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Study On The Impact Of New Quality Productivity On The Optimization Of Zhanjiang's Marine Industrial Structure And Marine Economic Growth

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Abstract:
Based on data from Zhanjiang City covering the period from 2010 to 2023, this study systematically constructs an evaluation index system for new quality of productive forces and a measurement index system for high-quality marine economic development. Through empirical analysis, it examines the direct impact of new quality productive forces on high-quality marine economic development and verifies the indirect role of new quality productive forces in driving high-quality marine economic development by optimizing industrial structure. The findings suggest that new, high-quality productive forces can foster the high-quality development of the marine economy. Empirical tests of the mediating effect clearly demonstrate that new quality productive forces can foster high-quality marine economic development by driving industrial structure optimization. This study provides empirical evidence for leveraging the marine economic benefits of new quality productive forces.

Keywords: *New quality productive forces; Industrial structure optimization; High-quality development of the marine economy*

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I. Introduction And Literature Review

Within the broader context of China's high-quality development, the marine economy serves not only as a vital vehicle supporting the nation's high-level opening-up but also as a core arena for international competition and cooperation at the global level, profoundly influencing the country's development landscape and international discourse power. Currently, China's marine economy demonstrates steady growth in overall scale. According to data from the Ministry of Natural Resources, by August 2025, the production efficiency of China's shipbuilding enterprises is expected to have continued improving, with the volume of ocean-going vessels completed in the first half of the year increasing by 4.7% year-over-year. The pace of transformation and upgrading in the shipbuilding industry has accelerated, with intelligent technologies such as digital inspection and spray-painting robots empowering ship construction, helping enterprises reduce costs and increase efficiency. Favorable policies, optimized supply, and rising travel demand have fueled sustained growth in the marine tourism market. China's marine tourism sector achieved an added value of 771.8 billion yuan, marking an 8.0% year-on-year increase. This demonstrates the steady and positive development of marine industries, injecting sustained momentum into the growth of the marine economy. However, it should also be noted that China's marine industry faces challenges such as insufficient levels of marine scientific and technological innovation, low efficiency in marine resource utilization, and inadequate resilience and influence of the marine economy [1, 2], which to some extent constrain the sustainable growth of the marine economy. Therefore, studying the mechanisms that drive marine economic growth can enrich the theoretical framework of the marine economy, advance the construction of a maritime power, and concretize the concept of high-quality development in the blue economy, providing theoretical support for the sustainable leap forward of the marine economy. Simultaneously, exploring the drivers of marine economic growth offers practical solutions to overcome bottlenecks in marine resource utilization, alleviate regional imbalances in marine economies, strengthen the resilience of marine industries and ecological security foundations, and ultimately provide practical momentum for the iterative upgrading of marine industries and the coordinated development of land and sea.

The 2024 *Report on the Work of the Government* proposes "vigorously advancing the construction of a modern industrial system and accelerating the development of new quality productive forces. "Developing new quality productive forces represents a significant strategic judgment and deployment by the Party Central Committee, grounded in historical evolution and national conditions. It can drive the high-end upgrading of industrial structures through technological iteration, empower the marine economy to achieve growth beyond resource constraints, and simultaneously address immediate development challenges while anchoring long-term strategic planning. Specifically, developing new, high-quality productive forces enhances resource allocation efficiency, drives the transformation of inefficient industries, and fosters the emergence of new industrial forms.

This, in turn, propels industrial structures toward more efficient and resilient tiers. Optimizing industrial structures can adjust the internal industrial mix of the marine economy, channeling production factors toward higher-efficiency, higher-value-added sectors and enhancing the efficiency of factor allocation. It also fosters deep synergy among marine industries, strengthens inter-industry linkages, accelerates the transformation of marine industries from traditional to modern forms, and elevates the overall competitiveness of the marine economy, thereby driving its growth. Thus, analyzing the logic of how new quality productive forces empower marine economic growth provides a theoretical reference for breaking through the constraints of traditional growth models, driving the evolution of industrial systems toward intelligent integration, and propelling the marine economy toward breakthroughs in efficiency and structural advancement.

In recent years, as global competition for ocean development intensifies and China's strategy to build a maritime power advances in depth, the development of the marine economy has moved beyond the foundational stage of "scale expansion" It has expanded into dimensions of high-quality development, including industrial synergy and coupling, ecological and low-carbon transformation, technological empowerment breakthroughs, and ascension within global value chains. Within this developmental context, "developing the marine economy" has emerged as the core proposition for its high-quality development phase. Academic circles have conducted theoretical explorations around its practical value and implementation pathways, accumulating significant research outcomes. Regarding practical value, Zhang Zhuoqun and Yao Qian'er(2025)[3] argue that developing the marine economy holds significant strategic value for enhancing national comprehensive strength. Zhou Ting and Zhou Changshi (2025)[4] emphasize that developing the marine economy has become a vital pathway for nations worldwide to alleviate natural resource constraints, advance marine and technological innovation, and strengthen international cooperation in marine affairs. Regarding implementation pathways, developing the marine economy still requires technological innovation as a key driver [5], accelerating the upgrading of marine industrial structures [6, 7], and enhancing the total factor productivity of marine industries [8-11], thereby empowering the sustainable and high-quality development of the marine economy.

Comprehensively speaking, academic research on the relationship among new quality productive forces, industrial structure optimization, and marine economic development has yielded some results, yet significant room for improvement remains. Most studies fail to systematically examine these three elements within a unified analytical framework, overlooking their intrinsic interactive logic. In fact, industrial structure optimization—as the core driver regulating economic efficiency and underpinning high-quality development—plays a pivotal role in transmitting the effects of new quality productive forces to marine economic development. Based on this, the potential marginal contributions of this paper are primarily reflected in the following aspects: First, it breaks through the fragmented limitations of existing research by integrating new quality productive forces, industrial structure optimization, and marine economic development into a unified analytical framework. It systematically outlines the specific pathways and underlying mechanisms through which China's new quality productive forces drive industrial structure optimization and subsequently impact marine economic development. Second, it examines the comprehensive impact of new quality productive forces and industrial structure optimization, which work synergistically to promote marine economic development. This effort aims to provide new insights for enhancing the quality and broadening the pathways of marine economic development in practice, while also enriching existing theoretical explorations in the field of marine economic development from both research perspectives and content dimensions.

II. Theoretical Assumptions

New quality productive forces reconfigure production functions through revolutionary technological breakthroughs. Innovations such as deep-sea equipment and intelligent monitoring enable traditional industrial transformation, giving rise to new sectors like marine biomedicine and deep-sea energy, thereby enhancing total factor productivity [12, 13]. Simultaneously, new quality productive forces optimize factor allocation through data-technology integration, enhance resource conversion efficiency via models such as three-dimensional marine utilization and precision aquaculture, and integrate green technologies throughout the development process. This enables synergies between ecological conservation and economic growth through marine carbon sinks and clean energy[14], forming an innovation-driven, efficiency-enhancing, and ecologically sustainable development loop that propels high-quality marine economic development.

Hypothesis 1: New quality productive forces can promote high-quality development of the marine economy.

New quality productive forces can leverage the deep integration of data elements with physical industries to optimize the allocation efficiency of production factors across different sectors, guiding resources toward high-value-added and high-efficiency domains, thereby enhancing overall industrial effectiveness. Simultaneously, the development of new quality productive forces can drive industries to transcend traditional boundaries, promote cross-sectoral synergy and innovation in business models, and build a more resilient and dynamic industrial ecosystem. This propels industrial structures toward more rational and advanced forms, achieving qualitative

optimization of the industrial system. This structural optimization fosters synergistic coupling among marine industries, strengthens upstream-downstream linkages and cross-sector penetration within industrial chains, and forms an ecosystem characterized by complementary functions and synergistic advantages. It unleashes economies of scale and collaborative efficiencies while maintaining a dynamic equilibrium between upgrading traditional marine industries and nurturing emerging ones. This approach enhances economic output efficiency while safeguarding ecological conservation[15], ultimately achieving high-quality development of the marine economy.

Hypothesis 2: New quality productive forces can promote high-quality development of the marine economy by driving industrial structure optimization.

III. Model Design And Data Sources

1. Model Specification

To verify the impact of new quality productive forces on the high-quality development of the marine economy, the following basic econometric model is established:

$$HQME_{it} = \alpha_0 + \alpha_1 NQP_{it} + \alpha_n X_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (1)$$

Where $HQME_{it}$ represents high-quality marine economic development, NQP_{it} denotes new quality productive forces, and X_{it} is the control variable; μ_i and δ_t represent individual and time fixed effects, respectively, while ε_{it} indicates the random disturbance term.

To explore the mechanism by which new, high-quality productive forces contribute to high-quality marine economic development, an intermediary effect model linking new, high-quality productive forces to industrial structure optimization is constructed. The model is defined as follows:

$$HQME_{it} = \beta_0 + c \bullet NQP_{it} + \beta_1 X_{it} + \varepsilon_{it} \quad (2)$$

$$IND_{it} = a_0 + a \bullet NQP_{it} + a_1 X_{it} + \delta_t \quad (3)$$

$$HQME_{it} = \gamma_0 + c' NQP_{it} + b \bullet IND_{it} + \gamma_1 X_{it} + \rho_{it} \quad (4)$$

In the above equation IND_{it} represents the mediating variable of industrial structure optimization. c and c' denote the total effect of the explanatory variable on the dependent variable and the direct effect of the explanatory variable on the dependent variable after incorporating the mediating variable, respectively. a and b represent the effect of the explanatory variable on the mediating variable and the effect of the mediating variable on the dependent variable after controlling for the influence of the explanatory variable, respectively. Mediation effects are reflected through the product of indirect effects （$a \bullet b$）.

2. Variable Descriptions

(1) Explanatory Variable: High-Quality Development of the Marine Economy ($HQME$)

The five new development philosophies—innovation, coordination, green, open, and shared are integral to China's socialist modernization drive and serve as guiding principles for high-quality development. Therefore, this paper constructs an indicator system for high-quality marine economic development (Table 1) comprising five primary indicators: innovation, coordination, green, open, and shared. The entropy weighting method is employed to calculate the annual levels of high-quality marine economic development in Zhanjiang City.

Table 1. Indicator System for High-Quality Marine Economic Development

Primary Indicators	Second-Level Indicators	Tertiary Indicators	Indicator Attribute
Innovation	Innovation Input	Marine Research Funding	+
		Marine Capital Investment	+
	Innovation Output	Marine Research, Education, Management, and Service Industries	+
		Urban Innovation Capacity	+
Coordination	Industrial Structure	Upgrading of Marine Industrial Structure	+
		Marine GDP	+
		Aquatic Product Price Consumption Index	+
Green	Resource Consumption	Offshore Crude Oil Production	+
		Marine Natural Gas Production	+
	Environmental Pollution	Direct discharge of industrial wastewater into the sea	-
		Solid Waste Emissions per Unit of Marine Output Value	-
Open	Foreign Trade	Total Foreign Exports	+
		Actual Utilization of Foreign Capital	+

		Port Cargo Throughput	+
Shared	Income Welfare	GDP per capita	+
	Education benefits	Maritime Majors Enrolled	+
	Employment Opportunities	Maritime Labor Input	+
	Public Services	Percentage of Internet Users	+
	Healthcare Access	Number of Nursing Home Beds	+

(2) Explanatory Variable: New Quality Productivity (NQP)

Based on the theoretical connotation of new quality productive forces, this paper constructs an evaluation index system encompassing three dimensions—new-type laborers, new-type labor objects, and new-type means of production—centered on the three fundamental elements of productive forces: laborers, labor objects, and means of production. The specific index system is presented in Table 2. The entropy weight method is employed to calculate the annual development levels of new quality productive forces in Zhanjiang City.

Table 2: Indicator System for New Quality Productivity Development Level

Primary Indicators	Second-Level Indicators	Indicator Attribute
New-type Laborers	Full-time equivalent R&D personnel in industrial enterprises above the designated size	+
	Proportion of Employees in the Tertiary Sector	+
	Number of employees in the information transmission, computer services, and software industries	+
New Types of Labor Objects	Industrial robot installation density	+
	Industrial solid waste utilization rate	+
	Share of tertiary industry value added in GDP	+
New production resources	Number of Mobile Phone Subscribers at Year-End	+
	Road Passenger Transport Volume	+
	Number of granted invention patents	+
	Total telecommunications business volume	+

(3) Mediating Variable: Industrial Structure Optimization (IND)

Optimizing industrial structure is a dynamic process of evolving from low-tier to high-tier industries, characterized by both hierarchical leapfrogging and efficiency upgrading. This paper integrates the industrial structure level coefficient and labor productivity dimensions to construct an indicator:

$$IND = \sum_{i=1}^{3} (Y_i / Y)(Y_i / L_i) \qquad (i = 1,2,3) \quad (5)$$

In the above formula, Y represents the industrial output value, L denotes employment numbers, and i corresponds to the three industrial sectors. First, labor productivity (Y_i / L_i) undergoes Z-score standardization to eliminate dimensional and distribution differences. It is then linearly transformed and normalized to the [0,1] interval, i.e., $IND = [Z_i / (\max(Z_i))] \times 0.4 + 0.6$ (coefficient adaptation avoids extreme value compression while preserving evolutionary characteristics). Here, Z_i indicates the industrial structure optimization data after standardization using the Z-score method. IND Higher values indicate greater optimization depth achieved through synergistic hierarchical advancement and efficiency iteration.

3. Control Variables and Data Sources

To prevent outcome bias caused by omitted variables, this study selects R&D expenditure, population size, transportation accessibility, mobile phone users, and social consumption level as control variables. Specific measurement methods are detailed in Table 3. Data primarily originate from the China Statistical Yearbook, the China Statistical Yearbook on Science and Technology, the National Bureau of Statistics' official website, and local statistical yearbooks and national statistical bulletins of Guangdong Province and Zhanjiang City. Panel data from 2010 to 2023 were selected as the research sample. Partially missing data were imputed using linear interpolation.

Table 3. Descriptive Statistics

Variable Definitions	Variable Name	Variable Definition	Mean	Standard Deviation	Minimum	Maximum
High-Quality Development of the Marine Economy	$HQME$	Calculated using the entropy weight method	0.369	0.226	0.127	0.831

New Quality Productivity	*NQP*	Calculated using the entropy-based approach	0.026	0.007	0.016	0.035
Optimization of Industrial Structure	*IND*	Industrial Structure Upgrading	6.298	0.085	6.162	6.427
Science and Technology Expenditures	*tec*	Log of Technology Expenditures	9.859	0.614	8.667	10.740
Population Size	*pop*	Logarithm of Permanent Population	6.716	0.040	6.658	6.768
Transportation Accessibility	*tra*	Logarithm of Highway Passenger Volume	8.895	0.699	7.382	9.619
Mobile phone subscribers	*mob*	Logarithm of mobile phone subscribers	6.453	0.161	5.964	6.597
Social consumption level	*con*	Logarithm of Total Retail Sales of Consumer Goods Above Designated Size	6.947	0.502	6.063	8.166

IV. Empirical Analysis

1. Benchmark Regression Test

Table 4 presents the benchmark regression results. Column (1) shows the regression results without control variables. The data indicate that the regression coefficient for the explanatory variable is 26.820, which is significantly positive at the 1% statistical level. This suggests that new quality productive forces can significantly promote the high-quality development of the marine economy. Column (2) presents the regression results with control variables included. The data show that the regression coefficient for the explanatory variable is 42.755, which is significantly positive at the 1% statistical level. This indicates that after incorporating control variables, the positive driving effect of new-type productive forces on the high-quality development of the marine economy remains significant. Hypothesis 1 is thus confirmed.

Table 4 Benchmark Regression Results

Variable	(1)	(2)
	High-Quality Development of the Marine Economy	High-Quality Development of the Marine Economy
New Quality Productivity	26.820***	42.755***
	(6.136)	(6.138)
Technology Expenditures		-0.363***
		(0.088)
Population Size		1.408
		(1.643)
Transportation Accessibility		0.072
		(0.088)
Number of Mobile Phone Users		0.394***
		(0.068)
Social consumption level		0.001
		(0.034)
Constant	-0.320*	-9.792
	(0.162)	(10.949)
N	14	14
R^2	0.582	0.939

Note: Standard errors are shown in parentheses. *** indicates p<0.01, ** indicates p<0.05, * indicates p<0.1, The same applies to the table below.

2. Mediating Effect Test

The preceding discussion systematically analyzed the transmission pathways and underlying logic through which new, high-quality productive forces drive the high-quality development of the marine economy from the perspective of industrial structure optimization. To validate this theoretical relationship, this paper employs a mediation effect model for empirical testing. The relevant regression results are summarized in Table 5. Column (1) presents the regression results of new quality productive forces on industrial structure optimization, with a significantly positive coefficient. Column (2) simultaneously incorporates new quality productive forces and industrial structure optimization into the regression for high-quality marine economic development, where both coefficients remain significantly positive. This result confirms the mediating mechanism of industrial structure optimization in promoting high-quality marine economic development through new quality productive forces. Hypothesis 2 is thus validated.

Table 5 Regression Results for Mediating Effects

Variable	(1)	(2)
	Industrial Structure Optimization	High-Quality Development of the Marine Economy
New Quality Productivity	30.239***	19.268*
	(6.362)	(9.003)
Optimization of Industrial Structure		0.777**
		(0.288)
Technology Expenditure	-0.270**	-0.154
	(0.099)	(0.096)
Population Size	2.401	-0.457
	(1.932)	(1.102)
Transportation Accessibility	0.093	-0.000
	(0.098)	(0.070)
Number of Mobile Phone Users	0.341***	0.129
	(0.068)	(0.122)
Social Consumption Level	-0.056	0.044
	(0.042)	(0.029)
Constant	-16.155	2.756
	(12.990)	(7.559)
N	14	14
R^2	0.906	0.962

V. Conclusion

Based on Zhanjiang City data from 2010 to 2023, this study systematically constructs an evaluation index system for new quality productive forces and a measurement index system for high-quality marine economic development. Through empirical analysis, it examines the direct impact of new quality productive forces on high-quality marine economic development and verifies their indirect influence via the pathway of driving industrial structure optimization. Based on the empirical exploration of these dual effects, the study draws the following conclusions: First, new quality productive forces exert a significant positive promotion effect on the high-quality development of the marine economy, serving as a key driver for enhancing its quality and efficiency. Second, new quality productive forces can indirectly promote the high-quality development of the marine economy by advancing industrial structure optimization as a critical pathway.

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