Theoretical Analysis of Environmental Regulation and Enterprise Behavior

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Abstract: From a traditional point of view, we are caught in the dilemma of eco-protection and economic development. Enterprises see environment protection as a confinement to their economic activities as it hinders freedom of production and reaction and generates extra cost to meet environmental regulations, thus compromising profitability and competitiveness. However, according to Michael Porter, it is unwise for enterprises to raise environmental standards and new regulations on environment. A rational set of environmental regulations could stimulate innovation, which would improve resource utilization and make up for increased initial cost caused by environmental regulations, thus ensuring competitiveness. Therefore, what is the mechanism of environmental regulations working on enterprise behavior? A decent understanding and appropriate handling of the relationship between environmental regulations would not only highlight Chinese enterprises in globalization but also play an active role in promoting sustainable social and economic development.

The paper started with an introduction of environmental regulations from its definition, classification, and channels, followed by descriptions of enterprise behaviors. Then the paper discussed the impact of environmental regulation on enterprise behaviors, including maximizing profits, technical innovation, and competitive behaviors. The production and cost function of enterprises related to environmental factors were used to establish the measurement model of enterprises' technological innovation. In the last part, this paper proposed measures and suggestions for improving social and economic effects of enterprises.

1. Introduction
The Environmental Regulation refers to the government’s intervention through regulation, environmental standard, and economic tools for the purpose of environmental protection. Regulation refers to guided management or restrictions imposed by law, which can be divided into two types: one is indirect regulation and the other is direct regulation. Direct regulation can also be divided into two types: economic regulation and social regulation. “Social regulation” refers to regulation on external harmful products, with environmental regulation a typical example of such regulations. There are three basic ways for the government to implement environmental regulation on enterprises: First, direct control, that is, command-control environmental regulation and policy; Second, the mechanism of market economy, that is, the incentive-driven environmental regulation and policy, including compulsory taxation, credit, fees and other costs as well as the pollution emission trading system. Third, non-mandatory measures, including environmental management certification and auditing, ecological labeling, voluntary environmental agreements, and other measures to promote efforts from enterprises.
Recently, environmental issues, closely related to production activities of enterprises, have aroused increasing concerns in the international community. Experts analyzed the sources of pollutants and pointed out that 80% of the existing pollutants found in the natural environment come from production activities of enterprises, and have shown no sign of slowing down. Statistics show that the annual loss of China due to environmental pollution alone reaches as high as 200 billion yuan, thus making the relationship between enterprises and the environment the focus of attention. Meanwhile, as environmental resources are owned by the public without exclusive ownership, massive external uses of these resources lead to environmental pollution. The market mechanism is usually efficient in terms of distribution and utilization of industrial resources while fails to function properly when it comes to external effects, thus raising extra cost or benefits and unable to be fully reflected by prices. Both industrial pollution and exhausting natural resources have to do with external effects. Market malfunction means some environment-oriented products and services would fail to function in the market, urging the government to implement public power for intervention and alleviation of the increasingly prominent problem. Practically, governments across the world tend to solve the problem through regulating enterprises of pollutant emission.

Based on the practice of Chinese enterprises, it is necessary to further study the relationship between environmental regulation and enterprise behavior from the microscopic perspective of enterprises. The paper provides novel ideas for exploring the impact of existing environmental regulation on the behavior of enterprises, serving as references in the formulation of environmental regulation, environmental protection and improvement of profits, technical innovation, and competitiveness in the hope of promoting sustainable development of economy and society.

2. Theoretical analysis

Enterprises are usually assumed to be chasing maximized profits. In other words, their ultimate goal is to maximizing the difference between profits and cost, which is given by:

\[
\text{Max}\left[\Pi\right] = R - C = PQ - C
\]

(1)

Assume the production function of enterprises as:

\[
Q = f(K, L, t)
\]

(2)

where \(Q\) is the production, \(K\) is capital, \(L\) is labor, and \(t\) is the technical coefficient.

Considering environmental factors, the production function is transformed into:

\[
Q_E = H[f(K, L, t), E, \tau]
\]

(3)

where \(Q_E\) is the production after taking environmental factors into consideration.

In the meantime, the environmental regulation is added to the cost function of enterprises, which is given by:

\[
C = CT + CE
\]

(4)

where \(CT\) is the CTU of traditional elements and \(CE\) is the CTU of environmental elements.

The CTU of environmental elements depends on demand of environmental resources \(QdE\) and the price of environmental resources \(PE\), which is given by:

\[
CE = QdEPE
\]

(5)

The demand of environmental elements is determined by the internal function consisting of price of the elements, productivity, technical conditions of major business and pollution control technologies, which is given by:

\[
QdE = G(P_E, Q_E, t, \tau)
\]

(6)

Therefore, the cost function of environmental resources for enterprises is given by:
\[ C_t = Q_t P_t = G(P_t, Q_t, t, t) P_t \]  

(7)

In the meantime, the production function of technical innovation without considering environmental restrictions is given by:

\[ I = f(P, M, A) \]  

(8)

where \( I \) is the output of technical innovation, \( P \) is the labor input, \( M \) is the capital investment, and \( A \) is other element involved in technical innovation.

The output function of technical innovation taking environmental regulation into account is given by:

\[ I = f(ERI, \text{Size}, \text{GDP}, P, M, A) \]  

(9)

where \( ERI \) is the intensity of environmental regulation, \( \text{Size} \) is the scale of enterprises, and \( \text{GDP} \) is the level of economic development.

Therefore, the paper assumes that enterprises aim at maximizing profits while controlling corporate scale, economic development, labor input, capital investment and other factors in an attempt to explore enterprise behaviors under environmental regulations.

3. Impacts of environmental regulation on enterprise behaviors

To study the impact of environmental elements as a production factor in the cost of enterprises. 3.1. The impact of environmental regulation on enterprises’ efforts to maximize profits

Maximizing profits is the core and ultimate goal of enterprises. From the formula \( \text{Max}[]=\text{R}-\text{C}=\text{PQ}-\text{C} \), enterprises maximize profits when the profit peaks and the cost stays at the lowest level. The factor \( Q \) of production involves capital, labor, technical coefficient, which are positively correlated with production \( Q \). Meanwhile, both utilization of environmental resources and regulations issued by government come with cost for enterprises.

Regulations released recently have affected profitability of enterprises to some extent. The impact depends on the transmission mechanism of environmental regulation, which refers to factors involved in the formulation and implementation of environmental regulation and the decision-making mechanism of enterprises. The implementation of environmental regulations makes environment a production factor in the decision-making mechanism of enterprises, i.e., environmental regulation plays a part in enterprises’ efforts to maximize profits by affecting prices of environmental factors in the production function. Meanwhile, environmental factors would affect the investment of other factors by enterprises, thus forcing them to optimize product portfolio. Improved structure and increased output could lower cost, not the other way around. Therefore, enterprises would have greater profitability with the presence of environmental regulation.

3.1. Price of environmental factors and its impact on enterprise behaviors

Generally, the output and technologies involved in major business of an enterprise are independent factors for a company while pollution alleviation technologies are beyond the control of enterprises, which depends on specific environmental regulations. For example, in some cases, the regulator may designate pollution control technology and equipment while in other cases, the regulator only stipulates the standard of pollution emission without specifying the technology used. Enterprises are more like recipients of prices, while the government plays a crucial role in determining the prices of environmental factors. The supply and demand of environmental factors are the core elements deciding the price, as shown in Figure 1.
Figure 1 Supply and Demand of Environmental Factors.

It is assumed that the supply of environmental elements available is fixed within a given period of time, as shown by the straight line perpendicular to the coordinate axis. When the amount of usage exceeds the limit, excessive use of environmental resources would result in rapid deterioration of the environment. Therefore, different enterprises and products would have different impacts on the maximization of enterprise profits. In other words, the nature of enterprises and the market structure play a role in the process. Enterprises can make a full use of their own characteristics to bring down the cost caused by environmental regulation to a level even lower than when there is no environmental regulation. However, failures to resolve the problem might increase external cost, thus bringing down profits of enterprises.

4. Measures to improve economic and social benefits under environmental regulations

The paper believed that the following measures should be taken to improve economic and social benefits of enterprises:

4.1. Development of clean and eco-friendly industries and circular economy

Based on the abovementioned analysis, it is observed that environmental regulations have a positive role in the long-term industrial profitability of China, probably as a result of technical innovation brought by environmental regulation, which make up for negative impact on production cost and other factors, thus improving profitability.

4.1. Development of scale economy and resource-based cluster industries

Enterprises located in areas of rich resources should rely on the advantage of resources to boost subsequent development and strive to develop new comparative advantages before the exhaustion of natural resources and capital, thus avoiding the “trap of comparative advantages” and “curse of resources”. The finiteness of natural resources determines that economic growth relying solely on natural resources will not be sustainable. Areas with abundant resources should vigorously develop resource-based cluster industries, which would promote circular economy, scale economy and economy of scope. It can not only reduce pressures on the environment, but also extend the production chain and create new advantageous industries, thus improving the added value of resources and maximizing the return of natural capital.

Innovation-driven industries and enhanced capability of innovation

Enterprises will further enhance independent innovation capability, adjust, and optimize the economic structure, better coordination between economic development and environmental protection, and embark on the road of low-carbon economic development. China needs to avoid excessive dependence on carbon-based fuels and reduce over-utilization and waste of resources for economic transformation while striving to maintain moderate and rapid economic growth and solve problems during development. Both the eastern and middle part of China have a long way to go in developing low-carbon economy. A carbon financial system integrating bank loans, direct investment and financing, carbon index trading, carbon option futures and a new technology investment and financing system should be established as soon as possible. We will build a sound low-carbon financing system, improve
policy investment funds, and establish low-carbon policy financial institutions. A low-carbon network and a low-carbon industrial system will be constructed to foster low-carbon enterprises with strong competitiveness. The low-carbon cluster of enterprises will be put in place to cultivate new energy and energy-saving industries, improve, and extend the low-carbon industrial chain, and form a low-carbon network integrating low-carbon finance and low-carbon government.

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