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Environmental Regulation, Region Industry Advantage and Trade Competitiveness

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Abstract: Using the panel data of 284 Chinese cities from 2002-2010, the study examines the effect of environmental regulation on exports. In order to measure the stringency of environmental regulation on trade development under the constraint of industrial advantage in different regions, the sample is divided into eastern, central, western, Yangtze River Delta and Pearl River Delta five groups respectively. Considering the endogeneity of the environmental regulation variable, the study adopts system GMM to estimate the model for robust results. It turns out that the environmental regulation exerts different impact on trade pattern owing to the difference in industry foundation, technology accumulation and factor endowment etc. On the national degree, the environmental regulation has a positive effect on the export trade. It also plays an important role in promoting the exports of central district as well as strengthening the trade competitiveness of western district, but its influence on the eastern district is not statistically significant. Furthermore, it is shown that the environmental regulation has insignificant effects on Yangtze River Delta and Pearl River Delta, since the capital-intensive production patterns have been gradually formed in the two major economic zones.

Key words: Environmental regulation, region industry advantage, trade competitiveness

INTRODUCTION

Since the 1970s, the relationship between environmental policy and trade has caught wide attention and always been a hot debate in academic field. Because of the difference in hypothesis, research methods and sample selection, whether environmental policy promotes trade still has a big divergence between different research literatures. The conventional hypothesis is that firms have made optimal allocation of resources with minimizing their corporate cost and the environmental regulations urge firms to pay an extra pollutant charge and purchase pollution abatement equipment which generate the costs relating to Operation and maintenance of the equipment thus exert a negative impact on the competitiveness of companies. Baumol and Oates (1988) firstly assume that both countries produce the same kind of products which could result in environmental pollution and through partial equilibrium analysis, it is shown that if environmental regulation policies are adopted unilaterally, comparative advantages on pollution-intensive products of the country would be weakened. The conclusion is similar to one proposed by Siebert (1977) that environmental policies raise production costs. However, views of the classical literature have been challenged since the 1990s and the key to why the theory is challenged lies in that countries and the world market are abstracted into a static and short-term market and the information involved is complete. But with the continuous development of international trade, information asymmetry exists largely among traders; more and more empirical analyses have found that a country's competitiveness is influenced greatly by dynamic factors like international element flow and technology innovations.

Porter and Van der Linde (1995) shows that stringent environmental regulations encourage firms to improve production efficiency and quality through technological and managerial innovations to gain dual benefits of environment and economy. Therefore, Porter comes up with "innovative compensation" theory and designs a proper environmental rules in theoretic to stimulate a company upgrading technology and compensate costs. Porter proposes at the same time that when the home government takes the lead in adopting stricter environmental standards, companies are able to retain a certain degree of first-mover advantage. Simpson and Bradford (1996) demonstrate that in a strategic trade model, the government can provide a strategic advantage to domestic industries through implementing strict environmental regulations. As a kind of commitment tool, the environmental regulation could ensure industries to be active in R&D investment in order to decrease the marginal cost. Copeland and Taylor (1994) shows that

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stringent environmental standards also put competitive pressure on export-oriented companies and motivate their technological innovation, thus could promote industrial structure optimization and product structure greening, finally generate "innovative trade effect" to favor their export. On the basis of the above-mentioned theoretical model, many studies try to seek the empirical evidence that the environmental regulation has impact on international trade and their conclusions are also ambiguous. The main points are as follows.

Views on environmental regulations are not conducive to export trade. After Gray and Shadbegian (1995) made an empirical analysis in pulp and study, oil refinery and steel industries in US, they find that with stringent environmental standard, there is a negative relationship between pollution abatement cost and productivity and the phenomenon supported by the Porter hypothesis that the environmental regulation can stimulate technological innovation to improve productivity does not occur. Cagatay and Mihci (2006) design an index of environmental sensitivity performance to measure the stringent degree of environmental regulations, their propositions shown that the stringency of environmental regulations is significantly negatively correlated with the export amount.

Views on environmental regulations are conducive to export trade. Lanjouw and Mody (1996) use data of America, Japan and Germany to show that there is a positive relationship between the number of environmental patents and pollution abatement expenses, which means technological innovation in the Porter Hypothesis actually exists, but usually there is a lag period of 1-2 years. Costantini and Crespi (2008) measure the impact of environmental technology on evolution of export patterns in energy industry. It is supported that the environmental regulation leads to significant comparative advantages in industries after contracting a Tokyo letter of intent, especially, as the technological innovation system has been strengthen, the energy sector has become the core driving for export. Their conclusions are completely in according with the hypothesis of Porter and Vanderlinde. Lu (2009) utilizes HOV model to analyze 95 national total samples and 42 regional sub samples. Taking endogenetic problems into account, he adds "Per capita incomes" in estimation of endogenous environmental regulation in the study. Meanwhile, he considers environmental sustainable indicators of 146 worldwide nations (areas) provided by CIESIN as exogenous instrumental variables to estimate the regression coefficients. It turns out that the environmental regulation could not impair the comparative advantage of the different countries; by contrast, the stringent environmental regulations consolidate the trade competitiveness in steel, chemical and study industries.

Different from the above studies, the study highlights in the impact of environmental regulations on China's regional economy. Considering the different resource endowment of China eastern, central and western regions, the study analyses the role of environmental policy in improving the regional trade pattern and examine the relevance of regional trade competitiveness, environmental quality and regulation. Due to the different research purposes, so the annual 284 cities' data are divided into eastern, central and western groups with special reference to the Pearl River Delta and Yangtze River Delta groups, it leads to some innovative conclusions as follows: (1) As the differences in regional industrial development, the environmental regulation in the central district has a positive role in promoting the export, its impact coefficient on western district is also large, but it is small and insignificant on the eastern district, (2) The effect of environmental regulation on the trade is not significant in Pearl River Delta and Yangtze River Delta for the reason that the capital-intensive and technology-intensive industries are the mainstream industries in these regions. At the same time, taking the endogeneity problem between explanatory variables into account, more robust conclusions are deduced with the system-GMM estimation under the conditions of dynamic Panel. The structure of the study is as follows, the models and data sources is described in the second part of this study , with emphasis on the selection and classification of 284 cities panel data and the rationality of system GMM estimation. In the third part of the study, the economic interpretation on the impact of regional environmental rules on regional trade pattern is put forward. Conclusion is given in the fourth part of this article.

MODEL SPECIFICATION AND THE DATA SOURCES

Since the purpose of this study is to investigate the effects of environmental regulations on trade competitiveness in China, therefore, it requires the measurement for environmental regulation in these cities. For another, we need to find the proxy variable for measuring the stringency of environmental regulation in different regions of China, for the reason that there is no comprehensive assessment indicators of environmental conditions in different cities. Currently, the international environmental evaluation indicators are divided into direct and indirect types. Direct evaluation indicators mainly reflect the status quo and the implantation effect of

environmental policies in different countries, regions and industries and consider the external environmental costs of firms as an important factor. Indirect evaluation indicators reflect the pollution emissions and governance in the environmental protection process, as well as the results of related political, economic conditions. Generally, the types of pollution can be classified as air pollution, water pollution, solid waste pollution, light pollution, noise pollution and so on. How to use a comprehensive indicator to represent the overall damaged degree of national or regional environment and resource scientifically, the research literature has not already give a satisfying answer.

Based on the above regulation variables, the study selected the total exports (Ex) of Chinese 284 cities as the dependent variable and the environmental regulation stringency (Envir) as an explanatory variable. The total export data of 284 Cities come from the China Statistics Yearbook and the Statistical Yearbook. The data of environmental regulatory variable source from the Urban Statistical Yearbook of China. Due to many factors impact on the export trade, the more control variables also been considered in the empirical model.

First of all, R and D expenditure could improve the existing technologies and thus the technological upgrading and innovation will no doubt enhance the competitiveness of enterprises, therefore, it has a positive impact on export trade. Secondly, according to the theory of industrial organization, the industrial structure and the industrial scales will also have an impact on the dominant industries and the export trade. In addition, the impact of foreign direct investment on export trade may also exist. Therefore, we select R and D expenditure, foreign direct investment, industry scale, capital intensity as control variables, the data are derived from the Chinese Urban Statistical Yearbook.

Research and development expenditure (R and D): The more investment in R and D, the better the city could have an ability to upgrade its existing technologies, so as to more effectively improve pollutant abatement rate and compliance rate. Due to the statistical yearbook failed to provide the R and D expenditures in various cities of China, so it cannot be a variable of investment in R and D as the environmental protection measures directly and needs to be replaced using other variables. Integrated the existing empirical literature, the expenditure on science and education in regional fiscal expenditure has been considered as a proxy variable of urban R and D investment, so the study also used the scientific and education expenditure to represent the urban R and D expense.

Foreign direct investment (FDI): The amount of foreign direct investment each year denotes the variable, unit (million US dollars).

Capital Intensity (CAP): The ratio (USD/person) of total assets and total employee in each industry is selected to denote the variable.

Industry scale (IND): The gross industrial output is denoted as the variable. Industry scale, to some extent, reflects the ability to dominate market and capture profit in a low cost way, thereby affects the export trade volume of the firms.

As international trade has dynamic characteristics, results may be biased with ordinary OLS regression methods of panel data. Based on the above considerations, this study intends to adopt dynamic panel methods to overcome the problem. On account of the good explanations for the results, the variables take the logarithm, thus the following forms of dynamic panel models is established as follows:

$$\log Ex_{it} = \beta_0 + \beta_1 \log Ex_{it-1} + \beta_2 \log Envir_{it} + \beta_3 \log Rd_{it} + \beta_4 \log Fdi_{it} + \beta_5 \log Ind_{it} + \beta_6 \log Cap_{it} + \lambda_t + \xi_{it}$$

where, i and t in the regression model denote the city i and the year t respectively, ξ is a random disturbance term, β is regression coefficients to be estimated.

ANALYSIS AND INTERPRETATION OF RESULTS

Recently, the issue of endogenous variables is highlighted by econometricians; endogenous problem could result in the severe non-consistency and bias in coefficient estimation. It has been resolved with the endogenous instrumental variable method; however, choosing the rational variable from external environment is difficult because the selected variable not likely meet the strict conditions or is only weak instrumental variable. As mentioned above, because the export has certain characteristics of system continuity, it is necessary to set the first order lag term in the regression equation; but after the introduction of the variable, it will generate endogeneity problem between environmental regulation and R and D variables. To overcome this problem, we choose GMM estimation method in terms of dynamic panel. Currently, in the dynamic panel data model estimation, there are two main ways: Differential GMM and system GMM. Arellano and Bover (1995) shown that the differential GMM estimation only use difference

equation, it may lose some useful information. In addition, Blundell and Bond (1998) considered the standard differential GMM estimation method may result in weak instrumental variables problem because the lag term of independent variables and its difference is not highly correlated. However, both horizontal equations and difference equations are adopted in System GMM estimation and the lag term of differential (horizontal) equation is set as a horizontal (differential) instrument variables. For the system GMM could use more information, so it is considered more effective than differential GMM estimation and then the system GMM estimation method is used in the study. Of course, this is a prerequisite for the effectiveness, namely, the added instrumental variable with system GMM estimation is valid. In order to verify the validity of instrumental variables, the study use Sargan test based on Arellano and Bover (1995) and Blundell and Bond (1998) recommendations.

On the basis of the methodology, the study estimate model from 2002-2010 Chinese 284 cities panel data with fix effect, random effect and GMM method.

The results of national regression are reported in Table 1, where Envir indicates the environmental regulation variable. It is shown that the effect of regulation on exports is positive and significant in national case, which verifies the rationality of Porter Hypothesis. The industry structures of eastern and central areas are experiencing or have experienced the shift from labor (or pollution)-intensive structure to capital (or technology)-intensive structure, the change is attributing to the government's great emphasis on structural adjustment in recent years. All sectors of the society have gradually realized that economic development should not sacrifice the local environment and therefore, as a powerful monitor of environment, government administrations have enacted some stringent but practicable environment criterions to avoid taking the old routine of "pollution first and treatment later". Once the products meet the environmental requirements of international market and it is possible for the trader to maintain even capture new international market share as is predicted by Copeland and Taylor (1994).

As for other variables, FDI also has a significant positive effect on exports and this implies that FDI has brought new production technologies to foreign capital regions, helping local production evolve into a clean technology pattern. In addition, local exports are also benefit from more convenient export channels provided by FDI. Intuitively, the increase in R and D would promote technology innovation which could undoubtedly increase the production efficiency and the international competitiveness. However, as can be seen in Table 1, the regression coefficient of R and D is not statistically significant and even negative in the SYSGMM with time effects, contrary to our expectation. According to Cohen and Levinthal (1989), that the increase in R and D investment would eventually upgrade the firm's production efficiency is a process of continuous accumulation and association. Further, the duration of this process mainly depends on the learning capacity of local enterprises. Actually even some state owned enterprises were caught in a dilemma because the achievement of R and D investment needs to experience a process of long-time accumulation but they could not bear the cost of bank credit after 2008 financial crisis. So, the ambiguous results about the effect of R and D investment could have a good reason behind. On contrary, capital intensity is insignificantly negative with exports, which consists with our expectation. On national degree, the comparative advantage of the whole country still concentrates on labor-intensive industry so the increase in per capital level could exert the insignificant negative effects.

Table 1: Regression analysis of the effect of environmental regulation on exports with national sample

Regressor	FE	RE	SYSGMM	SYSGMM
L.logEx	0.387***	0.866***	0.739***	0.741***
	(15.81)	(72.55)	(15.05)	(15.91)
logEnvir	0.021*	0.007	0.056***	0.035*
	(1.68)	(0.63)	(3.04)	(1.72)
logRd	0.020**	0.007	0.007	-0.059
	(2.11)	(0.73)	(0.74)	(-1.28)
logFdi	0.072***	0.096***	0.170***	0.141***
	(3.32)	(7.52)	(4.29)	(3.17)
logInd	0.480***	0.120***	-0.014	0.198*
	(7.90)	(3.05)	(-0.17)	(1.76)
logCap	-0.084	-0.128***	0.057	-0.036
	(-1.16)	(-3.20)	(0.75)	(-0.32)
_cons	-0.633	0.684***	0.061	-0.595
	(-1.32)	(2.87)	(0.15)	(-1.28)
Time	No	No	No	Yes
sargan			295.010	208.731
sar_df			101.000	101.000
N_g	284.000	284.000	284.000	284.000
Number	1817	1817	1674	1674

FE: Fixed effect estimation, RE: Random effect estimation, SYSGMM: System generalized method of moments, Standard errors are given in parentheses under the coefficients, The coefficient is statistically significant at the ***1% level, **5% or *10% significance level. Particular, year 2005, 2006, 2008 and 2009 have significant time effects and their coefficients are -0.284**, -0.212*, -0.132**and -0.496***, respectively

The results of the effect of environmental regulation on exports under eastern sample are given in Table 2. As can be seen, both in fixed and random effects estimation, environmental regulation have an insignificant negative effect on exports while its impact on exports is insignificant positive with system GMM. There are two plausible explanations for this finding. First, the firms of eastern area have taken lead in economic and technology

Table 2: Regression analysis of the effect of environmental regulation on exports under eastern sample

Regressor	FE	RE	SYSGMM	SYSGMM
L.logEx	0.571***	0.868***	0.777***	0.786***
	(12.66)	(43.71)	(16.57)	(15.33)
logEnvir	-0.010	-0.020	0.024	0.012
	(-0.65)	(-1.52)	(1.60)	(0.48)
logRd	0.028**	0.014	0.033**	0.008
	(2.18)	(1.17)	(2.12)	(0.25)
logFdi	0.052	0.070***	0.097***	0.082***
	(1.46)	(3.57)	(3.65)	(2.69)
logInd	0.264***	0.057*	0.090	0.126*
	(4.38)	(1.85)	(1.32)	(1.65)
logCap	-0.003	-0.111***	-0.115***	-0.074
	(-0.04)	(-2.90)	(-3.16)	(-1.56)
_cons	0.377	1.598***	1.294*	0.701
	(0.050)	(3.44)	(1.89)	(0.65)
Time	No	No	No	Yes
sargan			189.739	185.884
sar_df			101.000	101.000
N_g	105.000	105.000	105.000	105.000
Number	768	768	681	681

FE: Fixed effect estimation, RE: Random effect estimation; SYSGMM: System generalized method of moments, Standard errors are given in parentheses under the coefficients, The coefficient is statistically significant at the ***1% level, **5% or *10% significance level. Particular, year 2008 and 2009 have significant time effects and their coefficients are -0.104**, -0.321***, respectively

Table 3: Regression analysis of the effect of environmental regulation on exports under central sample

Regressor	FE	RE	SYSGMM	SYSGMM
L.logEx	0.454***	0.818***	0.680***	0.687***
	(14.28)	(44.52)	(13.91)	(11.55)
logEnvir	0.043**	0.017	0.079***	0.058**
	(2.19)	(1.02)	(3.04)	(2.02)
logRd	-0.005	-0.005	-0.011	-0.003
	(-0.34)	(-0.39)	(-0.82)	(-0.05)
logFdi	0.048	0.079***	0.092***	0.075*
	(1.38)	(3.96)	(2.77)	(1.94)
logInd	0.464***	0.061*	0.158*	0.206
	(7.01)	(1.66)	(1.71)	(1.26)
logCap	-0.241**	-0.109**	-0.127	-0.112
	(-2.42)	(-2.48)	(-1.64)	(-1.41)
_cons	0.601	1.591***	0.992	0.520
	(0.72)	(3.20)	(1.40)	(0.32)
Time effect	No	No	No	Yes
sargan			183.348	149.001
sar_df			101.000	101.000
N_g	112.000	112.000	112.000	112.000
Number	735	735	697	697

FE: Fixed effect estimation, RE: Random effect estimation, SYSGMM: System generalized method of moments, Standard errors are given in parentheses under the coefficients, The coefficient is statistically significant at the ***1% level, **5% or *10% significance level, Particular, year 2008 and 2009 have significant time effects and their coefficients are -0.188**, -0.606***, respectively

development, facilitating the progress of transportation and communication infrastructure. The eastern economic development is to strengthen the transformationfrom the manufacture (or labor-intensive) industries to service industries as well as to cultivate emerging industries. It is consists with Porter hypothesis that the decreased corporate profits is triggered by the capital substitution effect of environmental regulation in technology-intensive industries. Second, it is more available to exports since the products are more in compliance with the stricter environmental requirements from foreign markets thanks to the innovation on techniques of labor-intensive industries.

Therefore, the two contradictory effects of environmental regulation on different industries could counteract with each other, so as to result in this insignificant result, but in general, its impact on exports of eastern cites remains positive.

The observed positive relationship between R and D and exports is different from national cases. The results indicate that although from R and D investment to final achievement is a process of continuous accumulation, as mentioned before, firms in eastern area have already enjoyed the improvements of production efficiency and technology through R and D activities. A virtuous cycle is primarily attained. Furthermore, FDI has a significant positive effect on exports both in national and eastern samples, indicating that exports are also benefit from local firm's strong learning ability on technology.

Table 3 reports the impact of environmental regulation on exports in central area. The coefficient of environmental regulation is positive in fixed effect, random effect and system GMM estimation even is statistically significant in system GMM with time effect estimation. The central area is certainly abundant in coal, metal and nonferrous metal and therefore the region predominance focus on industries including coal mining, wood processing, black and nonferrous metal mining and smelting industries etc.

The environmental quality degradation resulted from local slack environment protection on account of the urgent desire to pursue economic development. The frequent occurrence of many natural disasters during recent years such as soil erosion, floods and sandstorms stimulated local government to realize that economic development could not sacrifice environment and have taken necessary measures to tackle the pollutant that discharged by polluting industries during the early stage of growth. In other words, environmental regulation can both enhance the trade competitiveness of polluting firms and embody the positive significance of "green commerce" by means of the innovations in existing technologies.

R and D has an insignificant negative effect on exports, which is similar with national case. Comparing the coefficient of this variable in these two samples, it is clear that in central area, R and D impact is below the national average, suggesting research achievement of this region can not entirely compensate the R and D expenditures.

Table 4: Regression analysis of the effect of environmental regulation on exports under western sample

Regressor	FE	RE	SYSGMM	SYSGMM
L.logEx	0.070	0.818***	0.624***	0.599***
	(1.03)	(19.27)	(3.98)	(3.97)
logEnvir	0.137**	0.020	-0.002	0.056
	(2.33)	(0.36)	(-0.04)	(0.78)
logRd	0.025	0.008	-0.011	0.044
	(0.40)	(0.12)	(-0.24)	(0.22)
logFdi	0.212***	0.110**	0.132	0.073
	(3.77)	(2.45)	(1.26)	(0.70)
logInd	0.848***	0.066	0.454*	0.585*
	(4.09)	(0.66)	(1.87)	(1.91)
logCap	-0.078	0.009	-0.078	-0.016
	(-0.43)	(0.07)	(-0.61)	(-0.11)
_cons	-6.282**	-0.382	-3.160	-6.298*
	(-2.43)	(-0.22)	(-1.30)	(-1.77)
Time	No	No	No	Yes
sargan			105.683	108.047
sar_df			89.000	86.000
N_g	56.000	56.000	56.000	56.000
Number	244	244	238	238

FE: Fixed effect estimation, RE: Random effect estimation, SYSGMM: System generalized method of moments, Standard errors are given in parentheses under the coefficients, The coefficient is statistically significant at the ***1% level, **5% or *10% significance level, Particular, year 2009 has significant time effects and its coefficient is -0.419***

The relationship between FDI and exports is significant positive and the interpretation of this parameter is straightforward. Since, FDI firms tend to adopt environment friendly production technology thus the local companies can increase production efficiency by learning these advanced techniques, an idea corresponded with theory of Eskeland and Harrison (2003)

The results of the effect of environmental regulation on exports in western sections are reported in Table 4. The coefficient of environmental regulation is insignificantly negative in system GMM estimation while it turns out to be insignificantly positive in system GMM estimation with time effect.

Because of the historical reasons, the imbalanced proportion of industries has triggered many deleterious consequences; one is the slack link between the heavy industry sponsored by national investment and agriculture (or light) industry. For another, the local factor endowments and the infrastructure are not effectively intergraded into the economic development pattern. So, that is why the coefficient of environmental regulation is insignificant.

In western district, R and D has a more profound influence on exports comparing with the eastern results. Although, the development of economy is comparatively late and the accumulation of R and D is comparatively scarce, the marginal contribution of production efficiency improvement and technology innovation though R and D is more obvious.

Different from precious empirical results, FDI has a positive but not significant impact on exports, which also consisting with our national conclusions. Actualutilized foreign direct in vestment mainly concentrated in eastern coastal area beneficial from historical factors including the change of economic geography and openness policy etc. In recent years, with the economic policies towards the central and western areas, FDI highlighted in these emerging markets and is gradually shifted from coastal area to interior area. But in general, the fact that most FDI is still clustered around eastern coastal area has not change. Jiangsu, Guangdong and Zhejiang provinces are always the predominant regions of FDI, moreover, Liaoning and Hainan provinces enjoyed the fastest growth rate of FDI while Tibei and Inner Mongolia remain the least FDI.

With regression analysis, the effect of environmental regulation on exports under Yangtze River delta and PearlRiverdelta Samples are reported in Table 5. Although, there are a lot of similarities between these two economic zones, many underlying differences could be found after deliberately observing the result. In the results of Yangtze River delta, the relationship between the environmental regulation and exports is insignificantly positive in the system GMM estimation with time effect and the relationship turns to be insignificantly negative with other estimation method, the result is totally opposite to PearlRiverdelta. The industry structure of Yangtze River delta is superior to PearlRiverdelta especially in high-technology industry. As is mentioned before, environmental regulation could result in a drop of corporate profits due to its capital substitution effect to technology-intensive industries. Nevertheless, it also can create technology innovations in labor-intensive industry, making our products more qualified in compliance with stricter environmental requirements of overseas markets. These two contradictory effects of environmental regulation that counteract with each other is an explanation for the results, but basically, environmental regulation has a positive impact on exports in the Yangtze River delta. In contrast with Yangtze River delta, the manufacture industry in PearlRiverdelta is more specialized. It could be an important reason that the increased producer cost triggered by the labor scarcity and the environmental requirement stringency compel the firms into a corporate dilemma.

Comparing with these two tables, R and D has a positive and significant impact on exports in Yangtze River delta while the coefficient of R and D in PearlRiverdelta case is smaller and insignificant. It implied that Yangtze River delta owned a relatively more reserves of high-tech expert and qualified labor. On the other hand, FDI has a positive influence on exports in Yangtze River delta while its effect of PearlRiverdelta is negative in all

Table 5: Regression analysis of the effect of environmental regulation on exports under yangtze river delta and PearlRiverdelta sample

	Yangtze River delta				PearlRiver delta			
Regress	FE	RE	SYSG	SYSG	FE	RE	SYSG	SYSG
L.logEx	-0.045	0.862***	0.802***	1.121***	0.603***	0.820***	0.817***	0.875***
	(-0.08)	(5.04)	(4.24)	(15.77)	(7.19)	(12.99)	(7.50)	(11.08)
logEnvir	-0.079	-0.075	-0.035	0.021	0.018	0.021	0.017	-0.021
	(-1.05)	(-1.15)	(-0.69)	(0.88)	(0.51)	(0.79)	(0.92)	(-1.52)
logRd	0.034	-0.002	0.019	0.327***	0.050**	0.035	0.031	0.004
	(0.59)	(-0.03)	(0.69)	(2.64)	(2.14)	(1.37)	(0.83)	(0.24)
logFdi	0.003	0.027	-0.008	0.031	-0.320	-0.011	-0.013	-0.086*
	(0.01)	(0.18)	(-0.13)	(0.54)	(-1.65)	(-0.10)	(-0.18)	(-1.78)
logInd	0.786	0.092	0.138	-0.051	0.377***	0.162*	0.181	0.233**
	(0.95)	(0.27)	(0.64)	(-0.40)	(2.79)	(1.82)	(1.61)	(2.16)
logCap	0.673	-0.102	-0.129	-0.022	-0.205	-0.187	-0.176*	-0.082
	(1.13)	(-0.42)	(-1.03)	(-0.24)	(-0.95)	(-1.54)	(-1.74)	(-1.07)
_cons	-7.365	2.278	2.389*	2.999**	4.910**	1.827	1.498	0.192
	(-1.14)	(0.70)	(1.73)	(1.99)	(2.02)	(1.10)	(1.26)	(0.18)
Time effects	No	No	No	Yes	No	No	No	Yes
sargan			158.558	159.275			51.220	42.783
sar_df			86.000	84.000			56.000	51.000
N_g	16.000	16.000	16.000	16.000	9.000	9.000	9.000	9.000
Number	127	127	111	111	65	65	56	56

FE: Fixed effect estimation, RE: Random effect estimation, SYSGMM: System generalized method of moments, Standard errors are given in parentheses under the coefficients, The coefficient is statistically significant at the ***1% level, **5% or *10% significance level. Particular, in the fourth column year 2002, 2003, 2004, 2005, 2006, 2008, 2009 have significant time effects and their coefficients are -1.302***, -1.019***, 0.290**, -1.005***, -1.560*, -0.254***, -0.571***, respectively, In the eighth column year 2008, 2009 have significant time effects and their coefficients are -0.136***, -0.337***, respectively

methods of estimation. There are several factors behind this phenomenon. First, Yangtze River delta is more independent to export due to its location advantage and developed infrastructure. Therefore, more intermediate products are supported by the intraoral firms comparing with PearlRiverdelta and the amount from imports is relatively small. Secondly, in Yangtze River delta, the products are less dependent on international markets thus it can somehow immune to external market disturbances. Although the proportion of FDI in PearlRiverdelta is stable at 11-20% of the national degree, its vulnerability to external disturbances is a main reason for the negative effect of FDI on exports.

CONCLUSION

The article does an empirical research on the influences of environmental regulation and other factors on export with the data of 284 cities. In order to measure the extent that environmental regulation promotes the foreign trade under the constraints of industrial advantage in different regions, the research samples are divided into eastern area, central area, western area, Yangtze River Delta and Pearl River Delta respectively for study. Taking the endogeneity problem into account, we use a more effective system GMM method to estimate the model; the main conclusions are as follows: Firstly, environmental regulation has positive effect on China's export in general and its positive impact on trade competitiveness is significant from the empirical model with total sample.

It is shown that environmental policy could generally stimulate the incentive to seek for clean technologies which gain a competitive advantage through product innovation and conducive to export, which conforms to the propositions of Porter hypothesis. In the eastern region, since the labor resource agglomerated, the economy had the developed and high-tech industry basis, the dominant industries including information service, finance, insurance, shipping and high & new technology industries have been gradually established. Consequently, the environmental regulation has no significant impact on the export of eastern region due to its substitution effect on the capital to some degree. On the contrary, with abundant mineral resources, such as metal and nonmetal, the central region establishes the economic development pattern mainly depending on the smelting and mining industries. From the empirical results, it could be found that environmental regulation is beneficial to improve the competitiveness of its products through technical improvement on polluting industries. In addition, because of institutional problem and self-constraint condition, western dominant industries are still mainly consisted of resource industries with low value-added products; their industry chains are short while resources are monopolized broadly by the large and medium State-owned enterprises. Despite the strong supports given by the government in recent years, these deep-rooted problems severely hampered the western region owning competitive leading industries. Therefore, environmental regulations have insufficient impact on export in the western region.

Secondly, there are obvious advantages in the information, finance and other technology-intensive industries of Yangtze River Delta. Since the activities of environmental policy could substitute capital in the technology- intensive industry with relatively lower pollution, it results in the insignificant effect on export in the Yangtze River Delta. Compared to the Yangtze River Delta, the Pearl River Delta has a relatively specialized industrial structure, Clothing, toys, electronics and light industries such as processing trade industry are main industries of this area; its ability for scientific and technological innovation is not strong and output is also reliant on foreign markets; Furthermore, environmental regulation increases the burden of SMEs in the Pearl River Delta and also hampers exports to some degree. As a result, environmental regulations in terms of foreign market downturn could heighten the burden of SMEs in the Pearl River Delta and thus have a negative impact on the trade competitiveness.

Thirdly, R and D investments tend to encourage technological innovation and upgrade, but as a matter of fact, there is an ongoing accumulative process from the increased R and D to the effective exports, the duration is often associated with the digestion and absorption capacity of firms and correlated with the local labor quality. For the Yangtze River Delta has more high-tech experts and high quality labors than other areas so the R and D investment in the Yangtze River Delta has a most significantly positive effect on export.

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