

The Specific Impact of Environmental Regulations on the Comparative Advantage of Resource-Based Industries

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Abstract: With the increasing emphasis on global environmental issues and the deepening of the concept of sustainable development, the application and impact of environmental regulation are becoming increasingly prominent. Especially for pollution-intensive products, the impact of environmental regulation on the import and export trade of different pollution-intensive products is subject to various factors. The impact of environmental regulation on different resource-based industries still needs a lot of research. Through the method of literature analysis, this paper integrates the literature on the impact of environmental regulation on resource-based industries and concludes that the overall impact of environmental regulation on resource-based industries is positive and significant. For the paper and pulp industry, both exogenous and endogenous environmental regulations have enhanced its comparative advantage. For the non-ferrous metal and non-metallic mineral industry, environmental regulation can promote its technological progress and gain comparative advantage.

Keywords: Environmental regulation, Resource-based products, Pollution-intensive industries, international trade, Industrial economy

1. Introduction

Since the establishment of the World Trade Organization (WTO), through continuous reduction of tariffs and non-tariff barriers, as well as promoting the transparency and stability of trade rules, a more open and fairer environment has been created for trade among countries. This undoubtedly provides more trade opportunities for pollution-intensive industries, further promoting their growth and development on a global scale. However, at the same time, WTO member states must also strictly comply with a series of environmental agreements, such as the "On Trade and Environment" and other documents, which stipulate the correlation between trade and environmental protection, requiring countries to strictly comply with environmental regulations and standards in trade activities.

Therefore, environmental regulations have begun to widely affect the development of pollution-intensive industries in various countries. In this context, to avoid high-level environmental regulations at home, some pollution-intensive industries in developed countries have begun to gradually transfer their industries to developing countries with relatively loose environmental regulations, which is known as the "pollution sanctuary effect" [1]. It is worth noting that pollution-intensive industries are not a single type, but can be divided into resource-based and non-resource-based types. Among them, the transfer of non-resource-based industries such as the steel industry is relatively easy, while the

transfer of resource-based industries such as paper and pulp, non-ferrous metals, and non-metallic minerals is more difficult due to their high dependence on the country's natural resource base [2].

Given the impact of environmental regulation on the comparative advantage of resource-based industries, scholars from various fields have different views, and believe that its impact is complex and changeable. Therefore, the specific impact of environmental regulation on the comparative advantage of resource-based industries is worth in-depth study and discussion. This paper attempts to use literature analysis to integrate the research results of scholars from various fields on environmental regulation and uses the HOV model to discuss the impact of environmental regulation on the comparative advantage of the paper and pulp industry. At the same time, through the environmental regulation intensity, green total factor productivity and other indicators, this paper discusses in detail the impact of environmental regulation on the comparative advantage of the non-ferrous and non-metallic minerals industry.

The research results show that although resource-based industries are highly dependent on the country's natural resources, the government's environmental regulations on such industries cannot be ignored. The impact of environmental regulation on the comparative advantage of resource-based industries is relatively obvious. Therefore, while promoting the development of resource-based industries, the government cannot give up environmental regulation because of the industry's dependence on national natural resources, to improve the industrial development structure and national trade pattern.

2. Literature Review

The determination of pollution-intensive industries is mainly based on the percentage of pollution control costs in the total costs of enterprises. Busse adopted the identification method that enterprises with pollution control costs accounting for more than 1.8% of the total costs are identified as pollution-intensive enterprises, and the pollution-intensive industries are divided into five industries: steel industry, chemical industry, paper and pulp industry, non-metallic mineral industry, and non-ferrous metal industry. Among them, paper and pulp, non-metallic mineral, and non-ferrous metal industries are classified as resource-based industries, and the export comparative advantage of such industries is mainly determined by the natural resource stock of the exporting country [3].

The HOV model is an extension of the traditional trade model H-O model. In the H-O model, the comparative advantage of a country is mainly determined by its factor endowments, and the country will export the products that use intensive factors and import the products that use scarce factors. For resource-based and other pollution-intensive trade products, their comparative advantage is subject to a large number of environmental endowment factors, and the traditional $2 \times 2 \times 2$ trade model cannot explain pollution-intensive products. Therefore, it is necessary to introduce the HOV model, which is Vanek's extension of the traditional model of two goods, two countries, and two factors to multiple goods, multiple countries, and multiple factors based on the H-O model. The core contribution of the HOV model is to treat trade between countries as an exchange between various factors, to quantify comparative advantage, and to take a country's net export as the explained variable, and various environmental endowment factors as the explanatory variable. Among the 12 environmental endowment factors in the model, if the environmental regulation variable is proven to be significantly positive, it can be indicated that this explanatory variable is the comparative advantage of pollution-intensive industries under the HOV model.

In terms of measuring the intensity of environmental regulation, it is crucial to understand that there are significant variations across different research studies focusing on resource-based industries. This disparity arises from the diverse measurement approaches employed in these studies. This paper aims to address this issue by utilizing three distinct measurement methods. The first approach considers environmental regulation as an exogenous variable of political policy. This means that the

level of environmental regulation is determined by external factors such as government policies and regulations. By analyzing the influence of political decisions on environmental regulation, this method provides valuable insights into the overall intensity of regulation in resource-based industries. The second method adopts per capita income level Gross National Income (GNI) as an endogenous variable for measuring environmental regulation. This approach recognizes that economic growth and development play a significant role in shaping environmental regulations. Higher per capita income levels often lead to increased awareness and demand for environmental protection. Therefore, by examining the relationship between GNI and environmental regulation, this method offers a comprehensive understanding of the underlying dynamics. The third measurement method focuses on the governance efficiency of specific environmental indicators, namely industrial wastewater, industrial sulphur dioxide, and industrial solid waste [4]. These indicators are crucial as they reflect the extent to which environmental regulations are effectively implemented and enforced. By assessing the efficiency of governance in managing these pollutants, this method provides a direct measure of the intensity of environmental regulation in resource-based industries. By employing these three measurement methods, this paper aims to capture the nuances and complexities associated with gauging the intensity of environmental regulation [5]. Each approach offers unique perspectives and insights, contributing to a comprehensive understanding of how environmental regulations are implemented and their impact on resource-based industries.

3. Analysis of the Impact of Environmental Regulations on the Paper and Pulp Industry

The paper and pulp industry, known for its massive production and processing capabilities, plays a crucial role in the global economy. However, it is also a sector that has a significant impact on the environment, making environmental regulation an essential aspect of its operations. Whether considered an exogenous or endogenous variable, environmental regulation has the potential to shape the industry's competitive advantage.

When environmental regulation is treated as an exogenous variable, the effects on the industry can be seen through the lens of forest certification. Forest certification, also known as forest sustainable certification, aims to create market and trade barriers for forestry products produced using unsustainable methods. As paper and pulp products are a significant component of forestry products, obtaining this certification becomes crucial for companies in this sector. By gaining certification, these companies are able to promote the concept of green and sustainable development, thereby gaining the trust of environmentally conscious consumers. This external certification has a significant impact on the export competitiveness of paper and pulp products, making it an important factor for companies to consider.

On the other hand, when environmental regulation is treated as an endogenous variable, the relationship between environmental regulation indicators and national income levels becomes clearer. Xu's research found that the correlation coefficients between environmental regulation indicators and GDP and GNP indicators were as high as 0.8698 and 0.8553 at the significance level of 0.01[6]. This suggests that there is a highly positive correlation between environmental regulation indicators and national income levels (GNI), indicating that as countries become wealthier, they are more likely to enforce stricter environmental regulations.

Lu Yang used the national income level as an endogenous variable to measure the intensity of environmental regulation, an econometric model was established using the HOV model, and it was concluded that the environmental regulation variable of the paper and pulp industry was positive at the significance level of 0.1 [2].

4. Analysis of the Impact of Environmental Regulations on the Nonferrous Metals Industry and the Nonmetallic Minerals Industry

For the non-ferrous metal industry and non-metallic mineral industry, there are differences in academic circles on whether environmental regulation can improve the comparative advantage of these two industries. However, a large number of studies have proved that environmental regulation has improved the comparative advantage of the non-ferrous metal industry and non-metallic mineral industry, which is more convincing. Lu Yang's conclusion that environmental regulation is ineffective for non-ferrous and non-metallic industries [2] has its limitations. The reason why GNI is not significant in measuring the intensity of environmental regulation in the non-ferrous metal and non-metallic mineral industries may be caused by the threshold effect of environmental regulation. As a macro variable of a country, the per capita income level has a strong explanatory power to measure the overall environmental regulation intensity of a country but lacks explanatory power when subdivided into specific industries. For the paper and pulp industry, as a sustainable development product, the higher the per capita income level is, the more developed the country is, and the more strict environmental regulation countries usually carry out a large amount of afforestation. With the continuous increase of investment, forest resources will be more abundant, and developed countries will be more likely to become exporters of paper and pulp products. However, the non-ferrous metal industry and non-metallic mineral industry do not have sustainable development, and they rely more on natural resources. Although the per capita income of some developing countries with such natural advantages is not high, in today's global trade pattern of green development concept, to improve the competitiveness of their products and meet international standards, the environmental regulation level of these two industries could be very high. Therefore, it seems that the selection of the treatment efficiency of industrial wastewater, industrial sulphur dioxide and industrial solid waste to measure the intensity of environmental regulation is more suitable for the non-ferrous metal industry and non-metallic mineral industry. In this paper, the industrial sector of China, a developing country, is taken as an example. The data proves that the environmental regulation intensity of the non-ferrous metal and non-metallic mineral industries in China is between 1.999 and 3.645 [7], which is within the effective threshold. According to the research of Zhang Cheng, Lu Yang, Guo Lu and Yu Tongshen and Porter, environmental regulation has a "U" type characteristic in terms of time and intensity in the progress of production technology in China's industrial sector, proving the rationality of the threshold effect, at the same time, the "U" type relationship is particularly obvious in the central and eastern regions of China [8, 9]. According to the analysis of Tian Guanghui et al. on the distribution of pollution-intensive industries in China, the non-metallic mineral industry and non-ferrous metal industry are mainly distributed in the central and eastern regions [10, 11]. In addition, the transformation of production mode brought about by the progress of production technology is the most direct way to improve the efficiency of industrial waste exhaust gas (environmental regulation intensity). Taking the Chinese industrial sector as an example, both data and space show that environmental regulation improves the comparative advantages of the non-ferrous metal industry and the non-metallic mineral industry.

5. Conclusion

Environmental regulation has a significant promotion effect on resource-based industries. Whether exogenous or endogenous environmental regulation, it can effectively enhance the comparative advantage of the paper and pulp industry. With appropriate intensity, high-intensity environmental regulation can further promote the comparative advantage of the non-ferrous metal and non-metallic mineral industries. This has been fully verified in China's actual economic development.

In the study, the measurement methods of environmental regulation intensity for the paper and pulp industry and the non-ferrous metal and non-metallic mineral industry are not the same. Taking the pollution control efficiency as the reasonableness of measuring the environmental regulation intensity of the non-ferrous metal and non-metallic mineral industry is not enough to change only from the macro to the micro perspective. This paper needs more rigorous data and econometric models to prove that the governance efficiency of industrial wastewater, industrial sulphur dioxide and industrial solid waste, and the measurement of environmental regulation intensity to measure the degree of environmental regulation have a stronger correlation than the Gross National Income (GNI). This is also the direction this research will continue to study in the future.

Environmental regulation plays an important role in promoting industrial upgrading, optimizing industrial structure, and improving resource utilization efficiency. However, how to measure the intensity of environmental regulation scientifically and reasonably, and how to adopt appropriate environmental regulation strategies in different industries, are still issues that need further research and discussion. In future research, this research will combine more actual data and cases to deeply analyze the specific mechanism of environmental regulation in different industries, providing a more scientific theoretical basis for the formulation of environmental protection policies in China.

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