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Empirical study of the transfer problem of pollution industry in China based the environmental regulation differences

Yan-Ping Bai[1], Yu Zhang[2,3*]

[1]College of Management, Capital Normal University,Beijing, (CHINA)

[2]School of Computer Science, Beijing University of Civil Engineering and Architecture, Beijing 100044, (CHINA)

[3]State Key Laboratory for GeoMechanics and Deep Underground Engineering, China University of Mining & Technology, Beijing, 100083, (CHINA)

E-mail: yibaibaby@126.com, zhangyu@bit.edu.cn

ABSTRACT

This paper constructed the measurement model between industrial transfer and the affecting factors, Studied the effects of pollution industry transfer inner mechanism based environmental regulation. The paper using the east and Midwest in 2002-2012 panel data of 27 provinces in China and unit root test of the research the data, and then using econometric model empirical to study the relation between the index of the east and Midwest pollution industry transfer and Level of environmental regulation, labour costs, marketization degree, transportation cost and land cost. This study gets three important conclusions.

KEYWORDS

Pollution industries; Environmental regulation; Transfer problem.

INTRODUCTION

Since the 1970s, along with the deterioration of ecological environment, the global economy has gained rapid development. Human realize that the reasonable utilization of resources and well ecological protection are the basic condition to ensure the sustainable development of the human health. With the Chinese provinces relaxing economic regulation, they also strengthen environmental regulation as a major control field. In recent years, Interregional industry transfer has become a prominent phenomenon of the regional economic development. Due to the unbalanced regional development in our country, developed areas are steadily in the industrialization metaphase, which are pressing for industrial structure upgrading , and the environmental barriers also is increasing day by day. But for the sake of economic development, undeveloped areas also have to undertake industry shift demand. In the short term, not only the origin pollution industry area but also the ingoing areas of pollution industry can obtain economic benefits. But in the long run, it will bring large harm to the ecological environment of the undertaken regional. The negative externality of environment will appear. It needs to be further systematic research on whether it is the environmental regulation intensity differences between different provinces lead the pollution industry transfer between regions. The phenomenon of the pollution industry transfer was systematically described, and 2002-2012 provincial statistics data was used. The paper used taking off share method to construct pollution industry transfer target, and constructed fixed effect model to empirically analyses and research the pollution industry transfer problem under environmental regulation intensity difference between provinces.

Along with the prominent contradiction between the environmental problems and economic development, Environmental regulation, pollution problems become the focus of the current academic circles. Scholars' study are divided into two aspects, which one is the environmental regulation research on the influence of FDI and international trade, the other is research on the influence of the environmental regulation to the industry transfer between regions.

It existspollution haven effect through the Industrial transfer phenomenon from east region to the western Region of China. In the primary stage of industry transfer would take more to undertake areas ecological environment cost. This is one of the important factors that promote industrial transfer for environmental externality internalization degree of differences between regions by the influence of environmental industries transfer to the Midwest. Scholars adopt the classical trade model of region and industry characteristics of the interaction, estimate the "pollution haven" effect of the regional in China and shows that pollution intensive industries will transfer from provinces of environmental regulation intensity to less environmental regulation area[1-4].

THE ANALYSIS OF GEOGRAPHICAL DISTRIBUTION CHANGES OF POLLUTION INDUSTRY IN CHINA

Change of locational distribution of pollution industry

Stillwellused deviation share method to analyze the spatial distribution of industry in different areas, the change of employment, the differences in economic growth in different regions and the space to labor transfer and so on. Then this method is used by many scholars. This paper, by using the way of analysis analyses the change of output value of heavy pollution industry, moderate pollution industry and light pollution industry in different provinces in China. It has the following relation[5-6].

$$\Delta E_{ij} = E_{ij} R_{ij} \quad (1)$$

In the pattern, ΔE_{ij} stands for the changes of total industrial output value of i industryin j province. E_{ij} stands for the changes of total industrial output value of i industry in prior period of j province. R_{ij} stands for the rate of increase of total industrial output value of i industry in j province in the inspection.

After deformationequation (1) change into the next.

$$R_{ij} - R_k = (R_{ik} - R_k) + (R_{ij} - R_{ik}) \quad 2$$

The left of the equation is NRC (Which is the Relatively net changes of Industrial production growth.), which shows the differences between the changes of total industrial output value of i industry in j province and the industrial output increased of The national average industry. The right of the equation are the two parts of NRC. The first is the structure transfer of i industry in j province. When it divides NRC, it stands for STR. The second on the right is transfer differences. When it divides NRC, it stands for DIF(Which stands for the contribution to the net change in relative share). It means that the output growth caused by the different between the growth rate of output in the industry and the growth rate of output of the whole nation. Directly represent the industry transfer caused by the competitiveness level of this industry in the province. If the symbol of STR or DIF is positive, it means that the direction promotes NRC. If the symbol of STR or DIF is negative, it means the direction hinders NRC, such as if both DIF and NRC are negative, it means differences between the transfer promotes the increase of the relative net changes. If the symbol of DIF is positive and the NRC is negative, it means differences between the transfers will promote relative reduction in the net change. According to this method, choosing the provinces in China in 2002-2012 data to analyses the distribution changes of the main region the distribution of heavy pollution industry output growth, and choosing the data of 2002, 2007, 2012 to compare.

TABLE1.Analysis of the departure shares of the change of output value in the areas of heavy pollution industry

	2002			2007			2012		
	NRC	**STR**	**DIF**	**NRC**	**STR**	**DIF**	**NRC**	**STR**	**DIF**
Beijing	0.114	-0.093	1.093	-0.08	-0.603	1.603	0.087	-0.294	1.294
Tianjin	0.154	-0.069	1.069	-0.03	-1.717	2.717	0.311	-0.082	1.082
Hebei	-0.07	1.594	-0.594	0.113	0.471	0.529	0.063	-0.407	1.407
Shanxi	0.109	-0.098	1.098	0.070	0.762	0.238	-0.064	0.400	0.600
Neimeng	-0.057	0.187	0.813	0.008	6.636	-5.63	0.344	-0.074	1.074
Liaoning	-0.076	0.139	0.861	-0.04	-1.129	2.129	0.269	-0.095	1.095
Jilin	-0.117	0.049	0.951	-0.26	-0.179	1.179	0.261	-0.098	1.098
Heilongjiang	-0.107	0.052	0.948	0.312	0.170	0.830	0.837	-0.030	1.030
Shanghai	0.003	-3.960	4.960	-0.00	-25.89	26.89	-0.125	0.205	0.795
Jiangsu	0.007	-1.586	2.586	0.084	0.635	0.365	0.017	-1.515	2.515
Zhejiang	-0.141	0.075	0.925	0.107	0.496	0.504	-0.006	4.618	-3.818
Anhui	0.036	-0.296	1.296	0.056	0.947	0.053	0.118	-0.216	1.216
Fujian	-0.030	0.354	0.646	0.053	1.006	-0.006	0.106	-0.241	1.241
Jiangxi	0.036	-0.300	1.300	-0.199	-0.266	1.266	0.230	-0.111	1.111
Shandong	0.028	-0.378	1.378	0.114	0.465	0.535	0.170	-0.150	1.150
Henan	0.062	-0.171	1.171	0.095	0.558	0.442	0.144	-0.177	1.177
Hubei	-0.069	0.154	0.846	0.021	2.557	-1.557	0.186	-0.137	1.137
Hunan	0.008	-1.278	2.278	-0.037	-1.418	2.418	0.179	-0.143	1.143
Guangdong	-0.042	0.253	0.747	0.015	3.564	-2.564	0.059	-0.429	1.429
Guangxi	-0.077	0.137	0.863	0.097	0.548	0.452	0.102	-0.250	1.250
Hainan	-0.105	0.102	0.898	0.154	0.345	0.655	0.051	-0.496	1.496
Chongqing	-0.053	0.201	0.799	-0.111	-0.479	1.479	0.131	-0.194	1.194
Sichuan	0.034	-0.312	1.312	0.081	0.653	0.347	0.394	-0.065	1.065
Guizhou	0.055	-0.195	1.195	0.105	0.507	0.493	0.069	-0.370	1.370
Yunnan	-0.034	0.314	0.686	0.042	1.251	-0.251	0.087	-0.293	1.293
Shanxi	0.014	-0.782	1.782	0.175	0.304	0.696	0.706	-0.036	1.036
Gansu	-0.110	0.097	0.903	0.043	1.234	-0.234	0.229	-0.111	1.111
Qinghai	-0.128	0.083	0.917	0.273	0.195	0.805	0.386	-0.066	1.066
Ningxia	-0.126	0.085	0.915	-0.463	-0.115	1.115	-0.050	0.510	0.490
Xinjiang	-0.202	0.053	0.947	0.373	0.142	0.858	0.958	-0.027	1.027

Infuse: the date from 2002 to 2012 is obtained by deviating from the share

From the relative net change, in heavy pollution industry the largest amplitude of the increase of relative net changes is Tianjin, Beijing and Shanxi Province that are respectively 15.3%, 11.4%, 10.9%, among which the bigger amplification are mainly focus on eastern coastal and middle part where have more abundant mineral resources in 2002. The western underdeveloped regions such as Xinjiang, Qinghai and Ningxia and other areas, the biggest reduce extent reaches to 20%. The bigger increase of NRC are focus on the northeast three provinces, and the western region in 2007. The increase of Xinjiang, Heilongjiang, Qinghai and other areas have reached into More than 15%. The biggest of Xinjiang is 37.3%. By 2009, relative net growth of heavy pollution industry is mainly in the central and western regions, which Xinjiang Province is reached 95.8%, Heilongjiang Province and Shanxi respectively are 83.7%, 70.6%, Neimenggu Province and Qinghai Province also reached more than 35%. By 2012, the bigger decreasing amplitude of relative net changes is mainly eastern coastal areas, such as Shanghai, Zhejiang Province are respectively about 12%, 5%.

From the point of transfer structure and transfer difference, this paper mainly focuses on the relative amount of structure transfer and transfer difference. From the contribution portion of the differences between the transfer to the relative net changes in heavy pollution industry, Jiangsu Province, Beijing, Guizhou Province, Shandong Province all promote the relative net change in different degree through the differences between the transfer in 2002. The DIF and NRC of Shanxi Province, Xinjiang Province, Heilongjiang Province are all positive and the value of DIF are bigger than the value of STR. Meanwhile, in Shanghai, Tianjin, Liaoning Province and other eastern coastal developed areas, the DIF is positive and the NRC is negative. It means that in these areas, it has been decreased of the net change in heavily polluting industries by using differences between the transfers. From the data of table 1, we can directly see that the regional distribution of heavy pollution industry regional distribution has been significantly changed from 2002 to 2012. As to speed up the industrialization process, gradually emerged the tendency from the eastern coastal areas to the central. The reasons for this shift phenomenon also need to be explained through the empirical analysis.

Environmental control measures

According to the literature in a variety of environmental regulation measure method, This paper argues that we can take the sulfur dioxide as the main pollutants of regulation in our country at present according to the actual situation of our

country, which have a certain representative significance. We choose Calculating formula for measuring the intensity of environmental regulation is [Industrial SO2removal/(Industrial SO2 removal+ Industrial SO2 emissions)] *100%.

MODEL AND VARIABLES

Model and measurement method

Now more research using time series or cross section data to research the relationship between environmental regulation and industrial transfer. But due to problems such as data quality and the inherent variable of the model, it makes the result not very ideal. In this paper, on the basis of considering the econometric model may be as much as possible omitted variable and multicollinearity problems, at the same time focus on the background of transforming the industry in China and The practical characteristics of sample data to build model.

There are many factors that can influence pollution industry transfer, such as economic development level, economic growth rate, the population density of areas, labour cost, government regulation and so on. On the one hand, considering the actual situation of our country, on the other hand drawing lessons from past research conclusions and experience, this paper select three kinds of polluting industries difference transfer index DIF which is calculated by the deviating from the share method as explained variable, environmental control level as the observed variables, labour cost ALC, the population density AMS, marketization degree AMP, transportation cost TPC and land cost LDC as control variable, which respectively reflect regional labour costs in China, economic scale, the degree of marketization, the infrastructure level. This paper uses the research idea and model of the effects of environmental regulation of pollution industry transferof Xiangang. A function of pollution industry transfer index and explanatory variables can be shown as follow.

$$DIF = f(ECL, ALC, AMS, AMP, TPC, LDC) \quad (3)$$

The index of differences between the transfer in different areas in Equation (3) are codetermined by environmental regulation level, labor costs, population density, the degree of marketization, transportation costs and land costs. To eliminate heteroscedasticity problems, Some sample data is for logarithm, panel data model is set up.

$$DIF_{it} = c_t + \beta_1 LnECL_{it} + \beta_2 LnALC_{it} + \beta_3 LnAMS_{it} + \beta_4 LnAMP_{it} + \beta_5 LnTPC_{it} + \beta_6 LDC_{it} + \varepsilon_{it}$$

$$(i = 1, 2, 3.....26, t = 2002, 2003.....2012) \quad (4)$$

In equation (4) i is for the provinces, t is for the year.

Variables

Table 2 explains in detail each of the variables in the regression model selection and calculation method.

TABLE2.The variable selection in detail

Variable nature	variable name	All kinds of variable calculation basis	unit
explained variable	Differences between the transfer of share DIF	See table 1	%
observable variable	Level of environmental regulation ECL	The provinces industrial SO_2 removal/(Emissions + massremovalrate)	%
control variable	labor cost ALC	Manufacturing worker average wage/All industry worker average wage	%
	The population density AMS	The provincial population/The provincial land area	per/square kilometers
	marketization degree AMP	The ratio of the Industrial output value of state-owned and state-holding enterprise on all enterprises gross value of industrial output	%
	transportation cost TPC	[▪ Highway freight volume/(High speed freight+Railway freight volume) * highway mileage)+(volume of railway freight/(High speed freight + Railway freight volume) * railway mileage)	Kilometer /square kilometers
	land cost LDC	Every year the actual sales price of Real estate commercial business premises in different province/total price	%

Data source and the measuring method

This paper adopts the Panel Data model which is the international commonly used to analyze. On the one hand, we can control the unobservable individual heterogeneity problem. On the other hand we can describe and analyses the dynamic process of impact of various factors on the pollution industry transfer between regions to better deal with error

problem.

In this paper using 2002-2012 panel data of 27 provinces, autonomous regions and municipalities directly under the central government, to analyses ,a total of 270 observations. The data of pollution industry transfer indicators come from China industrial economic statistical yearbook, the variable data come from China statistical yearbook, calendar year, Ceinet statistics database, China's environmental statistics yearbook, provincial bureau of statistics web site, etc.

THE MEASUREMENT RESULTS AND EMPIRICAL ANALYSIS

This paper uses EVIEWS 6.0 software with 2002-2012 in mainland China's 27 provinces and cities of seven variables panel data to make the regression analysis to research the influence relationship between environmental regulation and pollution industry transfer. This article divides the provincial industry in China into heavy pollution industry, moderate pollution industry, the pollution industry to make the regression analysis respectively. At the same time the 27 provinces and cities in our country is divided into two parts, the east and Midwest. The eastern provinces and cities including Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan, The rest of the provinces as the central and western regions that we can accurate to investigate environmental regulation and the actual situation of pollution industry transfer.

TABLE3.East and Midwest panel data regression results

	Heavy pollution industry		Moderate pollution industry		Light pollution industry	
	Eastern Region	central and western regions	Eastern Region	central and western regions	Eastern Region	central and western regions
c	2.74	-62.11*	-26.95	106.31**	-135.70**	-5.05
	(0.05)	(-1.74)	(-0.46)	(2.21)	(-2.23)	(-0.23)
ECL	-6.78**	4.47**	-0.38**	26.20**	-31.92**	-0.09*
	(-2.84)	(2.34)	(-2.12)	(2.25)	(-2.00)	(-1.7)
LnALC	-2.48*	13.07	23.76	-11.20**	21.32**	-10.52
	(-1.90)	(0.32)	(1.93)	(-2.69)	(2.54)	(-1.76)
LnAMS	-15.82	21.80*	0.25	2.62*	19.18***	4.70
	(-0.33)	(1.72)	(0.07)	(1.80)	(4.81)	(0.69)
LnAMP	3.64*	-3.36	0.44*	-26.64*	-29.21*	10.89*
	(1.87)	(-1.88)	(2.02)	(-1.76)	(-2.04)	(1.83)
province	11	16	11	16	11	16

Record: ***,**,*respectively by 1%, 5%, 1% significant level, t statistics are shown in brackets

Regression results for the east and Midwest panel data

Panel data model consists of mixed model, variable intercept model and variable coefficient model 3 kinds. Variable intercept is divided into fixed effect model (FE) and random effect model (RE). The paper used the related data statistics, we can find the F value of the three regions are passed the test of significance, so we can use variable intercept model. Then use Hausman test found that the P values of the three kinds of pollution industry transfer was less than 0.05, so refused to random effects model, accept fixed effects model. To avoid serial correlation, Part of the regression analysis should add the AR (1).

The table below is estimated results. By estimating the results we can find the adjustment R^2 of the models are more than 20%, it means that fit of the model is more ideal and it has ability to explanation. D-W test also suggests that there is no serial correlation.

The empirical result analysis

The study find that by estimates of the result that the regression coefficient of the observed variables of environmental regulation on heavy pollution industry transfer, moderate pollution industry transfer, and mild pollution industry transfer are -6.78, -0.38, -31.92 in eastern region. They are negative and have passed the 5% significance level. It means that every one percent increase of the eastern region environmental regulation level will make heavy pollution industry share decreased by 6.78%, moderate pollution industry share decreased by 0.38% and the light pollution industry share decreased by 31.92%. It consistent with expected results. Because of the chosen index of pollution industries is the share of differences between the transfers DIF, which directly reflect t such industry competitiveness in the region. The results showed that strict environmental regulation leads to the loss of three types of industry in the eastern region competitiveness. It plays a promoting role on the three kinds of pollution industry transfer out of the eastern region. However, the regression coefficient of the environmental regulation on three kinds of pollution industry in the Midwest are 4.47, 26.2, -0.09. It means that every one percent increase of the environmental regulation level will make heavy pollution industry share increased by 4.47%, moderate pollution industry share increased by 26.2%. The implementation of the environmental regulation makes the severe pollution and moderate pollution industry in the Midwest more competitive.

According to the theory of comparative advantage, we should prompt these three kinds of pollution industry transfer from the eastern coastal developed areas to less developed areas in the Midwest. To some extent, it shows that our country exists "pollution haven effect" between different areas.

CONCLUSIONS

This paper constructed the measurement model between industrial transfer and the factors affecting, Studied the effects of pollution industry transfer inner mechanism based on environmental regulation angle. Using the east and Midwest in 2002-2012 panel data of 27 provinces and unit root test of the research the data, and then using econometric model empirical to study the relation between the index of the east and Midwest pollution industry transfer and Level of environmental regulation, labour costs, marketization degree, transportation cost and land cost. This study gets the following conclusion:

First, the intensity of environmental regulation on transfer of pollution industry in China have a significant negative impact. It is one of the reasons for parts of polluting industries transfer to Midwest to evade the strict environmental regulation of eastern region, which lead to the pollution industry in eastern developed regions transfer to the central and western regions. Confirmed that China exist "pollution haven effect" between different areas.

In the second place, it can be seen from estimated results analysis that heavy pollution industry more likely to choose low environmental regulation intensity of the central and western regions than Moderate and mild pollution industry, while the eastern coastal developed areas are favour to light pollution industry, it means clean industry. The Midwest lowers the threshold of the environmental regulation of local government to attract more industry transfer in. But because they are not able to identify heavy pollution industry pollution to the environment and don't take effective preventive measures, It may lead to the industrial transfer to undertake party is likely to attract the heavy polluting industries.

Third, in the other factors that affect industrial transfer, the effect of the three factors of labor costs, population density and transportation cost on moderate and mild pollution industry transfer is less important than heavy pollution industry, at the same time in the eastern region is significantly higher than the influence of the central and western regions. At the same time, further evidence shows the eastern region has been from high pollution emissions of industrial production gradually step by step towards the development road of clean production, green colour production.

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