

# Private Investment, Environmental Regulation and Green Technology Innovation: A Literature Review

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## Abstract

**Economic development and environmental protection is a major problem in the process of sustainable economic development of various countries. Green technology innovation is the key to solve this problem. Existing studies have made in-depth studies on the impact mechanism of environmental regulation and private investment on green technology innovation. As for the relationship between environmental regulation and green technology innovation, the existing researches have mainly formed four viewpoints: positive promoting effect, negative hindering effect, u-shaped relationship and uncertain relationship. Most of the existing researches on private investment and green technology innovation believe that private investment promotes the development of green technology innovation in industrial enterprises. However, there are few studies on the relationship between the three. Most scholars believe that private investment plays a certain regulating role between environmental regulation and enterprise green technology innovation.**

## Keywords

**Environmental regulation; Green technology innovation; Private investment; Literature review.**

## 1. INTRODUCTION

China's long-term extensive economic development model makes our country into a "resource-economy" cycle, and resource and environment problems become more and more critical issues in China's economic development. In this regard, scholars believe that enterprises' green technology innovation ability is the key to environmental protection and economic development. Only by improving the utilization efficiency of resources and reducing the pollution of products in the production process can China get out of the "resource-economy" cycle. The environmental regulation policies of the government may have a direct impact on enterprises' green technology innovation activities. Meanwhile, as an important source of supplementary funds for government investment, private investment provides certain financial support for enterprises to carry out green technology innovation projects. At present, private investment is mainly concentrated in the low-end industrial chain, which fails to play its due role when combined with environmental regulation, and has no significant effect on enterprise green technology innovation. Therefore, how to effectively play the role of private investment in the mediation between environmental regulation and green technology innovation is worth further discussion.

## 2. RELATED CONCEPT SORTING

### 2.1. Green Technology Innovation

Green technology innovation mainly refers to the reduction of energy consumption, environmental pollution and production process innovation in the process of product production. This concept was first proposed by foreign scholars Ernest Braun et al. (1994). [1]Subsequently, the concept of green technology innovation has been constantly enriched and developed. The concept of green technology innovation can be simply summarized as green technology innovation. Compared with traditional technology innovation, green technology innovation lays more emphasis on the reduction of environmental pollution brought by technological innovation, as well as the cleanness, recycling and low energy consumption in production. [2]According to previous literature review, most scholars divide green technology innovation into three categories: green process innovation, green product innovation and end treatment technology innovation. [3]

### 2.2. Environmental Regulation

Environmental regulation mainly refers to a kind of social regulation that aims at environmental protection and resource conservation, targets at enterprises, and takes the form of tangible rules and regulations or intangible concept constraints. The government is responsible for the formulation and implementation of typical environmental regulations. Enterprises and the market need to strictly implement government orders, which have certain mandatory characteristics. With the increasing understanding of the relationship between economic development and environmental protection, the meaning of environmental regulation has been developing. At present, scholars' understanding and classification of environmental regulation mainly include the following three types: command-and-control environmental regulation, market incentive environmental regulation and voluntary environmental regulation. [4]

## 3. LITERATURE REVIEW

Many scholars at home and abroad have made a profound exploration into the influence mechanism of environmental regulation and green technology innovation. According to the existing studies, domestic scholars have not reached a consensus on the impact of environmental regulation on green technology innovation. There are four viewpoints, namely, the positive promoting effect of environmental regulation on green technology, the negative inhibiting effect of environmental regulation on green technology innovation, the uncertain relationship between environmental regulation and green technology innovation, and the u-shaped effect of environmental regulation on green technology innovation.

Firstly, environmental regulation has a positive role in promoting green technology innovation. This idea stems mainly from the famous "porter hypothesis". "Porter hypothesis" think appropriate environmental regulation to have a certain role in promoting enterprise's innovation ability, innovation ability of enterprises to improve business will greatly promote the promotion enterprise's productivity, to increase corporate profits, at the same time can also be offset by the increase of the enterprise production cost of environmental regulation, makes the enterprise to improve product quality, more conducive to enterprise in the domestic or international market to compete with other enterprises, at the same time may increase in industrial productivity. [5] Li wanhong and bi kexin et al. (2013) believe that the three types of environmental regulations have a positive effect on the green technology innovation of enterprises, and all of them can promote enterprises to carry out innovation activities. [6] Guo jin (2019) believes that the collection of pollutant discharge fees and the increase of fiscal expenditure on environmental protection are more effective than environmental administrative

penalties and local administrative regulations in stimulating enterprises to carry out green technology innovation activities and improving enterprises' capacity for green technology innovation. Yuan yijun and Chen zhe (2018) used the GMM estimation method to test the impact of environmental regulation on green technology innovation, and also examined the impact of green technology innovation on the transformation and upgrading of the manufacturing industry. The research results showed that command-based environmental regulation had a positive promoting effect on enterprises' green technology innovation activities.[8]

Secondly, environmental regulation has a negative effect on green technology innovation. Zhao xikang (2006) believes that environmental regulation has two main ways to inhibit enterprises from carrying out green technology innovation activities. First, the implementation of environmental regulation enables enterprises to increase the amount of environmental expenditure and investment, thus producing a crowding out effect on enterprises' r&d activities. On the other hand, the existence of environmental regulations will make it more difficult for enterprises in the process of production, sales and management, thus restricting enterprises from carrying out green technology innovation activities.[9]

Thirdly, the relationship between environmental regulation and green technology innovation is uncertain. According to the research of tong weiwei and zhang jianmin (2012), environmental regulation plays a significant role in promoting enterprises' green technology innovation ability in the eastern region, but not in the central and western regions.[10] Li wanrong (2015) also came to a similar conclusion. She believed that the "porter hypothesis" was significantly verified in developed regions, but had no obvious effect on less developed regions.[11] Li xuan (2017) believed that in different periods, the role of environmental regulation on enterprises' green technology innovation was greatly different, and the difference in resource endowment among different industries would also affect the play of environmental regulation effect.[12]

Fourthly, environmental regulation has a u-shaped impact on enterprises' green technology innovation. Zhang Juan, geng hong et al. (2018) rediscovered the effect of environmental regulation on green technology innovation from the macro and micro perspectives, using the provincial panel data from 1995 to 2016 in China. The study showed that the effect of environmental regulation on green technology innovation showed a "U" shape, with a significant impact of one-stage lag.[13] Kuang chang-e and lu jianglin (2018) established a nonlinear threshold model based on the panel data of hunan province from 2003 to 2014, and studied the effect of environmental regulation on green technology innovation. The study also confirmed that the impact of environmental regulation on green technology innovation showed a "U" shape with a significant v-shaped threshold.[14]

To sum up, the relationship between environmental regulation and enterprise green technology innovation has not been concluded. The above analysis shows that environmental regulation may have both positive and negative promoting effects on green technology innovation. At the same time, the impact of environmental regulation on enterprises' green technology innovation will vary according to different regions, industries and resource endowments.

#### **4. RESEARCH ON THE RELATIONSHIP BETWEEN GREEN TECHNOLOGY INNOVATION AND PRIVATE INVESTMENT**

Most scholars generally believe that private investment has a positive promoting effect on enterprises' green technology innovation. Su zhaohui (2013) investigated the effect of private investment on the green technology innovation of small and medium-sized enterprises in fujian province. The study showed that the vitality of private capital participating in enterprises' green technology innovation activities was not high due to the existence of factors such as inadequate government policy implementation.[15] ROM Ji (2006) argue that private investment is able to

effectively solve the problem of insufficient funds, green technology innovation is the current green technological innovation for the enterprise to provide certain financial support, improve the enthusiasm of enterprise technology innovation.[16]

Wang fengxiang and zhang wei (2017) explored the relationship between private investment, environmental regulation and green technology innovation based on China's provincial panel data from 2006 to 2015. The research showed that private investment had a significant positive effect on promoting Chinese enterprises' green technology innovation activities, but government environmental regulation inhibited the development of enterprises' green technology innovation.[17]Taking the Yangtze river economic belt as an example, pei xiao and jiang anxuan et al. (2019) established a dupin model of space between environmental regulation and green technology innovation, and the results showed that private investment had a positive driving effect on the improvement of technological innovation capacity, but its effect was not significant when the intermediary variable of environmental regulation was added.[18]However, there are some shortcomings in the research methods of both literatures. They fail to subdivide environmental regulation into command environmental regulation, incentive environmental regulation and voluntary environmental regulation, so as not to subdivide green technology innovation into green process innovation, green product innovation and end governance technology innovation

## 5. CONCLUSIONS

Through the above analysis, it can be found that the current research on the influencing factors of green technology innovation focuses on environmental regulation, government subsidies and private investment. However, these studies mainly examined the effect of a single factor on green technology innovation -- the relationship between environmental regulation and enterprise green technology innovation, or the relationship between private investment and enterprise green technology innovation. However, relatively few literatures related to the combined effect of environmental regulation and enterprise green technology innovation.

Although private capital can provide a certain amount of money support for the enterprise technology innovation activities, but as a result of the folk capital profit-driven, blindness and other characteristics, in the absence of relevant government policies to guide, private capital flows to the short-term benefit extremely easy strong sex but high energy consumption, serious pollution of industry, is not conducive to stimulate vitality of green technology innovation and creativity. Therefore, the implementation of environmental regulation can guide the flow of private capital to a certain extent and play a role in promoting enterprises' green technology innovation.

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