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THE EVOLUTION OF CHINESE ENVIRONMENTAL REGULATION AND ITS GREEN INNOVATION EFFECTS: A REVIEW AND PROSPECT

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Abstract: This study reviews the evolution of environmental regulation policies in China and summarises the literature on the effect of environmental regulation on green innovation in China. The study summarises the evolution of China's environmental regulation system into three stages, the first stage is the initial and exploratory period of environmental legislation, the second stage is the development and implementation of environmental policies, and the third stage is the enhancement of diversified environmental regulation policies. This study refers to past articles for literature research and found that: (1) China's environmental regulation is a typical approach with Chinese characteristics, mainly dominated by government command-and-control and combined with market-incentive and public participation-based environmental regulation. (2) The finding that environmental regulation in China is one of the main factors driving firms to green innovation is controversial. (3) The impact of environmental regulation on green innovation is regionally heterogeneous and policy heterogeneous in China. Future research could focus on the optimal integration of green innovation-oriented environmental regulation policies and consider the mechanisms of differentiation and regional heterogeneity of environmental regulation policies.

Keywords: China, Green innovation, Environmental regulations, Literature review

INTRODUCTION

Since Chinese economic reform and opening-up, China has relied on a heavy industry-first development strategy to drive its rapid economic growth (Cai, 2013), and environmental problems have become increasingly evident. In 2020, the China Ministry of Ecology and Environment reported that 135 of China's 337 cities at the prefecture level and above, accounting for 40.1 percent of all cities, exceeded ambient air quality norms. China ranks 120th out of 164 countries and regions in the 2018 Global Environmental Performance Index, and fourth from the bottom in terms of air quality, including PM2.5. At the 75th United Nations General Assembly in 2020, Chinese President Xi Jinping proposed that China attain peak carbon dioxide emissions by 2030 and carbon neutrality by 2060. The dual carbon goals will be an essential task for China over the next 40 years. The Chinese Central Government will take more robust policies and measures to facilitate the achievement of the targets.

However, China's economy is still developing at a medium to high speed, and the total energy demand is growing. The Chinese Central Government believes that it cannot sacrifice the economy and

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people's livelihoods to reduce emissions. Under these situations, how can the dual carbon goals be achieved? How do we balance the ecological environment and economic growth? Against this backdrop, green innovation is receiving unprecedented attention in China under the dual pressure of economic and environmental targets. In the next 40 years, China's development will inevitably focus on green innovation and low carbon transformation. Therefore, the Chinese Central Government advocates accelerating the transformation and upgrading of industrial structures under environmental regulation constraints (Yuan & Xie, 2014; Han et al., 2014), transforming production methods, achieving harmonious development of the environment and the economy, and injecting new impetus into economic growth (Jaffe & Palmer, 1997). Has China's environmental regulation worked? What are the implications for green innovation? This paper summarises the policy evolution of environmental regulation in China and analyses the green innovation effects of environmental regulation in China through a review of the literature to provide literature support for further improving China's environmental regulation approach, promoting green innovation among Chinese enterprises and facilitating the green transformation of Chinese industries.

1. Policy evolution of environmental regulation in China

1.1. The first stage: the initial and exploratory period of environmental regulation legislation (1949-1990)

The national economy began to recover with the creation of New China in 1949. During this period, the focus of government work was biased toward economic development, and no relevant environmental laws and regulations were introduced. It was not until the 1970s that the government began to take notice of the environmental problems and then began to explore the use of a series of administrative measures to combat environmental pollution. The first National Conference on Environmental Protection was conducted by the Chinese Central Government in 1973, and various policies for environmental protection and improvement were approved. Environmental protection was elevated to an institutional and legal level for the first time in China's history, formally establishing China's environmental governance system. In 1978, environmental protection was first incorporated into the Constitution of China, a move that laid the foundation for the country to enact specific environmental protection laws. The Law of the People's Republic of China on Environmental Protection was passed by the Standing Committee of the Fifth National People's Congress in 1979. Environmental protection was formally embraced as a basic state policy in 1983, and the legal standing of environmental protection was established at the national level.

China's environmental regulations were developed from scratch at this stage, and a legal system for environmental protection was initially formed. It can be seen that environmental regulation at this stage was proposed under the leadership of the Chinese Central Government, and strengthening control over environmental pollution through administrative means and regulations was considered to be the most optimal mode of governance at the time. Although there was more legislation during this period,

the implementation of environmental protection laws has been awkward in various places due to local governments' enthusiasm for local economic development (Tao et al., 2009).

1.2. The second stage: Environmental regulation policy development and implementation phase (1992-2008)

In 1992, the Chinese Central Government established the goal of reforming China's socialist market economy system. China's economy began to develop rapidly. Since then, China's environmental regulations have struggled to strike a balance between economic growth and environmental conservation. In this context, China for the first time included environmental data in its national economic and social development statistics bulletin. The State Council published the Ten Measures for China's Environment and Development, which also, for the first time, applied sustainable development to environmental governance. The State Environmental Protection Administration was upgraded to a direct agency of the State Council in 1988 and then to a whole ministerial level in 1998. By the end of 1996, different levels of local governments across the country had completed the establishment of environmental protection departments, and industry authorities had set up corresponding environmental management agencies. The intensity and the authority of implementation of environmental regulation were further enhanced at this stage.

During this period, China's environmental legislation broadened and became more standardised. The Chinese Central Government continued to use its authority to strengthen environmental governance. And the evolution of environmental regulation in China developed rapidly.

1.3 The third stage: The upgrading stage of diversified environmental regulation policies (2008-present)

The Communist Party of China's 17th Congress suggested the development of ecological civilisation as a new requirement. In this context, the Chinese Central Government has started to adopt a diversified approach to environmental governance. In 2007, the Chinese Central Government issued the National Environmental Protection Eleventh Five-Year Plan (2007-2012), which established the governance concept of optimising economic development through environmental protection. The State Council of China established a system for the paid use of emission rights in 2014. To tackle climate change, it has advanced the creation of a national carbon emissions trading market. In the same year, the Standing Committee of the National People's Congress passed amendments to the Environmental Protection Law of the People's Republic of China. The new environmental protection law is China's strictest environmental protection law. It enhances the enthusiasm of enterprises and the public to participate in environmental governance by adopting measures to encourage the participation of multiple entities, implement the environmental protection responsibility system, establish an environmental protection fund, etc. Subsequently, the Measures for People Participation in Environmental Protection were released by the Ministry of Environmental Protection to ensure the public's right to environmental protection and to create a policy foundation for public participation in environmental protection.

To further promote environmental protection and strengthen the responsibility of Communist Party leaders and cadres for environmental protection, in 2015, the General Office of the State Council of China issued the Measures for Pursuing Responsibility for Environmental Damage by Party and Government Leaders (for Trial Implementation). This approach refines the responsibilities of central and local government agencies for environmental protection, and provides accountability for dereliction of duty by leading cadres, a move that directly links environmental protection to the performance of local officials. Furthermore, since 2016, China's central government has conducted environmental protection inspection visits to provincial and local party committees and governments, as well as their relevant departments, in order to promote the implementation of local party committees and governments' primary responsibility for environmental protection. In 2020, China's Ministry of Ecology and Environment issued the Measures for Interviewing the Ministry of Ecology and Environment. The Measures interview the heads of local people's governments, their relevant departments, and the authorities of appropriate enterprises who fail to carry out their environmental protection responsibilities under the law or perform their duties properly. These methods further strengthen the awareness of environmental subjects and the implementation of duties in each department, reflecting the typical Chinese centralised system.

At this point, China's environmental regulation has completed its top-level design and progressed from a single command-and-control to a combined command-and-control and market-incentive environmental regulation, as well as ensuring the legal status of public participation-based environmental regulation. It has also developed and executed a set of environmental policies with Chinese characteristics.

2. The Effect of Environmental Regulation on Green Innovation in China

Green innovation is often seen as a simultaneous solution to environmental crises, particularly concerning energy and climate change-related sustainable development (Rennings, 2000). It has an irreplaceable role in promoting industrial transformation, energy efficiency and the development and diffusion of green, low-carbon technologies (Byron et al., 2015; Ooba et al., 2015; Sun et al., 2017). And has become a new driving force for green growth in China's economy (Feng & Chen, 2018).

In academics, the effects of environmental regulation on green innovation has become a heated topic of debate. Environmental regulation is a means for governments to control actions that cause public environmental pollution (Yin, 2012), and it serves as a tool for environmental governance by the Chinese Central Government to protect the environment; it is also believed to promote corporate green innovation to some extent (Porter, 1991; Porter & Linde, 1995; Jaffe & Palmer, 1997). Porter proposed the renowned Porter Hypothesis in 1991, arguing that effective environmental regulation might encourage enterprises to innovate, the benefits of innovation could compensate for the costs of environmental regulation (Porter, 1991; Porter & Linde, 1995). By applying green innovations to their production processes, firms can reduce their reliance on old polluting production methods and effectively avoid the costs of environmental regulation (Berrone et al., 2013).

Porter Hypothesis provides a theoretical basis for balancing environmental goals and economic goals from green innovation, but there are several different conclusions about the practice of this theory in China.

2.1 Environmental regulation promotes green innovation

Based on the innovation compensation effect in Porter Hypothesis, the mainstream opinion is that environmental regulation can stimulate green innovation. Using panel data from 30 provincial administrative areas of China from 2011 to 2019, Liu et al. (2022) construct a quasi-natural experiment using China's new environmental protection law to assess the impact of environmental regulation on green innovation, demonstrating that environmental regulation can enhance regional green innovation. Bi & Yu (2019) find that environmental taxes positively influence firms' innovation investment intensity in a study of polluting firms. By increasing environmental taxes, firms will be forced to engage in technological innovation, which will increase the number of patents and enhance their Research and Development (R&D) efforts. Ren & Ren (2016) find that environmental regulation greatly encourages enterprises' technical innovation based on a sample of listed firms in emerging industries. Some researchers have discovered that the intensity of environmental regulation affects the role of promoting green innovation. For example, Wang & Guo (2015) conducted an empirical analysis of data from 12 resource-based businesses in China and found that raising the strength of environmental regulations can encourage green innovation. Shi & Zhao (2018) also find that strong environmental policies have a more pronounced pushback effect on technological innovation and are more conducive to promoting industrial structural upgrading and improving environmental performance. The foreign direct investment (FDI) mechanism is also one of the most common aspects of study on the influence of environmental regulation on green innovation from the standpoint of international technology transfer. For example, environmental regulation may positively impact firms' eco-technological innovation through FDI (Cai & Li, 2019).

2.2 Environmental regulation inhibits green innovation

The view that environmental regulation inhibits green innovation is mainly from the neoclassical economics that harsh environmental regulations can increase firms' costs, squeeze out resources for green innovation (Petroni et al., 2019), and slow down economic growth (Blackman et al., 2010). Shen et al. (2019) find that increased environmental enforcement inhibits the process of green innovation in high-pressure firms. Ma et al. (2018) find that as firms grow in size, stronger environmental regulations can inhibit R&D investment and thus innovation. Peng & Lu (2017) found that the public expressing their environmental demands to the government and environmental protection departments through petitions and letters would pressure enterprises, while enterprises' rising cost of pollution control would significantly reduce their R&D investment and inhibit their green innovation. Tang et al. (2020) observed that the Eleventh Five-Year Plan environmental regulations impacted firms' green innovation efficiency in the short run by lowering cash flow.

2.3 Non-linear effects

Some scholars have found that the relationship between environmental regulation and green innovation is not straightforward. Dong et al. (2020), for example, find a U-shaped influence of environmental regulation on green technology progress in the locality. In Chinese thermal power generation enterprises, Ma et al. (2018) discover a substantial U-shaped association between the intensity of environmental regulation and innovation R&D expenditure. According to Guo et al. (2018), there is a substantial U-shaped relationship between environmental regulation and green innovation, and there is an inflexion point for environmental regulation's influence in green innovation, with China being at the inhibitory stage before the inflexion point. Furthermore, scholars have discovered that environmental regulation has a significant V-shaped threshold effect on green innovation (Kwong & Lu, 2019), indicating that the intensity of environmental regulation at different phases has different relative strengths in terms of the compliance cost effect and the pushback effect on green innovation.

2.4 Different effects of different environmental regulation policies

Diverse environmental regulation policies have different consequences on green innovation when viewed through the lens of various sorts of policies. At present, there are three main types of environmental regulation in China. The first type is command-and-control environmental regulation, which mainly emphasises the control and supervision of enterprises' emission pollution behaviour by government departments through various means, such as regulations, laws and administrative orders. The second type is market-incentive environmental regulation, characterised by internalising environmental externalities by setting a price on emissions, such as environmental taxes, emission fees and carbon trading systems. The third type is public participation-based environmental regulation, such as information disclosure, environmental certification, and public reporting. According to some academics, market-incentive environmental regulation is more effective in motivating firms to do green innovation research and development and so promote the green transformation of industry in China than other types of environmental regulation (Peng & Li, 2016). High-intensity pollution taxation, low-intensity public environmental advocacy and moderate innovation incentive compensation are the most effective in promoting green technological innovation (Cao & Zhang, 2015). Some researchers have discovered that different environmental regulation instruments have opposing effects on green innovation by firms, e.g. emission charges push firms' green innovation capacity, while environmental subsidies squeeze firms' green innovation capacity (Li & Xiao, 2020). A few scholars have studied the effects of environmental regulation policy combinations. For example, Meng & Han (2017) find that the implementation of low-carbon innovation input subsidies or carbon trading alone has a poor incentive effect on firms' low-carbon innovation behaviour and does not produce the desired effect, and needs to be combined with a carbon tax to play an influential role.

2.5 The impact of regional heterogeneity

Regional variability in the effect of environmental regulation on green innovation has been discovered by certain researchers. For example, Zhang & Chen (2018) found significant regional differences in public participation-based environmental regulation regarding environmental governance

effects and the green innovation effects. Environmental regulation in regions with lower economic development and education levels and regions with medium and low energy consumption significantly impacted green technology innovation (Liu et al., 2022). Environmental regulation based on command and control hurts green development in eastern China. In contrast, in the east and west, market-incentive environmental regulation has a positive direct impact on green development, while the beneficial impact of public participation-based environmental regulation is more prominent in the east (Feng & Chen, 2018).

3. Review of Environmental Regulation Research in China and Prospects

Overall, China's environmental regulation has progressed through three stages. It has now evolved into a hybrid of market-based incentives and public participation in environmental regulation, with command-and-control as the primary tool. The effects of environmental regulation on green innovation is a contentious topic in Chinese academia, arising from differences in research perspectives, differences in the selection of samples, differences in environmental regulation policies and differences in research regions. Although the existing literature has conducted extensive and in-depth studies on the effect of environmental regulation in China from multiple perspectives, including various Chinese environmental regulation policies and their relationship with green innovation, there are still some shortcomings, mainly in the following aspects. First, the existing literature in China has focused more on its macro-level effect on green innovation and less on the green governance, green innovation behaviour and decision-making aspects of firms. Second, most of the existing literature focuses on assessing the green innovation effects of environmental regulation policies. However, there is less research on how environmental regulation can be used to promote green innovation. Third, most studies on environmental regulation in China have assessed the effects of a particular type of environmental regulation or compared the effects of several types of environmental regulation on green innovation, and relatively little research has been conducted on the effects of a combination of environmental regulation policies on green innovation. Therefore, further research can be carried out in the following areas: first, to construct green innovation-oriented environmental regulation policies and study their mechanisms. Second, to optimise the combination of existing environmental regulation policies and study the effect of the combination of environmental regulation policies on green innovation, considering the differentiation mechanism and regional and industrial heterogeneity of environmental regulation policies.

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