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Impact of Educational Expenditure on the Development of Regional Marine Economy: Evidence from Chinese Coastal Provinces

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Abstract

Marine economy is an important growth stage of Chinese economic development in the 21st century. The Chinese marine economy has become a technology and capital-intensive economy from extensive past development of economy. The human capital factor has become an indispensable and important driving force for the domestic marine economy. Different with the existing literature on human capital elements, which is focused on the study of the average level of education represented by the stock of human capital, this article uses the per capita education expenditure within the region to measure human capital increment, explain the coastal marine economic development momentum. At the same time, the author analyzes the correctness of this interpretation and analysis from the data of 11 coastal provinces and autonomous regions in China from 2006 to 2014. Based on this, some feasible policy suggestions would be put forward.

Keywords

Per Capita Marine Economic Output, Human Capital, Regional Financial Education Expenditure

1. Introduction and Review of Earlier Work

As we all know, with the growth of the domestic population and the continuous reduction of per capita land resources, the exploitation of marine resources and the development of the marine economy have become the major directions for the Chinese people on continuously utilizing resources and developing their social economy in the 21st century. Since the beginning of the 21st century, China has made remarkable achievements and considerable progress in the field of marine economy. According to Statistical Communique of the People's Republic of China National Economic and Social Development and Chinese Ocean Economic Statistics Communique from 2000 to 2016, in total terms, the total domestic marine economy has increased from 229.70 billion yuan in 2000 to 7050.70 billion yuan in 2016, whose ratio to the GDP rose from 2.60% to 9.48% at the same time, and the average annual compound growth rate was over 23% in the same period, higher than the growth rate of the GDP of the country. In terms of structure, the share of primary economy in Chinese marine economy has dropped from 43% in 2003 to only 5.1% in 2016. At the national level, the domestic marine economy has become an indispensable and important engine for the national economy, because it has developed rapidly and its influence has been continuously enhanced.

However, with using the variable coefficients of per capita marine economic output of coastal provinces, which is based on sea-related employment population, there were great differences in the development of marine economy in coastal regions because of significant differences on resource endowments and political and economic environment, though these have been shrinking in recent years. The study of Li Peijin and Luan Weixin (2005) [1] who used principal component analysis and clustering analysis to evaluate the level of marine economic development in 11 coastal provinces suggested that the levels of marine economic development in the Chinese coastal provinces have been somewhat differentiated, and according to their level of development in the marine economy, Chinese coastal provinces can be roughly divided into three sequences; the first series includes Guangdong, Shanghai, Zhejiang and Shandong that were always leading domestic marine economic development with excellent industrial structure and high value-added marine economy based on location and industry and economic and cultural environment and other related advantages; the second series includes Tianjin, Liaoning, Jiangsu and Fujian, who provided a steady stream of important impetus to Chinese marine economic development by their local characteristic marine economy whose industrial structure needs to upgrade based on slightly inferior to the first series of geographical advantages and natural resources; the third series includes Hebei, Guangxi and Hainan who are regarded as short boards that need to be supplemented by Chinese marine economic development because of underdeveloped marine economy with disadvantages of natural resources and location. According to the analysis of the vicissitudes of marine economy in coastal administrative regions in recent years and the analysis of the marine economic development of different coastal provincial administrative regions by Li Peijin and Luan Weixin (2005) [1], we can draw the following two conclusions. On one hand, because there are differences between the coastal provinces on marine resources and primitive accumulation of economic development, differentiation between these coastal provinces on the level of marine economic development is inevitable; on the other hand, although marine resources and investment are indeed an important driving force for the development of the marine economy, other factors are also affecting the marine economic development. Otherwise, it is impossible to explain both differences between the coastal provinces on the level of marine economic development and trend that coastal provinces consistently reached a level of marine economic development.

Then, besides the marine resources and capital investment, what would affect the development of the marine economy? According to the Human Capital Theory established by Romer (1986) [2] and Lucas (1999) [3], regional economic growth is affected by the input not only on material capital input but also on human capital. It's not hard to conclude that, as an important part of the economy in the coastal provinces, the development of the marine economy will also be affected by its human capital, including its marine resources and material capital. Schultz's (1961) [4] empirical study on the formation and impact of human capital also suggested that the human capital formed by investment in education contributed over 30% of the U.S. economic growth during the period from 1929 to 1957. Therefore, it could be further concluded that the level of coastal marine economic development, is likely to be affected by its investment in education.

Reviewing the recent Chinese studies on the development of education and marine economy, most Chinese scholars focused on how to build an oceanographic education system around the marine economy, such as Lin Niandong (2005) [5] and Huang Jiaqing (2011) [6] and Lin Judong (2014) [7], or concerned about the employment prospects and potential of maritime professional education in the process of marine economic development and transformation, such as Pan Aizhen and Miao Zhenqing (2009) [8] and Sun Ruijie and Li Shuangjian (2013) [9] and Chen Fenggui and Chen Weilian (2014) [10]. Only a few Chinese scholars noticed the impact of educational factors as an important source of human capital formation and accumulation on the development of marine economy. For example, the empirical results of Jia Ning (2011) [11] and Su Weihua *et al.* (2013) [12] and Yu Mengxuan and An Ping (2016) [13] suggested that the regional level of human capital, measured by the average length of education, has a significant impact on the development of regional marine economy. Therefore, between the education investment and regional marine economic development, there is indeed the potential and significance of further mining.

In summary, this paper argues that choosing average years of schooling as the proxy for the stock of human capital in the region would explains the large differences in marine economic development among the coastal provinces, but the proxy variables for regional human capital growth may be more persuasive in explaining the gradual reduction in the divergence in marine economic development among the coastal provinces after 2005. Considering the current system of compulsory education in our country and the vast majority of government funding for education come from the government, this paper intends to use the regional per capita education expenditure as a measure of regional human capital increment variables to explain and analyze the motive force of marine economic development in the coastal provinces; with taking the data of 11 Chinese coastal provinces from 2006 to 2014 as a sample, we test the correctness of the above explanations and analyzes..

2. Theoretical Analysis and Empirical Assumptions

As Li Yin (2005) [14] points out, Chinese marine economic development relied on the extensive demand of the world economy and extensive consumption of coastal natural resources. In view of the problems of inefficient use of resources and the near-limit of coastal environmental carrying capacity, the growth and development of Chinese marine economy would be unsustainable in the long run. However, from 2006 to 2014, the Chinese total marine economy has increased from 2.10 trillion yuan to 5.99 trillion yuan, with an average annual compound growth rate of over 14%. The growth rate of marine economy remained at a relatively high level, there is no phenomenon of stagflation or even regression of the marine economy due to the restriction of the coastal natural resources and environmental carrying capacity. At the same time, the per capita marine economy output based on the sea-related employment population has also risen from 70,800 yuan in 2006 to 168,800 yuan in 2014, representing an average annual compound growth rate of more than 11%. The simultaneous growth of both the total marine economy and per capita labor output has suggested that the accumulation and investment in human capital is likely to be one of the driving forces behind the growth of Chinese marine economy since 2005. The accumulation and investment of marine economy in human capital mainly relies on education investment. There are several reasons.

The main reason is that since the 21st century, the technological advance on which Chinese marine economy depends is more likely to be the diffusion rather than the innovation of existing marine technologies. As Tang Na (2011) [15] emphasized, in the long run, the scientific and sustained growth of the marine economy could not be separated from the advancement of marine science and technology, and advances in science and technology have not been neglected and replaced in almost all the macroeconomic growth models. However, for a certain period, especially for developing countries with weak foundation in marine science and technology, it's difficult for marine science and technology to achieve a breakthrough progress, and then the improvement of labor productivity in the maritime industry is the result of the proliferation of existing marine technologies, which is equal to the popularization of the application of marine technology in the labor force in the marine economy related industries. The basis for the continuation of the diffusion of marine technology is the system of labor training and upgrading which is built and enriched by continuous investment in education. In other word, without corresponding degree of education, no matter how advanced the ocean technology which they introduce and create is, the scope of applications would become very small because of unscientific knowledge systems and weak learning abilities of marine labor. Chinese compulsory education system which maintained a high degree of emphasis on the coverage of education provides the highest quality mass base for the widespread diffusion and application of technology.

The secondary reason is the importance of ocean education investment in training of marine science and technology talents. As we all know, one of the core of marine scientific and technological progress is the cultivation and development of marine science and technology talents. As a big marine power and a big economic power, the construction of Chinese marine scientific and technological personnel should not depend wholly or largely on the introduction of foreign marine scientists and technicians in terms of economic independence. In terms of economy, the training of overseas marine scientists and technicians could not also meet the demand of Chinese marine economy. Therefore, the cultivation of marine science and technology personnel in China depends mainly on the strong commitment of coastal provinces. In the long run, investment in education is also an indispensable and important thrust of technological progress in the marine industry.

Based on the above analysis, it is not difficult to conclude that the continuous investment in education is the important foundation and key link in promoting coastal economic development in coastal provinces. Vigorous investment in marine education has promoted the improvement of the quality of workers in the marine industry and the improvement of training system of marine science and technology personnel. And then, the improvement of the quality of labor will promote the improvement of the labor productivity of the marine industry through expanding the application of marine science and technology in the marine industry; the cultivation of marine science and technology talents will provide vast space for development of Chinese marine economy through providing the talent base for the technological progress of Chinese marine industry. The excellent growth rate and vast space for development of Chinese marine economy will attract more investment in Chinese marine education in turn. Ultimately, it will form a virtuous cycle of continuous improvement in both marine education and marine education. On the contrary, if there is not sufficient investment in education, the popularization of science and technology and the cultivation of talents in the marine industry would not be completed. Lack of universal access to marine science and technology would result in low labor productivity in marine industries and the limited use of marine science and technology; inadequate personnel training would not form the core of Chinese marine technology and competitiveness. And then, the marine economy with backward technology and declining talent, would inevitably fail to complete the industrial upgrading and transformation, and could not attract investment from outside the government, resulting in further reduction of investment in education and decline of the marine economy. Therefore, it is self-evident that the vigorous investment in education plays an important role in maintaining the rapid growth of Chinese marine economy.

Based on the above conclusions of the theoretical analysis, we propose the following theoretical assumptions for empirical analysis and test: the higher the education expenditure of the local governments in the coastal provinces, the more the human capital of the regional marine industry will increase and the higher the level of marine economic output will be.

3. Empirical Test and Analysis

3.1. Establishment of Empirical Model

According to the theoretical analysis of part II, The object of our study is the impact of local education expenditure on regional marine economy. So, the explained variable in this paper is the regional marine economic output used to measure the development of marine economy, and the core explanatory variable is the regional education expenditure used to measure the input of education, and the key control variables include the regional fixed assets investment used to measure the input of material capital and the regional sea-related employment population used to measure the labor input. To separate the impact of demographic factors, except for the sea-related employment population, the variables used in this model are per capita variables calculated based on corresponding population. According to the Cobb-Douglas production function, we establish the following measurement model for empirical test.

$$\ln PerSeaGDP_{it} = \beta_1 \ln PerEdu_{it} + \beta_2 \ln PerAsInv_{it} + \beta_3 \ln Labor_{it} + \alpha_i + \varepsilon_{it}$$

In the model, $PerSeaGDP_{it}$ is the ratio of the regional total output of marine economy to that of the regional sea-related population in the for the year, which represents the per capita marine economic output of coastal provinces; $PerEdu_{it}$ is the ratio of regional education expenditures to the regional resident population for the year, which represents the annual per capita expenditure on education of local governments in the coastal provinces; $PerAsInv_{it}$ is the ratio of the amount of non-real estate development part of social fixed assets investment in the region to the regional resident population for the year, which represents the annual per capita investment in fixed assets of the coastal provinces; $Labor_{it}$ is annual maritime employment of coastal provinces; β_1 and β_2 and β_3 are the ordinal number of the independent variable and subscript i indicates the province (i = 1, 2, 3, ···, 11), subscript t represents the year (t = 2006, 2007, ···, 2014); α_i represents provincial characteristics which never change over time and could not be accurately observed, such as provincial policy factors for the marine economy; ε_{it} is stochastic disturbance. The 11 coastal provinces studied in the paper are Fujian, Guangdong, Zhejiang, Jiangsu, Shanghai, Tianjin, Hebei, Hainan, Shandong, Liaoning and Guangxi respectively.

3.2. Data Sources and Descriptive Statistics

The data of 11 coastal provinces from 2006 to 2014 mainly come from China

Ocean Statistical Yearbook and China Population and Employment Statistics Yearbook and China Statistical Yearbook and China Financial Statistics Yearbook. The main reason for choosing 2006 to 2014 as the empirical test data interval is that China Marine Statistical Yearbook disclosed the marine economic GDP of 11 coastal provinces and the corresponding sea-related employment population since 2007 and relevant data after 2014 have not been disclosed yet. Table 1 shows the descriptive statistics of the explained variable, explanatory variables and control variables. There are no extreme anomalies and the overall quality is good enough for further analysis.

3.3. Measurement Results of Model

According to the above, the data in this article is short panel data. With $\ln PerSeaGDP_{it}$ as the explained variable and $\ln PerEdu_{it}$ as the explanatory variable and $\ln PerAsInv_{it}$ and $\beta_4 LnlnLabor_{it}$ as key control variables, the empirical test uses stata13.0 to perform random effects and fixed effect regression analysis. Table 2 shows the measurement results of fixed effect model and random effect model.

3.4. Robustness Test

According to the Part 3.3, the regression results of the econometric model using the fixed-effects model and the random-effects model are basically the same, which suggests that the empirical test results of the econometric model is robust. At present, universities and colleges in China need to undertake quite a few scientific research tasks in addition to the corresponding higher education, and a considerable part of the scientific research funding is also used for the training of scientific researchers. Therefore, in a broader sense, the investment of human capital in Chinese society should include two parts: expenditure on education and expenditure on science and technology. Considering this situation, the

Table 1. Descriptive statistics of variables.

Variable	Implication	Mean	Std. Dev.	Min.	Max.
$\ln PerSeaGDP$	Logarithm of the output of regional per capita marine economy	11.5703	0.5987	10.2229	12.6001
$\ln PerEdu$	Logarithm of regional government expenditure on education per capita	6.9345	0.5761	5.6160	8.1339
$\ln PerAsInv$	Logarithm of regional investment in fixed assets	9.7129	0.5896	8.2624	10.9705
$LnLabor$	Logarithm of regional sea-related employment population	5.4845	0.6666	4.4006	6.7476

Source: China Ocean Yearbook and China Statistical Yearbook.

Table 2. The impact of regional per capita education expenditure on the per capita marine economic output.

Explanatory variable & control variables	FE	RE
$\ln PerEdu_{it}$	0.3227* (0.055)	0.4609*** (0.000)
$\ln PerAsInv_{it}$	0.1799*** (0.003)	0.1617** (0.017)
$LnlnLabor_{it}$	1.1406 (0.316)	0.0489 (0.751)
_cons	−1.3298 (0.806)	6.4363*** (0.000)
R-squared	0.8792	0.8775
F	44.32	623.23

Tips: the numbers in the parentheses in the table are the standard deviations of the estimated coefficients; *** and ** and * represent the significant at 1% and 5% and 10%, respectively.

robustness test of this paper is to increase per capita spending on science and technology in the original econometric model. The new measurement model after adding the science and technology spending per capita is as follows.

$$\ln PerSeaGDP_{it} = \beta_1 \ln PerEdu_{it} + \beta_2 \ln PerAsInv_{it} + \beta_3 LnlnLabor_{it} + \beta_4 \ln PerTel_{it} + \alpha_i + \varepsilon_{it}$$

Table 3 shows the descriptive statistics of proxy expenditure per capita for science and technology expenditures.

Table 4 shows the regression results of the stochastic effect model and the fixed effect model of the new econometric model.

According to the regression results of the econometric model considering the expenditure of science and technology, the result of this econometric model is generally robust.

3.5. Analysis of Empirical Test Result

Based on the above analysis and test, since the 21st century, the marine economic development in all the Chinese coastal provinces has relied more on the investment in fixed assets and the improvement of the quality of sea-related employment rather than on the growth of the labor force in the marine industry. Therefore, the increase of per capita education expenditure in the regional fiscal expenditure would promote the development of the regional marine economy through the improvement of the output level of per capita regional marine economy.

4. Conclusions and Suggestion

In summary, as an important source of human capital in the coastal areas, the higher the per capita level of education expenditure in local finance, the faster the growth of per capita human capital accumulation in the region, and the

Table 3. Descriptive statistics of per capita science and technology expenditure variables.

Variable	Implication	Mean	Std. Dev.	Min.	Max.
ln *PerTel*	Logarithm o per capita f regional science and technology expenditure	4.9311	0.9665	2.9239	7.0218

Source: China Statistical Yearbook.

Table 4. The impact of per capita educational expenditure on per capita marine economic output considering per capita expenditure on science and technology.

Explanatory variable & control variables	FE	RE
$\ln PerEdu_{it}$	0.3199* (0.098)	0.4169*** (0.000)
$\ln PerAsInv_{it}$	0.1797*** (0.004)	0.1635** (0.017)
$LnlnLabor_{it}$	1.1226 (0.373)	0.0489 (0.822)
$\ln PerTel_{it}$	0.0049 (0.976)	0.4329 (0.553)
_cons	−1.4255 (0.815)	6.6100*** (0.000)
R-squared	0.8792	0.8776
F	33.03	621.17

higher the quality of the sea-going labor force, and the greater the per capita output of marine economy. It suggested that increasing expenditures on education in the coastal provinces would effectively improve the productivity of the marine economy in the short term and also translate into the accumulation regional human capital in the long term. In other word, increasing government spending on education would be conducive to the sustainable development of marine economy and industrial upgrading during the entire economic development cycle.

Based on the conclusions of this study, the following suggestions are made.

The first is that educational expenditure in coastal provinces should not only focus on the innovation and popularization of marine science and technology in maritime-related majors in universities and colleges but should also provide more training courses and opportunities to practitioners in the marine industry. Of course, the improvement of the quality of newly-added labor force will significantly provide the average level of the total number of employed persons involved in the sea. However, the improvement of the quality of the existing labor force should not be overlooked. Providing training to serving marine industry practitioners not only helps to raise the overall quality and skill level of the entire sea-related labor force, but also serves as a guideline for the diversion of learning ability as an evaluation criterion during the period of industrial restructuring and upgrading.

The second is that education expenditures in coastal provinces should increase the investment in the integration of industry and education and research. Therefore, industrial practice and technological innovation will be better integrated in sea education. In addition, this approach will bring the following benefits. First, it can effectively reduce the time and cost of marine professional graduates from theory to practice; second, it can improve the practicability of marine scientific and technological innovation; third, it helps industrial practice to feed marine educational content.

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