

# The Impact of Environmental Pollution Control Investment on Industrial Structure in China

L Xiao<sup>1,a</sup>, P Dong<sup>2,b</sup> and L M Dong<sup>3,c,\*</sup>

<sup>1</sup>Institute of Economics and business administration, Central China Normal University, Wuhan, Hubei, China

<sup>2</sup>Colorado State University, Colorado, The United States

<sup>3</sup>Institute of Economics and business administration, Central China Normal University, Wuhan, Hubei, China

<sup>a</sup>xlu407@163.com, <sup>b</sup>2246453962@qq.com, <sup>c</sup>dml6805@126.com

Corresponding author and e-mail: L M Dong, dml6805@126.com

**Abstract.** In order to achieve a win-win result of economic development and ecological civilization and take the road of sustainable development, China has paid more and more attention to environmental regulation. Increasing investment in environmental pollution control year after year also responds to the national call for building a “rich, strong, democratic, civilized, harmonious and beautiful”. Through the regression analysis of the data of 30 provinces and regions across the country, the article added environmental pollution treatment investment to the measurement model to examine the impact of environmental investment on the industrial structure. Empirically, the overall increase in environmental investment from the country will lead to the optimization and upgrading of the industrial structure. Specific to different regions, combined with the regional characteristics of the industry, there are different needs for the distribution of environmental investment.

## 1. Introduction

With the development of nearly 40 years of reform and opening up, China's economy has witnessed a quantum leap in development. While harvesting the fruits of the rapid development of economic construction, it also buried the hidden danger of long-term development - environmental issues.

In the report of the Party's Nineteenth Congress, the words “ecological civilization” painted a bright picture and required the thorough integration of environmental protection into economic, political, cultural and social aspects. In today's vigorous development of the cause of environmental protection, investment in the treatment of environmental pollution has increasingly led to extensive discussions among scholars. To pay back the “environmental protection account” owed is not simply to solve the problem of serious environmental pollution by sacrificing the speed of economic growth and reducing economic growth. The economic and ecological environment are interdependent and affect each other. Increasing the regulation of the environment and the investment in the treatment of environmental pollution, whether it can bring benefits to the existing structure of the national economy and bring about gains to the economic development mode is the focus of this article.

## 2. Literature review

At present, empirical and theoretical studies on the relationship between environmental pollution treatment investment and economic growth have become more mature at home and abroad. Due to the antecedence of development, foreign countries began to study economic growth and environmental issues earlier. D'Arge[1] (1971) used the Harold-Domar model to demonstrate that the natural environment and economic growth interact. Subsequently, Forster[2] (1973), based on the neoclassical growth model, assumed that environmental pollution was caused by the input of physical capital, and inventory environmental pollution was regarded as the production factor that introduced the economic growth production function. Because there are two variables of pollution and consumption in the utility function, pollution governance investment squeezes out the resources used for production. Therefore, at the equilibrium point, the consumption and capital level are lower than the neoclassical model. With the deepening of research, there has been a larger branch of the discussion on environmental issues. Moe [3] (2010) studied the relationship between energy consumption and long-term economic growth, and argued that in order to avoid future technological lock-in, importance must be attached to policies that can directly influence the determination of regional leading industries and energy consumption systems. In recent years, Chinese scholars have also conducted extensive research on the issue of economic growth. Among them, research on environmental pollution treatment investment issues is very rich. Huang Jing [4] (2011) established an endogenous growth model for human capital, which introduced environmental and environmental pollution governance into the framework of endogenous growth for analysis. To achieve sustainable development, we must adopt increasingly cleaner production technologies and develop environmentally friendly economies through technological innovation. Zhang Yuesheng [5] (2016) added environmental governance factors to the Solow model, deducing that environmental investment has an impact on the economic growth path, but it does not necessarily reduce the economic growth rate. And through empirical analysis, it is found that increasing the amount of environmental governance investment will, to a certain extent, result in a decline in economic output, but it is good for long-term development. Yang Hao [6] (2009) believes that a certain proportion of the value of output is put into environmental governance and emission reduction control is the optimal growth path for economic growth and environmental protection. Dai Guiping [7] (2010) constructed a two-stage model of the relationship between environmental governance input and economic growth. The analysis proves that China is already in the second stage of environmental governance investment and promotes economic growth. Therefore, it is believed that environmental governance investment can not only be promoted through economic mechanisms. Growth can also play its promotion function by improving the environmental carrying capacity. Ma Zhaoliang [8] (2017) added key natural capital to empirical analysis. The results show that the accumulation and spillover of human capital caused by key natural capital is one of the key mechanisms that natural capital promotes regional economic growth. It is of great significance to increase investment in environmental pollution control to accumulate natural capital and thus achieve economic growth benefits. Gan Jiawu [9] (2017) based on the "double dividend" perspective, found that the second paragraph is indented. China's current environmental regulation has not yet achieved the "green dividend" to alleviate environmental pollution, but achieved a "blue dividend" that optimized the economic development mode.

Through the study of scholars at home and abroad, it can be seen that basically scholars believe that investment in environmental pollution control has a positive effect on economic growth. Based on the research of the scholars, this article uses empirical analysis to further explore the issue of economic growth - whether environmental pollution governance contributes to changes in the industrial structure in the context of promoting economic growth. This article will use the national data for analysis, taking into account the regional economic development differences, the country

will be divided into three major regions, testing the impact of environmental governance investment on the changes in China's economic industrial structure.

### **3. Theoretical analysis**

#### *3.1. Status quo of China's environmental pollution control investment*

China's environmental pollution control is mainly composed of urban environmental infrastructure investment, industrial pollution source investment and construction projects "three simultaneous" environmental protection investment.

From 2006 to 2015, the total investment in environmental pollution control has greatly increased, with a total investment of 256.6 billion yuan to 880.63 billion yuan. The total investment in environmental pollution control in 2015 accounted for 1.28% of GDP. Among them, the total investment in urban environmental infrastructure construction reached 494.68 billion yuan, the total investment in industrial pollution sources treatment was 77.368 billion yuan, and the total investment in "three simultaneous" environmental protection projects for construction projects was 308.58 billion yuan. With the rapid economic growth, investment spending on environmental issues has increased year by year, demonstrating the country's confidence in establishing an environment-friendly economy and society.

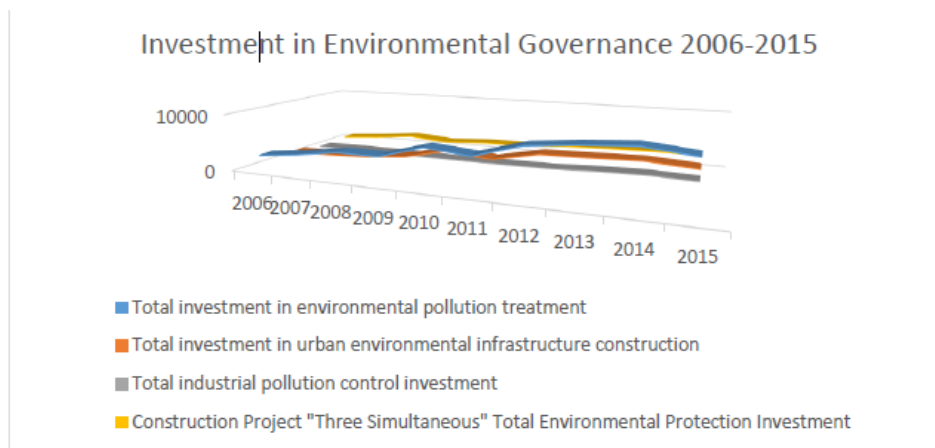
#### *3.2. Status quo of China's industrial structure*

Figure 2 shows the structure of China's industrial structure from 2007 to 2016. In 2016, China's primary industry added value accounted for 8.6% of total GDP, secondary industry added value accounted for 39.9% of total GDP, and tertiary industry added value accounted for 51.6% of total GDP. The proportion of the tertiary industry accounts for more than half, the proportion of the primary industry and the secondary industry shows a declining trend year by year, indicating that the industrial structure of our country is gradually being optimized.

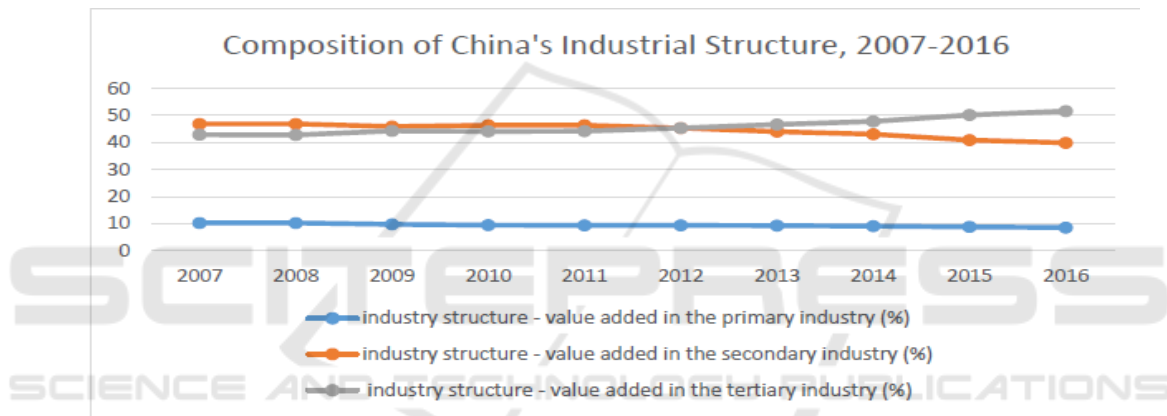
#### *3.3. Relationship between environmental pollution treatment investment and industrial structure*

- (1) Investment in the treatment of environmental pollution is basically flowing into the environment-intensive secondary industry. Increasing investment in environmental issues will help improve the cleaner production efficiency of the secondary industry, thereby accelerating technological innovation and guiding the transformation of industries in the secondary industry that places a heavy burden on the environment.
- (2) Investment in environmental pollution treatment will substantially increase the cost of production processes, and will cause consumption and investment demand to tilt toward the environment-friendly industry, thereby optimizing the industrial structure.

China's current environmental pollution problems are largely concentrated in the secondary industry. Under the premise that the primary industry structure is relatively solid, the use of the proportion of the tertiary industry to the total output value will be used to measure the changes in the industrial structure.



**Figure 1.** Investment in Environmental Governance 2006-2015  
Source: China Environmental Protection Database.



**Figure 2.** Composition of China's Industrial Structure, 2007-2016  
Source: National Bureau of Statistics of People's Republic of China.

**4. Empirical analysis**

This paper selects 30 provincial-level data from the whole country (Hainan Province has not been selected due to incomplete data) as a sample for panel data model regression. The selected indicators are the industrial structure ratio (the ratio of tertiary industry to GDP), capital stock, and labor capital, investment in environmental pollution, urbanization rate, and openness to the outside world.

The specific model is:

$$IS = \alpha_0 + \alpha_1 \ln Labor_{it} + \alpha_2 \ln K_{it} + \alpha_3 \ln R_{it-1} + \alpha_4 open_{it} + \alpha_5 urb_{it} + u_{it} + \epsilon_{it}$$

Among them, the explained variable “IS” express the industrial structure ratio, and the explanatory variable “R” express the investment for environmental pollution control. The control variables are: Labor is labor capital, K is capital stock, open is openness, and urban is urbanization rate. In the model, index “I” and “t” respectively represents the period data and the province. Index “u” measures the individual effect. 0-1 dummy variables are used to divide 30 provinces into east, middle, and west regions, and “ε” expresses a residual disturbance item. The investment in environmental pollution control will not produce significant benefits in the current investment period, so we uses an observation method that lags the t-1 period for the explanatory variable R. Aimed to all large quantifiers, which are inconsistent with other scalar magnitudes of the study, taking the

logarithm of the model can eliminate this large difference in magnitude, eliminate heteroscedasticity, and ensure the stability of the data.

**Table 1.** Effect of Investment in Environmental Pollution Treatment on Industrial Structure.

VARIABLES	(1)east construction	(2)west construction	(3)mid construction
lncapital	-0.140*** (0.0236)	0.0234 (0.0227)	-0.0603*** -0.0194
lnlabor	0.0830*** (0.0155)	-0.0300 (0.0224)	0.0179 (0.0226)
lninvest_1	0.0688*** (0.0172)	-0.0122** (0.00570)	0.0189** (0.00793)
urban	0.426*** (0.0626)	-0.289*** (0.0664)	0.302*** (0.0436)
open	0.0224 (0.0178)	0.102 (0.0664)	-0.379*** (0.0694)
2008.year	0.00875*** (0.00297)	-0.00289 (0.00503)	0.00478 (0.00448)
2009.year	0.0385*** (0.00628)	0.0116 (0.0109)	0.00709 (0.00900)
2010.year	0.0446*** (0.00971)	-0.00196 (0.0143)	0.00827 (0.0126)
2011.year	0.0241** (0.0101)	-0.00208 (0.0156)	0.00211 (0.0131)
2012.year	0.0483*** (0.0123)	0.00999 (0.0184)	0.0172 (0.0161)
2013.year	0.0599*** (0.0136)	0.0377* (0.0199)	0.0351** (0.0172)
2014.year	0.0792*** (0.0156)	0.0480** (0.0229)	0.0528*** (0.0191)
2015.year	0.105*** (0.0171)	0.0741*** (0.0249)	0.0885*** (0.0214)
2016.year	0.130*** (0.0179)	0.0887*** (0.0272)	0.109*** (0.0231)
Constant	0.529*** (0.129)	0.511*** (0.0436)	0.602*** (0.0915)
Observations	100	120	80
Number of year	10	10	10

Robust standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 1 is the dynamic panel empirical evaluation of the environmental governance investment on the industrial structure. From the regression results, the effect of environmental governance investment on the eastern industrial structure was significant at the 1% level, and the effect on the industrial structure of the central and western regions was significant at the level of 10%. Specifically, because of the large gap in economic development among the three major regions in China, the industry base and development focus between regions is different. Through the data, we can see that for the eastern region, a 1% increase in investment in environmental pollution treatment will result in an optimization of 6.88% of the industrial structure; for the western region, a 1% increase in the amount of environmental investment will reduce the ratio of the tertiary industry by 1.22%. %; for the central region, the investment in environmental pollution control has not increased by 1%, which will bring about an increase of 1.89% in the industrial structure. Environmental investment has led to technological progress and has guided the flow of capital to the tertiary industry in an environmentally friendly industry. For the western region, the development of the tertiary industry is relatively weak, relying mainly on the environment-intensive industries to stimulate rapid economic growth and catch up with developed regions. The management of ecological civilization can only reduce the degree of damage to the environment, but it cannot guide industrial transformation. Investments such as sewage charges may serve as a threshold for the development of secondary industries, allowing more capital to flow into the secondary industry. As for the control variables, the urbanization rate is significant at the level of 1%, and it can be demonstrated that China's current urbanization brings profound changes to the industrial structure, and urbanization will change the distribution and migration of industries. The degree of openness to the outside world is not significant. This may be due to the inconsistency between the changes in the total volume of regional import and export and the pace of regional GDP growth.

In view of the overall situation of the country, when weakening the differences in the development of different regions, the impact of investment in environmental pollution treatment on the industrial structure is positive. Judging from the empirical results, our country's investment in environmental structure is positive. Judging from the empirical results, our country's investment in environmental issues has optimized the industrial structure and has had a positive effect on industrial upgrading and ecological civilization.

## 5. Conclusions

Under the background that environmental pollution treatment investment will bring benefits to economic growth, the article studies the impact of environmental pollution treatment investment on the industrial structure. Through theoretical and empirical analysis, it appears from a nationwide perspective that increasing environmental investment is conducive to the transformation of the industrial structure to a friendly economy. Due to the historical development and the unbalanced nature of interregional resources, the eastern, central and western regions of China have different sensitivity to the industrial benefits brought by investment in environmental pollution control. For the developed eastern regions, the economic base is solid and the tertiary industry itself is relatively mature. The process of deepening industrial structure optimization will be smoother. The central region is in a critical period of industrial transformation. From 2016 to 2025, it is the "new decade" for the rise of central China.

The central region should take advantage of locational conditions, accelerate the innovation and development, accelerate the green development, and adjust and optimize with the help of the investment plan for environmental pollution control. Industrial structure, solid foundation for development. Firmly Grasp the Opportunity of "New Decade" and Realize the Industrial Transformation. The western region is constrained by natural and socio-economic conditions. From the perspective of industrial development, the main support points of the economy lie in the energy and resource industries. These industries threaten ecological civilization. At this stage, it is necessary

to reduce the ecological pressure in the western region by increasing investment in environmental governance, and ensure the coordinated growth of industrial growth, efficiency, and structure in the western region.

Therefore, make the following suggestions:

- (1) It is necessary for China to increase its support on the basis of increasing investment in environmental pollution control year by year, and to strengthen the role of government finances in environmental subsidies.
- (2) Encouraging enterprise technological innovation, the government guides the clean production technology of polluting enterprises.
- (3) Based on local conditions, and in combination with the inter-regional environmental system, allocating various environmental construction funds. The investment in urban environmental infrastructure construction, investment in industrial pollution sources, and the construction of "three simultaneous" environmental protection investments are targeted. Consider the actual development level of the three major economic regions and implement environmental regulations.

## References

- [1] D'Arge and Ralph C 1971 Essay on economic growth and environmental quality *J. The Swedish Journal of Economics* 73(1): 25-41
- [2] Forster B A 1973 Optimal capital accumulation in a polluted environment *J. Southern Economic Journal* 39(4):544-547
- [3] Lengyel B, Iwasaki I and Szanyi M 2010 Industry cluster and regional economic growth: evidence from Hungary *J. Hitotsubashi Journal of Economics* 51(2): 149 - 167
- [4] Huang J and Chen S H 2011 Environmental pollution control and economic growth: Model and China's empirical research *J. Nankai Economic Research* (01): 142-152
- [5] Zhang Y S 2016 Environmental governance investment and economic growth: theoretical and empirical research *J. East China Economic Management* 30(09):150-156
- [6] Yang H 2009 The path of economic growth under the constraints of environmental governance *J. Social Scientists* (11):49-52
- [7] Dai G L, An P and Gao J T 2010 Empirical Research on the Relationship between Environmental Governance Input and Economic Growth from the Perspective of Environmental Bearing Capacity—Based on Provincial Panel Data *J. Journal of Ocean University of China* (10)
- [8] Ma Z L and Tian S Y 2017 The influence of key natural capital on regional economic growth in China *J. Ecological Economy* 33(07): 78-81
- [9] Gan J W, Gong Y and Feng K Y 2017 Research on the Impact of China's Environmental Regulation on Economic Development Mode—Based on the "Double Dividend" Perspective *J. Ecological Economy* 33(01):14-20+27
- [10] Shi W X, Wei H K and Zhao Y 2017 Strategies for industrial restructuring and upgrading in western regions *J. Journal of Beijing University of Aeronautics and Astronautics(Social Sciences Edition)* 30(04):83-86
- [11] Teng F, Zhang Q J and Shen H Y 2017 Thoughts and Paths for the "New Decade" to Promote Industrial Transformation and Upgrade in Central China *J. Economic Review* (03):59-64