ISSN 2616-5902 Vol. 5, Issue 1: 143-148, DOI: 10.25236/AJBM.2023.050121

Effect of Digital Economy on Marine Economic Development Level by Big Data Analysis

Shujuan Wu[1], Minmin Li[1,*], Jianhua Tang[1]

[1]*Wuyi University, Jiangmen, China*
[*]*Corresponding author*

Abstract: *Digital economy is a new factor to promote regional development. To explore the impact of the digital economy on the level of marine economic growth, we establish a panel threshold model with capital for marine as the threshold variable and marine economic growth level as the explained variable based on the neoclassical economic growth theory and the panel data of regions in China during 2006 to 2016. We performed a threshold regression analysis to understand the digital economy's influence on marine economic growth. The results show that the impact of the digital economy on marine economic growth has a double threshold effect. When the marine capital investment is low, the digital economy influences marine economic growth negatively. When the digital level reaches the medium level, the digital economy enhances the growth of the marine economy significantly. However, if the digital level reaches a high level, its role in promoting marine economic growth is weakened.*

Keywords: *digital economy, marine economy development level, panel threshold model, big data analysis*

1. Introduction

At present, the digital economy is a new engine to allocate resources and improve the level of economic development. According to the Digital China Development Report (2020) by the Cyberspace Administration of China, China's digital economy is ranked second in the world and has become one of the main leaders in the field of the digital economy. The integration and application of the new intelligent technology in various industries support economic development from the micro and macro aspects. At the micro-level, the digital economy forms an economy of scale and scope to improve the equilibrium level of the economy. At the macro level, it promotes economic growth by realizing new input elements, resource allocation efficiency, and efficiency [1]. By forming the development level of the marine economy, digital technology produces significant results from the construction of the seafood chain, aquaculture, marine environment monitoring, and other aspects. However, the wave of digital development also affects the development of the traditional marine competitive industries. For example, the industrial chain, supply chain and marketing mode of the traditional marine fishery have undergone profound changes, which requires high start-up costs to adapt to the changes brought about by the digital industry. Under the background that the 19th National Congress of the Communist Party of China further defined to strengthen the establishment of marine power, it is important to realize the great leap forward development of the marine economy by using the digital economy.

Combined with the unique attributes of the digital economy, we measure the development of the digital and marine economy in 11 coastal provinces between 2006 and 2016 by using the panel threshold model to know the impact of the digital economy on the marine economy and its mechanism. The marine economy is indispensable to national economic growth. The correct judgment of the marine and the digital economy promotes the implementation of the maritime power strategy.

2. Literature Review and Research Hypothesis

According to the existing research, digital technology and economic development have always been the focus of debate in the economic circle. On the one hand, in the initial stage of digitization, we need to invest a lot of capital and professional labor force to adapt to the digital business model. Therefore, scholars believe that it is difficult for the digital economy to play a full role in economic growth. By analyzing the Internet cross-sectional data of various provinces in China from 2000 to 2005, Li found that the effect of Internet development on the economy is local and unstable, and the correlation between

ISSN 2616-5902 Vol. 5, Issue 1: 143-148, DOI: 10.25236/AJBM.2023.050121

the number of websites and other factors and economic development is very low [2]. Yang believes that underdeveloped areas are easy to fall into a vicious circle of "backward economic development - lack of material conditions for developing digital economy - slow economic growth rate"[3]. Li found that the use of the Internet has typical characteristics of network externality, and its impact on economic growth has a cumulative effect and a lag effect [4]. However, it takes long for the digital economy to affect economic growth. Therefore, some scholars' views are too one-sided.

On the other hand, Zhang et al. held the view that the digital economy can reduce production costs, improve operational efficiency, and optimize the economic structure [5]. Wang stated that the digital economy realizes the optimal allocation of factor resources and the difference in transformation and evolution, promotes the evolution of industrial upgrading, and optimizes the quality of economic growth [6]. Chen found that the digital economy has a marginal effect on the industrial structure, thus promoting economic development [7]. However, few scholars study the influence of the digital economy on the marine economy.

The influence of digital development on the development level of the marine economy has two stages. In the early phase of digital construction, the development of the digital economy does not have an immediate effect on the development level of the marine economy due to the time lag effect of market intervention cost and new generation information technology investment. Besides, the development of digital channels may make the wholesale market experience the evolution trend of aggregation, diffusion, and disintegration [8]. With the continuously expanding digital economy, the rapid development of e-commerce and the "Internet plus" platform has increased the production efficiency and operation efficiency of the seafood wholesale market. The promotion of the Internet of things has effectively improved the level of marine environmental monitoring. The application of artificial intelligence provides new technical support for aquaculture. Considering the network effect of the digital economy, the effect of the digital economy on the improvement of marine economic development level becomes obvious. However, when the digital economy enters into a certain stage, the competency of marine business departments needs to readjust their organizational structure and allocate resource elements. In addition, each department may also face the problems of inefficient internal coordination and unclear strategic positioning. Therefore, the sustainable development of the digital level may have the effect of diminishing return of scale on the marine economy.

To sum up, we propose the following research hypotheses.

H1: A U-shaped curve relationship is found between the digital economy and the marine economy.

3. Research Design

3.1. Model construction

For testing the influence of the digital economy on the development of the marine economy, we adopt the threshold regression model learned from Hansen. The further analysis model is set as follows.

$$MEC_{it} = \beta_0 + \beta_1 Dige(MC_{it} \ll \gamma_1) + \beta_2 Dige(MC_{it} > \gamma_1) + \beta_3 lnMT_{it} + \beta_4 lnPEF_{it} + \beta_5 lnFDI_{it} + \mu_{it} \quad (1)$$

In Eq. (1), the explained variable (MECit) is the development level of the marine economy of province *i* in the period *t* measured by the entropy method. The core explanatory variable (Digeit) is the digital economy development level of the province *i* in the period t measured by the entropy method, MCit represents the threshold variable, γ represents the threshold to be estimated, β is the variable coefficient, MC_{it}, PEF_{it}, FDI_{it} respectively indicate the proportion of marine technology investment, fiscal consumption expenditure, and foreign investment proportion of province *i* in year *t*, μit is a random error term.

3.2. Variables

3.2.1. Variable for explanation: level of marine economy development

We set up a multi-dimensional evaluation system with three secondary factors: marine economic scale, marine economic structure, and marine economic contribution. The marine economic development level of 11 coastal provinces and cities between 2006 and 2016 is evaluated with the entropy method.

ISSN 2616-5902 Vol. 5, Issue 1: 143-148, DOI: 10.25236/AJBM.2023.050121

3.2.2. Core explanatory variable: digital development level

Since there is no recognizable way to measure the level of the marine digital economy, we draw lessons from the practice of Zhao Tao [9], we construct an index system with Internet infrastructure, Internet-related output, and Internet penetration rate as secondary indicators which are combined with the focus of research.

3.2.3. Threshold variable: marine capital

Based on the estimation method of Zhang [10], taking 2006 as the base period, the sustainable inventory method is used to evaluate the capital stock of the regions as follows.

$$K_t = (1-\delta)K_{t-1} + \frac{I_t}{P_t} \quad (2)$$

where *i* is the provinces and cities, *t* is the year, *Kt* indicates the capital stock during period *t,* and δ is the depreciation rate of fixed assets with a value of 9.6%, *It* is the amount of investment in the fixed asset in current years based on 2006 in period *t*, *Pt* is the price index of fixed asset investment in period *t*.

The estimation of marine capital stock refers to the method of He [11], and the calculation method is performed as follows: marine capital stock (MC) = (coastal area marine GDP / coastal area GDP) × Capital stock in coastal areas (3)

3.2.4. Control variable

For a comprehensive analysis of the impact of the digital economy on the marine economy, we add control variables that influence the level of the development of the marine economy into the model, specifically as follows.

(1) Investment in marine technology (MT) is expressed as the proportion of fund income of marine scientific research institutions in coastal areas in GDP.

(2) Proportion of fiscal consumption expenditure (PFE) is evaluated by the proportion of fiscal consumption expenditure in GDP.

(3) Foreign investment (FDI) is evaluated by the ratio of the total investment of enterprises invested by foreigners in GDP.

Table 1 shows the construction index, index attribute, and construction process of the evaluation indicator of marine economic development level and digital economic development of rovinces and cities in coastal areas.

Table 1: Evaluation index of level of marine economic development and digital economic development of provinces and cities in coastal areas

Primary index	Secondary index	Tertiary indicators
Level of Development of marine economy	***marine economic scale***	Per capita GOP
		Number of sea related employees / total employed population
	marine economic structure	Proportion of added value of marine secondary industry in GOP
		Proportion of added value of marine tertiary industry in GOP
	marine economic contribution	GOP/GDP
	Internet infrastructure	Long distance optical cable line length / land area
	Internet related output	Total telecom business / GDP
	Internet penetration rate	Internet users / total number

3.3. Data source and description

Considering the completeness and availability of data, we take eleven provinces and cities in coastal areas in China as research objects and use data from China Statistical Yearbook (2006−2016), China Ocean Statistical Yearbook (2006−2016), and the Catalan database. To prevent heteroscedasticity from affecting regression results, we logarithmically process the data. Table 2 shows the descriptive statistics of the major variables of 121 study samples.

ISSN 2616-5902 Vol. 5, Issue 1: 143-148, DOI: 10.25236/AJBM.2023.050121

Table 2: Variable descriptive statistical results

	Variable	Number Of Observations	Maximum	Minimum Value	Standard Deviation	Mean value
Explained Variable	***MEC***	121	1.000	0.050	0.256	0.210
Explanatory Variable	***Dige***	121	0.880	0.049	0.180	0.456
Threshold Variable	***lnMC***	121	12.571	7.507	11.055	1.887
Control Variable	***MT***	121	0.177	0.003	0.042	0.164
	PFE	121	0.941	0.031	0.186	0.178
	FEI	121	0.769	0.006	0.106	0.104

4. Results

4.1. Basic estimation

Table 3 shows that there is a threshold effect on the digital economy and the level of marine economic development. The single threshold and double threshold pass the significance test of 5 and 1%, respectively. Specifically, the confidence interval of the two threshold values is narrower, so the recognition effect of the threshold value is more significant.

Table 3: Threshold effect test and threshold confidence interval

Threshold variable	Model	F value	critical value			Threshold value
			1%	*5%*	*10%*	
lnMC	1	29.67**	40.698	31.604	27.632	11.011
	2	33.89***	32.132	25.761	21.278	11.011. 11.314

Based on this, double panel threshold regression estimates are made, whose result is presented in Table 4. In the double threshold model, the influence coefficient first changes from negative to positive. This implies that there are different phases in the effects of digital economies on marine economic growth, which is consistent with the results of Gu [12]. This is mainly due to the low level of digital infrastructure in the early stage of digitization construction, and the main investment in marine capital is fixed assets, which makes it difficult to achieve scale effect. In other words, digital technology in promoting productivity has not played its role fully. Then, with the continuous investment of marine capital and reaching the first threshold, the digital technology development can fully reduce the cost of information dissemination and transaction costs, the marginal cost of linkage between various departments continues to decrease, and participants can obtain more benefits. In addition, digitization drives emerging marine industries in the process of development to directly enhance the marine economy development. However, the impact of the digital economy on the development of the marine economy begins to decline and shows a declining marginal utility with the continuous input of marine capital and the crossing of the second threshold value.

Table 4: Main model estimation results

variable	Double threshold model
lnMC	-
lnMC≤11.011	-0.242***
11.011≤lnMC≤11.314	0.807***
lnMC≥11.314	0.213***
lnMT	0.914
lnPFE	-2.716***
lnFDI	-0.567**

5. Conclusion

A panel threshold regression model is established with ocean capital as a threshold variable, and the non-linear relationship between the marine economic development and digital economy is explored with

ISSN 2616-5902 Vol. 5, Issue 1: 143-148, DOI: 10.25236/AJBM.2023.050121

the panel data of coastal areas in China between 2006 and 2016 (ii provinces and cities). The results show the following.

Digital economic implications on marine growth have a double threshold effect with thresholds of 11.011 and 11.314, respectively. When the marine capital investment is lower than 11.011, the impact of the digital economy on the growth level of the marine economy is significantly negative. In addition, when the marine capital investment is higher than the first threshold, the digital economy's influence on the growth level of the marine economy is significantly positive. Namely, the impact of the digital economy on the growth level of the marine economy is reflected only when the marine capital investment reaches a certain degree. In other words, the marine economy growth is significantly influenced by the digital economy, in which the capital investment in the marine economy mainly drives the growth. When the input of marine capital crosses the first threshold value, digital economic implications on the level of marine economic development show a non-linear trend of decreasing marginal effect.

The results of this study have value as a reference for how the digital economy promotes marine economy development. The suggestions are made in this study as follows.

The government needs to make efforts to develop the digital economy. First, it is required to develop the digital infrastructure and increase research and development and financial support for the digital economy. Secondly, it is required to formulate support policies for the digital economy development, cultivate the market main body, and expand the development platform; Finally, we need to open more to the world with breakthrough technologies and to absorb advanced foreign technologies.

The marine industry needs to seize the opportunity of the development of the digital economy, deeply integrate the digital economy in the real economy, maintain innovation, and consolidate the dividend advantages. The new generation of information technology for the high-level development of the marine economy is needed with the help of a series of support policies proposed for the new model of the digital economy.

The growth of marine economy depends on the investment of marine capital to a certain extent. Only when marine capital investment crosses the first threshold, the digital economy promotes the growth of marine economic development level. Therefore, the government accelerates financial agglomeration and formulates financial support policies. However, taking marine capital for supporting marine economic growth is not a long-term plan. Therefore, the government needs to transform China's marine economic growth with science and technology.

Acknowledgment

(1) This research was funded by the general project of philosophy and social sciences planning of Guangdong Province "innovation resource synergy, knowledge multi-dimensional spillover and total factor productivity: mechanism and effect research" (gd21cyj28)

(2) This research was funded by the "13th five-year plan" of Guangdong educational science project "Research on dynamic evolution law and influencing factor identification of intelligent efficiency in Guangdong, Hong Kong and Macao Bay Area" (2020gxjk105)

(3) This research was funded by the 2018 Guangdong Natural Science Foundation Project "selection of patent open licensing mode and mechanism construction in Guangdong Province from the perspective of sharing economy" (approval No.: 2018a030313493)

References

[1] Jing Wenjun, Sun Baowen. Digital economy promotes high-quality economic development: a theoretical analysis framework [J]. Economist, 2019 (02): 66-73

[2] Zhang Yue, Li Qi. The impact of Internet on the economic development of provinces and regions in China [J]. Journal of Shanxi University of Finance and economics, 2008 (06): 38-44

[3] Yang Wenpu. Digital economy and regional economic growth: late developing advantages or late developing disadvantages? [J]. Journal of Shanghai University of Finance and economics, 2021,23 (03): 19-31 + 94

[4] Li Liwei, Jing Feng. Research on the relationship between Internet Diffusion and economic growth -- An Empirical Test Based on the panel data of 31 provinces in China [J]. Journal of Beijing Industrial and Commercial University (SOCIAL SCIENCE EDITION), 2013, 28 (03): 120-126

ISSN 2616-5902 Vol. 5, Issue 1: 143-148, DOI: 10.25236/AJBM.2023.050121

[5] Zhang Hong, Liu Zhong, Wang Shuxuan. An analysis of China's high-quality economic development path under the background of digital economy [J]. Business Economics Research, 2019, (23): 183-186
[6] Wang Juan. Digital economy drives high-quality economic development: factor allocation and strategic choice [J]. Ningxia Social Sciences, 2019 (05): 88-94
[7] Chen Xiaohui, Zhang Hongwei, Wu Yongchao. How does digital economy affect the level of industrial structure? [J]. Securities market guide, 2020 (07): 20-29
[8] Chen Jianqing, Ren Guoliang. The development and evolution of agricultural wholesale market: agglomeration, diffusion and disintegration -- also on the development stage of China's agricultural wholesale trade [J]. Economist, 2012 (12): 74-84
[9] Zhao Tao, Zhang Zhi, Liang Shangkun. Digital economy, entrepreneurial activity and high-quality development - empirical evidence from Chinese cities [J]. Management World, 2020,36 (10): 65-76
[10] Zhang Jun, Wu Guiying, Zhang Jipeng. Estimation of China's inter-provincial material capital stock: 1952-2000 [J]. Economic Research, 2004, (10): 35-44
[11] He Guangshun, Ding Lili, Song Weiling. Theory, method and practice of marine economic analysis and evaluation [M]. Ocean Press, 2014
[12] Gu Chuan, Huang Anqi. Changes in the operating efficiency of agricultural products wholesale industry under the digital background -- empirical test based on panel threshold model [J]. China Circulation Economy, 2021,35 (06): 17-27