Environmental regulation, ownership type and green trade

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ABSTRACT

The paper considers the diversification of ownership types in Chinese export sectors, and examines the impacts of pollution regulations on state-owned sector, private sector and foreign owned sector with panel data of 37 industries, thus verifies the promotion of environmental regulations on green trade in the light of factor intensity in different ownership sectors. With regard to the endogeneity of the environmental regulation variable, the paper adopts system GMM to estimate the model for robust results. It turns out that due to the comparative advantage of labor resource in Chinese export, the pollution regulations have significant negative effects on the export in all ownership sectors. However, since both the state-owned sector and the foreign owned sector have the high technology-intensity and capital-intensity, so the pollution emission is low and the regulatory effect is trivial accordingly. On the contrary, for the highly labor-intensive and low technology-intensive patterns exist in the private export sector, so the constraint of regulations is stringent, which will be conducive to the development of green trade.

Key words: environmental regulation, ownership, green trade, GMM estimation

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INTRODUCTION

After China's accession to WTO, Chinese manufacturing industry has been gradually integrated into the global value chain system with the promotion of openness and technological progress, and Chinese export has become the important engine of economic development. However, industrial pollution, as a by-product of trade development, has become more and more serious, and impaired the ecological environment and sustainable economic development. In 2005, "environmentally sustainable index" (ESI) was officially released in Davos, Switzerland, it has been used to evaluate environmental quality of countries around the world, with Finland ranked 1st place of 144 countries and territories worldwide and China 133rd. For the environmental problem undermines the economic sustainable development, Chinese State Council department, local people's congresses and local people's governments have been promulgated more than 660 environmental regulations and local environmental protection laws. Governments have aimed at the environmental protection effectively for a long run by setting a stringent emission standard, so as to promote the green product in capital-intensive sector and technology-intensive sectors.

On the other hand, after reform and opening up policy, China's export sectors have maintained a diversified ownership composition, including state-owned sector, private sector and foreign owned sector. From 2004 to 2010, the average ratio of total asset is 915,000 yuan per employee in state-owned sector, 429,000 yuan in FDI sector and 260,000 yuan in private sector. At the same time, the ratio of R&D intensity is 23.0 yuan for every ten thousand yuan in state-owned sector, 93.9 yuan in FDI sector, and 46.7 yuan in private sector. As it shows, the state -owned sector and the foreign-owned sector belong to capital–intensive and technology- intensive types while the private sector is a labor-intensive and low-technology sector. Therefore, in terms of positive environmental policy, is there a consistent strategy effect of regulation on the export of different ownership type? And can these regulations promote the green trade with different ownership structures? Answers to these problems will be the purpose of this paper.

The literature based on porter hypothesis has become mature in recent years, but the research extension in terms of ownership classification has become an emerging academic field. Porter[1], Porter and Linde [2] shown that the stringent environmental regulations would encourage firms to improve production efficiency and quality by stimulating technology and management innovation, thus to capture both environmental and economic benefits. In the framework of institutional types, Earnhart and Lizal [3]supported that there are significant direct and indirect impacts of ownership structure on the environmental performance of firms and state-owned sector adopts more stringent emission standards than private sector. Lee [4]also obtained the similar conclusion that the public sector had stronger social responsibilities under the greater external monitoring pressure, and tended to abate pollution emission for achieving higher environmental standard. By using the GMM estimation, Lou Xianxiang and Xu Jing[5]selected the provincial panel data from 2003 to 2009 in China, and considered the relationship between the regional industrial pollution and the corporate performance of state-owned firms, private firms, and foreign firms in Hong Kong, Macao and Taiwan. It turns out that the development of these three kinds of firms will result in environmental deterioration. From the model, we can find that levying an environmental tax on pollution emission could improve the environment, but the expenditure in pollution abatement could not trun out the corresponding environmental benefits.

Different from the above researches, the paper considers the diversification of ownership in Chinese export sectors, and examines the impacts of pollution regulations on state-owned sector, private sector and foreign owned sector with panel data of 37 industries, and verifies the promotion of environmental regulations on green trade in the light of factor intensity in different export sectors. With regard to the endogeneity of the environmental regulation variable, the paper adopts system GMM to estimate the model for robust results. The result shows that due to the comparative advantage of labor in export, the pollution regulations have significant negative effects on the export in all ownership sectors. However, since both the state-owned sector and the foreign owned sector have the high technology-intensity and capital-intensity, so the pollution emission is low and the regulatory effect is trivial accordingly. However, as an sector featured by high labor-intensity and low technology-intensity,the constraint of regulations on the private export sector is strong.

The structure of the paper is as follows, the models and data sources are described in the second part of this paper , with the emphasis on the selection and classification of 37 industry panel data and the rationality of system GMM estimation. In the third part of the paper, the economic interpretation on the impact of environmental rules on trade pattern in terms of ownership structure will be presented.   Conclusion is given in the fourth part of the paper.

THE MODEL SPECIFICATION
According to previous researches, we choose total export value as explained variables, and industry environmental regulation as explanatory variables .The paper designs a comprehensive index (ERS) to measure the intensity of environmental regulation, which is calculated from the emission degree of waste gas, solid pollution and waste water.

Owing to many factors impacting on the trade, we choose the following control variables: research and development investment, cost margin, foreign investment, capital accumulation, and industry scale.

Research and development investment(R&D): the more investment in R&D, the greater capacity the industries could have to upgrade its existing technologies, so as to effectively improve pollutant abatement rate and compliance rate. The paper uses the industry R&D expenditure as the control variables.

Cost margin (CP): choose cost margin in the light of the three ownership types to measure the cost of industry additional value in the export.

Foreign investment (FDI): use total foreign owned capital to measure the foreign investment scale, unit (ten thousand US dollars).The total capital sourced from foreign countries, Hong Kong, Macao and Taiwan.

Capital accumulation (KL): we select the ratio of total assets and the total number of employees in the industry (one hundred million yuan/ten thousand persons) to measure KL. Capital accumulation can reflect whether industry belongs to capital-intensive industry or labor-intensive one.

Industry scale (SI): we choose the gross industrial output value in the industry to measure the variable. According to the principle of economies of scale, if the scale of the industry extends, the production cost inclines to decrease and export competitiveness could be enhanced.

For a better clarification of the results, the variables take the logarithm except for cost margin, thus the following

forms of dynamic panel models is established as follows:

$$LOG\,EX_{ijt} = \beta_0 + \beta_1 LOGR\&D_{it} + \beta_2 LOGERS_{ijt} + \beta_3 LOGCP_{ijt} + \beta_4 LOGKL_{ijt} + \beta_5 LOGSI_{ijt} + \beta_6 LOGFDI_{ijt} + \xi_{ijt}$$

Considering the lagged period of ERS and interaction terms, the model is given as follows:

$$LOGEX_{ijt} = \beta_0 + \beta_1 LOGR\&D_{it} + \beta_2 LOGERS_{jt} + \beta_3 LOGCP_{ijt} + \beta_4 LOGKL_{ijt} + \beta_5 LOGSI_{ijt} + \beta_6 LOGFDI_{ijt} + \beta_7 LOGERS_{jt-1} + \beta_8 LOG(CP_{ijt}*SI_{ijt}) + \beta_9 LOG(CP_{ijt}*KL_{ijt}) + \xi_{ijt}$$

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.

Taking different ownership types into account, we choose the state-owned sector (2001-2010), the foreign investment sector (include Hong Kong and Taiwan investment firms, 2001-2010) and the private sector (2004-2010). In the model , the data of export, cost margin (CP), foreign direct investment (FDI), value of gross production output, number of employees are all from china industry economic Statistical Yearbook (2002-2004 and 2006- 2011) and Chinese Economic Census Yearbook of 2004.

As data of R&D and environmental regulation (ERS) cannot be found based on ownership types, so we use the industry-level data instead. R&D data are acquired from the China Statistical Yearbook. those of environmental regulation (ERS) are calculated from China Statistical Yearbook.

RESULTS AND DISCUSSION

Recently, the issue of endogenous variables is highlighted by econometricians, endogenous problem could result in the severe non-consistency and bias in coefficient estimation. In the paper, there could be endogeneity problems between export, regulation expenditure, R & D expenditure and cost margin. To overcome these problems, GMM estimation method has been chosen in terms of dynamic panel. Currently, in the dynamic panel data model estimation, there are two main ways: differential GMM and system GMM. For 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 paper. In order to verify the validity of instrumental variables, Sargan test is utilized based on Arellano & Bover and Blundell & Bond's recommendations.

Table.1 The Regressive Results of Private Enterprise with GMM Estimation

Explanatory Variables	Model（1）	Model（2）	Model（3）	Model（4）
logr_d	-0.196 (-0.84)	-0.043 (-0.26)	0.011 (-0.06)	-0.058 (-0.41)
logers	-0.334*** (-3.77)	-0.144** (-2.03)	-0.291*** (-3.77)	-0.260*** (-3.58)
cp	-2.174*** (-2.89)	-1.676*** (-2.89)	-1.423*** (-2.85)	0.68 (-0.32)
logkl	-0.885** (-2.57)	-1.281*** (-4.96)	-2.862*** (-3.32)	0.058 (-0.05)
logsi	1.220*** (-7.28)	1.051*** (-7.65)	0.128 (-0.26)	1.057*** (-8.29)
logfdi	0.217** (-2.14)	0.294* (-1.91)	0.292** (-2.27)	0.289** (-2.55)
L.logers		-0.071 (-0.82)		
logklsi			0.250* (-1.77)	
logcpkl				-0.666 (-1.06)
_cons	5.017* (-1.85)	4.473* (-1.89)	9.411** (-2.04)	0.004 (0)
N	231	200	231	231
sargan	301.946	304.337	333.352	334.588
sar_df	71	70	72	72
N_g	35	35	35	35

Notes: model 1 is the original model; model 2 is formed by adding the first-order lag of environmental regulation into the model 1; model 3 is formed by adding the interaction term of capital accumulation and industrial scale into the model 1; model 4 is formed by adding the interaction term of capital accumulation and cost margin into the model 1. *, **, and *** indicate significance level of 10%, 5%, and 1%, respectively; numbers in parentheses are t statistics. The results of Sargan in model 1-4 are large enough, indicating that the GMM models have not over identification. The estimated coefficients in model 1-4 have the same signs correspondingly, indicating that the models are robust.

The regression results of private sector are presented in table 1. The estimated coefficients of environmental regulation are both negative and statistically significant in four models, and the first-order lag coefficient of environmental regulation in model 2 is also negative but not significant, indicating that environmental regulation can impair the competitiveness of export. This is mainly because the private firms are outstanding for its labor-intensity and low-technology, and environmental regulation on private enterprises increases their costs. At the same time, more pollution results in higher penalty cost and the increased total cost leads to a decline in export. Therefore, the research conclusion on private enterprises is in accordance with the classical economic hypothesis.

The positive effect of environmental regulation is that the regulation can gradually reduce the quantity of low-tech and high-pollution products, and thus promotes the green products which will meet the international standards to capture a larger market share from an objective perspective.

For the effects of other control variables, it can be seen that in model 1-3, the estimated coefficients of cost margin are all negative and statistically significant. The main reason is that Chinese private enterprises can only adopt the low-profit competition strategy because they are in the low part of the value chain curve. The estimated coefficients of industrial scale in model are all positive. And the coefficients are all significant except in the model 3. This is because of the effect of increasing returns to scale: the bigger the industrial scale is, the more obvious the scale effect will be. The reason why the coefficients of FDI in the four models are significant and positive is that the technology spillover of FDI improves the export competitiveness of private enterprises.

On the other hand, it turns out that there are significant interactions between the control variables. The coefficients of the capital accumulation are negative and statistically significant in model 1-3, and the interaction coefficient of capital accumulation and the industrial scale is positive and significant in model 3, indicating that when the industrial scale extends, high capital-intensity is beneficial to export.

The reason is that the advantage of the private enterprise in China is based on the relatively cheap labor costs, and labor-intensive industries strong competitive in export. However, the effect of increasing returns to scale will also be intensified accordingly with the expansion of industry, because the higher the capital intensity turn, the more competitive edge private enterprises will have.

Table.2The Regressive Results of Foreign Owned Enterprise with GMM Estimation

Explanatory Variables	Model （1）	Model （2）	Model （3）	Model （4）
logr_d	-0.137 (-1.06)	-0.17 (-1.28)	-0.159 (-1.34)	-0.063 (-0.62)
logers	-0.165*** (-2.66)	-0.088** (-1.99)	-0.191*** (-2.85)	-0.064 (-1.26)
cp	0.07 （-0.21）	0.236 （-0.82）	0.197 （-0.73）	-2.112*** (-4.21)
logkl	-0.627** (-2.15)	-0.682** (-2.54)	-1.478 (-1.57)	-1.795*** (-4.64)
logsi	1.157*** （-7.57）	1.219*** （-6.87）	0.636 （-1.15）	1.099*** (-6.31)
logfdi	0.285** (-2.03)	0.281* (-1.82)	0.338** （-2.1）	0.317* （-1.75）
L.logers		-0.089* (-1.81)		
ogklsi			0.123 （-1.09）	
logcpkl				0.482*** （-4.5）
_cons	-0.234 (-0.18)	-0.392 (-0.33)	3.13 （-0.93）	3.891*** (-3.26)
N	351	315	351	351
sargan	1096.549	1008.637	1048.297	754.616
sar_df	149	148	150	150
N_g	37	37	37	37

Note: The model specification is similar to the note of table1

The regression results of foreign sectors are given in table 2, environmental regulation has negative impacts on export from the model 1 to model 3, and the first-order lag coefficient of environmental regulation is significantly negative in model 2, indicating that for the foreign-owned firms, environmental regulations weaken their export competitiveness. But it is also found that the effect of environmental regulation on foreign-owned firms is lower

than that on private firms, which means that environmental regulation has a weaker negative effect on market share of foreign-owned firms than on private firms. As for China, foreign owned enterprises can in fact optimize its export structure and promote green trade, since most of these firms belong to high-technology and labor-intensive types so that environmental regulation can result in a capital flow from the low-technology and high-pollution export sectors into the foreign export sectors.In addition, it is shown that there were significant interaction terms in the models. The estimated coefficients of cost margin are positive but insignificant in most of the models, manifesting that overseas-owned firm has greater profit space than other types of firms. But in model 4, the interaction coefficient between cost margin and capital accumulation is positive and statistically significant. It can be explained that capital accumulation provides the fund guarantee for cost margin, and the increased cost margin further promotes capital expansion, and both factors could be positive to the export trade.

Table.3The Regressive Results of State Owned Firm with GMM Estimation

Explanatory Variables	Model （1）	Model （2）	Model （3）	Model （4）
logr_d	0.444***	0.451***	0.440***	0.445***
	（-4.7）	（-4.43）	（-4.3）	（-4.78）
logers	-0.105*	-0.072*	-0.125*	-0.117*
	(-1.64)	(-1.73)	(-1.73)	(-1.79)
cp	-0.161	-0.285***	-0.253***	-0.072
	(-1.34)	(-3.06)	(-2.88)	(-0.16)
logkl	-0.399***	-0.350**	-1.055	-0.258
	(-2.67)	(-2.08)	(-1.61)	(-1.15)
logsi	0.477***	0.502***	0.121	0.512***
	（-4.7）	（-5.1）	（-0.35）	（-4.58）
logfdi	0.117	0.097	0.095	0.076
	（-1.45）	（-1.17）	（-1.15）	（-0.87）
L.logers		-0.055		
		(-1.12)		
ogklsi			0.099	
			（-1.18）	
logcpkl				-0.051
				(-0.39)
_cons	-3.083***	-3.225***	-0.517	-3.563***
	(-2.95)	(-2.66)	(-0.21)	(-2.93)
N	329	297	329	329
sargan	757.258	748.599	758.403	745.209
sar_df	149	148	150	150
N_g	37	37	37	37

Note: The model specification is similar to the note of tabl

The regressive results of state-owned export sector are given in Table 3. It is shown that the environmental regulation on state-owned firms has a significant negative impact on the export in both current and first-order lag period, but the coefficient of the effect is the minimum, compared with private sector and foreign-owned sector.

We can infer that ownership play an important role in environmental regulation, owing to the technical and capital-intensive advantages of state-owned sector, as opposed to private sector and foreign-owned sector, so its pollution control capacity is relatively more stringent. Meanwhile, as a public sector, the state-owned sector received more attention and supervision, so the endogenous constraint for motivation to pollute is strong, and the marginal contributions of exogenous regulation for it are relatively small, which is similar to foreign sector, since the negative impact of environmental regulation on capital-intensive and technology-intensive sectors is trivial, so the developments of these sectors essentially promote green trade.

For another, there is a significant positive correlation between the R&D and export, indicating that R&D improves the export competitiveness of state-owned firms even if it has negative and insignificant effect on the foreign-owned sector and private sector. Such results may be related to the fact that state-owned firms can receive more government subsidies for research and development. Thus its R&D expenditure would be compensated in a short run. The coefficient of cost margin is negative in four models and is significant in model 2 and 3, indicating that it could weaken the export competitiveness of state-owned firms. The economic intuition behind is that the product of state-owned firms in the lower part of the value chain curve, lack of pricing power could only generate low profit margins. The coefficient of industrial scale is positive in four models, and is significant (1% level) in model1, model2 and model 4. Industry scale is more conducive to the export due to the impact of increasing returns to scale effects. The coefficients of FDI are small and insignificant in four models; the major cause is that the state-owned enterprises are based on the national capital, the paid-up capital of FDI is small and not enough to produce significant technology spillovers.

CONCLUSION

Under the theoretical framework of institutional classification, the paper examines the strategic effect of environmental regulation on three kinds of ownership structures: state-owned sector, private sector and foreign owned sector. Given that the increased export volume of the mainland China and the increasingly strigent trade protection in international trade, green barrier has gradually become the main tool for developed countries to compete with developing countries. Therefore, the research conclusion of the paper has strong practical significance. First of all, environmental regulation has an overall curbing effect on the export sector of different ownership types. Specifically, environmental policy decreases the market share in the international market from the perspective of strategic reaction, although it intends to diminish the pollution in the processes of production, circulation and consumption through cutting down the trade volume. At the same time, the overall advantage of Chinese resources endowment in export trade still lies in the labor-intensive sectors, which have high energy consumption but low additional production value. Therefore, the stringent environmental regulation on these sectors will impair their comparative advantage, but phase out high-pollution products at the same time, thus achieve the environmental standard monitoring by developed countries. It objectively promotes the technology innovation of firms and facilitates green trade.

what's more, according to the structure of institutional classification, environmental regulation has a stronger controlling effect for export on private sectors than state-owned and foreign-owned sectors. The economic logic behind this phenomenon is that the latter ones belong to the capital-intensive and labor-intensive sectors with a higher additional export value, so these sectors have stronger abilities to minify the pollution and have a higher standard of product quality in line with the international norms, and thus their product are less vulnerable to the environmental regulation. Instead, the majority of private export sectors are susceptible to environmental regulation because most companies in the sector are labor-intensive type with low-tech type, which means they could generate a relatively high proportion of pollution. Specially, it would indicate that the Chinese private sector must improve the environmental– friendly quality of their product to gradually reach standards on the high-tech and high-quality products in export, which would be also conducive to the development of green trade.

Furthermore, for the three ownership types, the first-order variable of environmental regulation has a negative effect on the current export volume, and its effect is slightly smaller than the impact of current variable of environmental regulation.

Finally, in the analysis of control variables, both FDI and industrial scale can increase the competitiveness of export in three types of enterprises, indicating the effects of technology spillover and increasing returns to scale, respectively. Moreover, cost margin and capital accumulation are negatively correlated with export competitiveness, which means current foreign trade of our country is still in the low part of the value chain and relies on cheap labor resource. The R&D investments have a positive correlation with the export volume in the state-owned sector, but show a negative correlation with it in the other two sector types, reflecting that state-owned enterprises in China enjoy more subsidies and financial supports. In addition, the interaction term between cost margin and capital accumulation in foreign capital sector is significantly and positively related, indicating that the foreign-invested enterprises are in the upper part of value chain, and there is a mutual promotional relationship between the high capital-intensive products and high added-value products.

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