Discussion on Reducing the Environmental Damage Caused by Climate Change with Innovative Thinking of Financial Management

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Abstract. Due to the greenhouse effect caused by greenhouse gas emissions, the earth's climate has changed, which has brought many types of environmental disasters. This study discusses the types of these environmental disasters and explores which financial instruments can be applied to reduce these environmental disasters. This study points out that abnormal climates, temperature rises, sea levels rise, and uneven rainfall distribution have led to intensified earth and rock flows and flood disasters, all of which are environmental disasters caused by climate change. The available financial instruments include environmental taxes, carbon trading, and catastrophe insurance. The implementation and effectiveness of these methods are also discussed in this study.

Keywords: Climate change, Carbon reduction, Carbon trading, Financial management

1. Introduction

Greenhouse effect has become human being’s grand challenge in recent years owing to the rapid industrial development and the increase in energy consumption. Many environmental disasters, such as abnormal weather, rising sea levels, and increasing infectious diseases occurred and resulted in casualties and property loss. In addition to the methods used in engineering science and technology, researchers have put in efforts to study new ways to solve issues of climate change using financial techniques. Can these methods really reduce these environmental disasters? This research aim at
discussing the above issues and evaluating the effectiveness of financial measures on reducing environmental disasters [1][2][3].
The greenhouse effect refers to the phenomena that the planet's atmosphere absorbs radiant energy and warms the surface of the planet. The temperature rise has brought about many negative effects including various environmental disasters. One of the major contributor to the greenhouse effect is the burning of fossil fuel, which results in a large amount of carbon dioxide emission. The carbon dioxide hinders the energy the Earth itself radiates into space, which causes the Earth's temperature to rise. Therefore, reducing carbon emissions is the best way to reduce the negative effects of the greenhouse effect.
The following research questions will be discussed in this study:
1. What are the environmental disasters caused by the greenhouse effect?
2. What financial measures can help us reduce these environmental disasters?
3. What are the experiences of successfully improving environmental disasters after implementing financial management?

2. Literature Review

2.1. Environmental disasters caused by the greenhouse effect
The greenhouse effect has led to major changes in the global environment, such as climate warming, increased frequency of natural disasters, and even species extinction. Detailed explanations are as follows: 1) increased pests and diseases around the world; 2) rise in sea level; 3) abnormal weather and increased frequency of ocean storms; and 4) increased drought land and desertification area. Scientists predict that if the temperature of the earth's surface continues to rise at the current rate, the global temperature will increase by 2 to 4 C by 2050, and the icebergs in the north and south poles will melt significantly, causing sea levels to rise.

2.2. Green tax system
Engineering way for the climate change is to prevent the release of greenhouse gases into the air after their formation. The green tax system is a precautionary measure. It is a tax system originally designed for the environmental pollution. The green tax system is designed to internalize external costs, enable the tax rate to reduce the marginal cost of pollution, and make the external costs equal to the marginal social loss. The significance of establishing a green tax environmental protection tax is to build a green fiscal and taxation system to regulate the pollution control behaviour of those who emit pollutants. Because of the promotion of the green tax system, a system of green production and consumption can also be established [4][5][6][7][8].

2.3. Carbon trading theory
In carbon trading theory, carbon means carbon dioxide. Regarding carbon emissions as a quota, carbon trading can thereby achieve the role of energy conservation and emission reduction. Whether it is carbon tax or carbon trading, the goal of these approaches is to motivate enterprises to save energy and reduce emissions. It is a means to reduce carbon dioxide emissions during the production process and help the country's economy transition to a low-carbon economy. The only difference is that the carbon tax focuses mainly on the price, while the carbon trading market focuses more on total amount control.

2.4. Catastrophe insurance theory
Insurance is a way to share risks. However, the environmental disasters are often severe disasters, which means that it is often impossible to use small property insurance to settle claims, and the purpose of preventing risks is often not achieved. The catastrophe insurance was therefore introduced. As the name suggests, catastrophe insurance is an ex-post compensation for these large environmental disasters.

3. Research Method
This article applies case literature exploration and case analysis methods, discusses various possible solutions, and explains these possible methods through actual cases. The main theories discussed include carbon trading theory, green tax system theory, and catastrophe insurance theory. The cases discussed include: environmental disasters caused by the greenhouse effect in recent years, carbon emissions that can be reduced by carbon trading, green tax systems implemented in various countries, and the content of catastrophe insurance.

4. Results and Discussion

4.1 Environmental disasters due to the greenhouse effect

When heavy rains took place in the Yangtze River Basin in China (such as the one occurred in June 1991), the downstream areas typically flood as a result. Due to decades of deforestation in the upper reaches, the forest has lost its function of conserving water. The surrounding lakes in the lower reaches have been used for farming, and the areas of Dongting Lake and Poyang Lake have been reduced so that they have no function of regulating water levels. It is also one of the main reasons for the flood of the Yangtze River.

Even for floods of Western Europe in the spring of 1994, many scientists suspected that it was related to the overexploitation of downstream areas. Excessive rainfall was only one of the reasons for the floods. These examples all point out that human damage to the environment is the main cause of the exacerbating natural disasters, and the greenhouse effect is one of the contributing factors.

At the Mauna Loa Research Station in Hawaii since 1958, Charles D. Keeling has measured the carbon dioxide content in the atmosphere every month, showing that the carbon dioxide content has continued to rise for more than 40 years, from 315 ppm to about 358 ppm. The increase is more than 1 ppm per year, and this rising trend is unabated. Since the content of various greenhouse gases is increasing, one would wonder whether the earth has been affected by the greenhouse effect and subsequently warmed by it. This is not a phenomenon that can be easily verified. However, the temperature observations have shown that the average temperature of the earth has risen by about 0.6 °C over the past 100 years. The Taiwan area seems to be in line with this phenomenon, and the records of the Tainan Meteorological Station show the similar increase in temperature.

In addition to floods, disasters caused by rain are earth landslides or earth and rock flows. The torrential rain was terrible because it came suddenly, and it rained a huge amount within a short time. If the soil is already very humid and cannot absorb too much water, or the soil and water are not well maintained, the soil's ability to hold water is insufficient, which can easily lead to floods. The floods of Okayama in September 1994 are a good example. Although there was abundant rainfall during this period, if the soil and water conservation is good and the drainage system is good, it will not cause floods for nearly a week. Later, there was a heavy rainfall in the afternoon of July 24 (52.5 mm/hr.) and the early morning of August 11 (41 mm/hr.). In August, heavy rainfall occurred for three consecutive days. Immersion took place in residential houses, which was quite rare in the past. This can also be regarded as an environmental disaster caused by the greenhouse effect. Table 1 summarizes the environmental disasters caused by the greenhouse effect.
Table 1. Environmental disasters caused by climate change

| Items | Disaster types | Description | Affected area |
|-------|----------------|-------------|---------------|
| 1     | Sea level increase | Sea level rises due to melting glaciers | Netherlands, small island states of Oceania |
| 2     | Climatic anomalies | Climate abnormalities due to warming of the atmosphere | Global |
| 3     | Rainfall increases, floods increase | The heavy rainfall made the original drainage system unaloadable, which caused floods. | Global |
| 4     | Increase in infectious diseases | As the temperature rises, bacteria are more likely to grow and cause more infectious diseases. | Global |
| 5     | Mudslide | The damage caused by earth and rock flows has increased due to increased rainfall. | Global |
| 6     | Typhoon scale increase | Climatic anomalies have caused typhoons to be larger than before, and they have also brought even greater disasters. | Taiwan, Japan, Philippines, Southeast Coast of China |

4.2 *Can carbon emissions be reduced by implementing carbon trading?*

If a carbon trading system can reduce the rate of climate change, various environmental disasters caused by global warming can be slowed down through this system. Therefore, implementing the carbon trading system can possibly reduce the environmental disasters caused by climate change [9][10][11].

To correlate the reduction of carbon trading system with environmental disasters directly is not always easy, but we can get some general understanding from the carbon emissions reduced by the implementation of carbon trading system. Figure 1 shows the effects of implementing the carbon trading and the subsequent changes in carbon emissions.
4.3 Green tax system

The basic concept of environmental taxes is “Polluters pay.” Environmental taxes (fees) can be divided into three categories: emission fees (taxes), user fees, and goods taxes (fees). These environmental taxes (fees) are levied by environmental protection units. The environmental taxes must be spent on preventing and cleaning the pollutants. The "emission fee (tax)" includes the air pollution prevention fee using gasoline or fuel and the water pollution prevention fee that are levied by the environmental protection bill.

To analyse with corporate profit function, the corporate cost function that includes green tax is:

$$C = C_1 + C_2 + T = C_1(q) + C_2(q) + t \times Q(C_2) \times q$$

(1)

Where \(q\) is the output of the enterprise;
\(C_1\) is the production cost of the enterprise;
If \(\frac{\partial C_1}{\partial q} > 0\), That is, the production cost is positively related to the output;
\(C_2\) is the cost of pollution control by the company; \(T\) is the green tax; \(t\) is the green tax rate per unit of pollutant discharge; \(Q\) is the unit of product pollution by the enterprise.
If \(\frac{\partial Q}{\partial C_2} < 0\), that is, the amount of pollution per unit product is negatively related to the investment in corporate pollution control,
But \(\frac{\partial Q}{\partial C_2} > 0\), and the marginal utility of pollution control costs diminishes.
The corporate earning function is:

$$p = R - C = p \times q - C$$

(2)

Where \(p\) is the profit of the company \(R\) is the income of the company \(P\) is the output of the product.
Green taxation is an effective way to solve the problem of economic externalities, and its role can be illustrated by Figure 2:
Figure 2. Benefit of Green Tax System.

4.4 Catastrophe insurance
Catastrophes refer to natural disasters that cause particularly huge damages to people's lives and property, and have a serious impact on the economy or society of a region or country. Natural disasters here include earthquakes and tsunamis, severe floods, and severe storm surges. Catastrophe insurance refers to the risk of huge property losses and serious casualties caused by natural disasters such as earthquakes, hurricanes, tsunamis, floods, etc., and the risk is dispersed through insurance.

| Items | Business entity | Implemented by | Financial tool | Disaster Category | Description |
|-------|-----------------|----------------|----------------|-------------------|-------------|
| 1     | Government-led model | United States | Non-profit Catastrophe Insurance Plan | flood | Catastrophic insurance projects implement fiscal subsidy rates and enjoy federal tax-exempt treatment. When the national flood insurance fund is inadequate, the state fiscal appropriation can be requested. |
| 2     | Government + Insurance Company Cooperative Management Model | New Zealand Japan | Natural Disaster Fund | earthquake | 1 Compensation for loss of statutory insurance using natural disaster funds 2 Mandatory collection of premiums for earthquake catastrophe and fire insurance. |
3. Commercial operation mode | Germany | Catastrophe Business Insurance | Not specific | Catastrophe insurance protection is provided by commercial insurance companies.

The United States is pursuing a government-led non-profit catastrophe insurance program. National Flood Insurance Program by the Federal Government Catastrophe Insurance Project, and Catastrophe Insurance Projects by States. Most catastrophe insurance programs implement fiscal subsidy rates and enjoy federal tax exemption. When the national flood insurance fund is insufficient, national fiscal appropriations can be requested.

New Zealand has promulgated laws and the government will form an earthquake committee and establish a natural disaster fund. Residents purchasing house or house property insurance daily from insurance companies will be forced to collect earthquake catastrophe insurance and fire insurance premiums. During the event of a disaster, the Earthquake Commission will use the Natural Disaster Fund for statutory insurance for damages, and the insurance company will be responsible for compensation in excess of the statutory insurance liability based on the insurance contract.

In terms of underwriting, Japan adopts a method in which commercial insurance companies cooperate with the government, and private business supports government subsidies. Japan Earthquake Insurance has a strong public interest, and all the insurance premiums received are used to prepare for losses caused by the earthquake. The subject matter of the insurance is residential property and family property. After the residents have taken out insurance from a commercial property insurance company, the property insurance company reinsured all risk responsibilities to the reinsurance company, and the reinsurance company reinsured the government. The government provided the reinsurance liability sharing and support.

German catastrophe insurance implements a cooperation mechanism between insurance companies and professional reinsurance companies. Large insurance groups have established special departments or subsidiaries for catastrophe risk management. Direct insurance companies reinsured two-thirds of the liability of catastrophe insurance to reinsurance groups, and the insurance companies commercialized catastrophe insurance.

5. Conclusion
This study discusses the use of various financial methods to reduce the environmental disasters caused by the greenhouse effect. Through literature and case studies, we have obtained various ways that can be used to reduce greenhouse gas emissions. Environmental taxes can reduce companies’ arbitrary carbon emission behaviours. Carbon trading can have proactive effects under the company’s own incentives. However, in the case of ex post remediation, the use of catastrophe insurance is a more pragmatic strategy. This study only makes a qualitative description of these feasible financial instruments, and for quantitative analysis, it is expected that future researchers can continue to conduct research.

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