

An economic impact evaluation of environmental policy

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Abstract. With the rapid development of the modern economy, the importance of improving energy efficiency and reducing environmental pollution is increasing. Developing an ecological economy is an inevitable course to achieve sustained economic growth. In order to ensure the smooth development of the green economy, the government has introduced a series of environmental protection policies. Meanwhile, a large number of environmental protection and green industries have emerged. However, the economic impact of environmental policies on environmental protection and green industries is difficult to predict. Environmental policy in national level promulgated more frequently, but these policies specifically for environmental protection industry green industry and environmental policy is not much. So the analysis of the process focused on Water Pollution Control Action Plan and public service in-depth promotion of government and social capital cooperation work notice. Results show that the Water Pollution Control Action Plan has a binding effect on the yield of green industries and public service in-depth promotion of government. In contrast, public service in-depth promotion of government and social capital cooperation work notice increases the income of the environmental protection industry, and it has a negative constraint on the green industry.

1. Introduction

The ecological environment is the basis for human survival and development, and it is related to the sustainable development of the economy and society [1-2]. At the same time, the 2008 global financial crisis has also sounded the alarm for the rest country of the world. This proclaims that traditional economic development models that depend on intensive resources can no longer meet the needs of national economies for sustainable development, and each country have faced the challenges of economic restructuring. In this situation, the development of green industry and environmental protection industry has become the key to promote economic recovery. Western countries have regarded this as an opportunity to promote the transformation of the national industrial structure, as a result, their economy also recovered gradually [3].

As a developing country with a large population, China relies heavily on resources. The green economy has played a vital role in China's economic and social development. The necessary content of the green economy is to save natural resources and improve the ecological environment, using high-tech industry approach, starting at the point of sustainable development of economy, achieving resources, environment, economy and social development harmonically. And strives to achieve a new



economic model of economic efficiency, ecological benefits and social benefits development unified, and benefit from it in the protection of the environment at the same time [4-6]. Therefore, China has promulgated a series of environmental laws and regulations, which provide a policy guide for the country's economic structure convert fundamentally, but also provide power for the development of environmental protection industry and green industry.

However, there is still no unified understanding of the impact of environmental policies on economic development. Some scholars and policymakers argue that there is a mutually binding relationship between environmental policy and economic development. They think there is a negative constraint between economic growth and environmental policy [7-8]. But there are some scholars think that some specific environmental laws and regulations may be able to enhance rather than hinder the development of the economy [9-10]. In the United States, for example, those states that are most protected the environment, not has a low economic growth rate as prediction, but has the highest economic growth rate. This is because there are some environmental protection policies, although the surface appears to improve the production costs of enterprises, but it makes some enterprises obtain a protective business. The introduction of environmental policy prevented other companies from entering the industry. In addition, there are some environmental policies will attract other enterprises to enter the relevant industries, enhance the competitiveness of the industry, which is conducive to the further development of the industry.

With the corresponding introduction of China's environmental policy, China's environmental quality has been improved, but the empirical analysis of the impact of environmental policy on the environmental protection industry and the green industry is not enough. Therefore, we proceed from the overall environmental industry and green industry, the effect of environmental policy is analysed by event analysis, in order to study the impact time, influence level and the scope of influence of environmental policy to predict the effect of environmental policy. Besides, this paper can also help policy makers understand the advantages and disadvantages of environmental policy, which can be more targeted to develop the appropriate environmental policy.

The paper proceeds as follows. Section 1 provides an introduction. Sections 2 summarizes the data and environmental policies. Section 3 discusses the research design and the econometric methods used to implement this design. Section 4 presents the empirical findings. Section 5 concludes.

2. Environmental policy and data sources

2.1 Environmental policy

Water Pollution Control Action Plan (Hereinafter referred to as "water 10") formally promulgated and implemented for water use and treatment of environmental policy by the State Council on April 2, 2015. In the prevention of industrial water pollution at the same time pay close attention to rural sewage treatment thus to promote the transformation of economic structure. In view of this, it can be inferred that the promulgation of "water ten" will reduce investors' confidence in investment in environmental protection industry, green industry and water pollution treatment industry, and thus the decline of its income will show up.

The public service in-depth promotion of government and social capital cooperation work notice (Hereinafter referred to as mandatory use of "PPP") measures have played an important role in China's infrastructure construction after introduced in China since the 80s of last century. As an already mature financing policy, "PPP" formed a series of relevant policies since the implementation. Although "PPP" is mostly used in the construction of infrastructure, in our country, the relevant infrastructure construction is mostly concentrated in the environmental protection industry and green industry, this article selected the most representative of the "PPP" policy in last two years to analyse, like on the public service in-depth promotion of government and social capital cooperation work notice. "PPP" compulsory use policy is promulgated by the Ministry of Finance on October 12, 2016 for the implementation of the policy of deepening government and social capital cooperation in the field of public services. The introduction of the policy promulgated in the situation that "PPP" has

matured in the garbage disposal, sewage treatment and other areas, aimed at further expanding government and social capital cooperation, urging new projects to use the "PPP" policy. The introduction of the policy should be able to enhance investor confidence in the investment in related industries, thus contributing to the improvement of its earnings.

2.2 Data sources

The data source for this article is based on "2016 China's environmental protection industry boom report: A shares of environmentally friendly listed companies" and "China's green industry prosperity index report". Since the base period selected during the calculation is January 4, 2015, so deleting the business that does not have trading data within one week after this date. Finally selected 30 environmental protection enterprises (Environmental protection business accounted for more than 50% of the main business of environmental protection company referred to as E30), 85 green business (referred to G85) and 31 water pollution treatment enterprises.

3. Research Design

Considering the Event analysis has the advantages of simple calculation process and clear logic, so it has been applied in large scale in the field of finance and so on. The basic principle is: Assuming that if the event has not happened, then the company's earnings would be consistent with the normal return before the event occurs, but, if the company produced a significant extraordinary rate of return, that means the event do have some influence on these industries. The statistically significant test is used to test the extraordinary rate of return, if it is significant, it proves that the event has an impact on the enterprise income, otherwise it has no effect. And environmental policy as a sudden event, can have an impact on the real economy's income. Therefore, the analysis of the method in this paper also selected the event analysis.

The two key steps used in event analysis are the selection of the estimated window and the event window. Since the implementation date of the policy is accurate to the date, the data used in the analysis process are daily data. Unlike previous correlation analysis, event analysis takes into account the possibility of an event escaping in advance, so when selecting an event window, it usually also includes a period of time before the event. As the selection of the window and estimation of the parameter are based on the basis of the standard calculation, this article will only list the estimation parameter matrix, more detailed calculation and interpretation, see the reference [11].

Table 1. Estimation parameter matrix

Industry	"Water 10" (W)	"PPP mandatory use" (P)
Environmental Protection Industry(E)	—	$(\alpha_i^{PE}, \beta_i^{PE})_{i=1,2...30}$
Green industry(G)	$(\alpha_i^{WG}, \beta_i^{WG})_{i=1,2...85}$	$(\alpha_i^{PG}, \beta_i^{PG})_{i=1,2...85}$
Water pollution treatment industry(W)	$(\alpha_i^{Ww}, \beta_i^{Ww})_{i=1,2...31}$	—

^a For example, $(\alpha_i^{WE}, \beta_i^{WE})$ for green enterprise i in the "water 10" event estimation window Parameter, $i = 1, 2 \dots 30$.

Then, we calculate the following indexes based on the estimation parameter matrix.

- Normal rate of return (NR_{it}) refers to if the environmental policy does not implement during the event window that the enterprise would have.
- Extraordinary rate of return (AR_{it}) refers to due to the promulgation of environmental policy, during the event window, the enterprises' actual return mins the AR_{it} .
- Average excess rate of return (AAR_t) refers to the average rate of return on business units in the time interval.
- Cumulative excess rate of return (CAR_t) refers to the enterprise in the event window due to the implementation of environmental policy brought about by the cumulative excess rate of return.

4. Empirical test result

4.1 Analysis on the results of the "Water 10"

In this paper, the average transcendent yield, the cumulative normal yield and the t value of each industry are listed in each event window. The test results of the green industry are shown in table 2.

Table 2. Calculation results of Green industry

Time	AAR_t	CAR_t	T value
-5	0.002	0.002	0.605
-4	0.000	0.002	0.683
-3	-0.292	-0.290	-1.031
-2	-0.147	-0.437	-3.155**
-1	-0.077	-0.514	-10.707***
0	-0.006	-0.520	-9.255***
1	-0.003	-0.523	-9.198***
2	0.002	-0.521	-8.803***
3	-0.215	-0.736	-3.480***
4	0.004	-0.732	-9.005***
5	-0.000	-0.733	-8.969***

^a * represents significant level of 10%, ** represents a significant level of 5%, and *** represents a significant level of 1%.

Table 2 shows that, from the two trading days before the implementation of the "Water 10", cumulative excess rate of return of the green industry has been significantly negative at the level of 1%. With the implementation of the policy, its significant degree is also increasing, indicating that the policy has begun to play a role in the benefits of green industry before the implementation. What's more, the binding effect of this policy has been strengthened over time.

In particular, the water pollution treatment industry is directly related to the "water 10", so this study specifically analysed the impact of "water 10" for the water pollution treatment industry.

Table 3. Calculation results of water pollution treatment industry

Time	AAR_t	CAR_t	T value
-5	0.104	0.104	5.436***
-4	-0.017	0.0878	5.297***
-3	0.0234	0.111	5.415***
-2	-0.0899	0.021	3.333**
-1	-0.635	-0.613	-5.659***
0	-0.0785	-0.691	-5.491***
1	-0.1589	-0.850	-5.505***
2	0.762	-0.088	-2.828**
3	-0.054	-0.142	-5.389***
4	-0.028	-0.170	-5.394***
5	-0.055	-0.225	-5.481***

^a * represents significant level of 10%, ** represents a significant level of 5%, and *** represents a significant level of 1%.

Table 3 shows that the water pollution treatment industry is very sensitive to the implementation of the "water 10", since the fifth trading day before the implementation of the "water 10", its cumulative abnormal rate is significantly different from 0 at 1% level. Although, before the implementation, the cumulative abnormal rate of return is positive, it then turned negative, which shows the trend of investor's investment confidence, and indicating that the implementation of "water 10" had a significantly constraint effect on this industry. Water pollution treatment industry as the most closely

related industry to the implementation of the "water 10", it had the most significant and most rapid response, which shows that in the short term, "water 10" effect is significantly.

Through the inter-industry comparative analysis, it can be seen that the water pollution treatment industry is the first to respond to the "water 10" implementation, and the response is the most significant, the cumulative excess rate of water pollution treatment industry is the first to deviated from 0 axis and the deviation is also the most significantly in statistics than others. The second one is the green industry. In the event window, the cumulative abnormal rate of return of the green industry has always been negative and showed a gradual decline trend, indicating that the green industry has received a greatest damage.

4.2 Analysis on the results of the "PPP" compulsory use

According to the above analysis process, this paper tests the "PPP" compulsory use policy's impact on the environmental protection industry and the green industry. The results are showed in Table 4.

Table 4. The calculation results of environmental protection industry, green industry

Time	AAR_t (E)	CAR_t (E)	T value (E)	AAR_t (G)	CAR_t (G)	T value (G)
-5	0.012	0.012	-1.135*	-0.023	-0.023	16.353***
-4	-0.006	0.006	-1.042*	-0.157	-0.180	2.642**
-3	0.052	0.058	-7.036***	0.017	-0.163	42.547***
-2	0.001	0.0587	-6.049***	0.018	-0.145	5.408***
-1	0.019	0.077	-1.802**	-0.142	-0.287	7.079***
0	-0.003	0.074	-8.449***	0.012	-0.276	5.137***
1	0.0287	0.101	-8.345***	0.017	-0.259	7.374***
2	0.010	0.112	-8.079***	0.010	-0.249	5.936***
3	-0.016	0.096	-8.728***	-0.000	-0.249	4.621***
4	0.007	0.104	-7.469***	0.026	-0.223	5.793***
5	0.019	0.123	-8.274***	0.009	-0.214	6.380***

^a * represents significant level of 10%, ** represents a significant level of 5%, and *** represents a significant level of 1%.

Table 4 shows that the environmental protection industry generated a significant positive rate of return at the 0.1% level since the fifth trading day before the implementation of the "PPP" policy, indicating that the mandatory use of "PPP" Policy greatly enhances investor's confidence in the investment of these enterprises, making the company's earnings have upward trend. On the contrary, in the first five trading days of the implementation of the policy, the green industry had a significant negative excess rate of return at the 5% level. With the change of time, the cumulative excess rate deviated from the 0 axis, and its significant degree gradually increased, indicating that investors' investment confidence has been in a downward trend.

Through the industry comparative analysis can be seen, "PPP" mandatory use of the policy plays a positive role in stimulating the environmental protection industry while produced a negative constraint on the green industry. This might because, with the country's emphasis on social capital investment, the waste disposal and the water pollution treatment has reached a high degree of maturity, and has entered a high-speed develop stage. In the environmental protection industry, the proportion of these two types of enterprises is much higher than the green industry.

5. Conclusion

The results suggest that the development of environmental protection industry and green industry is better than the overall economic development, indicating that China's industry is experiencing upgrading and transformation. At the same time, the development of green industry is better than environmental protection industry, which also means that environmental protection industry still has larger development space should be supported in a greater degree, making it to become the driving force of economic development and transformation. In addition, "Water 10" will constrain the income

of the green industry in the short term. With the implementation of this policy, its binding role is further strengthened, and the water pollution treatment industry is more sensitive to the reform policy than the green industry. The "PPP" compulsory use policy has a positive effect on the income of the environmental protection industry, and has a negative constraint on the overall green industry.

Therefore, in order to ensure the sustainable development of economy and ecology, China needs to further strengthen the implementation of environmental policies and increase supervision of policy implementers. At the same time, it is also necessary to increase certain financial input, the financial means can maximize the enthusiasm of all parties to participate in, which to ensure that environmental issues can get the most effective solution.

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