Study on the Influence of Marine Environment Control on Industrial Structure Adjustment of Manufacturing Industry in Hainan Province

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Abstract. In the background of Hainan Province, this paper analyzes the dual impacts of ocean environmental control on manufacturing industrial structure upgrading and pollution Industry shift. Our studies shows that there exists a positive "U" relationship between marine environmental remediation and pollution industry migrate, industrial structure promotion. According to these two break points, the impact of ocean environmental protection on Hainan’s industrial structure regulation can be classified into the following periods: double inhibition of shift and promotion, priority of transfer and twofold promotion of shift and upgrading. Hainan is in the stage of double inhibition. Besides, in the impact of ocean environmental control on manufacturing structure upgrading, technological innovation has intermediary effects in command control, economic incentives, chemical oxygen demand and so on. Yer, this influence does not show significance in the case of cyanide regulations and ammonia nitrogen.

1. Introduction
Dating back to 1980s, China together with other countries try to maintain the stability of the ocean environment from a legislative perspective. Despite legislated environmental guidelines, about 97% of the global 66 large Marine ecosystems have suffered ocean warming in several tens of years, according to a survey by UNESCO’s Intergovernmental Oceanographic Commission in July 2016. Resource utilization and pollution emission are closely related to industrial structure. Based on the degradation of ecosystem, the promotion of industrial structure will be conducive to maintain economy--environment configurations. Marine environmental governance can not only achieve the goal of optimizing environmental quality based on governance effects, the production behavior of the enterprise has also changed based on channels that increase enterprise costs, so as to achieve the innovation of compensating the adjustment of industrial structure. Therefore, environmental protection as an endogenous influencing factor for industrial structure adjustment has significant value in theory and practice, and analyze the positive role of ocean environmental governance in industrial structure adjustment, eventually we can promoting the coordinated progress of environment and economy

How can we excavate the mechanism of environmental governance to industrial structure? One channel is the space substitution effect induced through the enterprise space transfer to evade pollution cost-driven environmental regulation. Another way is to keep the polluting enterprises constant, but rather adjust the input structure of the factors of production, that is, the compensation for IN. In the aspect of industrial structure shift, we can discuss it from the following two levels: Provincial
industrial structure promotion and shift. Does the process of environmental governance take industrial shift or industrial structure upgrade as the primary task?

2. Marine Policy in Hainan Province

As an island province in China, Hainan Province is surrounded by the South China Sea and shares the Beibu Gulf Economic Area with the Guangxi. Beginning with the promulgation of the MEPL in 1982, the governance policy history of China’s marine environmental protection law can be divided into three stages: 1982-1995 is the initial stage, 1996-2005 is the implementation stage, and 2006 is the in-depth stage.

At the initial stage, a governance policy and corresponding administrative regulations, regulations and policy documents were developed under the Marine Environment Protection Act. There is a clear tendency to adopt administrative orders and containment measures including fines and emission restrictions to prevent pollution.

During 1996-2005, in order to maintain the marine environment, the government has promoted relevant policies, such as "China Ocean Agenda 21" and "Bohai Blue Ocean Activity Plan (2001-2015)". The compensation system of marine ecological environment damage is discussed. The government will collect sewage charges and other economic incentives as governance measures.

During the current policy formulation phase, the government further builds plans such as the outline of the national marine development plan. Comprehensive management policies are being developed, comprehensive use of command and control, economic incentives, public participation and other policy tools.

3. Empirical Design

3.1. Variables

3.1.1. Industrial structural upgrade: Using Haggett methods to define the upgrading speed of the industrial structure. Industrial structure upgrading = (the proportion of upscale technology industry production to the gross manufacturing production of the current year - the proportion of upscale technology industry production to the gross manufacturing production during the previous year - the proportion of high-end technology industry output value to the total manufacturing output value of the previous year)/ the proportion of high-end technology industry output value to the total manufacturing output value of the previous year.

3.1.2. Industrial transfer: The relative pollution rate of industrial transfer is calculated by location entropy method.

3.1.3. Regulations for the command and control of the marine environment (ERSC): Industrial waste water discharge, petroleum transportation, heavy metals and other substances are the culprit causing serious pollution of coastal waters. The main pollutants in the polluted sea area of our country are COD, ammonia nitrogen and petroleum. Hence, according to the pollution intensity of some pollutants in the adjacent sea of our country and the available data, the reciprocal discharge of COD, Ammonia nitrogen and cyanide is adopted. we measure and analysis ocean environmental regulation intensity on the basis of the reciprocal of COD, ammonia nitrogen and cyanide pollution emissions, respectively: Chemical oxygen demand ocean environmental governance (ERSC1); ammonia nitrogen ocean environmental governance (ERSC2); Cyanide ocean environmental governance (ERSC3). On this foundation, the index construction method of reference Fu jing yan et al. A comprehensive index (ERSC) of marine environmental regulatory intensity was constructed by entropy method using the reciprocal of COD, ammonia nitrogen and cyanide emissions.
3.1.4. Marine Environmental Regulation of Economic Incentives (ERSE): Sea area use fee is a kind of sea area use fee, namely, the central government grants the right to use sea areas to requisition sea areas use fee from the institution and individuals using the seas. This fee is a user fee, which can be summarized as an economic incentive measure for the governance of the marine environment. We introduce unit sea fee = sea fee/area of recognized rights to define economic incentives for the intensity of marine environmental regulation.

3.1.5. Technological Innovation (RD): The interior research and development expenditure of industrial enterprises above the designated size in Hainan province is selected to measure technological innovation input, and the number of valid invention patents of the above industrial enterprises the designated size in Hainan Province is selected to measure technological innovation output. Secondly, combining the input and output of technological innovation, the entropy method is used to evaluate the technological innovation level of Hainan Province.

3.1.6. Controlling variable: Foreign direct investment (FDI) in Hainan Province, gross export-import volume of Hainan Province, and the ratio of MGDP in Hainan Province.

3.2. Model Research

Research related to this article shows that there exists a threshold for companies. This critical value measures how companies choose to transfer, reduce pollution, and increase their investment in technological innovation when environmental regulation continues to face difficulties. After reaching the threshold, enterprises will tend to transfer out and give more weight to technological innovation. Technological innovation is the core structural factor for industrial restructuring. Technological innovation has replaced the traditional high-energy consumption and low-efficiency production methods, increased production efficiency, and promoted a new round of industrial structure upgrade. Furthermore, the researchers found that U-shape is reflected between environmental regulation and industrial structure adjustment. Therefore, this article takes Hainan Province as the research object, introduces the square term of the marine environmental control variable, and investigates whether there is a non-linear relationship between marine environmental control and industrial transfer and industrial structure upgrade. In addition, the influencing factors of other industrial structure adjustments are introduced as control variables to confirm the dual role of marine environmental regulation on industrial transfer and upgrading. In addition, industrial structure adjustment is a gradual process, so we considered the lag of the dependent variable.

Therefore, this paper constructs the following model about the impact of ocean environmental regulation on the shift of pollution industries:

\[
\text{transfer}_i = \alpha_0 + \beta_1\text{transfer}_{i-1} + \beta_2\text{ERS}_i + \beta_3\text{ERS}^2_i + \beta_4\text{FDI}_i + \beta_5\text{TR}_i + \beta_6\text{MGDP}_i + \epsilon_i
\]  

(1)

Technological progress is the core variables concerning industrial structure adjustment. Technological innovation is conducive to the transformation of underdeveloped industries to advanced industries and the upgrading of industrial structure. Therefore, technological innovation is a prerequisite for environmental regulation to promote the upgrading of industrial structure. If enterprises can not be effectively encouraged to achieve such innovation, it is far from sufficient to strengthen environmental supervision as a tool for upgrading industrial structure. The influence of marine environmental regulation on industrial structure promotion will studied by the following model:

\[
\text{upgrade}_i = \alpha_0 + \beta_1\text{upgrade}_{i-1} + \beta_2\text{ERS}_i + \beta_3\text{ERS}^2_i + \beta_4\text{FDI}_i + \beta_5\text{TR}_i + \beta_6\text{MGDP}_i + \epsilon_i
\]  

(2)

ERS represent marine environmental regulations, including command and control marine environmental regulations (ERSC), COD marine environmental regulations (ERSC1), ammonia nitrogen marine environmental regulations (ERSC2), cyanide marine environmental regulations (ERSC3) and economic incentives marine environmental regulations (ERSE).
3.3. Empirical Results

According to the previous model and variables to carry out empirical research, the following results are obtained.

Table 1. Empirical findings

|          | Transfer | Upgrade |
|----------|----------|---------|
| ESRC     | -0.046** | -0.489**|
|          | (2.15)   | (2.48)  |
| ESRC\(^2\) | 0.910*** | 0.359** |
|          | (2.63)   | (2.29)  |
| ESRE     | -0.432***| -0.568***|
|          | (2.60)   | (-2.71) |
| ERSE\(^2\) | 0.543*** | 0.231***|
|          | (-3.51)  | (3.08)  |
| RD       | -0.001*  | 0.054***|
|          | (-1.97)  | (4.29)  |
| FDI      | 0.004*   | 0.345*  |
|          | (1.88)   | (4.29)  |
| TR       | 0.455*** | 0.231   |
|          | (6.24)   | (2.70)  |
| MGDP     | 0.453**  | -0.074  |
|          | (2.41)   | (1.94)  |
| Intercept| 0.017*** | 0.001   |
|          | (3.49)   | (0.04)  |

We will analyse the test result expressed in table 1. For table 1(1) and (2), the square term coefficients of the two types of marine environmental regulations show a significantly positive test characteristic, indicating that there is a positive U-shaped relationship between the two types of marine environmental regulations and the transfer of polluting industries, as the degree of marine environmental supervision exceeds the threshold, it can have a positive effect on the shift of polluting industries. Table 1(3) and (4) investigate the impact of two types of marine environmental regulations on the upgrading of industrial structure. The coefficients of the square terms of the two types of marine environmental regulations still show considerable significance and sign, and have a positive U curve relationship with structural upgrading. When the strength of the two marine environmental regulations exceeds the threshold, it will have a positive effect on the upgrading of the industrial structure. In addition, the RD coefficient is positive and highly significant, confirming that technological innovation plays an intermediary role in the impact of two marine environmental regulations on structural upgrading. As for Hainan Province, with the increasing supervision of the marine environment, the pressure of manufacturing industry transformation and upgrading is increasing, forcing enterprises to carry out green technological innovation, strengthen the feasibility of green innovation and essentially promote the upgrading of the province’s industrial structure. At the same time, Hainan Province with geographical advantages has attracted a large number of advanced technology, so that manufacturing enterprises learn green advanced production technology from foreign enterprises. In addition, under the background of increasing environmental regulation constraints in Hainan Province, the advantages of regional absorptive capacity are used to continuously improve innovation ability, realize manufacturing development and enhance core competitiveness.
4. Further Discussion
In order to get a more intuitive understanding of the impact of marine environmental regulations on the upgrading of industrial structure and the transfer of polluting industries, this article graphically fitted the above test results.

![Figure 1. Command and control impact](image1)
![Figure 2. The impact of economic incentives](image2)

We observe that there is a positive U curve relationship between marine environmental regulation and practically promote the shift of polluting industries and promotion of industrial structure. The curves of marine environmental regulation on pollution industry transfer are all located on the left side of the structural upgrading curve. Marine environmental supervision is strengthened, first to promote the transfer of pollution industries, and then to promote structural upgrading. Subsequently, each kind of regulation and control has two inflection points on the industrial structure adjustment, we use these two inflection points to divide this influence into three stages. To divide into two stages: transfer upgrade double inhibition I, transfer priority II, transfer upgrade double promotion III.

We screened the average intensity of various types of policy regulation in Hainan Province from 2010 to 2017. By comparing the average intensity with the two thresholds under each regulation method, the impact of different types of legal regulation on the adjustment of industrial structure in Hainan Province is divided into three scenarios. The results show that Hainan Province is in the first stage of marine environmental control. The economy of Hainan is still in the rising stage, and the degree of environmental pollution is relatively weak, which can be confirmed by lower regulations and weaker environmental protection. Therefore, the Hainan Provincial Government needs to effectively improve the level of supervision. Because the regional economic development is mainly realized through domestic and foreign pollution industries, the command and control of marine environmental laws and regulations and economic incentives should be strengthened. From the domestic situation in these three kinds of pollutants, it can be seen that the regulations should emphasize increasing the emission limit standard of chemical oxygen demand, at the same time, pay attention to the emission limit standard of chemical oxygen demand when introducing pollution industry, prevent the blind introduction of high pollution industry and reduce the negative impact on the environment. In addition, the government should help polluting enterprises to cross the inflection point as soon as possible from the perspective of capital subsidies and policy preferences. First, give financial subsidies and tax incentives to enterprises, and provide financial subsidies to enterprises in the short term; on the other hand, it is conducive to creating more relaxed financing channels for enterprises and introducing pollution industries outside emerging technology platforms to achieve regional economic development. Therefore, we should strengthen the command and control of marine environmental laws and regulations and economic incentives.

5. Conclusions
According to the panel data of Hainan Province from 2004 to 2017, the dual effects of different types of marine environmental regulations on the upgrading of the manufacturing structure and the transfer of polluting industries were compared and analyzed. There is a positive U-shaped relationship between
various types of marine environmental governance, pollution industry transfer and industrial structure upgrade. The inflection point value of the pollution industry transfer appears on the left side of the inflection point of the industrial structure upgrade. Based on these two inflection points, the impact of various marine environmental control laws and regulations can be divided into three phases: they can be divided into three phases: suppression of transfer upgrade, transfer priority, and double promotion of transfer upgrade. Hainan Province is in the stage of double suppression, considering that COD, ammonia nitrogen and cyanide are the main pollutants in the offshore area, according to the regulations command and control of marine environment management, according to the types of pollutants, chemical oxygen demand and marine environmental management are the easiest to reach the inflection point. In terms of the impact of marine environmental regulation on the upgrading of industrial structure, technological innovation plays an intermediary role in command and control, economic incentives, chemical oxygen demand, etc. Yet, this effect does not show significance in the case of the action of ammonia nitrogen and cyanide.

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