



The Research Mechanism of Knowledge Source Duality on Regional Green Sustainable Innovation: Based on the Perspective of Dynamic Capability

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Abstract. This article aims to use panel data from industrial enterprises in various provinces of China as a sample and conduct empirical research using a fixed effects model to explore the differences in binary knowledge strategy selection and its impact on the sustainability of green innovation, and provide corresponding suggestions based on the conclusions drawn. This opens the black box between knowledge sources and regional green innovation sustainability, and also promotes various regions in China to examine their own development from a sustainable development perspective. Promote them to focus on regional development trends and environmental changes, enhance resilience, carry out green innovation activities, and gain public recognition.

Keywords: Knowledge sourcing, Duality, Sustainability of regional green innovation, Dynamic capability

1 INTRODUCTION

Since the reform and opening up, China has always maintained a fast economic growth rate and industrial development speed, but at the same time, it has also caused a series of problems such as resource shortage and environmental pollution. With the deepening of green and innovative development concepts, various regions have also achieved certain innovative results, there are still shortcomings. The reason behind this is that companies often only innovate once or in the short term, while ignoring the sustainability of green innovation^[1]. It refers to the process in which region continuously implements green innovation projects aimed at energy conservation, consumption reduction, pollution reduction, and environmental quality improvement for a considerable period of time, and continuously achieves innovative economic benefits. Based on literature, it has been found that there has been relatively little discussion on "innovation sustainability" in the past, while green innovation sustainability, as a new innovation model, can be based on the success of early innovation, which can increase the probability of future success and is of great significance for maintaining long-term competitive advantages^[2].

At present, scholars often explore the sustainability of knowledge and green innovation from a micro perspective, neglecting its macro relationship. Knowledge is one of the most valuable intangible resources and an important innovation resource, which is the result of the application of advanced knowledge. Therefore, in order to achieve sustainable green innovation in the region, it is necessary to integrate multi-source knowledge, creating and acquiring new knowledge through internal and external research and development, that is, knowledge sourcing^[3]. Compared to traditional technological innovation, the sustainability of green innovation requires higher standards of technology and a large amount of green knowledge as support. Exactly, knowledge sourcing can gather knowledge from different sources and promote the sustainability of green innovation through the acquisition of new green concepts. Therefore, it is necessary to explore the driving factors and formation mechanisms of regional green innovation sustainability.

In existing research on knowledge and innovation, qualitative and quantitative methods are often used to study the relationship between the two from a static perspective, but the problem of inertia traps is gradually becoming prominent. Dynamic capability, as an ability to cope with rapidly changing environments, can break through the static perspective of strategic analysis and overcome the shortcomings of core rigidity from an evolutionary perspective^[4]. Based on existing research findings, this article divides dynamic capabilities into "absorption capacity", "integration capacity", and "reconstruction capacity". The reason is that absorptive capacity, as an ability to identify and assimilate relevant knowledge and technology, can help regions obtain diverse knowledge and information; Integration ability can coordinate and integrate internal and external knowledge to promote the effective allocation of knowledge resources; The ability to refactor can quickly adjust and restructure resource combinations to fit the dynamic external environment. Therefore, the contribution of this study lies in: firstly, enriching the forms of innovation; Secondly, the research results on the relationship between knowledge and innovation have been improved; Finally, from a dynamic and macro perspective, the black box of the relationship between knowledge sourcing and the sustainability of green innovation has been opened up.

2 THEORETICAL BASIS

Through a review of relevant research at home and abroad, the following reveals the main influencing factors and their mechanisms of green innovation sustainability.

2.1 Relationship between knowledge sourcing and the sustainability of regional green innovation

Internal knowledge sourcing is the core innovation source driving development, which can promote the generation of technology. The green knowledge generated by it helps to enhance the company's green innovation effectiveness. However, Few scholars have explored the new innovation model of continuous innovation. Based on the perspective of knowledge accumulation, Malerba^[5] found that most of the entrants are accidental

innovators, while there are very few persistent innovators. As the number of knowledge fragments from internal knowledge sources increases, the more knowledge fragments can be used, which will better promote the sustainable development of innovation. And according to the theory of innovation sustainability, the accumulated knowledge will continue to be learned and output at a lower cost in subsequent innovation development, which in turn further increases the knowledge reserve and provides assistance for the green sustainable innovation development that requires a large amount of knowledge support. Then, due to changes in the later stage environment, "core rigidity" gradually becomes apparent, reducing the promoting effect of knowledge formed in the previous environment on enterprise innovation in the current environment. In addition, regions will pay for internal green R&D activities, but the spillover effects of new knowledge and technologies will bring benefits to market entities, resulting in lower marginal benefits for themselves compared to social marginal benefits, thereby affecting the sustained enthusiasm for green innovation.

Many times, the resources required for green development cannot be self-sufficient, because solving environmental problems may not be the core activity of the enterprise, and some environmental related knowledge cannot be obtained within the company^[6]. At this point, knowledge transfer can help expand their knowledge base, bringing diversified knowledge or more implicit technical know-how to the transfer subject. LIAO^[7] supports this viewpoint from the perspective of legitimacy, believing that external cooperation is a learning process that spans across organizations. Using external knowledge can acquire knowledge that is different from internal knowledge, update and accumulate knowledge, and promote green innovation in enterprises. However, Wang^[8] believing that the acquired external knowledge has a knowledge span increases cognitive comprehension difficulty and is not conducive to innovation. It is not difficult to understand that when a large amount of knowledge resources flood in, if the innovation entities in the region lack good absorption capacity and diverse knowledge, it will affect the region to make strategic choices that are not suitable for the development of regional green innovation; When encountering economic depression or malicious external suppression, there may also be a bottleneck situation, leading to a slowdown or even stagnation in the development of green innovation, which is not conducive to the sustainability of innovation.

2.2 The interactive relationship between internal and external knowledge sourcing

Knowledge has heterogeneous characteristics, which are the foundation of a unique resource combination for enterprises and the source of "new" in the "new combination" of knowledge elements^[9]. Generally speaking, internal research and development levels and external diversified knowledge can help overcome the shortcomings of knowledge and capabilities within the region. Through knowledge sharing, resource sharing, and technological collaboration, sustainable green innovation in the region can be promoted. However, cooperation with external entities with high alliance stickiness will have a "crowding out effect" on internal research and development activities, reducing the effectiveness of independent innovation^[10]. If there is a lack of sufficient

knowledge, technology, and capabilities to support development, it will create certain constraints on the efficient conversion of external knowledge and technology, and the collaborative innovation of internal and external knowledge will be hindered; Especially when the compatibility between regions and foreign knowledge is low, innovation entities find it difficult to efficiently internalize external knowledge, and therefore cannot industrialize the introduced green innovation technologies, affecting the accumulation of knowledge and the effectiveness of learning. This is not conducive to improving their own R&D endowment structure, and thus falling into a vicious cycle of "external cooperation - difficult knowledge accumulation - internal R&D crowding", which is not conducive to the sustainability of innovation.

2.3 The mediating role of dynamic capabilities

Dynamic capabilities can provide sustainable and innovative solutions for strategic development, helping to increase public acceptance of green innovation behavior^[11]. Absorption ability refers to the ability to recognize and assimilate knowledge. The formation of absorptive capacity involves high-intensity internal R&D investment, the accumulation of regional local environmental technology knowledge enables innovative entities to have high absorption capacity, which is conducive to interacting and complementing external knowledge. Therefore, internal knowledge sourcing is one of the important influencing factors for the formation of absorption capacity, and the improvement of its level can significantly enhance knowledge absorption capacity. In addition, the absorptive capacity theory suggests that absorbing new knowledge from the outside becomes more flexible and creative, as a tool for transforming resources and innovation. absorptive capacity applies acquired and created knowledge to the production of new ideas and technologies, thereby expanding regional technological tracks, reducing excessive reliance on existing mature technologies, avoiding technological stalemate, and enhancing sustained innovation capabilities.

Integration ability refers to the ability to re coordinate and allocate various resources and basic capabilities. Green innovation is a complex knowledge creation activity and result that involves product research and development, green production, energy conservation and emission reduction, and other aspects. If the potential innovation benefits of internal dormant knowledge and external knowledge resources are not integrated and utilized, knowledge will be in an asset state, making it difficult to transform into innovation capability. This means that only enterprises with certain knowledge integration capabilities can effectively transform knowledge into enterprise innovation capabilities^[12], so integration capabilities play an indispensable role between knowledge and sustained innovation capabilities. In other words, under the influence of integration capabilities, the acquired knowledge is ultimately applied to products, services, or technologies, helping regions achieve asset coordination and appreciation between internal and external aspects within the commercial ecosystem, and increasing the possibility of achieving green innovation.

Refactoring capability is the ability to adapt to a dynamically changing environment and restructure internal operational strategies. The domestic and international environment in which a region is located is constantly changing, and only by keeping up with

the rapidly changing social environment can it not lag behind other regions. From the perspective of path dependence, a region is dependent on existing strategies, which limits its ability to further explore breakthrough innovation. But the ability to refactor can better adapt to the development needs of green innovation, ensure the effective allocation of organizational resources, and improve the sustainability of green innovation. The reconstruction ability formed within a region can be exhausted, so it is also important to pay attention to the impact of external knowledge sources on the reconstruction ability^[13]. Establish cooperative relationships with external parties, acquire heterogeneous knowledge resources, and increase knowledge reconstruction elements. On this basis, carry out knowledge and resource reconstruction, create new value growth points, and promote the realization of innovation^[14].

3 CONCEPTUAL FRAMEWORK

This study establishes a conceptual framework to explore the impact of knowledge sourcing on the sustainability of regional green innovation in the context of Chinese industrial enterprises, establishes a structural model, and analyzes relevant variables.

Knowledge sourcing can be mainly divided into two dimensions: internal knowledge sourcing and external knowledge sourcing, measured by the conversion of R&D investment into capital stock. Dynamic capability includes absorption capability, integration capability, and reconstruction capability, which are measured by the total number of technical personnel in industrial enterprises in the region, the total asset turnover rate of industrial enterprises in the region, and the proportion of asset profit margin of industrial enterprises in the region. The sustainability of green innovation refers to the innovative economic benefits brought by the implementation of green innovation projects, measure the number of green patents across multiple time dimensions.

4 CONCLUSION AND SUGGESTIONS

The sustainability of regional green innovation increases with the increase of internal knowledge sourcing, but the marginal benefits decrease; There is an inverted U-shaped relationship between external knowledge sourcing and the sustainability of green innovation; Through comparison, it was found that compared to external knowledge sourcing, internal knowledge sourcing has a greater impact on absorption capacity and sustainability of green innovation. There is a significant interaction between knowledge sourcing and the sustainability of green innovation, and there is a substitution effect in improving the sustainability of regional green innovation. In the dimension of dynamic capability, absorptive capacity is an important path for internal knowledge sourcing to affect the sustainability of green innovation; External knowledge sourcing can have a positive promoting effect on the sustainability of green innovation through absorption and reconstruction capabilities. Heterogeneity analysis found that in areas with high market competition, internal knowledge sourcing has a significant positive promoting effect on the sustainability of regional green innovation, while the interactive substitution effect of internal and external knowledge sourcing is not significant; In low market

competition areas, internal knowledge sourcing positively promotes the sustainability of regional green innovation; The sustainability of green innovation increases with the increase of external knowledge, and its innovation benefits increase; Collaboration between internal and external knowledge sources can significantly promote sustainable green innovation.

It should be emphasized that the dual role of knowledge sourcing within the region, and the region should coordinate the relationship between the two based on internal strategic development needs, with internal knowledge sourcing as the main focus; Strengthen the cultivation of regional absorption and reconstruction capabilities, increase investment in basic research and innovation funds within the region, continuously cultivate one's own absorption and reconstruction capabilities, introduce highly educated talents, and improve the regional knowledge base reserve; Pay attention to the differentiated selection of knowledge sourcing strategies in different regions, evaluate their international market competitiveness, adjust regional development strategies in a timely manner, and fully utilize high-quality resources from external regions to form complementary advantages.

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