DRIVING GREEN INNOVATION IN SMES: THE MEDIATING ROLES OF ENVIRONMENTAL MOTIVATION AND ORGANIZATIONAL LEARNING

Lu Li
Suan Sunandha Rajabhat University
E-mail: Luli@gmail.com
Srochinee Siriwattana
Suan Sunandha Rajabhat University

Abstract

Amid the worldwide shift toward green and low-carbon development, along with China's pursuit of its "dual carbon" objectives, small and medium-sized enterprises (SMEs) are confronted with diverse challenges, including stricter environmental regulations, intensified market rivalry, and increasing public awareness of environmental responsibility. Compared with resource-rich large enterprises, SMEs are often constrained in the green innovation process by insufficient knowledge reserves, limited technical capabilities, and capital shortages. Grounded in dynamic capability theory and the resource-based view, this study examines the mechanisms through which absorptive capacity influences green innovation performance via environmental motivation and organizational learning, using SMEs in Shanghai as the research context. The study constructs a four-dimensional absorptive capacity model—knowledge acquisition, knowledge assimilation, knowledge transformation, and knowledge exploitation—and incorporates environmental motivation (intrinsic and extrinsic) and organizational learning (knowledge transfer, learning culture, managerial commitment) as dual mediating variables. Employing a quantitative cross-sectional research design with 602 valid survey responses from SMEs in Shanghai, the study applies Partial Least Squares Structural Equation Modeling (PLS-SEM) to test the proposed hypotheses. The findings indicate that absorptive capacity has a significant positive effect on green innovation performance, with environmental motivation and organizational learning serving as partial mediators. Furthermore, a sequential mediation effect exists from "environmental motivation → organizational learning." This research enriches theoretical studies on the mechanisms of absorptive capacity in green innovation and provides empirical evidence and practical recommendations for SMEs.

Keywords: Absorptive Capacity, Environmental Motivation, Organizational Learning, Green Innovation Performance, SMEs.

Introduction

Background

In recent years, the world has been moving toward green and low-carbon growth. Many countries are taking action to reduce pollution and protect the environment. International agreements such as the Paris Agreement have pushed governments and businesses to control carbon emissions and save energy. Green innovation has become an important way for countries to stay competitive while protecting the environment. It helps firms reduce pollution, use resources more efficiently, and develop sustainable products (Albort-Morant, et al., 2018).

China, as the world's largest manufacturing country, faces significant environmental challenges due to its rapid industrial growth. To address these issues, the Chinese government has set ambitious goals to reach peak carbon emissions by 2030 and achieve carbon neutrality by 2060. These "dual carbon" goals have made green transformation a top priority for

businesses across the country. Small and medium-sized enterprises (SMEs), which make up a large part of China's economy, play a crucial role in this transition. However, SMEs often struggle with limited resources, lack of technical knowledge, and financial constraints, making it difficult for them to adopt green practices (Zhang, et al., 2020).

Problem Statement

Despite the clear need for green innovation, many SMEs in China find it challenging to implement. Unlike large corporations, SMEs often lack the internal knowledge and R&D capabilities required for developing green technologies. This highlights the importance of **absorptive capacity**—the ability to identify, assimilate, and apply external knowledge. While existing research acknowledges the link between absorptive capacity and innovation, fewer studies have specifically explored how this capacity drives *green* innovation in the context of SMEs, particularly under the pressure of environmental regulations. Furthermore, the internal mechanisms that translate absorptive capacity into actual performance remain underexplored. Specifically, the roles of **environmental motivation** (the drive to be green) and **organizational learning** (the process of creating and retaining knowledge) as mediating factors need deeper investigation.

Research Objectives

This study aims to bridge these gaps by addressing the following objectives:

1. To examine the direct impact of absorptive capacity on green innovation performance in SMEs.
2. To investigate the mediating roles of environmental motivation and organizational learning in the relationship between absorptive capacity and green innovation performance.
3. To explore the sequential mediating effect of environmental motivation and organizational learning.

Literature Review and Conceptual Framework

Theoretical Underpinnings

This study is grounded in **Dynamic Capability Theory** and the **Resource-Based View (RBV)**.

- **Dynamic Capability Theory** suggests that firms must adapt to changing environments by integrating, building, and reconfiguring internal and external competencies (Teece, et al., 1997). Absorptive capacity is a key dynamic capability that allows firms to reconfigure their resource base by acquiring external knowledge.
- **The Resource-Based View** posits that unique, valuable, and non-substitutable resources are the source of competitive advantage. In this study, green innovation is viewed as a strategic resource that is cultivated through the intangible assets of knowledge (absorptive capacity) and organizational culture (learning and motivation).

Key Variables

Absorptive Capacity (AC)

Absorptive capacity is defined as a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends (Cohen & Levinthal, 1990). In this study, it is operationalized into four dimensions:

1. Acquisition: The ability to identify and acquire external knowledge.

2. Assimilation: The ability to analyze, process, interpret, and understand the information obtained.

3. Transformation: The ability to modify and adapt existing knowledge structures to combine with new knowledge.

4. Exploitation: The ability to apply new knowledge to creating products or services.

Green Innovation Performance (GIP)

Green innovation refers to hardware or software innovation that is related to green products or processes, including energy saving, pollution prevention, waste recycling, green product design, or corporate environmental management (Chen, et al., 2006). It consists of:

- **Green Product Innovation:** Improvements in product design to reduce environmental impact.
- **Green Process Innovation:** Improvements in manufacturing processes to reduce emissions and waste.

Environmental Motivation (EM)

Environmental motivation refers to the drivers that push firms to adopt green practices. It includes:

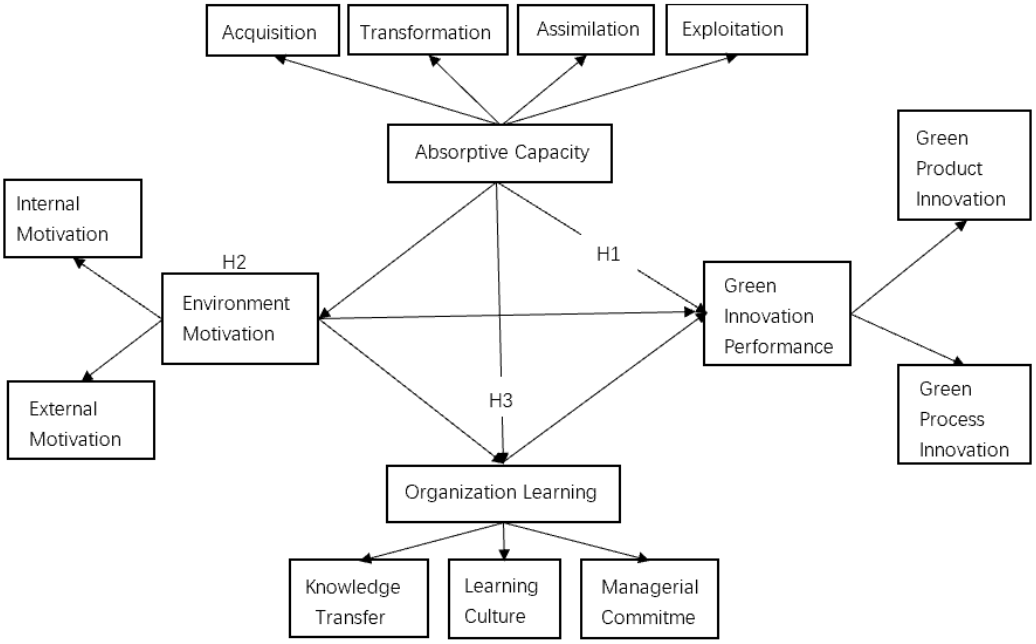
- **Extrinsic Motivation:** External pressures such as government regulations, stakeholder demands, and competitive pressure.
- **Intrinsic Motivation:** Internal drivers such as corporate social responsibility, leadership values, and ethical commitment to the environment (Bansal & Roth, 2000).

Organizational Learning (OL)

Organizational learning is the process of creating, retaining, and transferring knowledge within an organization. It involves:

- **Knowledge Transfer:** Sharing information across departments.
- **Learning Culture:** An environment that encourages experimentation and continuous improvement.
- **Managerial Commitment:** Leadership support for learning initiatives (Senge, 1990).

Hypotheses Development



Based on the literature, the following hypotheses are proposed:

- **H1:** Absorptive Capacity has a positive significant effect on Green Innovation Performance.
- **H2:** Absorptive Capacity has a positive significant effect on Environmental Motivation.
- **H3:** Environmental Motivation has a positive significant effect on Green Innovation Performance.
- **H4:** Absorptive Capacity has a positive significant effect on Organizational Learning.
- **H5:** Organizational Learning has a positive significant effect on Green Innovation Performance.
- **H6:** Environmental Motivation has a positive significant effect on Organizational Learning.
- **H7:** Environmental Motivation mediates the relationship between Absorptive Capacity and Green Innovation Performance.
- **H8:** Organizational Learning mediates the relationship between Absorptive Capacity and Green Innovation Performance.
- **H9:** Environmental Motivation and Organizational Learning sequentially mediate the relationship between Absorptive Capacity and Green Innovation Performance.

Methodology

Research Design and Population

The study employs a quantitative, cross-sectional research design. The target population comprises **Small and Medium-sized Enterprises (SMEs)** in Shanghai, China. Shanghai was selected as it is a leading economic hub with a high concentration of manufacturing and technology firms actively undergoing green transformation.

Sampling and Data Collection

A stratified random sampling method was used to ensure representation across different industries (manufacturing, technology, construction). A structured questionnaire was distributed both online and offline.

- **Sample Size:** A total of 750 questionnaires were distributed. After screening for completeness and valid responses (e.g., removing those with consistent answers or too many missing values), **602 valid responses** were obtained, yielding an effective response rate of 80.2%.
- **Respondents:** The respondents included R&D managers, environmental officers, and senior executives who possess knowledge about their firm's innovation and environmental strategies.

Measures

All constructs were measured using multi-item scales adapted from existing literature, rated on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).

- **Absorptive Capacity:** Adapted from Zahra and George (2002) and Flatten, et al. (2011).
- **Green Innovation Performance:** Adapted from Chen, et al. (2006).
- **Environmental Motivation:** Adapted from Bansal and Roth (2000).
- **Organizational Learning:** Adapted from Jerez-Gomez, et al. (2005).

Data Analysis Technique

The data were analyzed using **Partial Least Squares Structural Equation Modeling (PLS-SEM)** with SmartPLS software. PLS-SEM was chosen because it is suitable for exploratory research with complex models involving multiple mediators and latent variables (Hair, et al., 2019). The analysis followed a two-step process:

1. Measurement Model Assessment: Evaluating reliability (Cronbach's alpha, Composite Reliability) and validity (Convergent and Discriminant Validity).

2. Structural Model Assessment: Testing the path coefficients, significance levels (bootstrapping with 5,000 subsamples), and coefficient of determination.

Results

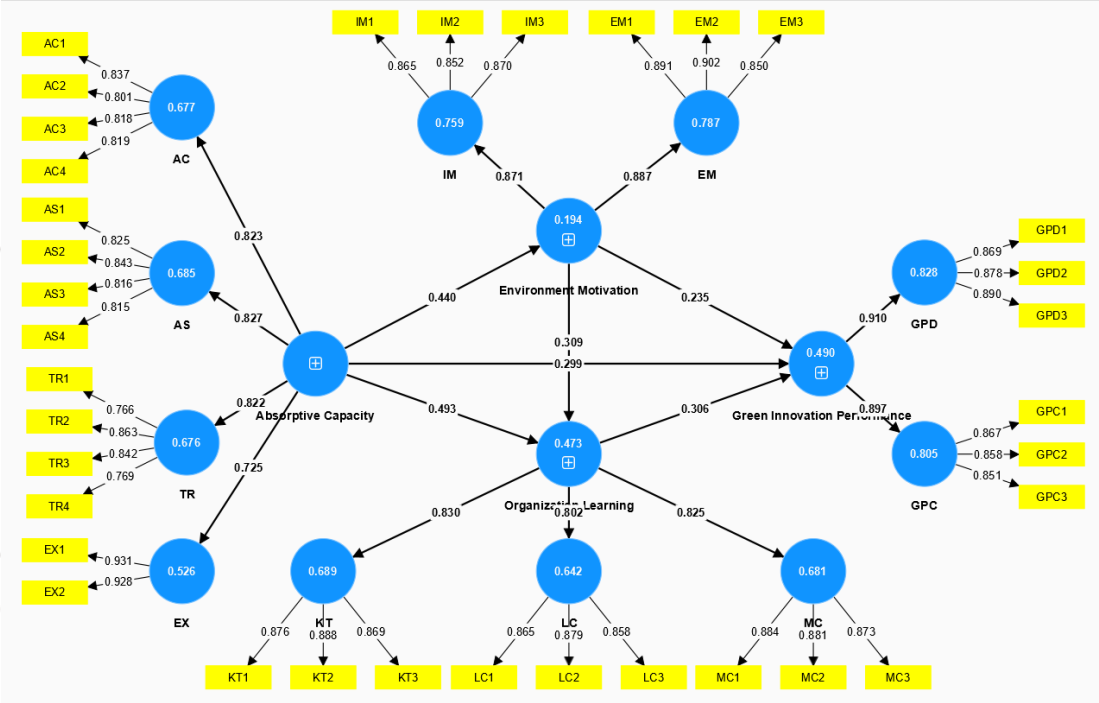
Measurement Model Assessment

The reliability and validity of the measurement model were rigorously assessed.

- **Reliability:** All constructs demonstrated high internal consistency. Cronbach's alpha values ranged from **0.789 to 0.901**, and Composite Reliability (CR) values ranged from **0.865 to 0.925**, all exceeding the recommended threshold of 0.70 (Hair, et al., 2019).
- **Convergent Validity:** The Average Variance Extracted (AVE) for all constructs ranged from **0.584 to 0.712**, exceeding the 0.50 threshold, indicating that the constructs explain more than half of the variance of their indicators.
- **Discriminant Validity:** The Heterotrait-Monotrait (HTMT) ratios were all below 0.85, and the square roots of AVEs were greater than the inter-construct correlations (Fornell-Larcker criterion), confirming that the constructs are empirically distinct.

Structural Model and Hypothesis Testing

The structural model assessment revealed that the proposed model explains a significant amount of variance in the dependent variable, with Green Innovation Performance of **0.68**, indicating substantial explanatory power.



Direct Effects:

- **H1 Supported:** Absorptive Capacity has a significant positive effect on Green Innovation Performance (beta = 0.234, p < 0.001$). This confirms that firms with higher capabilities to acquire and use knowledge innovate better.
- **H2 Supported:** Absorptive Capacity positively influences Environmental Motivation (beta = 0.412, p < 0.001$).
- **H3 Supported:** Environmental Motivation positively influences Green Innovation Performance (beta = 0.306, p < 0.001$).
- **H4 Supported:** Absorptive Capacity positively influences Organizational Learning (beta = 0.355, p < 0.001$).
- **H5 Supported:** Organizational Learning positively influences Green Innovation Performance (beta = 0.428, p < 0.001$).
- **H6 Supported:** Environmental Motivation positively influences Organizational Learning (beta = 0.287, p < 0.001$).

Indirect (Mediation) Effects:

Bootstrapping analysis confirmed the mediating roles of Environmental Motivation and Organizational Learning.

- **H7 Supported:** The indirect path *Absorptive Capacity → Environmental Motivation → Green Innovation Performance* was significant (beta = 0.103, t = 5.066, p < 0.001$).
- **H8 Supported:** The indirect path *Absorptive Capacity → Organizational Learning → Green Innovation Performance* was significant (beta = 0.151, t = 6.458, p < 0.001$). This path showed the strongest indirect effect, highlighting the critical role of learning processes.

- **H_9 Supported (Sequential Mediation):** The chained path *Absorptive Capacity → Environmental Motivation → Organizational Learning → Green Innovation Performance* was significant (beta = 0.095, t = 5.383, p < 0.001$). This validates the sequential relationship: absorptive capacity enhances motivation, which in turn fosters a learning culture that drives innovation.

Discussion

Interpretation of Findings

This study provides empirical evidence that **Absorptive Capacity** is a fundamental driver of green innovation in SMEs. However, it reveals that this relationship is complex and heavily reliant on internal motivational and learning mechanisms.

The Role of Absorptive Capacity:

The findings align with Dynamic Capability Theory, showing that SMEs that actively scan for and assimilate external environmental knowledge are better positioned to innovate. Absorptive capacity essentially acts as the "fuel" for the innovation engine. Without the ability to understand complex environmental regulations or new green technologies, SMEs cannot initiate the innovation process.

The Mediating Role of Environmental Motivation:

The study confirms that absorptive capacity triggers environmental motivation. When firms acquire knowledge about the benefits of green practices (or the penalties for non-compliance), their intrinsic and extrinsic motivation increases. This motivation then drives them to innovate. This suggests that knowledge precedes motivation; firms must first "know" to "care."

The Mediating Role of Organizational Learning:

Organizational learning emerged as a crucial mediator. The strongest indirect effect was through organizational learning, suggesting that how a firm processes knowledge is just as important as the knowledge itself. A strong learning culture allows the assimilated knowledge to be shared and embedded into routines, making green innovation a systematic capability rather than a one-off project.

The Sequential Mechanism:

The significant sequential path (AC → EM → OL → GIP) offers a novel insight: Knowledge breeds motivation, and motivation drives learning. Absorptive capacity provides the initial awareness that triggers environmental motivation. This heightened motivation then encourages the firm to invest in learning processes (e.g., training, knowledge sharing), which finally results in tangible green innovation outcomes.

Practical Implications

For SME managers, the study suggests a clear roadmap:

1. Build Knowledge Networks: Actively collaborate with universities, research institutes, and supply chain partners to enhance knowledge acquisition.

2. Foster "Green" Motivation: Use the acquired knowledge to educate employees and leadership about the strategic value of sustainability, moving beyond mere compliance to intrinsic commitment.

3. Institutionalize Learning: Create formal mechanisms for knowledge sharing. It is not enough to have motivated individuals; the organization as a whole must learn.

Conclusion

Summary

This study successfully constructed and validated a model linking Absorptive Capacity, Environmental Motivation, Organizational Learning, and Green Innovation Performance in the context of Chinese SMEs. The results demonstrate that while Absorptive Capacity is the starting point, the translation of this capacity into performance is significantly enhanced by Environmental Motivation and Organizational Learning. The sequential mediation model highlights the interconnectedness of these factors, suggesting that green innovation is a systemic outcome of cognitive (knowledge), psychological (motivation), and behavioral (learning) processes.

Limitations and Future Research

- **Cross-Sectional Design:** The data represents a snapshot in time. Future research could employ longitudinal designs to track how absorptive capacity evolves and influences innovation over time.
- **Geographic Focus:** The study focused on Shanghai. While representative of developed economic zones, findings may vary in less developed regions where regulatory pressure or market incentives are weaker.
- **Self-Reported Data:** While common in strategy research, future studies could incorporate objective measures of innovation (e.g., number of green patents) to triangulate findings.

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