Research on Environmental Issues from the Perspective of Technological Progress

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Abstract: In recent years, environmental pollution has become more and more serious all over the world, especially in developing countries, which seriously threatens the health of residents and sustainable economic development. Through the discussion of the relationship between economic growth, technological progress, and environmental pollution, this paper proposes a new plan for environmental governance: at the national level, it is necessary to increase support for enterprise innovation and actively promote the establishment of supporting policies such as adopting an accelerated examination and approval system for green patent. At the enterprise level, companies must actively respond to government policies and increase investment in R&D activities.

1. Introduction

In 2019, UNEP released the sixth Global Environment Outlook (GEO6) during the UN Environment Conference, the world's only comprehensive assessment of the global environment, written by 252 scientists and experts from more than 70 countries. The report pointed out that the global environmental pollution situation is critical, and the threat to human's health is increasing. At the same time, the GEO6 also pointed out that if the country can use 2% of GDP for green investment, it can not only achieve the long-term goals of economic growth within the forecast but also ensure that existing pollution can be treated as efficiently as possible. Countries that prioritize low-carbon, resource-saving practices may gain a competitive advantage of the global economy in the future.

Technological progress plays a vital role in the governance of environmental pollution. On the one hand, technological progress, as an endogenous variable of economic growth, indirectly improves the ecological environment through economic growth (environmental EKC curve); on the other hand, green technology advancement also improves the ecological environment by directly affecting pollution control. Therefore, in the process of pollution control, enterprises should increase investment in technological innovation, pay attention to environmentally friendly technological innovation, and promote the green transformation of industrial industries; the government should change development ideologies and provide institutional support for the green transformation of industrial institutions.

The first part of this paper discusses the relationship between technological progress and environmental pollution by combing relevant economic theories. Subsequently, the verification of the environmental EKC curve was introduced, and the mechanism of economic growth on environmental pollution was discussed. Based on the above analyses, this paper proposes a new scheme for environmental pollution control: system design and technological progress must be made together.

2. Technological Progress and Economic Growth

In 1776, Adam Smith first put forward the theory of economic growth in his study on the Nature and Causes of National Wealth: the expansion of the market and the accumulation of capital lead to the division of labor, and the division of labor improves productivity which leads to economic growth. David Ricardo agreed with Adam Smith that increasing labor or productivity and foreign trade lead to economic growth. In the late 1940s, Harold and Thomas proposed an economic growth model based on Keynes's ideas, namely "Harold - Thomas economic growth model." The Harold - Thomas model assumes that economic growth increases as the savings rate increases and decreases as the capital-output ratio expands. These economists assume that capital accumulation and rising labor rates are the cause of economic growth, but ignore the technological progress.

Since 1960s, neoclassical economic growth theory became popular, based on the inputs of labor and material capital inputs as the independent variable of Cobb-Douglas production function to establish the growth model, the technological progress as exogenous factors to explain economic growth, so you get when the element yield decreased the conclusion of long-term economic growth stop gradually. The endogenous growth theory developed in the 1980s put forward some new ideas based on neoclassical theory. Different from neoclassical economics, endogenous growth theory holds that the economy can achieve sustained growth without external forces, and endogenous technological progress is the decisive factor to ensure sustained economic growth. The "learning by doing" model proposed by Arrow in 1962 deduced a production function of increasing returns to scale from the ordinary revenue production function of the conventional Coversangrass model. This model assumed that technological progress is caused by capital accumulation, and with the increase of physical capital investment, "learning by doing" will lead to the corresponding improvement of a human capital level. The vision of endogenous technology progress was realized. Later, the Romer model, Lucas model, and Grossman-Hermann model also believed that the endogenous variable of economic growth was technological progress, and economic growth could only be attributed to technological progress.

3. Economic Growth and Environmental Pollution

3.1 Propose and Verify the Theory

The earliest study of economic growth and environmental pollution is the famous environmental Kuznets curve. Grossman and Krueger found an inverted U-shaped, downward opening relationship between pollution indicators such as Sulphur dioxide and soot and economic growth in 1991. This curve was in the same form as the one between income distribution and economic growth discovered by the economist Kuznets in 1955, so it was called the environmental Kuznets curve (EKC) by Panayouton (1993).

Since the idea that ‘pollution and per capita income show an inverted U-shaped curve’ was put forward in 1991, a large number of economists have done the empirical research revolved around the existence and manifestation of EKC. Shafik (1992) used data from 149 countries and regions from 1960 to 1990, in different environmental degradation index (water-deficient ratio, lack rate of

urban health, particulate pollution levels, air pollution level of sulfur oxides, forest cover, dissolved oxygen rate in rivers, Escherichia coli rate in rivers, per capita waste emission rate, Per capita carbon dioxide emissions) to verify the environmental Kuznets curve inverted U-shaped.

Panayouton(1993) studied the relationship between economic growth and pollution emissions by using the data of three types of pollution emission indicators (namely sulfur dioxide, nitrogen oxide and suspended particulate matter), deforestation and total GDP in the United States, and the results also confirmed the existence of the inverted U-shaped curve, that is, economic growth would promote the improvement of the environment. Selden and Song (1994) used panel data of 30 countries to analyze four major air pollutants (suspended particulate matter, sulfur dioxide, nitrogen oxide, and carbon monoxide) and found out that the per capita emissions of these four pollutants were correlated with per capita GDP in an inverted U-shaped curve. Pauli (2006) used a new model to study the changing trend of CO2 emissions with economic growth, and the results showed an inverted u-shaped curve in OECD countries. Timmons Roberts and Peter Grimes (1997) discussed the intensity of carbon dioxide emission, that is, the change relation of carbon dioxide emission per unit of GDP and economic growth and concluded that the EKC curve showed strong significance since the 1970s. However, this is because the productivity of the eastern countries has increased, while the middle-income and even emerging countries have become worse and worse.

In addition to the traditional inverted U-shaped curve, other scholars have some different results. Friedl and Getzner(2003) used the data of economic growth and pollution emission of Austria from 1960 to 1999 to fit the environmental Kuznets curve and found that the curve with the highest degree of fitting was N-shaped. Elif and Serap (2008) analyzed the changing relationship between the emission of pollutants and the level of economic development in Turkey. However, the results did not conform to the inverted U-shaped hypothesis of the environmental Kuznets curve, indicating that there was a monotonically increasing relationship between carbon dioxide and economic growth, and an N-shaped relationship between sulfur dioxide and economic growth.

3.2 The Mechanism of Economic Growth and Environmental Pollution

There are many explanations for the mechanism of economic growth on environmental pollution. The following are some common hypotheses.

3.2.1 Elasticity Hypothesis

Some economists argued that the environment is particularly good with an income elasticity of demand greater than 1. The demand for a particular commodity such as the environment is small when people’s income level is low. As the economy grows and people's incomes rise, the need for the environment will grow stronger. People gradually improve the awareness of environmental protection, strengthen environmental protection, reduce the level of environmental pollution, improve the quality of the environment. Therefore, the inverted u-shaped EKC curve will be presented as follows: with continuous economic growth, environmental pollution will deteriorate first and then be repaired.

3.2.2 Technical effect Hypothesis

As the economy grows, companies will have more money to spend on research and development of new technologies and products, improve production technology, and reduce emissions of pollutants. The EKC's inverted U-shaped shows up in different periods of economic growth. In the early stage of economic growth, the scale effect is the main driving force for economic growth, and the adverse effects of scale effects are more prominent than that in later stages. Environmental pollution emissions increase with the expansion of economic scale; In the middle and late stages of economic

growth, the structural and technological effects that are more favorable to the economy and the environment gradually exceed the scale effect, the economic structure becomes more reasonable, the production technology becomes more advanced, and the level of environmental pollution is reduced.

3.2.3 Pollution Paradise Hypothesis

The pollution paradise hypothesis is based on comparative advantage theory and government system to be analyzed. From the perspective of comparative advantage, developed countries have comparative advantages in capitals and technologies, while some developing countries lag behind developed countries in capitals and technologies, only have comparative advantages in resources and labor. Thus, developed countries tend to produce capital-intensive and technology-intensive products, while developing countries tend to production resource-intensive, labor-intensive, and pollution-intensive products. So, in the context of global trade, developing countries have taken on the task of producing pollution-intensive products, while developed countries have improved their pollution situation. From the perspective of the system, the governments of developed countries have stricter requirements and higher environmental standards; Developing countries pursue economic growth and have low environmental standards. Therefore, in the context of global trade, high-polluting industries in developed countries are transferred to developing countries. The law of the environmental EKC curve is more evident in developed countries than in developing countries.

4. New Schemes for the Treatment of Environmental Pollution

As more and more countries engaged in the process of industrialization, from a global perspective, the transfer of pollution-intensive enterprises from developed countries to developing countries will not benefit global pollution treatment. In the process of industrialization, most developing countries' environmental governance model is similar to that of developed countries, which pays attention to the end treatment in terms of system design and lacks the active green transformation consciousness. Therefore, in the environment pollution treatment, the system design and the technical progress must work together.

4.1. System Support for the Treatment of Environmental Pollution

The green transformation of industrial structure cannot be separated from institutional support. The environment-friendly system can lead the enterprises to break away from the dependence on old technology and take the road of sustainable development.

4.1.1. Formulate Appropriate Environmental Regulation Policies

Environmental regulation has a significant regional consistency on the impact of the green transformation of industrial structure, and it is necessary to avoid blindly increasing the intensity of environmental regulation. The excessive intensity of environmental regulation will increase the burden on enterprises and form greater cost-effectiveness, which will hinder the green transformation of the industry. Meanwhile, the formulation of environmental regulation policy should avoid the one-size-fits-all approach, and the intensity of environmental regulation in different regions should be adapted to local conditions. If the intensity of environmental regulation increases too quickly, the environmental protection expenditure of industrial enterprises will have a crowding-out effect on the input of technological innovation, resulting in a decline in the level of production technology of enterprises and hindering the promotion of green industrial efficiency and the advanced transformation of industrial structure.

4.1.2. Establish an Environmental Compensation Mechanism

For the enterprises that pollute the environment, it is necessary to levy Pigouvian taxes to raise the cost of environmental pollution; for the enterprises that are friendly to the environment, it is necessary to implement green tax system, and give some tax relief to the products that have the effect of saving energy and reducing emissions. Meanwhile, we can increase the preferential tax policies for enterprises to invest in energy-saving and emission-reducing equipment and provide some financial subsidies for enterprises to adopt production equipment with advanced technologies.

4.1.3. Adopt an Accelerated Examination and Approval System for The Green Patent

Speeding up the examination system of green technology applications can stimulate the innovation enthusiasm of patent applicants and accelerate the application of green technology in production. The pace of green patent examination and approval will be increased by reducing the number of steps while increasing the number of green patent examiners to avoid the problem of squeezing patent examination.

4.1.4. Strengthen the Protection of Intellectual Property Rights.

Green technology patents are distributed across many technology areas in the International Patent Classification, making it difficult for users to access them. So, a green technology information sharing platform can be established to provide relevant green technology knowledge to technology developers. Meanwhile, green technology industry standards can be developed so that green technology can be more widely used in the industrial field.

4.2. Technical Support for Environmental Pollution Control

The green transformation of industrial structure cannot be separated from technical support. The technological innovation of enterprises promotes the green transformation of industrial enterprises and the transformation from pollution-intensive enterprises to environment-friendly enterprises.

4.2.1. Attach Importance to Developing Quality and Actively Introduce Advanced Technology

Developing countries should change their development concept, increase their investment in technological innovation, and pay attention to environmental-friendly and resource-saving technological innovation to promote the green transformation of the industry. Developing countries should give up the previous end treatment of “treating after polluting," learn from the experience of developed countries, and learn advanced pollution treatment technologies and methods from developed countries. Meanwhile, the developed countries should pay attention to the transfer of green technology when they transfer industries to establish the first-mover advantage in the early stage of industrial development and limit the pollution from the source.

4.2.2. Increase in R&D Spending

At the macro level, the government should establish perfect financial subsidy standards for R&D and increase the government’s R&D subsidy to green innovation enterprises. Meanwhile, the government can bring the number of green patents and R&D expenditure into the standards of R&D subsidy standards so that the R & D subsidy can encourage enterprises to carry out technological innovation. At the micro-level, enterprises can enlarge the input of R & D activities, speed up the transformation and upgrade, and improve the output effect of scientific research and innovation activities through government funds support, investment of social venture capital, and their own funds’ input.

4.2.3. Establish Patent Pools and Cross-licensing Systems

The patent pool is a patent license method which integrates the patent certificates of different holders and manages and uniformly authorizes the third-party license. Cross-licensing refers to the act of granting the conditional or unconditional license to the other party to use their patent based on negotiation. The establishment of the patent pool and cross-licensing system can reduce the cost and increase the innovation output of enterprises. Companies holding green patents can form alliances to resolve complex patent licensing issues in the form of patent pools and cross-licensing and overcome conflicts between patents and technology standards. In this way, green patent technology can be more quickly spread to other enterprises, promoting the upgrading and transformation of the entire industry.

5. Conclusions

Environmental pollution is an inevitable problem faced by countries or regions during industrialization. Controlling environmental pollution requires the joint efforts of the state and enterprises to get rid of the dependence on the old "treating after polluting" development path and change the development ideas. The following industrialized countries should learn from the experience of managing industrialized pollution in developed countries, accelerate the promotion of green technology progress, accelerate the pace of green development, and control pollution from the source. Developed countries need to accelerate technology transfer to developing countries based on technological innovation and help developing countries to carry out pollution control.

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