Research on the Impact of Environmental Regulation Based on Marginal Cost on the Development of Green Economy

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Abstract-Green economy is a new economic form that is market-oriented, based on the traditional industrial economy, and developed for the purpose of harmony between the economy and the environment. It is produced and manifested by the industrial economy to meet the needs of human environmental protection and health. A state of development. Green development has become the primary development concept and inevitable development model under the background of high-quality development of modern economy. With the continuous development of the economy, green technological innovation has become a powerful means and effective connector for balancing economic growth and environmental protection. Combining the differences of different environmental regulations, this paper studies the impact of green technological innovation on the development of green economy based on the marginal cost theory, expounds the conduction role of green technological innovation in environmental regulation and the impact of green economy, and further provides theories for realizing the development of green economy Support and policy recommendations.

Keywords: Technological innovation; Environmental regulation; Green economy

1. INTRODUCTION

With the sustainable development of economy and society and the acceleration of industrialization process, the efficient utilization of energy, especially the consumption of nonrenewable resources represented by fossil energy, is increasing in an order of magnitude [1]. This not only aggravates the pressure of resource shortage, but also brings more severe challenges to the global ecological environment. Countries all over the world are more and more aware of the importance of solving the problem of environmental pollution, and gradually put the environmental problem into the work schedule. Under the background of high-quality development, it is imperative to develop green economy [2]. The contradiction between economic development and environmental pollution restricts China's development. Economic development is the top priority, but environmental issues cannot be ignored for this. In the face of the strange cycle of the rise and fall of environment and economy in the past, green technology innovation has become a powerful means and effective connector to balance economic growth and environmental protection [3]. In terms of green finance, it has become a common consensus in the financial sector to develop a multi-level green financial system to support green technology innovation activities [4]. Energy saving and environmental

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protection industry has a high technology content and a large amount of capital investment in technological innovation activities. Green finance and government environmental regulations will have an important impact on green technology innovation activities [5]. The problem of resources and environment is a systematic and complex project. As a micro economy, enterprises have opportunism. Therefore, it is difficult to realize the harmonious development of economy, resource environment and society only by market means. Those problems are supposed to rely on the government's environmental regulation policies to make up for the defects of market failure [6].

In fact, the environment is a special resource and wealth that realizes by the increasing number of local governments. The destruction of the environment will not only affect the economic development, but also endanger human health and ecological balance, which is not conducive to the long-term development of mankind [7]. To a large extent, the environmental pollution problem in China is caused by the enterprise pollution, and the green technology innovation with the enterprise as the main body has become the basic way to solve the environmental pollution problem. Different types of environmental regulation tools have different mechanisms for green technology innovation, and naturally have different effects on solving environmental problems [8]. As an effective means to make up for market failure and solve environmental problems, environmental regulation can reduce the adverse impact on economic development as far as possible while realizing environmental protection, so as to realize the "win-win" of environment and economy [9]. The realization of "win-win" of economy and environment largely depends on whether environmental regulation can promote technological innovation and diffusion of enterprises [10]. Based on the difference of environmental regulation intensity, this paper studies the effect of environmental regulation on green technology innovation and green economy, and the transmission effect of green technology innovation in environmental regulation and green economy.

2. TECHNOLOGICAL INNOVATION AND ITS PRODUCT CHARACTERISTICS

Environmental regulation means that due to the external diseconomy of environmental pollution, the government formulates corresponding policies and measures through special administrative agencies to restrict or even punish manufacturers and enterprises that cause environmental pollution or damage, so as to achieve the goal of coordinated development of the environment and economy. The size of the "innovation compensation effect" determines the influence direction of environmental regulation on green technology innovation, that is, the key to environmental regulation's influence on green technology innovation lies in whether the "innovation compensation" generated by enterprises' green technology innovation can make up for the costs incurred by enterprises for green technology innovation [11]. In fact, green finance not only influences the enterprise's green technology innovation by directly changing the R&D investment, but also influences the enterprise's technological innovation decision. Enterprises with the advantages of energy saving and environmental protection technology are more likely to get investment from financial institutions, because financial institutions will bring their low energy consumption and low pollution technologies into investment decisions. Market-inspired environmental regulation tools are mainly based on sewage charges and environmental taxes. Their purpose is to increase the cost of enterprises by means of economic incentives and force enterprises to carry out pollution control and

technological innovation. This means indirectly achieves the purpose of improving environmental quality by using the "polluter pays principle". Environmental pollution is becoming more and more serious, which affects the healthy life of our country and even the world. Therefore, environmental regulation has been widely used, with the aim of solving the negative externalities of the environment. The impact of green finance on enterprise green technology innovation decision is shown in Figure 1.

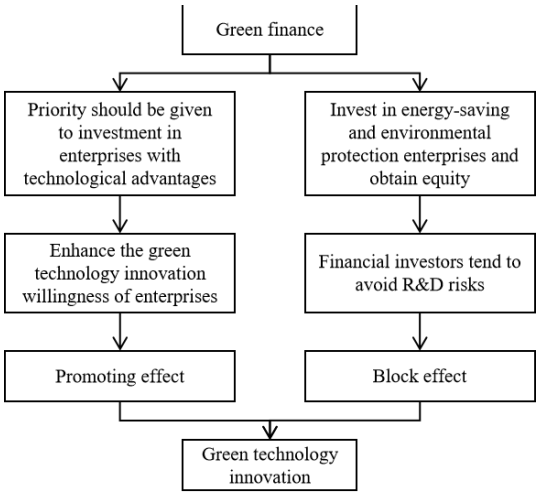

Figure 1 The impact of green finance on corporate green technological innovation decisions

In order to achieve the unity of profit maximization and environmental protection, enterprises usually choose to invest directly to control the pollution discharge level or carry out green technology innovation to achieve the purpose of pollution reduction, when faced with market incentive regulation means such as limiting pollutant discharge and collecting sewage charges, or command control regulation means such as setting environmental access conditions and setting environmental technical standards. Most commodities are competitive, that is, the use of a commodity by one person will exclude the use of the commodity by others [12]. Another important feature of creativity, like most other commodities, is that creativity is more or less exclusive. The degree of exclusivity of a commodity is measured by the degree to which its owner can charge for the use of others. Enterprises can obtain better financial investment by innovating existing green technologies, and the management of enterprises will be more willing to carry out green technology innovation activities under the green financial system. On the other hand, the risk preference of investors will also have an impact on the innovation decision of enterprise management.

3. ENVIRONMENTAL REGULATION AND GREEN TECHNOLOGY INNOVATION ABILITY

3.1 The development of China's manufacturing industry and the challenge of resources and environment

With the continuous weakening of the advantage of backwardness, the speed of introducing technology from developed countries into China's manufacturing industry has slowed down, and the production with high energy consumption and high emissions, mainly in the form of industrial transfer, has continued to be maintained. The improvement of green technology innovation ability of manufacturing industry is faced with both internal and external constraints, so that it cannot adapt to increasingly strict resource and environment constraints. Capital inflow mechanism means that green financial institutions inject funds into energy conservation and environmental protection industries according to national policy guidance, provide financial support for their development, and promote energy conservation and environmental protection enterprises to carry out green technology innovation activities. Green economy is a new development concept, new development goal, new economic structure and development mode. It replaces the old people-oriented idea with a new idea of harmonious coexistence between man and nature, replaces the traditional single old growth goal with a new goal of pursuing efficiency, harmony and sustainable development, and replaces the old development mode with low efficiency, high energy consumption and unsustainability [13]. The capital outflow mechanism is contrary to the capital inflow mechanism. The green financial system requires strict control of the financing of enterprises with high energy consumption and high pollution, and allows capital to flow out of industries with high energy consumption and high pollution.

Green finance makes enterprises with high energy consumption and high pollution lack funds for production and operation and new technology research and development, which restricts the development of industries with high energy consumption and high pollution and also inhibits their green technology innovation activities. The temporal relationship among the different stages of green technology innovation is shown in Figure 2.

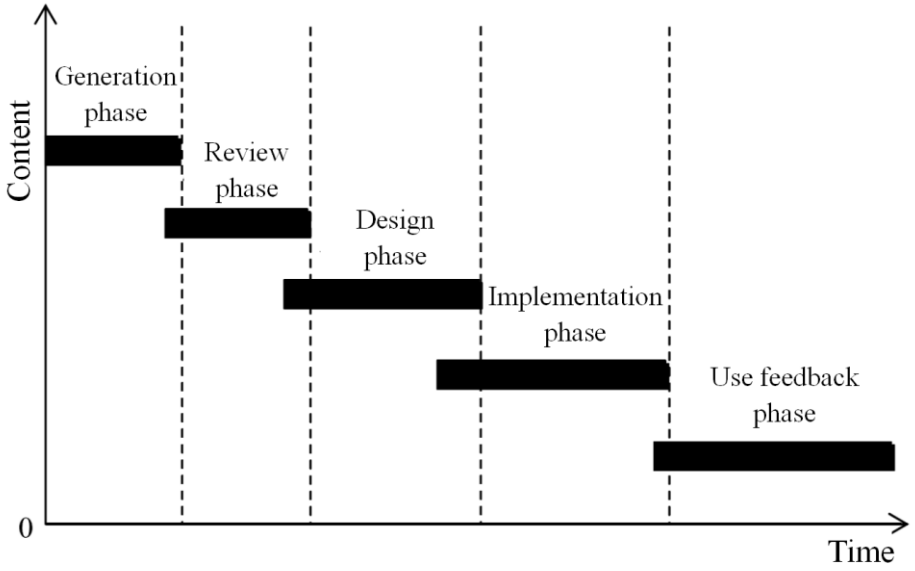

Figure 2 The relationship in time between the various stages of green technological innovation

Along with the road of a new round of industrial revolution, China's industrialization process will also enter a new stage. The deep-seated contradictions and problems accumulated by the traditional extensive development mode of manufacturing industry will be more severe in the future. Compared with the traditional industry, the development prospect is good, but the investment risk is higher, and the market acceptance degree is unknown. Green technology innovation has high technology content and strong uncertainty of technology research and development. If R & D cannot reach the expected output, or the new energy-saving and environmental protection technology cannot be popularized and applied in the market, it will have a significant impact on small and medium-sized enterprises, and even lead to their bankruptcy. Green technology innovation is an inevitable choice under the current constraints of resources and environment. It has a far-reaching significance for coping with environmental and resource constraints and climate change, practicing the concept of green development, and realizing clean and sustainable development [14]. In terms of green technology innovation, decentralized attention allocation of senior management team will inhibit the effective effect of environmental regulation on enterprises, and enterprises will make weakened strategic feedback due to the reduction of environmental attention, thus hindering the development of green technology innovation. As an important part of economic regulation and control system, supply side structural reform must gradually focus on green technology innovation in the future policy implementation. A series of investment and financing information reached by the green financial market can be quickly transmitted. Financial institutions can select high-quality energy-saving and environmental protection enterprises according to these valuable information, and conduct their own investment decision-making analysis. Enterprises can also decide whether to carry out green technology innovation according to the information, so as to enhance the technical competitiveness and get more financing from financial institutions.

3.2 Analysis on the effect of environmental regulation on green technology innovation

The purpose of environmental regulation is to reduce the environmental pollution in the production process of enterprises with the help of government intervention, so as to achieve the goal of coordinating environmental protection and economic development. The incentive to create creativity lies in the profits that inventors expect to obtain, not in the social benefits that creativity itself can bring, that is, whether an idea can appear depends on the size of personal interests relative to the one-time input cost of its invention. In the absence of environmental regulation, enterprises lack awareness of environmental protection and incentive mechanism for green technology innovation in order to maximize profits. In addition, due to the negative externality of environmental pollution, the allocation of social resources is improper, the Pareto optimal state cannot be reached, and the utilization rate of resources is not high. If the public only pay attention to social benefits, some creative ideas with great social value will not appear. Until individuals can get huge rewards from the market with guarantee, or individuals are "rational" and "pursuing the greatest personal gains", and social benefits are not considered, endless innovations can emerge to promote sustained economic growth.

The factors affecting carbon emissions are divided into four categories: energy structure, energy intensity, industrial structure and economic scale. The decomposition model can be expressed as:

$$C^t = \sum_{i=1}^{7} ES_i^t \times EE^n \times TG^t \times GDP^t \tag{1}$$

Among them, ES represents the share of various types of energy consumption each year, EE represents the energy consumption per unit output per year, YG represents the annual GDP percentage, and GDP represents the regional gross product.

Let C^0 represent the carbon emissions in the base period, the change in the emissions in year t relative to the base period is:

$$\Delta C_{tot} = C^t - C^0 = \Delta C_{ES} + \Delta C_{EE} + \Delta C_{YG} + \Delta C_{GDP} \tag{2}$$

The new market demand has stimulated the internal incentive mechanism of enterprises to a large extent, prompting enterprises to increase investment in green technology research and development. With the continuous strengthening of environmental regulatory policies, the government can raise more funds from this policy [15]. And these funds can be used for green technology research and development, and provide more financial support for enterprises' environmental protection technology, and promote enterprise technological innovation. Environmental regulation is a tool and method, and its ultimate goal is to serve my country's economic growth, especially the growth of a green economy coordinated with resources and the environment. For the main players in the technological innovation product market that price based on fixed costs and demand, they must work hard to reduce development costs, and also consider competition from other competitors, rather than "worry-free" like monopolistic and oligopoly markets. consider".

The government conducts carbon verification on companies participating in the carbon trading mechanism. In the time period t, the calculation formula for the CO_2 emissions of enterprise j in sector i is as follows:

$$E_{i,j,t}^{c} = \frac{11}{3}\sum_{n=1}^{6} a_n b_n c_n F_{n,i,j,t} \tag{3}$$

Among them, $E_{i,j,t}^{c}$ is the carbon emission of enterprise j in the production sector i during the t period, and a_n, b_n, c_n and $F_{n,i,j,t}$ are the conversion factors of the energy n used by the enterprise, the oxidation rate of carbon emission factors, and the consumption.

Environmental regulation policy tools will charge corresponding fees to enterprises with excessive pollution, which will lead to an increase in the prices of production factors and environmental factors of enterprises with excessive pollution, thus reducing the supply of products produced by enterprises. Under the same environmental regulation and facing the same market demand, rational enterprises can realize their own development direction in the future. Environmental regulation has an impact on technological innovation mainly because the environmental regulation policies implemented by the government have an impact on the environmental and institutional uncertainties in the process of technological innovation of enterprises. These uncertainties will change the allocation of resources for technological innovation, thus affecting the direction, scale and speed of technological innovation. From the perspective of environmental cost, the improvement of environmental regulation intensity will increase the environmental cost faced by enterprises in the production process, thus increasing the product cost, which is not conducive to the expansion and reproduction of enterprises and squeezing out the profits of enterprises [16]. Environmental regulation policy tools will charge corresponding fees to enterprises with excessive pollution, which will lead to an increase in the prices of production factors and environmental factors of enterprises with excessive pollution, thus reducing the supply of products produced by enterprises. Consumers are increasingly favoring green products, so green products not only enable enterprises to have the advantage of product differentiation, but also enable enterprises to sell more products and increase their profits. Under the background of the current implementation of environmental regulation policy, if enterprises can seize the opportunity to take the lead in mastering green production technology through product and process innovation, and gain the first-mover advantage in the market, it will undoubtedly increase huge profits for enterprises.

4. CONCLUSIONS

The impact of environmental regulation on a country's economy is not only related to the tightness of environmental regulation intensity, but also lies in the form combination of environmental regulation. It is particularly important to give full play to the positive effect of environmental tool combination on technological innovation. In the situation of technological change, society has benefited a lot from it. If the proportion of private or enterprises benefiting from technological innovation is not increased, the innovation process will be hindered. It is necessary for the government to adjust the environmental regulation policy in time, but it is necessary to predict the impact of policy adjustment on enterprise strategy, otherwise it will

inhibit the innovation and diffusion of green technology of enterprises. Environmental regulation does not directly affect the green technology innovation effect of enterprises, but indirectly through the environmental attention of senior management team, which is quite different from previous research conclusions. The government needs reasonable use of environmental regulation means to make it a "catalyst" to promote green technology innovation and green economy development. Too light intensity of environmental regulation is not conducive to the development of green technology innovation and green economy, and too heavy intensity will also increase the burden of related enterprises and bring a series of negative effects. Reasonable combination of environmental regulation means can not only achieve the goal of environmental protection, but also have a positive impact on economic development. To improve the environmental regulatory policy system in the new era, the government should further accelerate the innovation of environmental protection legal systems and methods, increase environmental supervision and law enforcement, and strengthen the coordination of environmental regulatory policies with fiscal, taxation, financial, and innovation policies to form a joint force to jointly advance the new era Construction of ecological civilization. Furthermore, this process which addressed solving the problems is supposed to create entrepreneurship in the development of the economy.

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