelty of this research is the quantification of pressure-specific mediation. Although eco-innovation is taken as a mediator [1,66], previous studies rarely calculate what share of the effect is mediated. Findings indicate that innovation plays a vital role in

transforming mimetic pressure to performance, where 32.5% of competitive pressure is mediated as opposed to approximately 10% of the stakeholder and regulatory pressures.

The fsQCA findings demonstrate equifinality in two ways. Solution 1a verifies that STP, ER, and Eco-Inn result in high EP, reflecting cases where a firm facing frequent environmental inspections and intense buyer pressure for sustainability engages in cleaner production and subsequently exhibits high environmental performance. Solution 2a verifies that STP and Eco-Inn lead to high levels of Performance without CP, which reflects firms where previous competitive benchmarking had already triggered adoption of eco-innovations; in the future, strong stakeholder relationships continue to support high performance, even when direct competitive pressure is not high, revealing that CP is a generator of, rather than a continuous driver for, high performance.

These findings might seem to contradict the SEM results, which show competitive pressure to be the strongest influencer of eco-innovation. But these results are not contradictory: rather, they are complementary and, when taken together, provide a more comprehensive picture of the causal dynamics. SEM shows that competition is the strongest influencer of eco-innovation ($\beta = 0.373$) and that innovation accounts for almost 32.5% effect of competition on performance. fsQCA shows that once a firm has eco-innovation capability, competition is no longer necessary for high environmental performance; other combinations (e.g., stakeholder pressure and eco-innovation) are also sufficient.

This is a feature of the two different analytical approaches. SEM estimates the net effect of each pressure across the sample, showing which pressure has the greatest linear impact on eco-innovation and performance. fsQCA, in turn, reveals configurational sufficiency, demonstrating that several different combinations of conditions are sufficient to achieve high performance. For example, SEM reveals the causal significance of competition as the strongest driver of innovation for performance, while fsQCA reveals its causal substitutability, given the presence of innovation. Together, they show that competition is not a necessary condition for performance, but a particularly effective way to develop the innovation capacity needed for performance. This combination has two profound implications: first, competition is a generative mechanism for innovation, rather than a mechanism for performance (firms under highly competitive pressure are most likely to report high eco-innovation); second, eco-innovation is a convergent mechanism that allows for many institutional pathways (mimetic, normative, or both) to achieve high performance. This functional disinfection reinforces the study's central claim that institutional pressures differ not only in magnitude but also in their causal role within sustainability outcomes.

Though the concept of normative, coercive, and mimetic pressures is framed as parallel forces in the Institutional Theory [7], empirical research notes normative pressures as dominant [8,9]. This study's findings partially confirm this, but improve it: in emerging-market SMEs, mimetic pressures stimulate innovation, and normative pressures improve performance. This brings out the contextuality of institutional impacts in situations of weak enforcement and a shortage of resources.

In conclusion, the findings are discussed within the framework of the dual-carbon development agenda, putting the analysis in the institutional change framework of the national strategies. Despite the existence of regulatory frameworks, their viability is usually constrained by poor enforcement, especially in the SME sector, which is the key to socio-economic development [67]. On the contrary, competitive and stakeholder pressures define the supply chains and serve as a de facto governing mechanism [12,64]. This implies that macro-level commitments are not executed by regulation itself but strengthened by the non-regulatory social and market-based forces, which underline the applicability of Institutional Theory to the emerging economies, at large.

5.1. Theoretical Implications

This research contributes to the development of Institutional Theory by distinguishing coercive, normative, and mimetic effects and the respective roles they play. Although classical theory argues that these effects are equally important in promoting isomorphism in organizations [7], and previous studies have aggregated these effects [12] or focused on one dimension of these effects, such as regulations [68]. The current study's findings challenge the classical view. Mimetic pressure exerts the strongest influence on eco-innovation, while normative pressure exerts the strongest direct effect on environmental performance, and coercive pressure lags in both. The findings offer empirical evidence of mechanism differentiation: the systematic variation in how institutional pressures rely on innovation-mediated versus direct pathways. This shows that the three pressures are not of equal strength nor of equal causal pathways, thus extending institutional theory by providing insights into how each pressure results in sustainability performance.

Moreover, the integration of fsQCA and SEM demonstrates that institutional factors do not only manifest individually but also in combination in different ways. This is seen through the presence of stakeholder pressure in all configurations and the differential impact of competitive pressure. This implies that not only are institutional forces variably effective, but they may also complement each other. Competitive pressure is a key driver of eco-innovation (SEM), but its necessity is reduced when eco-innovation is already high, implying different routes to achieving environmental performance. This addresses the need to specify conditions under which institutional mechanisms are relevant [69].

Another theory-based contribution relates to the role of eco-innovation as a bridge between institutional pressures and performance. Although previous studies have acknowledged this role of eco-innovation as a mediator [70,71], they consider it a general mediator. The results, however, reveal that the mediation effect of eco-innovation varies depending on the pressure, especially for mimetic pressure, where the effect of eco-innovation is the highest (32.5%), and for normative and coercive pressures, where the effect of eco-innovation is lower (10%). Eco-innovation is also observed in both solutions of fsQCA, and this confirms the significance of eco-innovation.

This research also contributes to the contextualization of Institutional Theory by placing it in the context of SMEs with different levels of enforcement. The majority of the literature, which is primarily conducted in Western economies, identifies normative pressures as the most significant drivers of innovation and performance [7,8]. These findings both partially support this and also extend this concept. Stakeholder pressures are a driver of performance, but competitive pressures are identified as the most significant driver of eco-innovation. This supports findings in resource-constrained environments, where competition is a stronger driver of innovation than stakeholder pressures [72,73]. Competitive pressures are consistently identified in the robustness tests of the fsQCA, which supports their significance, whereas the omission of competitive pressures in some models identifies alternative paths to innovation. However, the present study points to the context-dependent nature of the effects of institutions and further emphasizes their importance in the context of emerging economies.

The results also help to advance the Corporate Social Responsibility (CSR) literature, which has struggled to define whether institutional pressures result in substantive or symbolic action. The findings reveal that stakeholder pressure can directly improve environmental performance, even in the absence of eco-innovation, which suggests the legitimacy derived from stakeholder alignment is not just "greenwash", but can lead to real environmental performance. The significant dependence of mimetic pressure on eco-innovation suggests that competitor-based CSR is a substantive form of innovation. Hence, differentiating between mechanisms provides CSR researchers with a better under-

standing of which institutional circumstances lead to substantive rather than "symbolic" environmental performance.

5.2. Practical Implications

The study shows that the most influential pressure for eco-innovation in SMEs is mimetic pressure. From the SMEs managers' point of view, it is crucial to have a benchmarking system for competitors. This includes observing and imitating the successful eco-innovation of competitors. The results that 32.5% of the competitive pressure is mediated by eco-innovation indicate that imitating competitors should not be interpreted as a simple copying. It involves active observation of competitors' sustainability strategies and the use of benchmarking systems. When competition for SMEs is based on sustainability, eco-innovation strategies can result in good performance [70,71]. In practical terms, this implies that managers that dedicate time to observe and implement their competitors' successful green innovations can improve environmental performance at a lower cost and risk, as compared to creating new solutions.

CSR and sustainability managers should develop a greater stakeholder engagement, which would be the most influential factor for environmental performance, given the strongest direct effect of the three identified institutional pressures on performance. In this context, since SMEs are resource-constrained, effective engagement with stakeholders and NGOs would improve their reputation and credibility, hence leading to improved sustainability performance [12]. This would, therefore, be considered a strategic activity and not a symbolic activity, which could lead to sustainable competitive advantage.

In addition, the findings also indicate that regulatory pressure has a relatively weak direct and mediated (eco-innovation) effect on environmental performance, hence being the least influential of the three institutional pressures in the empirical analysis. From the perspective of policy implications, it can be stated that applying uniform command and control measures is not sufficient in the case of SMEs. It is also essential to apply incentive-based instruments such as green finance, regional regulation, and subsidies for SMEs to minimize their costs of compliance and stimulate innovation activities in the sector. Previous studies have already indicated that subnational institutions and their diversity in terms of governance have significant effects on eco-innovation [74,75].

Lastly, supply chain managers and international partners will find our findings to be quite significant. Large buyers act as institutional multipliers, distributing sustainability demands to SMEs because supplier networks are often affected by competitive and stakeholder pressures. Previous research indicates that the governance procedures that multinational corporations apply are very beneficial to SMEs [73,76]. From a pragmatic perspective, this means that buyers should provide SMEs with digital traceability tools to monitor their performance, include clauses of sustainability in their contracts at the same time as organizing their technical training. If purchasing and supply chains incorporate eco-innovation criteria into their purchases, SMEs can convert symbolic acceptance into real environmental results. Through compliance with these cascading demands, SMEs gain beneficial consequences as well as opportunities for integration into global markets.

5.3. Limitation and Future Direction

The limitations of the study provide pathways for further investigation. First, a two-wave time-lagged survey design was intentionally chosen to reduce common method variance and to ensure a temporal separation between the independent variables, mediator, and dependent variable. However, observational designs like this cannot fully address endogeneity concerns (e.g., omitted variables, reverse causality) that would require instrumental variables or panel data. Quasi-experimental designs would be helpful in

establishing causality, especially as regulatory settings change. Second, while this research has identified eco-innovation as an important mediating construct, other such organizational constructs like corporate culture, absorptive capacity, or green dynamic capabilities can also enrich the understanding of how firms may cope with the external mandates into sustainable outcomes. It would enhance the theoretical exposition in this area to investigate such mechanisms. Third, although this study focused on the relative strengths normative, coercive, and mimetic pressures, there is a need for future research to examine moderators such as supply chain governance, digitalization, or green transformational leadership factors facilitating these relationships. Fourth, the results are from Chinese manufacturing SMEs in the context of the dual carbon agenda, which is an institutional environment with particular regulatory, cultural, and enforcement features. This deliberate focus strengthens the study's internal validity, but to increase the generalizability of the results, cross-country research in developed and other emerging economies is thus required to determine whether the hierarchy of pressures observed and the mechanism differentiation framework are applicable in other contexts. Fifth, the study examines phenomena that could be evaluated using network theory (e.g., the spread of eco innovations via competitor mimicry and supply chain linkage) and governance theory (e.g., the impact of enforcement quality and regulatory governance). Researchers could combine institutional theory with a network or governance framework to explore how the position of SMEs in inter-firm networks and local governance affects the mechanisms identified here. Lastly, as the study concentrated on manufacturing, testing the framework in other sectors, such as services or energy-intensive industries, can help establish the validity of the dual-pathway framework.

6. Conclusions

Under the dual-carbon agenda, we investigated how coercive, normative, and mimetic forces influence eco-innovation and environmental performance among Chinese-manufacturing SMEs. The findings show a significant impact of institutional pressures. Mimetic pressure most strongly influences eco-innovation, which in turn leads to environmental performance, while normative pressure has the strongest direct influence on environmental performance. Coercive pressures are less influential, reflecting compliance issues at the SME level.

The combination of SEM and fsQCA is complementary: SEM estimates direct, indirect, and total effects between variables, whereas fsQCA shows that multiple pathways are possible to achieve high performance. The study advances institutional theory by quantifying the mediation effects and showing that all three pressures include both direct and innovation-mediated effects. In particular, mimetic pressure is the most innovation-dependent, while normative pressure has the strongest direct impact. Eco-innovation explains 32.5% of the total effect of mimetic pressure on environmental performance, and almost 10% of normative and mimetic pressure. In this way, the study advances institutional theory by moving beyond the binary view of pressures by showing that the three pressures are not only distinct in their magnitude but also through quantifying their different reliance on eco-innovation.

These findings challenge the assumption that institutional pressures are uniform or interchangeable, particularly in contexts of fragmented enforcement, and highlight the importance of competitive benchmarking and stakeholder engagement. The study further suggests that imitation of competitors in eco-innovation can lead to substantive environmental performance improvements rather than symbolic adoption. Future research may explore the conditions under which such mimicry leads to meaningful outcomes, particularly in relation to supply chain incentives and performance-based mechanisms,

which may be more effective than uniform regulatory approaches in encouraging SME participation in carbon reduction goals.

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Data Availability Statement: Data will be available from the corresponding author upon reasonable request.

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Appendix A

Table A1. Statistics of confirmatory factor analysis.

Constructs	Items	SFL	α	CR	AVE
Stakeholders Pressure	STP1	0.704	0.871	0.874	0.581
	STP2	0.708			
	STP3	0.769			
	STP4	0.794			
	STP5	0.829			
Environmental Regulations	ER1	0.753	0.851	0.872	0.532
	ER2	0.749			
	ER3	0.709			
	ER4	0.679			
	ER5	0.718			
	ER6	0.765			
Competitors Pressure	COP1	0.717	0.807	0.846	0.580
	COP2	0.787			
	COP3	0.770			
	COP4	0.770			
Eco-Innovation	ECOINN1	0.728	0.781	0.814	0.593
	ECOINN2	0.774			
	ECOINN3	0.807			
Environmental Performance	EP1	0.724	0.838	0.860	0.506
	EP2	0.724			
	EP3	0.671			
	EP4	0.761			
	EP5	0.687			
	EP6	0.699			

Appendix B

Table A2. Robustness test.

	1a	1b	2a	2b	2c	3a	3b	3c
	Percentile (20/50/80)		Theoretical lens (2, 3, 4)			Theoretical lens (1, 3, 5)		
STP	●		●	●				
ER		●		•	●	●		
CP		●	●		●		●	
Eco-Inn	●	●		●	●			●
Consistency	0.856	0.868	0.846	0.914	0.901	0.839	0.793	0.848
Raw coverage	0.562	0.389	0.605	0.472	0.477	0.753	0.815	0.818
Unique coverage	0.238	0.064	0.194	0.061	0.067	0.028	0.038	0.037
Overall solution consistency	0.847		0.844			0.752		
Overall solution coverage	0.627		0.733			0.942		

● = core condition present; • = peripheral condition present; ⊗ = absence (negation); blank = condition not in the configuration.

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