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The Interactive Development between Coastal Ports and the Regional Economy in Fujian Based on the VAR Model

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ABSTRACT

The development of ports contributes to promoting regional economic growth, and the development of the regional economy also exerts a certain pull effect on port development, establishing an interactive relationship between the two. This paper constructs a vector autoregression (VAR) model to empirically analyze the dynamic interaction between coastal ports and the regional economy in Fujian. The aim is to provide theoretical support and decision-making references for policy formulation and practical operations in the interactive development of coastal ports and the regional economy in Fujian. The study employs methods such as impulse response and variance decomposition analysis to quantitatively analyze the correlations between the gross domestic product (GDP) of the Fujian region, the cargo throughput of coastal ports, and the total import and export volume. Through VAR model empirical analysis, the paper identifies a long-term equilibrium relationship between the regional economy in Fujian and the coastal port economy, as well as the region's export-oriented economy. Based on empirical research results, strategic recommendations are proposed to promote interactive development between coastal ports and the regional economy in Fujian: continuous upgrading of port infrastructure, promotion of green and secure port construction, establishment of a coastal multi-level and multi-functional port system, and acceleration of industrial integration across the Taiwan Strait to facilitate the upgrading of industrial structures near ports.

Keywords: *VAR model, coastal ports in Fujian, regional economy, impulse response, variance decomposition*

INTRODUCTION

With the continuous deepening of globalization and the strengthening of economic interconnectedness, ports, serving as vital transportation hubs connecting the sea and land, play a crucial role in promoting regional economic development. As an important coastal province in Southeast China, Fujian Province holds a significant position with its coastal ports in facilitating regional economic growth and international trade. The development of ports and the prosperity of regional economies are interdependent, making the interaction between them a significant subject in contemporary economic research.

The objective of this study is to explore the dynamic interaction between coastal ports in Fujian and the regional economy by constructing a vector autoregressive (VAR) model. This research aims to provide valuable theoretical and practical references for the interactive development between coastal ports and the regional economy in Fujian. While numerous studies have already focused on the relationship between ports and regional economies,

research specific to the Fujian region remains limited. This study seeks to fill this gap, offering new empirical evidence to deepen the understanding of the relationship between ports and the regional economy. The scope of the research covers the interactive relationship between coastal ports in Fujian and the entire regional economy. Through empirical analysis using the VAR model, this study will focus on the dynamic relationship between key indicators such as coastal port cargo throughput, import and export volume, and regional gross domestic product (GDP), aiming to reveal their long-term equilibrium relationships. Throughout the research process, methods such as impulse response and variance decomposition will be employed to comprehensively understand the mutual contributions and impacts of coastal ports in Fujian on the regional economy.

However, this study has certain limitations. Due to the availability of data and the constraints of the time range, it may not cover all potential influencing factors in the empirical analysis. Future research could further expand on these factors to enhance the model's explanatory power and predictive capability.

In the era of maritime economies, the interaction between ports and regional economies has become increasingly close, attracting widespread attention and research from scholars both domestically and internationally. Foreign research on the interactive development between ports and regional economies started early, with a relatively mature theoretical framework. Scholars have explored the stimulating role of ports on regional economies from various perspectives, including the optimization of regional industrial structure through port infrastructure construction, the contribution of port logistics to enhancing regional competitiveness, and the radiating effects of port cities as growth poles in the economy. Additionally, some scholars focus on the balance between port development and environmental protection, as well as strategic adjustments to ports in response to global economic fluctuations. Mudronja Gorana (2020), analyzing 107 port regions in the EU from 2005 to 2015, demonstrated the significant impact of ports on economic growth in the EU port regions, emphasizing the need to consider other factors influencing regional economic growth, such as research and development investment and human capital. Firmansyah M. (2020) highlighted the development of the maritime economy, especially ports, as an essential component for enhancing regional and national economic competitiveness in Indonesia, analyzing how export activities related to port throughput can improve the trade balance in East Java.

Comparatively, research in this field in China started relatively late but has achieved rich outcomes. Domestic studies not only incorporate the essence of foreign theories but also innovatively adapt them to the Chinese context. For instance, Liu Pengqun (2022) focused on the collaborative development of port clusters in China's coastal areas, exploring the role of division of labor and cooperation within port clusters in promoting regional economic development. Sun Ling (2023) analyzed the regional economy of Zhoushan City using the gray relational degree model, elucidating the crucial role of the port economy in the regional economic development process. It was emphasized that the port economy effectively propels regional economic development and openness, while the regional economy reciprocally influences the port economy, leading to mutual promotion and shared development. Fang Hui (2024) measured the coordination level of the Yangtze River Delta port cities using a coupled coordination model and empirically investigated the spatial effects of the coordination level on urban economic growth using a spatial Durbin model. These studies provide abundant theoretical support for the relationship between ports and regional economies, offering valuable experiences for related research.

This study will employ the Maritime Port Location Theory and Vector Autoregressive (VAR) model as the theoretical foundation to delve into the interactive relationship between coastal ports in Fujian and the regional economy. In this process, a series of research questions

will be posed with the aim of providing empirical support for academic research and policy formulation in relevant fields.

According to the Maritime Port Location Theory, the geographical position of a port directly influences its stimulating role in the regional economy. A favorable geographical location can turn a port into a crucial node in international trade, facilitating the flow of goods, information transmission, and industrial cooperation. The locational advantage of a port contributes to enhancing its position in the global supply chain, providing the surrounding areas with broader market opportunities and more efficient logistics services. This study will explore the geographical location of coastal ports in Fujian and how this location impacts the interactive relationship between the ports and the regional economy, offering detailed theoretical support for the investigation of the relationship between ports and regional economies. The study will introduce the vector autoregressive (VAR) model, based on time-series data, to empirically analyze the dynamic relationship between coastal ports in Fujian and the regional economy. This model quantitatively analyzes the mutual impact between ports and the regional economy, revealing causality relationships and long-term equilibrium states between them.

During the development of the paper, the following research questions will be addressed:

1. What is the economic environment of the coastal ports in Fujian?
2. How is the regional economic development in Fujian?
3. What dynamic relationships exist among the key indicators of regional gross domestic product (GDP), coastal port cargo throughput, and import and export volume in Fujian?

The contribution of this study lies in the skillful integration of the above theoretical frameworks, comprehensively and deeply analyzing the interactive relationship between coastal ports in Fujian and the regional economy. By posing and answering the research questions, the study provides new theoretical and empirical perspectives on the interaction between ports and regional economies in the era of maritime economies, serving as a scientific basis for policy formulation and practical operations.

METHODOLOGY

This study aims to explore the dynamic interaction among Fujian's regional GDP, coastal port cargo throughput, and total import and export volume. The primary research tool utilized is the vector autoregressive (VAR) model. The study spans from 1983 to 2022, encompassing 40 annual data points. This design enables capturing both long-term and short-term relationships, providing a profound understanding of the interplay between port indicators and regional economic variables.

The research is conducted in Fujian, a region with multiple coastal ports, making it a typical area with significant port and regional economic relations due to its status as an export-oriented region in the Chinese economy.

The study covers the regional GDP, coastal port cargo throughput, and total import and export volume of Fujian. These three indicators are the core economic variables under scrutiny, reflecting the economic strength, port development level, and characteristics of an export-oriented economy in the Fujian region.

Key research tools include the Vector Autoregressive (VAR) model, Eviews7.0 software, and relevant statistical methods. The VAR model is employed to unveil dynamic relationships between variables, and Eviews7.0 software is utilized for data processing and model construction.

Data for the study are extracted from the Fujian Statistical Yearbook of 2023, covering the period from 1983 to 2022. To ensure reliability and stability, considering the potential impact of price factors on the Gross Domestic Product (GDP), the study adjusts the GDP using the GDP index (base year = 100) with 1983 as the base year. This adjustment aims to eliminate

interference from price factors and enhance the accuracy of the data. Additionally, to address data heteroscedasticity, the study applies natural logarithm transformation to the time-series data using Eviews7.0 software.

Data Analysis

The data analysis procedure encompasses the following steps:

a. ***Stationarity Test***. Ensuring the reliability of time-series data by testing the stationarity of each variable.

b. VAR Model Construction. Utilizing the VAR model to reveal the dynamic relationships among Fujian's regional GDP, coastal port cargo throughput, and total import and export volume.

c. ***Johansen Cointegration Test***. Conducting cointegration tests to determine whether there is a long-term equilibrium relationship between the research variables.

d. ***Granger Causality Test***. Verifying causality relationships between variables is necessary to establish the temporal order of their influences.

e. ***Impulse Response and Variance Decomposition***. Employing the model for impulse response function and variance decomposition analysis to gain in-depth insights into the mutual influences of various variables.

Through these methods, the study comprehensively and systematically analyzes the interactive relationships between Fujian's regional GDP, coastal port cargo throughput, and total import and export volume, providing profound theoretical and empirical support for the relationship between ports and regional economies.

RESULT AND DISCUSSION

1. Overview of the Development of Coastal Ports and the Regional Economy in Fujian

a. Overview of Coastal Port Development in Fujian

Fujian, thriving toward the sea, possesses abundant port resources that serve as a powerful driving force for the development of the maritime economy. With an extensive coastline of 3,752 kilometers, Fujian covers one-sixth of the national coastline, ranking second in the country. Rich in deep-water port resources, Fujian has 255.9 kilometers of natural coastline with berths exceeding ten thousand tons. The coastline features numerous excellent natural harbors, including the four major ports along the Fujian coast: Xiamen Port, Fuzhou Port, Quanzhou Port, and Meizhou Bay Port.

At present, Fujian's coastal ports have 457 production berths, including 198 berths of ten thousand tons or more, with 95 specialized berths. In 2022, the coastal ports of Fujian achieved a cargo throughput of 7.14 billion tons, a 3.2% increase from the previous year, and a container throughput of 18 million standard containers, reflecting a 3.1% increase. The growth trend of Fujian's coastal port cargo throughput over the past decade is illustrated in Figure 1. In the 2022 global port throughput ranking, both Fuzhou Port and Xiamen Port secured positions among the top fifty. Additionally, Xiamen Port, Fuzhou Port, and Quanzhou Port were listed in the world's top 100 container ports. In 2020, Fujian Provincial Port Group emerged, facilitating the integration of provincial and municipal port enterprises and further promoting the integrated operation and management of ports. Fujian's coastal ports handle over 90% of the province's coal and 100% of the imported transportation tasks for energy, raw materials such as iron ore, and crude oil. Simultaneously, they undertake 95% of the transportation tasks for foreign trade imports and exports. These ports not only serve as crucial pillars for Fujian's economic and

social development and external opening-up but also function as key nodes in the comprehensive transportation system, providing robust support for coastal industries and urban development. Moreover, they have become essential channels for cross-strait economic and trade exchanges.

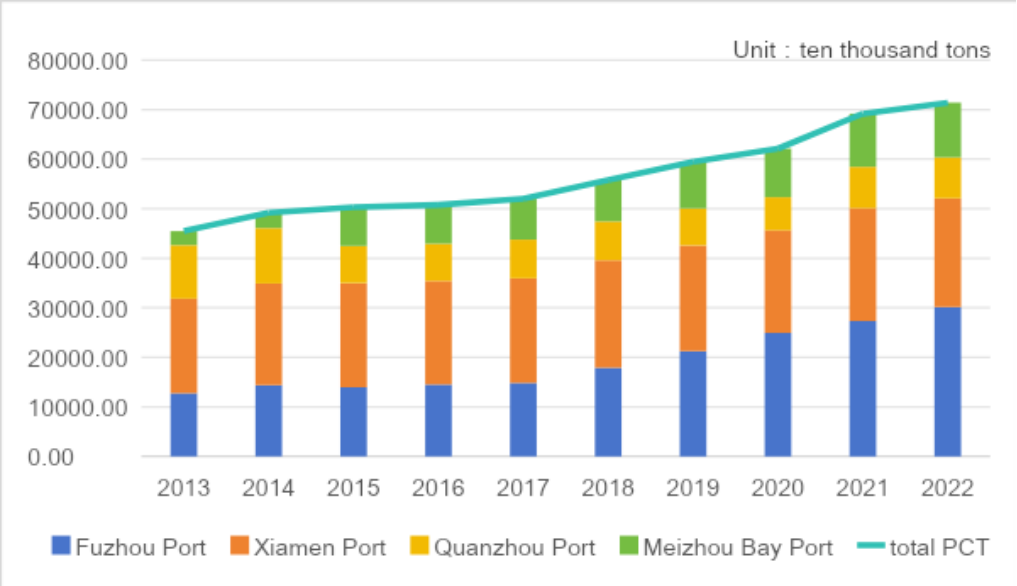

Figure 1. Cargo throughput of Fujian coastal ports from 2013 to 2022
Source: Fujian Statistical Yearbook 2022

b. Overview of Regional Economic Development in Fujian

Fujian Province, situated on the southeast coast of China, faces the East China Sea to the east, the Taiwan Strait to the south, borders Jiangxi Province to the west across the Min River, and is adjacent to Zhejiang Province to the north. It serves as a vital junction point for four important economic regions: East China, South China, Central-South Asia, and Southeast Asia. This strategic location makes Fujian a link between the inland and the ocean, creating a picture of economic development with convenient transportation and superior geographical positioning.

In recent years, Fujian has upgraded and optimized its industrial structure by attracting foreign investment and introducing advanced technologies. Emerging industries such as electronic information, biopharmaceuticals, and new energy have flourished, injecting new vitality into Fujian's economic growth. Infrastructure development has been continuously strengthened, with improvements in highways, railways, ports, and other essential facilities providing convenient conditions for economic activities. Over the past two decades, the total regional GDP of Fujian and its growth rate, as shown in Figure 2, have steadily increased. While the economic growth rate has exhibited some fluctuations, experiencing a slowdown in 2019 and 2020 due to global economic uncertainty and the impact of the COVID-19 pandemic, it has generally maintained a relatively stable trend. In 2022, the regional GDP of Fujian reached 53,109.85 billion yuan, a 4.7% increase from the previous year. The value-added of the primary industry was 3,076.20 billion yuan, with a growth rate of 3.7%; the secondary industry was 25,078.20 billion yuan, with a growth rate of 5.4%; and the tertiary industry was 24,955.45 billion yuan, with a growth rate of 4.0%.

As a window of openness to the outside world, coastal cities and ports in Fujian, such as Xiamen, Fuzhou, and Quanzhou, have become important hubs connecting the Maritime Silk Road. The scale of import and export trade continues to expand, as depicted in Figure 3. Fujian Province has gained prominence in global cooperation, actively participating in international

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trade and promoting deep integration between the region and the global economy. In 2022, the total import and export volume of goods in Fujian Province was 1,982.855 billion yuan, a 7.6% increase from the previous year. The export volume was 1,214.053 billion yuan, with a growth rate of 12.3%, and the import volume was 768.802 billion yuan, with a growth rate of 0.9%. The trade surplus was 445.251 billion yuan.

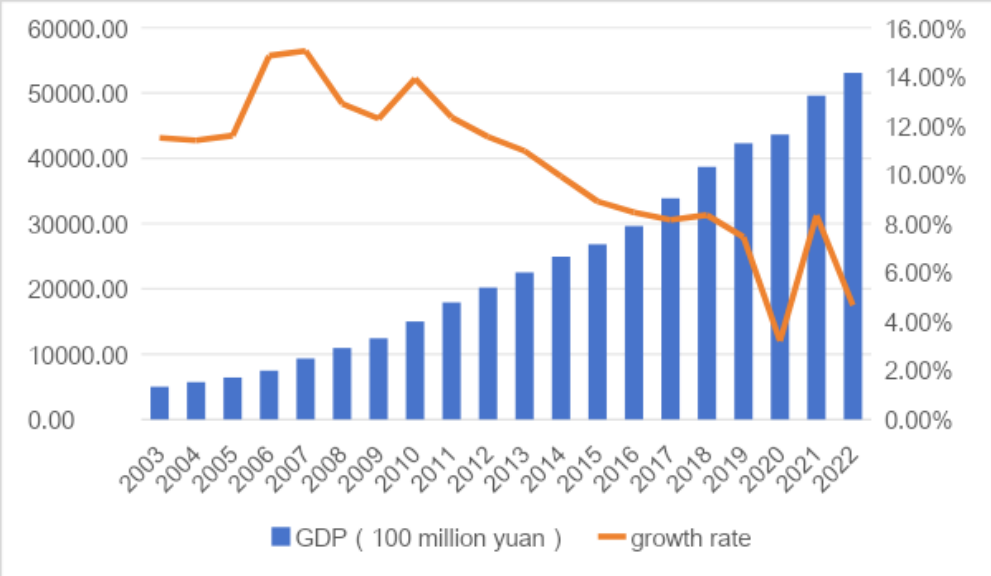

Figure 2. Gross domestic product (GDP) and growth rate of Fujian from 2003 to 2022
Source: Fujian Statistical Yearbook 2022

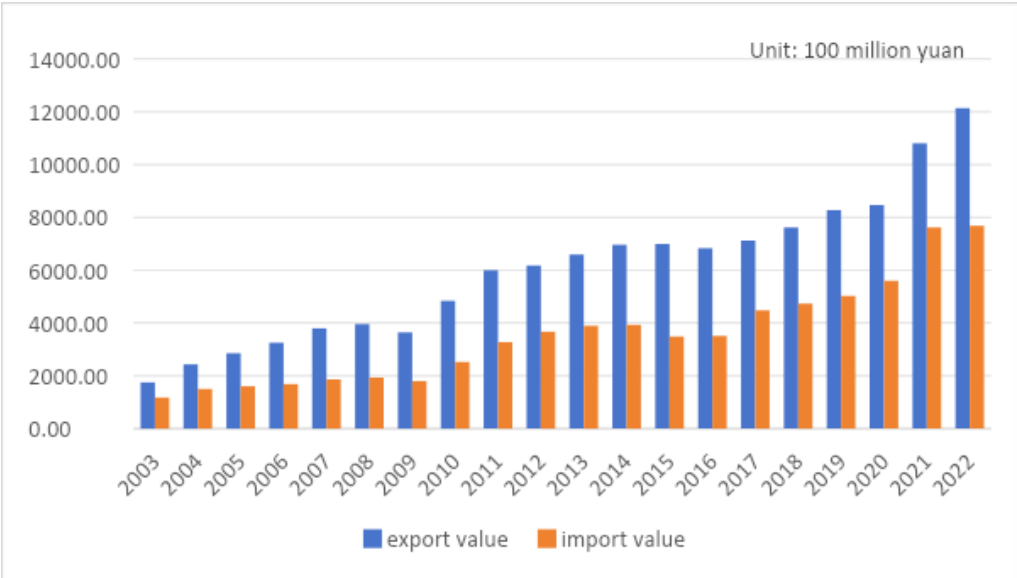

Figure 3. Goods Export Value and Import Value of Fujian Province from 2003 to 2022
Source: Fujian Statistical Yearbook 2022

2. Empirical Analysis of the Interactive Development between Coastal Ports and the Regional Economy in Fujian

This study establishes a vector autoregressive (VAR) model to investigate the interactive relationships among the regional gross domestic product (GDP), coastal port cargo throughput, and total import and export volume in Fujian. The regional GDP is a comprehensive indicator of economic strength, reflecting not only the regional economic power of Fujian but also serving as a crucial sign for evaluating the development status of its hinterland economy. The cargo throughput of coastal ports is a core indicator for assessing port functions and operational efficiency, providing a visual representation of the development level of coastal ports in Fujian. Total import and export volume, on the other hand, is a comprehensive indicator for measuring the development of an outward-oriented economy in a region, indicating the significant role played by coastal ports in facilitating the import and export of goods in Fujian.

For ease of data analysis and model construction, this paper represents regional GDP, coastal port cargo throughput, and total import and export volume as LNGDP, LNPCT, and LNTMX, respectively.

a. Stationarity Test

In order to avoid the issue of spurious regression in the analysis of time series data, this study conducted a test for stationarity on the data. Spurious regression refers to a situation where two non-stationary time series exhibit a high degree of correlation, which is not caused by genuine economic relationships but rather due to the presence of common trends. The Augmented Dickey-Fuller (ADF) test was employed in this study to ensure the stationarity of the data, aiming to enhance the accuracy and reliability of the analysis.

Table 1
Augmented Dickey-Fuller Unit Root Test for Time Series Variables

Variable	Test form (C, T, L)	ADF test statistic	ADF critical value			P-value	Result
			1%	5%	10%		
LNGDP	(C,0,0)	-3.680083	-3.610453	-2.938987	-2.607932	0.0084	Stationary
LNPCT	(C,0,2)	-1.408498	-3.610453	-2.938987	-2.607932	0.5683	Non-stationary
△LNPCT	(C,T,1)	-5.023757	-4.219126	-3.533083	-3.198312	0.0012	Stationary
LNTMX	(C,0,0)	-4.245727	-3.610453	-2.938987	-2.607932	0.0018	Stationary

Legend: 1. △ represents the differential code; 2. In the test form (C, T, L), C is the constant term （intercept）, T is the linear trend term, and L is the lag order.

The ADF test values of LNGDP and LNTMX from the data in Table 1 are less than the critical values at the 1%, 5%, and 10% significance levels, rejecting the null hypothesis that there is no unit root and indicating that they are stationary time series. On the other hand, the

ADF test values for LNPCT are greater than the critical values, accepting the null hypothesis that a unit root exists, suggesting it is a non-stationary time series. After taking the first-order difference of the variable LNPCT, the corresponding ADF values are all below the critical values, leading to the rejection of the null hypothesis. Thus, it is considered that the variable has achieved stationarity, meeting the basic conditions for establishing a VAR model. There is a possibility of cointegration among them, and further empirical tests using cointegration theory are needed.

b. VAR Model Construction

Vector Autoregression (VAR) is a multivariate time series analysis method widely used in research across economics, finance, and other fields. This model allows for the mutual influence of multiple variables by describing the dynamic evolution of the system by considering their past values and the past values of other relevant variables. When constructing the model, it is essential to determine the maximum lag order of the model. To achieve this, a comparison analysis can be conducted based on statistical measures such as LR, FRE, AIC, SC, and HQ. The optimal lag order can be identified as 1 from the analysis in Table 2.

Having ensured the stationarity of the data, we proceed to build the VAR model and utilize it to explore the interactive relationships among the Gross Domestic Product (GDP) of the Fujian region, cargo throughput at coastal ports, and total import and export value. The estimated results of the model are presented in Table 3.

Table 2
Standard Statistic of Optimal Lag Order Selection of VAR Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-44.11192	NA	0.002562	2.546590	2.677205	2.592638
1	170.3566	382.5655*	3.86e-08*	-8.559819*	-8.037359*	-8.375627*
2	174.4520	6.641077	5.08e-08	-8.294701	-7.380397	-7.972366
3	180.8189	9.292310	6.03e-08	-8.152375	-6.846225	-7.691896

Table 3
The Estimation Results of the VAR Model

	LNGDP	LNPCT	LNTMX
LNGDP(-1)	0.877078	-0.051882	-0.089292
	(0.03540)	(0.09905)	(0.13226)
	[24.7750]	[-0.52379]	[-0.67515]
LNPCT(-1)	0.038950	0.949057	0.110154
	(0.02511)	(0.07025)	(0.09380)
	[1.55133]	[13.5100]	[1.17437]
LNTMX(-1)	0.048146	0.071309	0.934339
	(0.01473)	(0.04121)	(0.05503)
	[3.26860]	[1.73026]	[16.9790]

C	0.369489	0.554959	0.159205
	(0.06958)	(0.19469)	(0.25996)
	[5.30996]	[2.85049]	[0.61243]

Table 4
Regression Statistics of VAR Model

R-squared	0.999545	0.997217	0.996391
Adj.R-squared	0.999506	0.996979	0.996082
Sum sq.resids	0.029285	0.229244	0.408713
S.E.equation	0.028926	0.080931	0.108063
F-statistic	25607.91	4180.853	3220.935
Log likelihood	84.94940	44.82371	33.54833
Akaike AIC	-4.151251	-2.093524	-1.515299
Schwarz SC	-3.980629	-1.922902	-1.344677
Mean dependent	7.280009	9.240359	5.700203
S.D.dependent	1.300889	1.472386	1.726315

The regression statistics of the VAR model are shown in Table 4. The values of R-squared and adjusted R-squared are both close to 1, indicating that the model has strong explanatory power for the data. The high degree of fit suggests that the model is well-fitted, demonstrating its reasonability. Based on the estimated VAR parameters, the following equation is established:

LNGDP=0.877078LNGDP(-1)+0.038950LNPCT(-1)+0.048146LNTMX(-1)+0.369489
LNPCT=-0.051882NGDP(-1)+0.949057LNPCT(-1)+0.071309LNTMX(-1)+0.554959
LNTMX=-0.089292LNGDP(-1)+0.110154LNPCT(-1)+0.934339LNTMX(-1)+0.159205

To ensure the reliability and accuracy of the model estimation results, stability tests are necessary. Unit root tests are crucial for evaluating the stability of the model. The stability of the VAR model was verified using the AR root test method. According to the data in Table 5, the reciprocals of all root moduli are less than 1. Additionally, as shown in Figure 4, all moduli are within the unit circle. Therefore, the VAR model is stable.

Table 5
The AR Roots Table

Root	Modulus
0.962822	0.962822
0.939025	0.939025
0.858627	0.858627

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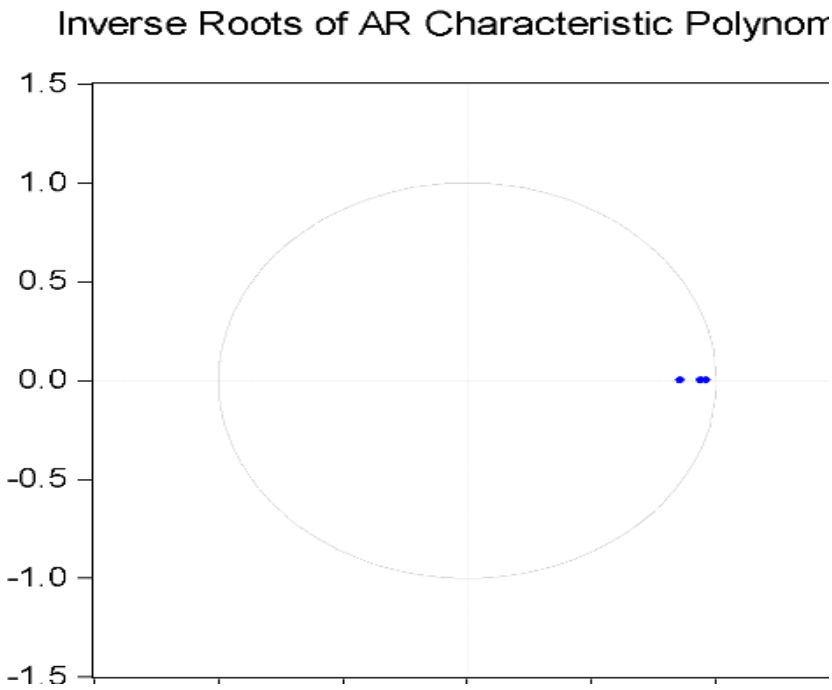

Figure 4. AR Roots Plot

c. Johansen Cointegration Test

In time series analysis, there are primarily two methods for cointegration tests: the Engle-Granger two-step method and the Johansen cointegration method. The Engle-Granger method is suitable for cointegration tests in two-variable models, while the Johansen cointegration method is more suitable for multivariate VAR models. Therefore, this study opts for the Johansen cointegration method, specifically choosing the test with cointegration equations containing intercept terms and the VAR model without intercept terms. The test results are presented in Table 6.

When the null hypothesis assumes no cointegration relationship, the trace statistic of 130.2077 exceeds the 5% critical value of 35.19275, and the P-value of 0.0000 is less than 0.05, rejecting the null hypothesis. On the other hand, when the null hypothesis assumes at most one cointegration relationship, the trace statistic of 15.1659 is less than the 5% critical value of 20.26184, and the P-value of 0.2170 is greater than 0.05, thus accepting the null hypothesis. This indicates the presence of a cointegration relationship among LNGDP, LNPCT, and LNTMX, suggesting a long-term stable relationship among regional GDP, coastal port cargo throughput, and total import and export value.

Table 6
Johansen Cointegration Test

Null hypothesis	Eigen value	Trace statistics	5% critical value	P-value	Result
None*	0.947649	130.2077	35.19275	0.0000	Reject
At most 1	0.295166	15.16599	20.26184	0.2170	Accept

d. Granger Causality Test

Granger causality refers to the situation where, considering the past information of two variables, if the predictive performance of one variable improves with the inclusion of another variable, we can consider the latter variable to have predictive value for the former, indicating that it is a Granger cause of that variable.

To further investigate whether there is a mutual influence between the economic development of the Fujian region and the development of coastal ports in Fujian, the study conducted Granger causality tests on the Gross Domestic Product (GDP), coastal port cargo throughput (PCT), and total import and export value (TMX). The detailed test results are provided in Table 7.

Table 7
Granger Causality Test Results

Null hypothesis	F-Statistic	P-value	Result
LNPCT does not Granger Cause LNGDP	1.48173	0.2314	Accept
LNGDP does not Granger Cause LNPCT	0.39743	0.5324	Accept
LNTMX does not Granger Cause LNGDP	9.77550	0.0035	Reject
LNGDP does not Granger Cause LNTMX	0.26624	0.6090	Accept
LNTMX does not Granger Cause LNPCT	3.20345	0.0819	Reject
LNPCT does not Granger Cause LNTMX	1.21066	0.2785	Accept

Table 7. Granger Causality Test Results Based on the results of the Granger causality test in Table 7, there is no Granger causality relationship between LNGDP and LNPCT. Since the experimental results do not conclusively establish the absence of a true causal relationship between the economic development of the Fujian region and the port economy, economic development is typically influenced by multiple factors and is not solely determined by a single variable. Therefore, further research is needed to confirm this. In the relationship between LNGDP and LNTMX, a unidirectional causal link exists, specifically at a 5% significance level, where the total import and export value is a Granger cause of regional GDP. Simultaneously, there is a similar unidirectional causal relationship between LNPCT and LNTMX, indicating at a 10% significance level that the total import and export value is a Granger cause of coastal port cargo throughput. These results further confirm the interactive

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relationships among regional GDP, coastal port cargo throughput, and total import and export value.

From the perspective of econometrics, the development of Fujian's export-oriented economy drives the growth of the coastal port economy and, in turn, stimulates the overall economic growth of the Fujian region.

e. Impulse Response and Variance Decomposition

Impulse Response

The impulse response function is used to describe the function of the impact on the current and future values of all endogenous variables when the random error term of a particular endogenous variable experiences a shock of one standard deviation. To delve deeper into the interrelationships and impact characteristics among the variables of Gross Domestic Product (GDP), coastal port cargo throughput (PCT), and total import and export value, as well as to illustrate the impulse effects generated by mutual shocks among these three variables, this study conducts an analysis through the plotting of impulse response graphs. In the graph, the horizontal axis represents the lag periods of the impact, while the vertical axis represents the current and future values of endogenous variables after the impact. The solid line represents the actual impulse response function, and the dashed lines represent the positive and negative two standard deviation bands used to measure the volatility range of the impulse effects. The impulse response graph intuitively demonstrates the mutual influence among variables, aiding in a deeper understanding of the dynamic interactions among them.

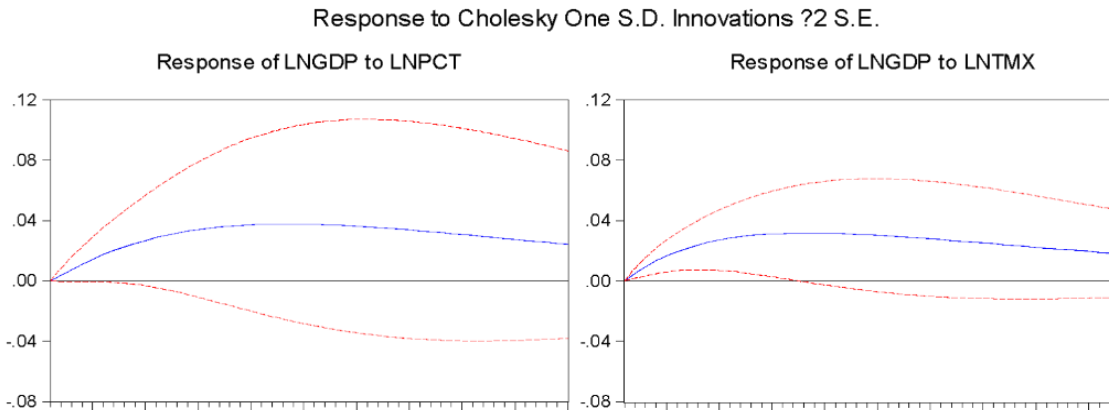

Figure 5. Impulse Response Graph of Gross Domestic Product

Figure 5 depicts the impulse response graph for the Gross Domestic Product (GDP) of the Fujian region, illustrating the stimulative effect of shocks in coastal port cargo throughput and total import and export value on the GDP of the Fujian region. When coastal port cargo throughput and total import and export value experience positive shocks, the GDP of the Fujian region responds positively, showing an upward trend. As shown in the graph, the positive stimulative effects peak in the 23rd and 18th periods, maintaining a sustained positive response for an extended period and gradually diminishing as the lag periods increase. This indicates that the positive impact of coastal port cargo throughput and total import and export value on the GDP of the Fujian region has a lasting effect.

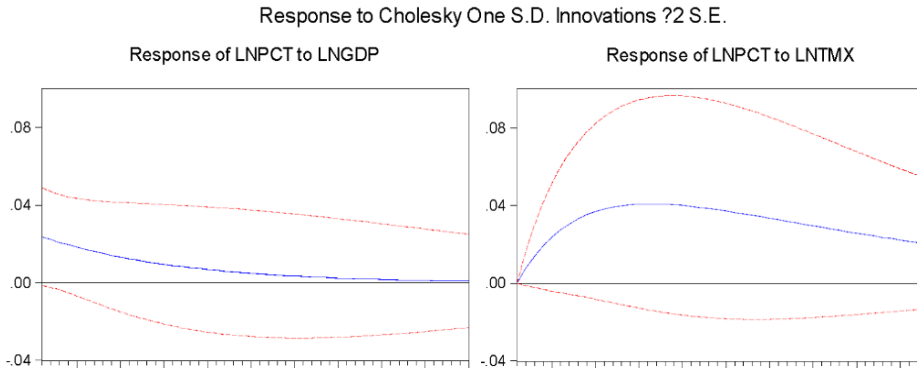

Figure 6. Impulse Response Graph of Coastal Port Cargo Throughput

Figure 6 illustrates the impulse response graph of coastal port cargo throughput, reflecting the stimulative effects of shocks in the Gross Domestic Product (GDP) of the Fujian region and total import and export value on the coastal port cargo throughput in Fujian. When there is a positive shock to the GDP of the Fujian region, coastal port cargo throughput responds positively in the current period. Subsequently, this influence gradually weakens, reaching a state of long-term stability and slow attenuation after the 30th period until the impact becomes negligible. When there is a positive shock to the total import and export value of Fujian, coastal port cargo throughput exhibits an upward trend, rapidly increasing and peaking in the 16th period before starting to decline. In the long term, it remains in a stable state of positive impact.

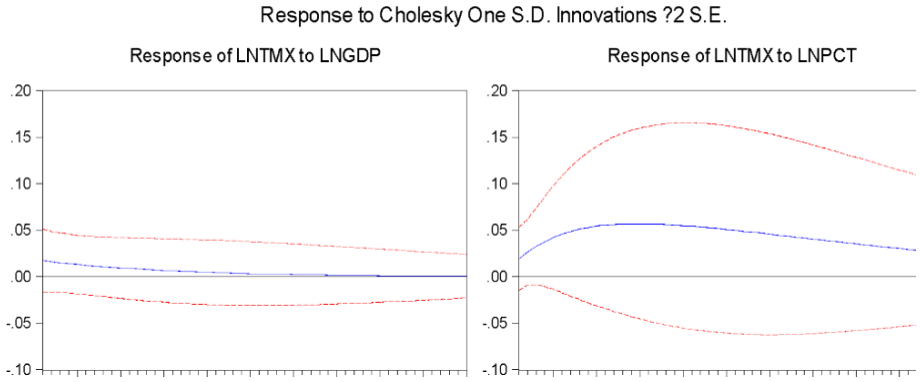

Figure 7. Impulse Response Graph of Total Import and Export Value

Figure 7 represents the impulse response graph of total import and export value, illustrating the stimulative effects of shocks in the Gross Domestic Product (GDP) of the Fujian region and coastal port cargo throughput on the total import and export value. When there is a positive shock to the GDP of the Fujian region, the total import and export value responds positively in the current period, but the response is not pronounced and the effect is not significant. Subsequently, this influence gradually weakens until it nearly disappears. When coastal port cargo throughput in Fujian experiences a positive shock, the total import and export value responds positively in the current period, reaching its peak in the 15th period before slowly declining. As the number of periods increases, the impact of the shock maintains a stable and gradual weakening state.

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Variance Decomposition

When assessing the importance of different shocks, we typically employ the Relative Variance Contribution (RVC) as a measure. Variance decomposition is a method used to evaluate the significance of various shocks by analyzing the extent to which each structural shock influences the variation in endogenous variables. This approach aids in understanding the contribution of different factors to the fluctuations in endogenous variables, allowing for an accurate assessment of the importance of various shocks.

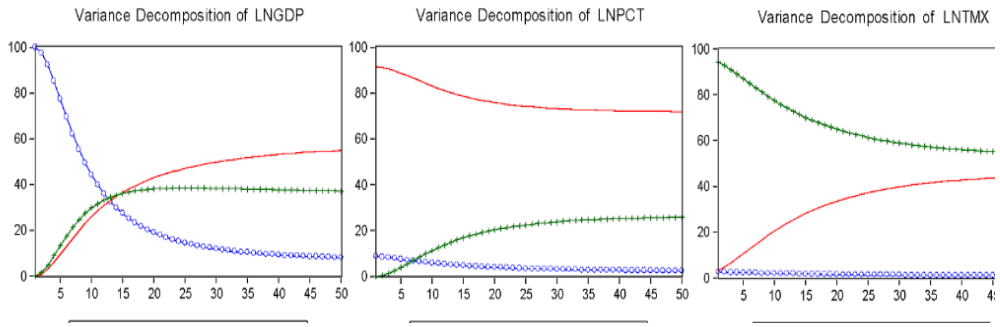

Figure 8. Variance Decomposition Plot

As shown in Figure 8, the contribution of Fujian regional GDP in the short term mainly comes from itself. With the passage of time, the contribution degree of Fujian's regional GDP to itself showed a downward trend, while the contribution rate of cargo throughput and total import and export volume of coastal ports increased rapidly from 0 until the contribution degree of the 13th phase approached the contribution rate of regional GDP. The contribution rate of cargo throughput in coastal ports continued to increase to 54% and remained in a long-term stable state, while the contribution rate of total imports and exports was stable at about 38%, and the contribution degree of regional GDP itself fell to about 8% and remained stable.

The fluctuation of cargo throughput in coastal ports is mainly due to its own factors, and the contribution rate is about 73%. The contribution rate of total imports and exports gradually increased and stabilized at about 25% after the 31st period. The impact of cargo throughput on the regional GDP tends to be small and positive and remains at 2%.

Finally, the total volume of imports and exports explains itself to a greater extent, and although the contribution has a downward trend, it is basically stable at about 57% in the long run. The contribution rate of cargo throughout coastal ports gradually increased to the 41st phase and stabilized at 42%. However, the total volume of imports and exports is very dependent on the regional GDP, and its contribution rate is only about 1%.

As shown in the above diagram, the driving effect of Fujian's regional economic aggregate on the port economy and export-oriented economy is not obvious, and it fails to play an effective promoting role. However, the prosperity of the region's foreign trade provides favorable conditions for the expansion of the coastal port throughput, and with the development of the coastal port economy, it also drives the development of the region's export-oriented economy. The role of the port economy and export-oriented economy in the Fujian coastal area is increasing day by day, and the promotion effect is more significant in the long run.

CONCLUSION

In the context of contemporary economic globalization and market interdependence, the interaction between coastal ports and regional economies is indispensable. Ports are the cornerstone and driving force to promote regional economic development, while the regional economy provides the necessary carrier and support for the development of ports. Through the empirical analysis of the VAR model, there is a long-term equilibrium relationship between the Fujian regional economy, the coastal port economy, and the regional export-oriented economy. Coastal port economies and regional export-oriented economies are important driving forces of Fujian's economic development, and the economic growth of Fujian also drives the development of coastal port economies and regional export-oriented economy to a certain extent. In order to promote the interactive development of Fujian coastal ports and the regional economy, and give better play to the mutual pulling function of the two, this study puts forward the following suggestions:

1. Continue to upgrade port infrastructure and promote modern development.

In order to cooperate with the continuous development of the Fujian regional economy and the rational layout of port industries, it is necessary to continuously optimize and improve the level of Fujian coastal port infrastructure. This includes the construction of docks, waterways, breakwaters, anchorages, and collection and distribution channels, focusing on promoting the overall development of key port areas, improving the scale, intensity, and modernization of ports, and striving to build more advanced and efficient port infrastructure to promote the modernization of regional economies.

2***. Comprehensively promote the construction of green and safe ports to achieve synergy between environmental protection and development.***

The Fujian port industry should strive to achieve intensive and efficient utilization of port resources and promote the overall reduction and layout optimization of ports to enhance the level of green development of ports. At the same time, the utilization of new port shoreline resources should be controlled to improve the efficiency of resource integration and utilization. Strengthen the capacity of pollution prevention and control, promote the construction of pollutant reception and treatment facilities for dust, noise, and other aspects of the port, to take comprehensive measures, set up dust barriers and noise prevention equipment, and promote the wide application of clean energy.

3. Build a multi-level and multifunctional port system along the coast of Fujian.

Based on a comprehensive consideration of the resource characteristics, function positioning, and transportation layout of the ports on the Fujian coast, a multilevel and multifunctional port system on the Fujian coast is constructed. Fuzhou Port and Xiamen Port are positioned as major coastal ports in the country, while other ports are given the role of regionally important ports.

As the core of the national comprehensive transport system, Xiamen Port is a key support for the construction of the "Silk Road Maritime Transport" and plays an important role in the industrial development and economic growth of Xiamen and Zhangzhou. In order to accelerate the construction of the Xiamen International Shipping Center, Xiamen Port should clarify the direction of international development and gradually build a modern, comprehensive port with a reasonable layout, complete functions, advanced facilities, safety, and green.

Fuzhou Port plays a key supporting role in regional economic development and opening up, which is of great importance to the harbor economic development of Fuzhou City, Ningde

City, and Pingtan Comprehensive Experimental Zone. As the main port of Fujian's transport to Taiwan and the main support for promoting the river-sea combined transport, Fuzhou Port should further promote the optimization, integration, and layout adjustment of port resources while expanding the port scale in a planned way. At the same time, Fuzhou Port should accelerate the cultivation and development of port industries, optimize modern logistics services, and enhance the level of specialization in transport and tourist passenger transport to Taiwan.

Quanzhou Port and Meizhou Bay Port are important transportation hubs in the coastal areas of Fujian province. They not only play a key role in opening up to the outside world but also play a key window to promote the integrated development of Fujian and Taiwan. Quanzhou Port will focus on the development of domestic trade container transportation business, while taking into account the needs of mining construction materials, coal, and other bulk and general cargo transportation and gradually expand foreign trade container routes to build a modern comprehensive port. In order to further expand modern logistics and harbor industrial service functions, Meizhou Bay Port should strengthen its bulk cargo transportation capacity and focus on the development of energy, raw materials, and other businesses.

The four ports along the coast of Fujian contain 25 port areas, which play unique roles in regional economic and social development, the construction of a comprehensive transportation system, and the layout of port industries. However, their development bases and stages are different, so it is necessary to further clarify the development priorities of each port area and plan the port areas that need to be developed. At the same time, in order to better play the role of these port areas, it is also necessary to strengthen cooperation and contact between the port and the surrounding areas and jointly promote the development of the regional economy.

4. Accelerate cross-straits industrial docking and promote the upgrading of port-adjacent industrial structures

Fujian Province has transformed coastal areas into a concentration of advanced manufacturing, and the proportion of basic and raw material industries is increasing. In the context of the continuous and peaceful development of Cross-Strait relations, the improvement of international competitiveness has become a common goal, and emerging strategic industries and advanced service industries have received special attention. Information technology, automobile manufacturing, new materials, new energy, and marine industries will be further integrated. Fujian coastal ports need to carry out overall planning in order to promote the coordinated development of the harbor industrial belt. Provide efficient transportation services for port industry and foreign trade, and provide accurate spatial guidance and support for industrial development. Thus, the advantages of Fujian coastal ports can be better utilized to promote the sustainable development of the regional economy.

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