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A review of research on collaborative innovation and green development

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Abstract: Since the "double carbon" goal was proposed in September 2020, China has established a "1+N" policy system to promote the realization of carbon neutrality and carbon peak, hoping to accelerate the pace of green economic development. The report of the 20th National Congress of the Party proposed to "actively and steadily promote carbon peak carbon neutrality", "adhere to green development, promote harmonious coexistence between man and nature", and once again play a flag-raising role in building ecological civilization and helping sustainable economic and social development. As a long-term project, the development of green economy can solve the problem of ecological environmental pollution and realize the economy Growth is coordinated with ecological progress. With the goal of green economic development, China has vigorously strengthened ecological constraints by taking an active role in enabling the government and effective markets. With the help of diversified ecological restraint strategies, the state, on the basis of the original key binding policies on the ecological environment, we will focus on carbon reduction, pollution reduction, green expansion and coordinated development of growth, and promote the transformation of the extensive economic development model to green and low-carbon development. Understanding the role of ecological constraints on the development of green economy can not only promote the optimization of industrial structure, low-carbon and green development of production and life, but also help sustainable economic and social development.

Keywords: Collaborative innovation; Green development.

1. Research on green development

By reviewing and sorting out the literature of previous scholars, it is found that the research on green development mainly focuses on green economy and green innovation. The concept of "green economy" was first proposed by David Pearce, that is, an economic model that reduces human inequality and improves human welfare without exposing future generations to environmental risks. Clive pointed out that green economy should be integrated into the sustainable development of human society. Green economy emphasizes that economic development should not lead to natural decline and environmental damage, that is, economic growth under the premise of environmental protection. Domestic and foreign scholars on the study of green economy focus on the following aspects: first, the theoretical study of green economy. Scholars define the concept of green economy and construct the framework of green economy from the perspectives of environmental economics theory, ecological economics theory and sociological theory [4-6]. The second is the empirical study of green economy. It mainly focuses on the measurement of green economy efficiency [7-9], regional differences of green economy efficiency [10,11], and convergence of green economy efficiency [12,13].

The research on green innovation mainly focuses on the influencing factors and economic consequences of green innovation. In terms of the influencing factors of green innovation, including the characteristics of enterprises and the influence of government on green innovation, Li et al believe that the better the financial performance of enterprises, the stronger the profitability, the stronger the ability to provide funds, and the more likely it is to carry out green innovation. Amore et al. believe that the corporate governance level affects the efficiency of corporate green innovation, and a low corporate governance level will lead to less output of corporate green innovation. Based on the institutional theory, Zhang et al. analyzed that environmental regulation has a positive impact on green product innovation and green process innovation. Yang Zhaojun et al. analyzed the impact of government regulation on green innovation by constructing a green innovation game model, and the results showed that government regulation cost had a negative impact on the diffusion of green innovation. Government subsidy mechanism helps domestic enterprises to adopt green innovation to a certain extent; The government's regulation of foreign-funded enterprises and the adjustment of intellectual property royalties will lead to the change of green innovation diffusion. In terms of the economic consequences of green innovation, including its impact on economic and environmental performance, scholars believe that green innovation can improve economic and environmental benefits. For example, Wang Jianqiu analyzed the relationship between green innovation and industrial economic growth through multiple regression, and the research showed that there is a positive correlation between green innovation and industrial economic growth, and the development of green innovation is conducive to industrial economic growth. Zhang et al. found through research that green innovation can not only reduce carbon emissions, but also improve environmental performance.

2. Related research on collaborative innovation

The idea of "collaborative innovation" was proposed by the American strategic management scientist Gaansoff in 1965, that is, based on the two-way flow of resources between innovation subjects, oriented by goal collaboration, and finally achieve win-win cooperation. Collaborative innovation is conducive to improving the sharing mechanism of innovation resources, enhancing the sense of trust among enterprise members, and enhancing the innovation capability

of enterprise members [20,21]. At present, the research on collaborative innovation is mainly carried out based on the logic of influencing factors - innovation elements - performance results. Yu Liping et al. studied the lack of impetus for collaborative innovation in China's high-tech industries, proposed the concept of collaborative innovation depth, and analyzed the influence mechanism of collaborative innovation depth from the macro and micro levels respectively. Based on the empirical data of 316 small and medium-sized manufacturing enterprises in 16 cities of the Yangtze River Delta, Xie Xuemei identified five types of factors affecting enterprise collaborative innovation, namely "enterprise main body", "knowledge and technology", "collaborative mechanism", "collaborative network" and "social relationship network" In addition, some scholars have summarized the factors affecting collaborative innovation into four categories: main factor, environmental factor, mechanism factor and relationship network factor . Based on the empirical analysis of dynamic capability, collaborative innovation and performance, Zhang Feiyan found that dynamic capability can promote collaborative innovation and thus improve the performance of the entire supply chain. Xie Xuemei constructed from the subject and content dimensions, and analyzed that supplier participation, customer participation and cross-department participation in collaborative innovation in the subject dimension and supply chain collaborative knowledge innovation, collaborative technology innovation and collaborative management innovation in the content dimension can significantly improve enterprise performance.

3. Related research on collaborative innovation and green development

Since the "two-carbon" strategy was proposed, green transformation development has become a research hotspot, and collaborative innovation is a new driving force to improve the level of green development. Innovation-driven strategy is an inevitable choice to promote the transformation and upgrading of industrial structure, especially in promoting the realization of green sustainable and high-quality economic development has an irreplaceable role. Some scholars pointed out that the effect of innovation on green development depends on innovation input and innovation performance. For example, Hou Peng et al. pointed out that the improvement of institutional environment, resource input and market system optimized the innovation environment, promoted the improvement of regional scientific and technological innovation ability, and thus promoted green development. The innovation and application of new technologies have improved the green total factor productivity, and the innovative production of green products has fostered a number of emerging technology enterprises to achieve side-by-side development of economy and environment. Wei et al. used ANP and QSIM models to study the effect mechanism of collaborative innovation network on green innovation performance. Chen Zhangxi et al. used grey correlation analysis method and coupling coordination degree model to analyze the coupling relationship between scientific and technological innovation and high-quality economic development in the Guangdong-Hong Kong-Macao Greater Bay Area . Hua Jian et al. selected the panel data of 11 provinces and cities in the Yangtze River Economic Belt and analyzed the relationship between multi-agent industry-study-research collaborative innovation and green development level with the help of the composite system cooperation degree model and the SBM model.

4. Mechanism of synergistic innovation on green economy development

Through the flow of innovation factor resources, collaborative innovation can effectively integrate technology, talent, capital and other scientific and technological resources, break the regional and even enterprise-level restrictions, establish cross-regional and cross-enterprise deep cooperation mechanism, and then improve the level of productivity, promote industrial transformation and upgrading, and promote the realization of green development. Generally speaking, the impact of collaborative innovation on the development of green economy can be divided into direct effect and indirect effect. Direct effect refers to the impact of innovation activities of enterprises or regions on their own green economic development, while indirect effect refers to the impact of innovation activities of enterprises or regions on green economic development of other enterprises or surrounding cities, that is, the spatial spillover effect of collaborative innovation on green economic development.

According to existing research findings, innovative activities can promote the upgrading of industrial structure, improve energy efficiency, reduce pollution emissions, and thus promote green development. The effect of collaborative innovation on green development can be realized in the following ways: First, technological innovation often has the phenomenon of synergy and spatial spillover. The independent innovation of an enterprise or city can promote the imitation of surrounding enterprises or cities, and such innovation and imitation can help curb the scale of carbon emission. Second, collaborative innovation can promote the flow of innovation factors such as scientific and technological personnel and scientific and technological capital between cities, accelerate environmental innovation, thereby improving the energy utilization efficiency of surrounding cities, reducing pollution emissions, and promoting the development of green economy. Third, collaborative innovation can promote the formation of cooperation and competition between regional cities, promote the city with a low level of industrial structure to absorb advanced experience, accelerate the transformation and upgrading of industrial structure, and thus promote the development of green economy.

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