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A Study on the Impact of Industrial Relocation on Environmental Quality: A Review of the Literature

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Abstract. Industrial relocation is a main reason for coordinated regional development, but its effect on the environment in the receiving area is still a topic of debate among scholars. Many systematic reviews have been conducted on how the two are related to offer supporting information for optimizing the environment-friendliness and industrial planning. Collectively, the four types of research that have been conducted to date are listed below. According to the above studies, the academic discourse on the environmental impacts of industrial relocation can be divided into three types: positive effects, negative effects and non-linear effects. The four reasons for the change in the environment after the industrial relocation are: size effect, structure change, technological change and regulatory adjustment. Regional disparities in environmental regulations, insufficient absorption capacity of the host area, path dependence, and government behaviour biases are the main reasons why the environmental benefits of industrial relocation have not been realised. Building on the systematic synthesis of the multi-dimensional research framework for the environmental impacts of industrial relocation, this paper identifies the main controversies and deficiencies in existing research, thus providing a theoretical foundation for subsequent studies and policies to deepen the understanding of the connection between industrial relocation and environmental quality.

Keywords: industrial relocation, environmental quality, pollution haven, environmental regulation

1. Introduction

Economic Development Will Lead to Industrial Relocation. As the pace of regional integration increases, industrial relocation is gradually occurring in the course of economic development. Coordinated development and industrial restructuring across the region have also shifted the spatial pattern of environmental pollution due to industrial relocation. The eastern coastal area has transferred a large number of resources and polluting industries to the central and western regions to improve the ecological environment; at the same time, the central and western regions have been given a considerable number of processing and manufacturing enterprises, and they are also facing the risk of pollution transfer [1].

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For the above reasons, the following issues will be addressed in this study. Environmental justice: The industrial relocation will be done in areas with fewer environmental resources; therefore, the region with limited resources will bear the brunt of industrial pollution. Inland areas in central and western China may have to bear a larger environmental cost for the development of the economy; whether this 'pollution refuge' effect is widespread still needs to be studied further [2]. Policymakers will have more specific data to know about the effects of moving factories and can issue reasonable environmental policies for the relocation work more accurately [3]. The technology and industrial-relocation system can help the host area be a "green" area, achieve environmental protection and foster all-round sustainable development [4].

Compared with the previous studies, this paper will make the following extensions: first, it will systematically analyse the existing views, impact paths and limiting factors; second, it will pay more attention to differences at various scales of geography and focus more on the specific circumstances of enterprises at the micro level.

Based on the above analysis, this paper will systematically review the relevant literature on the impact of industrial relocation on environmental quality, summarise the main perspectives, impact pathways and constraining factors of existing research, and put forward some directions for future research and policy-making to provide a reference for subsequent studies.

2. Analysis of the heterogeneous impacts of industrial relocation on environmental quality

2.1. Industrial relocation promotes environmental improvement and green transition

Some scholars have pointed out that industrial relocation promotes the improvement of the environment. The main forms of environmental improvement are in the relocation areas of the industries and technological upgrades in the new industrial areas.

For the areas where industries have moved, the relocation of energy-intensive and highly polluting industries has created space and labour for the development of high-tech industries and modern service sectors, thus improving the environmental quality of the region significantly [5]. In the eastern coastal areas, under the 'emptying the cage to welcome new birds' initiative, a large number of energy-intensive and high-emission industries have been moved out; thus, there has been a slow improvement in ecological and environmental quality [1].

Industrial relocation in the receiving area generally involves high-end production equipment and good management skills. This will promote the development of technology in enterprises in the receiving area and reduce pollutant emissions per unit of output. Cross-regional industrial relocation can introduce more advanced production technology to less developed areas, drive industrial synergy, and promote the optimisation and upgrading of the economic structure in the receiving area [4].

In addition, in terms of green innovation, an external force will be the relevant environmental regulations; therefore, enterprises will need to make green technological innovations and reduce some of their compliance expenses. Green innovation can also help save resources and protect the environment to promote the all-round development of the entire industry [6].

2.2. Pollution transfer and aggregation resulting from industrial relocation

Some scholars believe that industrial relocation is, in fact, a displacement of pollution, and as a result, the environment at the new site is deteriorating.

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According to the 'pollution haven' theory, developed areas generally have stricter environmental regulations and are thus more costly for polluting enterprises to operate. Therefore, highly polluting enterprises move to developing areas that have looser environmental regulations and cause pollution in the new places [7]. Due to different levels of stringency in environmental regulations and labour costs in the east and west, some polluting enterprises have moved from the eastern to the western side of China. As a result, a large number of such industries have moved to the central and western regions, where environmental protection is comparatively weak; thus, the resources and ecological support capacity of these areas have been excessively stressed [1].

Most polluting industries are relocated to areas outside the city, such as suburbs and rural areas, where environmental protection efforts are relatively weak; at the same time, these areas are often built near rivers or transport hubs connecting developed areas with underdeveloped ones, and the environmental management regulations are also less stringent [3].

2.3. The environmental effects of industrial relocation are constrained by multiple factors and exhibit conditional characteristics

Some scholars have proposed that the impact of industrial relocation on the environment is not uniform, and rather it differs from place to place and changes over time due to all sorts of reasons.

First of all, the spillover effects of technology are also limited by the absorption capacity of the receiving area. Whether central and western China can enjoy the technological spillovers resulting from the relocation of domestic industries is constrained by threshold conditions related to the level of local economic development, human capital reserves and the sophistication of the financial sector [4].

Secondly, the effect of the environment is not continuous. The impact of environmental regulations on the location of polluting enterprises is in a cycle of delay, promotion and then delay; when a region is developing at a lower level, tightening environmental regulations may prevent the relocation of polluting enterprises, but conversely, it can stimulate technological innovation by the enterprises and draw them to move [3].

The relationship between a firm's pollution emission intensity and capital intensity is in a U-shape; it decreases initially and then increases, and only when the firm's capital intensity is consistent with the factor endowment structure of the area in which it operates will there be a positive environmental effect [8].

3. Channels through which industrial relocation affects environmental quality

3.1. Economies of scale

Economies of scale refer to the effect of industrial relocation on environmental quality due to an increase in the scale of production.

The economy of scale that results from trade liberalisation is an expansion of economic activity; this expansion directly increases resource consumption and pollution emissions [9]. The new areas in the reception area are developing at an increasing rate, so resource consumption and pollution emissions are expected to rise as a result. A scale effect on the change in a company's entry and exit decisions and the redistribution of market share can be used to show how environmental policy changes affect resource allocation. When firms cluster and pollutant emissions are concentrated, the impact of environmental regulations will increase production and pollution control costs; thus, some

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firms will leave the market, leading to a reduction in the total scale of production and pollution emissions [10].

3.2. Structural effects

Structural effects refer to the impact of industrial relocation on the environment caused by changes in the regional industrial structure.

From the standpoint of the reasons for industrial structural change, technological progress in the supply side and changes in consumer preferences for demand on the demand side both drive industrial restructuring [10]. Changes in the Structure of Industry May Improve the Environment or Increase Pollution. Heavy industry and the chemical industry are relatively high-polluting; the service sector and high-tech industries are relatively low-polluting. If an area has stringent environmental requirements, some low-polluting industries will be drawn to set up there; as a result, fewer new high-polluting enterprises will be established or these enterprises will be relocated elsewhere. Thus, the proportion of high-polluting industries will be reduced, and environmental conditions will improve. Recently, as the eastern parts of China have developed rapidly, some highly polluting industries have been moved out, and a greater number of cleaner production enterprises have appeared; consequently, the industrial structure has gradually become more environmentally friendly, and the overall environment has improved. Therefore, the structural changes resulting from the relocation of industry have also affected environmental quality.

3.3. Technological effects

Technological effects refer to the changes in the environment quality of the area where industry has relocated due to the spread of new technology. Advanced technologies and management experience in industrial relocation can be distributed in many ways to promote the technological development of enterprises in the receiving area [4].

The two good effects of green innovation are knowledge diffusion and environmental protection [6]. On the one hand, there will be a dispersion of green technology and expertise to raise the overall level of technology; at the same time, new technologies will be developed to reduce pollution and resource consumption, thereby alleviating environmental damage. The capacity of the receiving area to absorb the technology of the relocated industries is limited by reasons such as a lower level of economic development, a relatively small human capital base and insufficient R&D investment [4].

3.4. Environmental regulation effects

Effects of Environmental Regulations refer to how different regions' environmental policies affect the trend of industrial relocation and thus change their environments. Polluting enterprises are likely to move to areas with relatively loose environmental regulations, and this has been referred to as the 'pollution haven' effect [7]. Two ways that environmental regulations affect enterprise relocation are increased corporate costs and incentives for innovation [3].

The impact of environmental regulations on the selection site of polluting enterprises is not monotonic, but rather has shown a pattern of first suppression, then promotion, and finally restraint [3]. The effects of all types of environmental regulations on the relocation of polluting enterprises are not uniform, and formally implemented environmental regulations, such as laws and regulations, have a stronger constraining force than informally enforced ones, such as public participation [3].

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4. Factors hindering the impact of industrial relocation on environmental quality

4.1. External environmental factors: Regional and institutional differences in environmental regulation

Regional differences in environmental regulations are a reason why the expected ecological benefits of industrial relocation have not yet been realised. Different Areas have varying levels of environmental protection policies; as a result, high-pollution enterprises have moved from areas with stricter environmental regulations to those with less stringent policies and thus formed a "pollution haven". Eastern, Central and Western China have significantly different levels of environmental control and labour cost pressure. The above reasons have led to the cross-regional migration of polluting industries; as a result, they have concentrated in the central and western regions with looser environmental standards, thereby increasing the environmental pressure at this time [1].

Differences in the social environment among the areas will also be a cause for the industrial relocation not to proceed smoothly. The less developed areas have deficiencies in the 'hardware' conditions of infrastructure, marketisation level and government operational efficiency, and also in 'software' conditions such as public attitude, overall quality of the workforce and social credit. The above reasons have led to a slow-moving industrial relocation project [11].

4.2. Factors relating to the receiving entities: Insufficient absorption capacity and constraints on enterprise capabilities

The enterprises in the receiving area have been established and do not yet have the necessary absorption power to spread the technology. The economy of the receiving area, the availability of talent, and the level of financial development are all conditions that need to be met for the technological spillovers resulting from industrial relocation to take place. Only when the above conditions exceed a certain limit will there be a positive technological spillovers; otherwise, industrial relocation will only result in the transfer and concentration of pollution [4].

Differences in the own conditions of the enterprises also affect the environmental impact of industrial relocation. A large-scale enterprise is also relatively influential; small and medium-sized enterprises (SMEs) tend to move to areas with less strict environmental regulations [3], and they generally have a weaker technological absorption ability, making it difficult for them to make good use of the technological spillovers generated by the relocating enterprises [4].

4.3. Factors in the relocation process: Path dependence and spatial constraints

Path dependence and locational stickiness have occurred in the development of industrial clusters, and as a result, the relocation of these industries has been difficult. Once an industrial cluster is established, the pattern of its spatial distribution tends to be fixed, and most enterprises in the cluster are unwilling to move out of it; thus, relocation and upgrading of these industrial enterprises are difficult to achieve. The Chifeng-Tongliao area is a traditional area that has not been updated recently, so it faces the problem of an old industrial structure [12].

Spatial Distance Limits the Impact of Technological Spillovers to Some Extent. The impact of technology diffusion is weaker over a long distance; relocation to a far-off area of industry generally fails to promote technological progress [13]. Industrial relocation in China is also in this pattern: the shorter the distance, the easier the relocation. As a result, the industries first move to the eastern

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provinces, then move among the eastern provinces, and finally move from the east to the central and western areas.

4.4. Policy implementation factors: The impact of government behaviour

Governmental Measures are also likely to hinder industrial relocation. In the pursuit of achieving the above goals, the government has occasionally intervened in economic activities and, as a result, may have competed with private enterprises for profits [14]. There is no coordination among the local governments in the industrial relocation plan, so they will not take any measure to protect their own interests by restricting the outflow of local resources and the relocation of industries [15].

The Rigour of policy implementation also affects the environmental impact of industrial relocation. Local governments have failed to implement the rural environmental protection policies, weakly enforced these policies, their comprehensive rural economic development model promotes the relocation of polluting enterprises to rural areas, and distortions in the local government's performance appraisal system collectively contribute to this [3].

5. Conclusion

In short, research has gradually advanced in recent years on the theoretical interpretation, empirical testing and mechanism analysis of environmental impacts from industrial relocation, establishing a development path from macro to micro levels, and studying multiple effects and pathways simultaneously. Industrial relocation is by its nature an economically challenging problem, and due to various differences in the level of development, resource conditions and institutional environments among regions, research on the environmental impact of industrial relocation needs to be strengthened in academia.

The following areas will likely be the subjects of research in the future. First, future studies will expand the research on firm behaviour and environmental performance at a micro level. Most of the previous studies have used large-scale data at the regional and sector levels, and a more granular study of how individual enterprises act and perform environmentally could be carried out. In the future, enterprise-level pollution emission data will be available to trace the movement of polluting enterprises and alterations in their environmental performance more precisely, thereby better determining the environmental impact of industrial relocation. Secondly, in the future, people will improve the all-encompassing assessment system for environmental quality. Most of the current studies have used a single pollutant emission index or a composite pollution index to measure environmental quality, and these indices are relatively limited in their ability to reflect ecological and environmental conditions all-round. In the future, more studies will be carried out to build a large number of environmentally performance evaluation systems that can provide comprehensive and reliable support for the research results. Thirdly, more research needs to be done at the university level on how to integrate various policy tools effectively. Most of the existing studies have focused on the effect of single-region environmental policies on industrial relocation, but in fact, many such policies are often implemented simultaneously and interact with each other. Fourthly, more research can be done on the difference in regions. China is a large country, and the resources and industrial structures in the eastern, central and western regions, as well as between the internal and external areas of urban agglomerations, are not the same. More studies will be carried out in the future to investigate why the environmental problems in these different places are so different and to take corresponding measures. Fifthly, new problems in the environment of industrial relocation under the new policy goals must also be addressed by scholars. With the introduction of

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China's carbon peaking and carbon neutrality goals, attention has been focused on the problem of altered carbon emissions during industrial relocation. How to realise low-carbon development and industrial relocation simultaneously is still unknown.

In short, the effect of industrial relocation on the environment is not unilaterally positive or negative; rather, under the joint influence of scale, structure, technology, and environmental regulations, it can be either. Research at home and abroad has established a theoretical foundation and conducted experiments, but more work is still to be done. Future research will explore the mechanisms at a micro level more deeply, build more all-encompassing multi-dimensional environmental performance assessment systems, and strengthen studies on the synergistic effects of policy combinations in the context of these new goals.

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