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Relationship between Port Capacity and Cities' Economy – Case of Shanghai and Hamburg

By

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Acknowledgement

The completion of this thesis means that my master's career has come to the end. One year is not long for a master's degree, but this year is quite special. It is not only the first time for me to live away from home independently, but also a year for me to overcome academic pressure and learn new knowledge in a new environment that is completely different from my previous study and life environment.

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Abstract

The common development of port and city economy is the objective requirement of regional economic and social development and an important way to improve port competitiveness. In the era of economic globalization, urban transformation is a process of co-evolution of industrial transformation, spatial transformation, institution and coordination mechanism.

This paper takes the relationship between Port Capacity and urban economic growth as the research subject. Firstly, it expounds the research background, purpose, significance and research methods of the topic selection. Then, from port logistics and other port industries and port performance two aspects of the relationship between port logistics and urban (regional) economic growth of the relevant theories and empirical research results are reviewed and summarized. After determining the application of VAR model to analyze the interaction between port logistics and city economy, the port throughput, container throughput and port city GDP are selected as indicators for experimental analysis. Taking Shanghai and Hamburg as examples, this paper studies port performance and urban economy. Among them, the case of Shanghai carried out two experiments to study the relationship between port performance and city's economy under the premise of urban industrial transformation. The results show that there is a stable equilibrium relationship between the total throughput of Shanghai ports and urban economy, while container throughput has no such relationship. The comparison between Shanghai case1 and Shanghai case 2 shows that the impact of GDP on container throughput is much smaller than that of GDP on total throughput. However, the relationship between total throughput and container throughput in Hamburg and urban GDP cannot be related by VAR model. Through the analysis, this is due to the two cities have a wide range of hinterland, and their development history is different and other reasons.

Hamburg and Shanghai are the representatives of the core hub ports of the East and the West. Both of them are among the most representative port cities in the world. Although the development of the two cities has its own characteristics, the development process and governance mode are similar. Therefore, through comparative analysis of the experimental results, from 6 aspects.

Key words: city, city economy, port, port economy, VAR model

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1 Introduction

Port is the gateway for coastal cities to the outside world, the basic support for foreign trade, and the important driving force for urban development. In recent years, the functions of ports have gradually developed from simple logistics and transportation to the logistics chain system and industrial chain system, and the port economy has increasingly enhanced the role of promoting urban development.

The function of port logistics and transportation can gradually guide the direction of industrial development and urban planning. Meanwhile, a perfect industrial system and reasonable urban spatial layout can further improve the operation efficiency of ports.

Industrial evolution is the driving factor of urban transformation, which is characterized by accelerated development of traditional industry, dominated by manufacturing owner-oriented service industry, dominated by traditional service industry to modern service industry, and driven by capital to innovation. With industrial transformation, urban spatial reconstruction and structural optimization is one of the important symbols of successful urban transformation. In addition to industrial transformation and spatial transformation, the government's strategic planning and institutional innovation have also played a fundamental role in guiding and promoting the transformation. In the early stage of transformation, many cities have made transformation plans that fit the reality, as well as corresponding macro policies and institutional guarantees.

Hamburg and Shanghai are friendly sister cities, both of which are among the most representative port cities in the world. Although they have their own characteristics in urban development, they share similar development history and governance model.

The spatial relationship of Hamburg's urban development in the early stage, was the close connection in port-city space and function. A large number of bulk grocery trade and free port policies made Hamburg rapidly grow into one of the European trade centers. After the industrial revolution, heavy and chemical industries and manufacturing industries were distributed in ports, residential areas moved out, and the functions of cities and ports gradually had clear boundaries. The demand of large-scale ships for deep-water ports and the development of railways make the distance between ports and cities gradually expand.

According to Hafencity Hamburg Masterplan (2000), the construction of Hamburg Port New City expands the original urban area by nearly 40%. The reconstruction of old urban area, new docks and other urban renewal measures provide a sound infrastructure for Hamburg port to become a high-end port industry and service industry agglomeration area. Hamburg port city is actively cultivate high value-added industry type, shipping finance, insurance, consulting and other high-end shipping service has been gradually replacing the traditional port industry types such as warehousing, wholesale, in Hamburg city, fort Elbe river Hal has already begun to push inland port around industrial port industry of high-tech industry to replace.

From the mid-1990s to 2005, the port construction of Shanghai was carried out around the site selection and development of deepwater hub ports. Since 2009, modern shipping services such as shipping insurance, information services, maritime law and ship technical services have become the focus of Shanghai's construction as an international shipping center. At the same time, the development of high value-added industries promoted by Shanghai is similar to the type of industrial clusters mainly created by Hamburg. The industrial development of the two cities focuses on high-tech intensive, high investment in R&D and sustainable development, giving full play to scale effect by building clusters.

Through two cases of Shanghai and Hamburg, this paper discusses the relationship between urban economic development and port. Both ports are very competitive, and Hamburg is more mature after industrial transformation and development. Therefore, the example of Hamburg has certain reference significance for Shanghai. On this basis, an in-depth study of the case of Shanghai is carried out to analyze the role of Shanghai's industrial transformation and development in promoting the development of the city and port.

2 Literature review

In order to study the relationship between cities and ports, we start from the following aspects

The relationship between port and city economy can be discussed from the perspective of port logistics. A port is an important transportation hub for the city in which it is located. It is used to transport goods as well as passengers. Because of its ability to distribute goods, it has promoted the industry of the city. In addition, port tourism, port finance and other industries can be developed to further generate income for the city. These port functions and port industries can directly become the driving force of urban economic development.

In addition to the direct relationship between port and city economy, many scholars have indirectly analyzed the relationship between city and port by discussing the relationship between various indicators of port performance and representative indexes of city economy. Some scholars listed various indicators for analysis and comparison. In most studies, the selected indicators are processed and then brought into the mathematical model, and then the results of the model are discussed in depth.

2.1 Port Logistics

Because of port logistics operation, the import and export volume of the city should be increased, so as to drive the development of port economy, the progress of port industry, and the growth of regional economy. Finally, the gross national income of the country will increase, and the development of the whole economy will be driven.

2.1.1 The port serves as an important transportation hub of the city

Logistics is the most basic function of coastal ports, but also one of the core functions. Port has unique geographical advantage and location advantage in developing modern logistics.

Modern ports play an important role in the international trade integrated logistics supply chain. Ports not only play the basic functions of storage, sorting, cargo handling, distribution and so on, but also take charge of the scheduling of the information system of the whole international logistics supply chain as well as the stowing and transportation of goods. Port as its regional development of the open door, port transport demand is mainly driven by the development of urban economy, the main is the development of export-oriented economy. Therefore, it can be said that the development of urban economy and the exchange of international trade fostered the port. At the same time, port, as an important node in the supply chain, once formed, its development has a greater pulling effect on regional economy. Port and regional development have different characteristics in different stages. Grasping the development vein and correlation between port and city is conducive to forming the correct development ideas and relevant policies of port logistics and urban economy. In order to enhance the core competitiveness of the port, many port enterprises also attach importance to the development of port logistics, regard it as one of the important elements of development, in order to realize the great goal of good interaction between port logistics and urban economic development. (Yi, 2012)

2.1.2 The promotion of port to urban industry

The advantages of the port itself can not only promote the development of shipping and related industries, but also promote the development of the manufacturing industry relying on the port, especially the industry and commerce that depend on the bulk freight by water. The strong correlation effect produced by port economy can even affect the composition of the main industries of the corresponding port city. Therefore, port economy can be defined as an industrial cluster: in the geographical location of the port and its connection, related industries have cooperation and competition, and have interaction and synchronization in industrial upgrading and technological progress. Meanwhile, they can share resources, reduce costs and improve competitiveness.

Port economy can improve the local industrial structure. As an important link of cargo transportation, port plays an important role in resource allocation and industrial structure improvement. Taking developed countries as an example, in the industrial structure adjustment of port areas in coastal areas, under the guidance of scientific and technological development, transformation and upgrading of traditional industries should be implemented, new industries should be developed, and industrial layout and structure adjustment of port areas and hinterland should be promoted to achieve coordinated development. (Wang, 2015)

Li et al (2020). used grey correlation degree and vector autoregression model for empirical analysis. The results show that the primary industry has a small and stable impact on port throughput, the secondary industry has a large direct impact on port throughput, and the tertiary industry has a certain impact on the increase of port throughput, but the impact degree is lower than that of the secondary industry. Industrial structure adjustment brings about port throughput growth to slow down gradually.

2.1.3 Port development of tourism

Port tourism development needs to rely on the city, in a certain regional scope, the port as the center to develop business, tourism, vacation, and entertainment, product processing and other services. By using a meta-regression, an Ordinary Least Square model and a fixed-effects model as well as Capital-Goodman Mediation Tests， Jamie (2019) et al provided a meta-analysis of the direct economic impacts of cruise tourism,. They found out that there exists a significantly positive coefficient between direct economic impacts and: number of passengers, number of crew members, number of cruise lines, expenditures per passenger, and expenditures per cruise line. That is to say, port tourism plays a significant role in promoting port economy. By rationally developing tourism resources and providing tourists with various services, port creates a lot of value for the city.

2.1.4 Port Finance

From the basic port construction to the transport of port logistics, and then to the development of related industries, the development of port economy needs the support of a large number of funds. The construction of infrastructure, ship construction and personnel investment can be supported by port finance. Adequate financial support facilitates the upgrading of port infrastructure, thus improving port operation efficiency; Can improve the economic scale of the port, produce scale economy; Optimize the development structure of port economy, enrich the capital direction of port economy and accelerate economic growth. From the aspects of port economy and financial care, the supporting role of port economy on the marine port finance, and the financial support law of the development of international marine ports, the results shows that, in the levels of financial overview and financial measures, ocean ports will have a strong role in promoting the development of port economy.

2.2 Port Performance

Port performance indicators are the measures of the efficiency of various port activities. These indicators provide reliable advice to port management. Indicators like port throughput, container throughput are often collected and analyzed.

2.2.1 Comparison and Analysis of Port Performance Indicators

In the 1960s, geographer Bird (1963) constructed the Anyport model from the perspective of port infrastructure based on the investigation of river ports in Britain, and proposed for the first time that port logistics and urban economy have a benign interaction. The model dentified three major phases: settings（the initial setting of a port）, expansion (facilities and operations expanded because of increased port activities), specialization (development to handle specialized freight). It has some limitations analyzing contemporary port development without considering the recent development of shipping networks.

In 'Port and City Integration: Transportation Aspect' (Gurzhiy, 2021), the conclusion is drawn through observation and analysis of three major ports: Shanghai, Rotterdam, and Hamburg. The author proposes many criteria for measuring a large port, especially the area it occupies and its rate of cargo turnover. The author thinks that transportation planning can realize the coordinated development of all kinds of transportation in urban planning activities and rationally select the most effective transportation system development measures. Applying IT technology to logistics control can improve the quality of logistics and enable effective planning according to the key strategic aspects of each particular port.

Hamburg and Shanghai are regarded as representative port cities of the West and East in 'the study of Industrial Transformation and Spatial Governance of port cities.' From the perspective of urban history, this paper investigates the development trajectory and governance of Hamburg and Shanghai, summarizes the experiences of these two cities in solving urban problems and designing strategies, and predicts the prospects of these two cities. Through comprehensive comparison, the author thinks that the evolution process of Hamburg the port city relationship is similar to that of Shanghai port city. Hamburg and Shanghai, two two-port ties developed to a certain extent, have a good reference for the development of port cities in the world.

2.2.2 Analyze Indicators through mathematical model

In 'port-city Relationships in Europe and Asia', the author studies the nature of Port city relationships in Europe and Asia, two major Port regions in the world. A complementary approach based on available city and port indicators for 121 port cities is proposed. Through the comparison of indicators (including population of the metropolitan area, container throughput and other indicators), it is found that there are distinct differences between European and Asian port cities, especially in their hinterland. According to the insertion in the city and port system, port city relations have regional differences, in Europe's core-periphery dualism and Asia's port city hierarchy (Ducruet, 2010). Therefore, the distance between European ports and inland markets and the size of coastal markets for Asian ports are the main factors explaining the nature of the port-to-city relationship in these two regions.

Based on a matrix of port-city centrality and intermediacy, the main indicators available for international comparison are urban population and container throughput. Through the research, it is found that the economic driving effect of port logistics is not only reflected in the increase of quantity, but also reflected in the improvement of jobs and average wage level.

(Ducruet, 2013)

Mahatama proposed the hypothesis of quantitative relationship between port logistics and urban economy, classifying ports into four main types, Global Pivot, Load Centers, Regional Ports and Minor Ports. A quantitative analysis comparing the growth of national economies and their ports show that each port type has different relationships with their national economies. The accuracy of the hypothesis is proved by Pearson correlation coefficient.

'Research on the Economic efficiency of Shanghai Port and city Based on DEA Model' adopts DEA model to analyze the economic efficiency of Shanghai port from 2000 to 2018 and the efficiency of the port's contribution to the city's economy, and puts forward suggestions (Lv, 2020)results show that: affected by scale efficiency and pure technical efficiency respectively, the comprehensive economic efficiency of Shanghai port shows an upward trend; The comprehensive efficiency, pure technical efficiency, and scale efficiency of Shanghai port's contribution to the urban economy are all at a high level, among which the main influencing factor of the comprehensive efficiency is pure technical efficiency. This paper mainly discusses the contribution of port efficiency to urban economic development.

'Research on the Relationship between Port Logistics and Urban Economic Growth' combined with the actual situation of Dalian, summarizes the development of Dalian port logistics, through the study of data from 1994 to 2010 Dalian port logistics and economic growth of the relationship between the time sequence (Wang, 2015).

Analysis. The dynamic correlation and causality between Dalian port logistics and urban economic growth are analyzed employing Granger causality test, impulse response function and variance decomposition. The results show that there is a long-term stable equilibrium relationship between Dalian port logistics and economic growth. There is a one-way causal relationship between port logistics and economic growth, and there is a two-way causal relationship between port throughput and container throughput. The variance contribution of port throughput to economic growth and container throughput is greater than that of container throughput to economic growth and port throughput respectively, while the variance contribution of economic growth to port logistics is lower.

In ' for the Study of Port Logistics and the Development of the City's Economic Interaction' (Yi, 2012) the relationship between port logistics and urban economy development made the relevant qualitative analysis at the same time, also in combination with the VAR model established port logistics relevance evaluation model with the city's economic development, solving the Dalian port throughput and three industrial output value, the correlation of Further study on the mechanism of port logistics and urban economic growth.

2.2.3 Conclusion

From the summary of the above literature, it can be known that port and urban economy are related and mutually influenced from the functions and performance of ports. Scholars have studied the relationship between port and port economy from many angles.

Qualitative analysis is applied to the interaction between port and city economy. According to the literature review, through quantitative analysis to determine the dynamic relationship between port logistics and urban economy, the main methods are relational degree Model, gray relational Model, Data Envelopment Analysis, and Vector Autoregression Model. The main research objects are cargo throughput, container throughput, port infrastructure and urban economy.

As for Shanghai and Hamburg, some studies have pointed out the similarities in their development plans. However, due to historical reasons, Hamburg started earlier than Shanghai, so the study of Hamburg has certain guiding significance for Shanghai.

By summarizing the literature, this paper uses vector autoregressive model to study the relationship between the economies of Shanghai and Hamburg and their ports. At the same time, under the premise of industrial structure optimization, the case of Shanghai is deeply studied.

This article uses vector autoregression model and Vector Autoregression Model for the analysis of port logistics and the relationship between urban economic development. The GDP of a city is used to represent the economic development of a city, and the throughput of ports and container throughput represent port performance. The relationship between GDP and port performance of the two cities is analyzed through the model, and the model results are analyzed and interpreted. In addition, taking Shanghai as a case, the experiment is conducted again to study the relationship between GDP of the city's secondary and tertiary industries and port performance, and the conclusion is obtained through analysis.

3 Methodology

Compared with other model Vector Autoregression Model can better represent the relationship between port, its connectivity with the hinterland and the city economy. It is bidirectional, rather than focusing on the impact of port efficiency on urban economy like DEA Model. Therefore, Vector Autoregression Model is selected as a main part of the methodology in this paper.

3.1 Vector Autoregression Model (VAR)

Vector autoregression (VAR) is based on the statistical properties of the data to build a model. VAR model constructs the function of lag value of all endogenous variables in the system. It is an unstructured multi-equation model which is suitable for the prediction of interrelated time series variable systems. At the same time, it is also widely used to analyze the dynamic influence of different types of random error terms on system variables.

The setting of VAR system mainly involves three aspects: the stationarity of variables in VAR model; the selection of variables in VAR system; and the selection of lag periods in VAR model. Among them, the basic principle of hysteresis selection is to find the number of hysteresis periods satisfying the requirement that the disturbance term obeys the white noise process.

In practice, the operation of this process mainly adopts the following two methods: one is to judge the optimal lag period based on various information criteria, and the other is the likelihood ratio test method.

3.1.1 Unit Root Test

For regression analysis of a time series model, the stationarity of variables should be tested first, that is, whether the time series contains unit roots. Methods commonly used for unit root test are ADF, KPSS and PP.

3.1.2 Co-integration Test

Co-integration indicates that there is a long-term stable relationship between variables. Even if multiple variables have their own long-term change rules, it also indicates that there is a long-term equilibrium relationship. The concept of cointegration embodies a definite long-term equilibrium relationship between non-stationary time series. It avoids the problem of "false regression" caused by traditional least square estimation.

3.1.3 Granger causality test

Granger causality can be used to test whether all the lag terms of a variable have an effect on the current values of another or several variables, which is essentially to test the significance of (a set of) coefficients by using vector autoregressive model.

Granger causality indicates that if there is a significant influence between the two, it indicates the existence of Granger causality, otherwise there is no Granger causality.

The following two regression models were used to verify granger causality:

$$y_t = \sum_{i=1}^{q} \propto_i x_{t-i} + \sum_{j=1}^{q} \beta y_{t-y} + \mu_{1t}$$

$$x_i = \sum_{i=1}^{q} \lambda_i x_{t-i} + \sum_{j=1}^{q} \delta y_{t-y} + \mu_{2t}$$

3.1.4 Impulse Response Function

Impulse response function refers to the response of the system to a shock or innovation of one of its variables. It can accurately describe the response of the affected variables in the model system when one unit of a variable is expected to change.

3.1.5 Variance decomposition

The variance decomposition can examine the decomposition of the mean square error of forecasts of any endogenous variable, reflect the contribution degree of the explanatory variables that cause the expected change of the dependent variable in the model system, and further evaluate the importance of different structural shocks.

3.2 Data and Data Sources

The problem of port logistics mainly involves shipping and transportation, collection and distribution, port loading and unloading, storage, packaging and processing, supervision of inspection and quarantine departments, customs departments and information processing. This is a large span, relatively complex system problem. There are no formal indicators and systematic statistical methods for the statistics of port logistics. Therefore, when establishing the model and evaluating the development level of port logistics, it is necessary to select the indicator data that can fully represent the level of port logistics.

Port throughput is an important index reflecting port production and management activities. It can fully reflect the existing production scale of the port and the actual situation of economic productivity of the port city. At the same time, it can also reflect the economic development of the port area and the structural characteristics of import and export trade.

In addition, the port logistics index should be selected from the production capacity of the port. The basic task of the port mainly includes the realization of the transportation of goods, which needs to adjust the rapid connection of various modes of transportation, so as to accelerate the transit transportation of cars, ships and goods. The main index to measure the function of a port is the throughput of goods, which reflects the position of a port in the national economy and social development.

GDP represents the total amount of social production, and port is a transportation sector that serves social production. Social production conditions determine port sources of goods. Assuming that the port can meet the needs of social production, port throughput can reflect the development of port logistics, so there must be some functional relationship between port throughput and port throughput. Therefore, this paper chooses GDP as one of the important indicators to reflect the level of urban economic development.

At the same time, from the perspective of industrial structure, GDP is composed of primary industry, secondary industry and tertiary industry, that is, the sum of the three industries as a whole constitutes the total amount of urban economy. Port logistics has a close relationship with it. These major industrial activities of modern ports generally belong to the scope of the second and third industries. Specifically related to the port and water transport industry and its auxiliary industry and related industries. According to the form of production and operation, related industries include manufacturing, construction, transportation, wholesale and retail trade, finance, insurance and service industry. These port logistics activities are part of the overall logistics system. Through these logistics activities, the port city and its hinterland economic development. Therefore, when selecting urban economic indicators, we can study the correlation effect between port logistics and urban economic growth from the perspective of analysing the correlation between port cargo throughput and the three major industries.

In order to further study the correlation between port logistics and urban economic growth, we will discuss the relationship between GDP and port throughput, as well as the correlation between the three major industries and port throughput. The data for Shanghai are available through the government's yearbook, while those for Hamburg are available through Statista and the official websites of the Port of Hamburg.

Table 1 Data used in Shanghai Cases

City	GDP	1	2	3	CARGO	CONTANER	CONTANER
Shanghai	GDP 10^9 rmb	Primary Industry 10^9rmb	Secondary Industry 10^9 rmb	Tertiary Industry	cargo throughput t*10^4	container throughput t*10^4	container throughput TEU*10^4
2000	4 812.15	74.76	2 215.75	2 521.64	20440	5169.6	561.2
2001	5 257.66	76.05	2 413.83	2 767.78	22099	5911.4	634
2002	5 795.02	77.69	2 635.28	3 082.05	26384	7821.7	861.2
2003	6 804.04	78.99	3 239.62	3 485.43	31621	10225.1	1455.4
2004	8 101.55	81.39	3 872.16	4 148.00	37897	13294	1808.4
2005	9 197.13	88.06	4 314.90	4 794.17	44317	16250	1808.4
2006	10 598.86	91.55	4 929.16	5 578.15	53748	19595	2171.9
2007	12 878.68	99.39	5 677.51	7 101.78	56144	23850	2615.2
2008	14 536.90	109.37	6 215.45	8 212.08	58170	25992	2800.6
2009	15 742.44	112.37	6 184.79	9 445.28	59205	24619	2500.2
2010	17 915.41	114.45	7 434.89	10 366.07	65339	27992	2906.9
2011	20 009.68	126.44	8 169.34	11 713.90	72758	31220	3173.9
2012	21 305.59	129.33	8 174.13	13 002.13	73559	32480	3252.9
2013	23 204.12	131.63	8 286.53	14 785.96	77575	34243	3361.7
2014	25 269.75	131.96	8 633.25	16 504.54	75529	35335	3528.5
2015	26 887.02	125.53	8 408.65	18 352.84	71740	35850	3653.7
2016	29 887.02	114.34	8 570.24	21 202.44	70177	36763	3713.3
2017	32 925.01	110.78	9 525.89	23 288.34	75051	39759	4023.3
2018	36 011.82	104.78	10 360.78	25 546.26	73048	41126	4201
2019	37 987.55	107.06	10 193.60	27 686.89	72031	42314	4330.3
2020	38 700.58	103.57	10 289.47	28 307.54	71670	43473	4350.3

Source: Shanghai Statistics Bureau Shanghai Statistical Yearbook, http://tjj.sh.gov.cn/tjnj/index.html

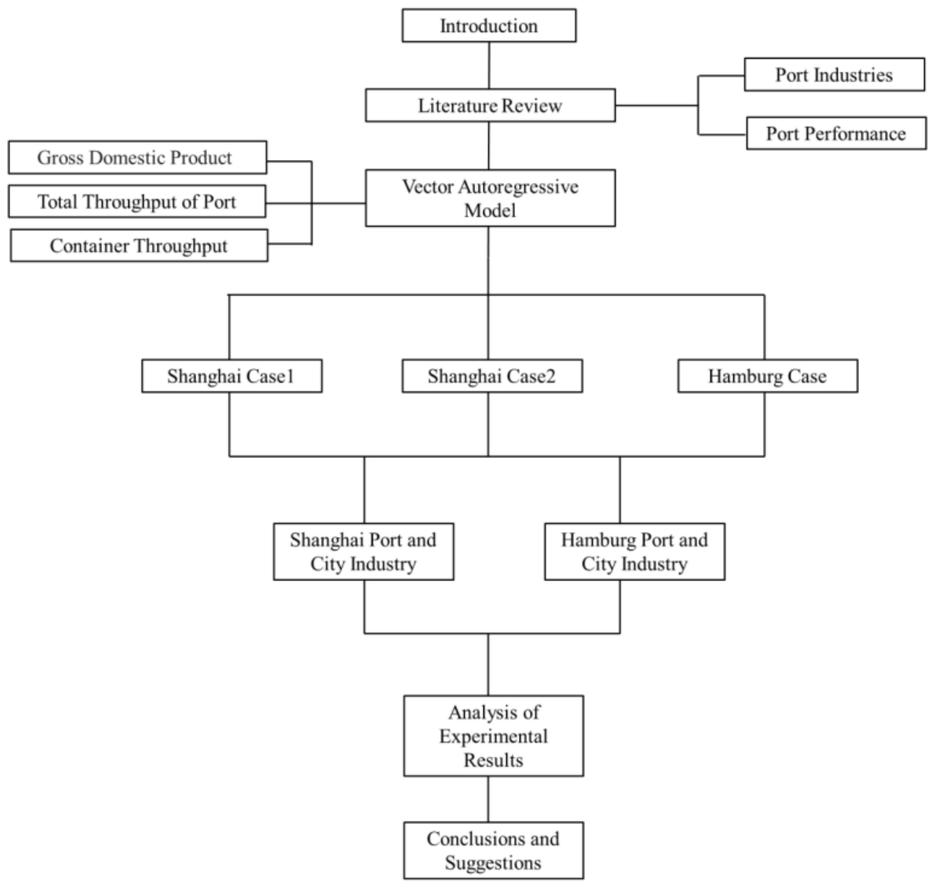
Table 2 Data used in Hamburg Case

City	GDP	CARGO	CONTANER
Hamburg	GDP 10^6 euro	cargo throughput 10^6 t	container throughput 10^6 TEU
2000	77837	50.1	4.3
2001	82158	55.7	4.7
2002	83116	58.2	5.4
2003	83480	63.5	6.1
2004	85436	67.6	7
2005	87135	72.9	8.1
2006	88325	78.8	8.9
2007	91470	82.5	9.9
2008	94516	82.1	9.7
2009	91129	62.2	7
2010	93643	70.4	7.9
2011	94664	76.2	9
2012	97009	73.9	8.9
2013	101145	77.9	9.3
2014	103431	81.1	9.7
2015	108166	77.2	8.8
2016	110541	79.1	8.9
2017	116589	78.4	8.8
2018	119104	79.7	8.7
2019	124571	78.4	9.3
2020	117892	70.1	8.5

Source: Satatista, Gross domestic product of Hamburg in Germany from 1970 to 2020, https://www.statista.com/statistics/1107516/gross-domestic-product-hamburg-germany/,

Port of Hamburg Statistics, https://www.hafen-hamburg.de/en/statistics/

3.3 Conceptual Framework



4 Findings from the model

Due to the change of the data over time, the time series will not be stationary at the same order, resulting in the existence of false quantitative relationship. Therefore, it is necessary to carry out unit root test on the data, that is, to verify whether the data are in a stationary state of the same order. The cointegration relationship is verified for the data that are not stationary in the original series, so as to obtain whether the relationship between the data is a long-term equilibrium state. Then, regression analysis was conducted to verify the quantitative relationship between variables, and Granger causality test was conducted to verify the causal relationship between variables. After that, VAR model was estimated, impulse response graph could be drawn and variance decomposition was carried out to understand the proportion of the influence, and finally the research conclusion of this paper was obtained.

4.1 Case1 of Shanghai

The research data of Shanghai from 2000 to 2020 were selected for analysis to understand the impact of LNTT and LNCT on LNGDP and the impact of LNGDP on LNTT and LNCT.

Table 3 Variable explanation

GDP	Gross Domestic Product	LNGDP	LN(Gross Domestic Product)
TT	Total Throughput	LNTT	LN(Total Throughput)
CT	Container Throughput	LNCT	LN(Container Throughput)

4.1.1 Establishment of OLS Model

Establish the Ordinary least-squares (OLS) model as follows:

$$LNGDP_t = \alpha_0 + \alpha_1 LNCT_t + \alpha_2 LNTT_t + \varepsilon_t$$

Where α_0 is a constant, representing the average value of the explained variable when other values are 0. α_i is the coefficient term, which represents the influence coefficient of explanatory variables or control variables on the explained variables. It can be seen how the influence direction of variables is. t is the time of the data. ε_t represents the difference between the actual value and the real value, which is not taken into account by other factors in the model. LN is the natural log. In order to reduce the unreasonable coefficient caused by the difference between the data and the possible heteroscedasticity, the natural logarithm of the value is generally processed.

4.1.2 Constructing the VAR Model

VAR model is the regression of its own lag period and the lag period of other variables on the variable in the current period. It is a regression model with mutual influence. The model is as follows:

$$Z_t = \alpha_0 + \sum_{t=1}^{k} A_i Z_{t-i} + \varepsilon_t$$

Among which $Z = (LNGDP, LNCT, LNTT)$, K represents the lag order, t is the year, $\varepsilon_t$and is the random error term.

4.1.3 Descriptive Statistics

Next, the descriptive statistics of the variable data are carried out. Acknowledge the basic distribution, minimum, maximum, and mean of the data. The fluctuation degree of data can be judged according to the standard deviation, so that we can have a basic understanding of the research data in this paper.

Table 4 Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
LNGDP	21	16.5746	0.6817	15.3867	17.4714
LNCT	21	6.2809	0.4299	5.3201	6.6538
LNTT	21	3.1743	0.6126	1.7249	3.7728

The mean value of LNGDP is 16.5746, the minimum value is 15.3867, and the maximum value is 17.4714. Relatively speaking, the variation range of LNGDP is not large, and the standard deviation is 0.6817, which is also relatively low. This is because LNGDP is the value after the natural logarithm, the mean value of LNCT is 6.2809, and the mean value of LNTT is 3.1743.

4.1.4 Unit root Test

Next, unit root test was conducted to test the stationarity of the data. If the original sequence is not stationary, continue differential processing until the data is stationary. If the data are in the stationary state of the same order, the regression analysis of the original sequence data can be continued. If they are all stationary in the original series, it is not necessary to verify the cointegration test, and regression is directly performed. If they are all stationary in the first order or higher order, the cointegration test is needed to verify whether the relationship between the data is not false in order to carry out regression analysis on the original series data. Next, the unit root test is performed as follows:

Table 5 ADF Test of Variables

	ADF Statistic	1% Critical Value	5%Critical Value	10%Critical Value	Result
LNGDP	0.441	-4.380	-3.600	-3.240	Unstable
D(LNGDP)	-3.327	-4.380	-3.600	-3.240	Stable
LNCT	-0.949	-4.380	-3.600	-3.240	Unstable
D(LNCT)	-3.840	-4.380	-3.600	-3.240	Stable
LNTT	-2.159	-4.380	-3.600	-3.240	Unstable
D(LNTT)	-3.601	-4.380	-3.600	-3.240	Stable

Note: D stands for first difference.

Through the unit root test, the ADF test value of LNGDP was 0.441, which was above the 10% critical value of -3.240. That is, LNGDP is not stationary, and the first difference of LNGDP is stationary. The ADF test value is -3.327, which is less than the 10% critical value -3.240. That is, the difference series is in a stationary state. All the other variable sequences are inferred, and all the sequences are in the first-order stationary state, which can be continued for the next step of analysis.

4.1.5 Co-integration Test

The sequence is not stationary in the original sequence, but stationary in the first order. In order to carry out regression analysis on the original series, cointegration test is needed for verification. Firstly, the optimal lag order is determined according to the relevant criteria.

Table 6 Selection of Optimal Lag Order

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	32.3713				0.0000	-3.2635	-3.2430	-3.1151
1	109.9660	155.1900	9.0000	0.0000	0.0000	-10.8851	-10.8033	-10.2915*
2	114.5610	9.1893	9.0000	0.4200	0.0000	-10.3956	-10.2524	-9.3569
3	133.4670	37.812*	9.0000	0.0000	3.1e-09*	-11.4963*	-11.2917*	-10.0124

Judging from the asterisk automatically annotated by the software, the order that meets the maximum number of criteria is 3, so the optimal lag order is 3.

Table 7 Co-integration Test

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	24	100.0603	.	79.1711	34.5500
1	29	126.5578	0.9474	26.1761	18.1700
2	32	135.2607	0.6198	8.7702	3.7400
3	33	139.6458	0.3857		
maximum rank	parms	LL	eigenvalue	max statistic	5% critical value
0	24	100.0603	.	52.9950	23.7800
1	29	126.5578	0.9474	17.4059	16.8700
2	32	135.2607	0.6198	8.7702	3.7400
3	33	139.6458	0.3857		

It can be seen that there are two kinds of tests. One is trace test and the other is max maximum eigenvalue test. The test results of both tests are that the trace statistic or max statistic is greater than the critical value of 5%. Therefore, the null hypothesis that there is no cointegration relationship is rejected. That is, there is a cointegration relationship between variables, and the results of the two tests are consistent, indicating that the cointegration test is passed.

4.1.6 Regression Analysis

Next, OLS regression analysis is used to analyze the quantitative relationship between variables. We can make t test, F test and goodness-of-fit test to make an overall comprehensive judgment on the model and get the result.

Table 8 Regression Analysis

LNGDP	Coef.	Std. Err.	t	P>t
LNCT	0.1763	0.6016	0.2900	0.7730
LNTT	0.9284**	0.4221	2.2000	0.0410
_cons	12.5201***	2.4832	5.0400	0.0000
R-squared	0.8899			
Adj R-squared	0.8777			
F(2,18)	72.7700			
Prob>F	0.0000			

Note: *** means the impact is significant at the 1% level of significance. ** means the impact is significant at the 5% level of significance, and * means the impact is significant at the 10% level of significance.

Regression results: the R square of the model was 0.8899, and the adjusted R square was 0.8777. It shows that the degree of fit of explanatory variables and control variables selected in this paper to the model is 87.77%, and the goodness of fit is good. The F-test value is 72.7700, which is significant at the significance level of 1%, and the significance test of the whole model is also passed. The influence coefficient of LNCT is 0.1763, which is not significant at the significance level of 10%. This indicates that LNCT has no significant impact on LNGDP, while LNTT is significant at the significance level of 5%. In other words, it has a significant promoting effect on LNGDP. Every 1% increase in TT will cause an average increase of 0.9284% in GDP.

4.1.7 Granger Causality Test

Next, Granger causality test was conducted to verify the causal relationship between variables. That is, whether one variable changes before the other. The lag order was determined to be 3 according to the corresponding AIC and SC criteria, and the causality test was conducted as follows:

Table 9 Granger Causality Test

Equation	Excluded	chi2	df	Prob>chi2
LNGDP	LNCT	3.6074	3	0.307
LNGDP	LNTT	8.5832	3	0.035
LNGDP	ALL	11.2830	6	0.080
LNCT	LNGDP	5.2079	3	0.157
LNCT	LNTT	10.6880	3	0.014
LNCT	ALL	11.2720	6	0.080
LNTT	LNGDP	86.2460	3	0.000
LNTT	LNCT	25.9370	3	0.000
LNTT	ALL	100.5100	6	0.000

Note: *** represents significant at 1% level of significance, ** represents significant at 5% level of significance, and * represents significant at 10% level of significance.

At this time, it can be seen that when testing whether LNCT is the Granger cause of LNGDP, the chi-square value is 3.6074, and the corresponding P value is 0.307, which is greater than 0.1. That is, at the significance level of 0.1, LNCT does not have enough probability to cause the change of LNGDP. In other words, the lag term of LNCT has insignificant influence on LNGDP. Similarly, LNTT is the Granger cause of LNGDP, LNTT is the Granger cause of LNCT, and both LNGDP and LNCT are Granger causes of LNTT.

4.1.8 VAR Model Estimation

The estimation of VAR model involves many lag terms. Collinearity is also easy to exist when there are many lag terms. Therefore, VAR model rarely looks at whether a single variable is significant, and generally analyzes it through impulse response and variance decomposition.

Table 10 VAR Model Synthesis

Equation	Parms	RMSE	R-sq	chi2	P>chi2
LNGDP	10	0.0271	0.9988	15491.9100	0.0000
LNCT	10	0.0471	0.9843	1130.6730	0.0000
LNTT	10	0.0306	0.9958	4318.1640	0.0000

It can be seen that the goodness of fit is 0.9988, 0.9843, 0.9958, respectively, which is relatively good. And the P values corresponding to the chi-square values are all 0.0000, which means that they have passed the significance test.

4.1.9 Stability Test

Since the impulse response and variance decomposition after the VAR model are carried out on the basis of the stability of the model, it is necessary to verify the stability of the VAR model in advance to ensure that there is no divergence in the following impulse graph.

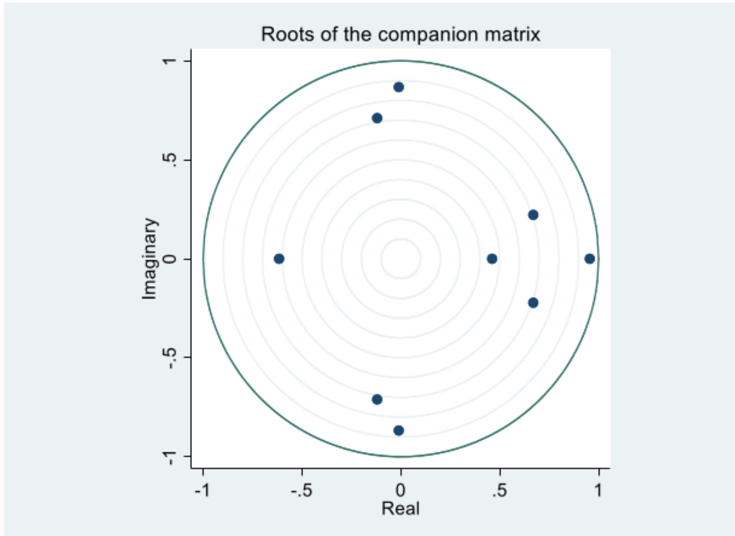


Figure 1 AR root test

It can be seen that all the dots are inside the circle, and there is no dot outside the circle. The stability test has passed, and the next analysis can be carried out.

4.1.10 Impulse Response Analysis

The impulse response diagram can reflect the persistent changes that the impact of one variable will drive on the other variable, thus reflecting the dynamic relationship. Next, the impulse response diagram is drawn:

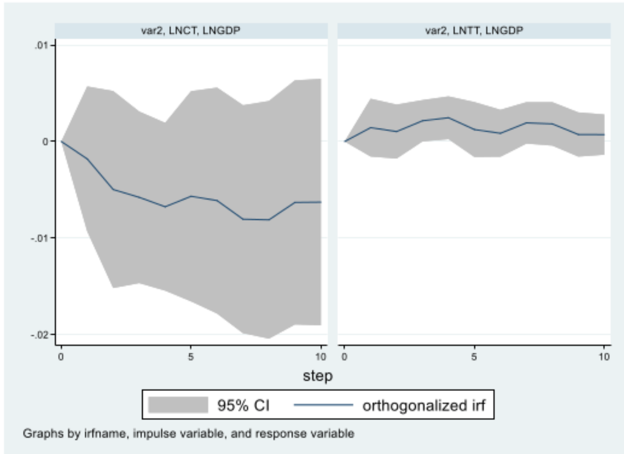


Figure 2　Impulse Response Analysis (LNCT, LNTT vs LNGDP)

As can be seen from the above figure:

When LNCT produces a positive shock of one unit standard deviation to LNGDP, the shock response of LNGDP is always below 0. It start at zero, and then develop into a negative shock response. When the negative impact reaction reaches a certain value, the negative impact reaction slows down.

However, when LNTT produces a positive impact of one unit standard deviation on LNGDP, LNGDP always produces a positive impact response, fluctuating above 0.

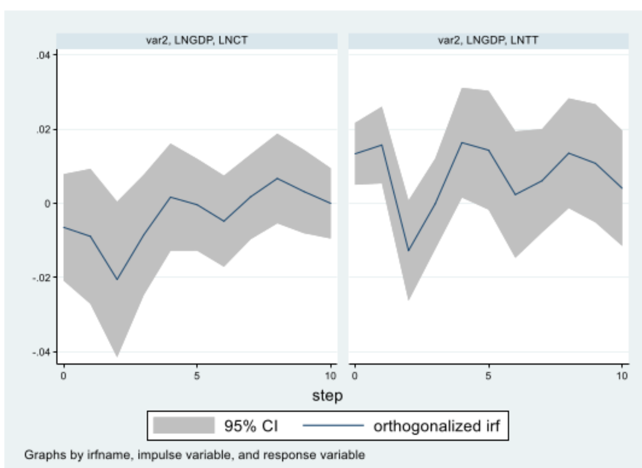


Figure 3　Impulse Response Analysis (LNGDP vs LNCT, LNTT)

It can be seen that when LNGDP gives LNCT a positive impact of one unit standard deviation, LNCT will have a negative change at first and then a positive change, and the final impact will tend to be positive. When LNGDP gives a positive impact of one unit standard deviation to LNTT, LNTT has a positive impact first, then a short-term negative impact, then a positive impact, and fluctuates above 0, and finally tends to 0.

4.1.11 Variance Decomposition

Impulse response can generally see the positive and negative reactions of variables, while variance decomposition can see the change of the influence proportion of variables, so as to understand the importance of influencing factors.

Table 11 Variance Decomposition

	LNGDP			LNCT			LNTT		
	LNGDP	LNCT	LNTT	LNGDP	LNCT	LNTT	LNGDP	LNCT	LNTT
1	1.0000	0.0000	0.0000	0.0425	0.0012	0.5678	0.4310	0.9575	0.0000
2	0.9917	0.0051	0.0032	0.0712	0.0022	0.3622	0.6356	0.9281	0.0006
3	0.9573	0.0384	0.0043	0.2293	0.1550	0.2479	0.5971	0.7643	0.0063
4	0.9177	0.0731	0.0092	0.2471	0.1811	0.2500	0.5688	0.7409	0.0120
5	0.8974	0.0909	0.0117	0.2420	0.2167	0.1993	0.5840	0.7446	0.0134
6	0.8923	0.0971	0.0107	0.2396	0.1999	0.1730	0.6271	0.7471	0.0133
7	0.8765	0.1132	0.0103	0.2463	0.2006	0.1730	0.6264	0.7402	0.0136
8	0.8508	0.1380	0.0113	0.2456	0.2350	0.1632	0.6019	0.7397	0.0147
9	0.8380	0.1507	0.0113	0.2579	0.2444	0.1444	0.6112	0.7276	0.0146
10	0.8350	0.1545	0.0105	0.2606	0.2355	0.1363	0.6282	0.7248	0.0146

The proportion of LNGDP's impact on its own impact was from 100% to 83.50% in the 10th period, indicating a relatively high proportion of its impact on itself. The influence of LNCT ranged from 0 in the first stage to 15.45% in the 10th stage, which was relatively high compared with other variables. The influence of LNTT accounted for 1.05% in the 10th stage, indicating that the influence of LNCT was relatively high in the short term.

The impact of LNGDP on LNCT and LNTT was 26.06% and 62.82% in the 10th stage, respectively. The impact of LNGDP on TT was also relatively high.

4.2 Case2 of Shanghai

On the basis of the previous experiment, the same data of Shanghai from 2000 to 2020 were processed and analyzed again to understand the influence of LNTT and LNCT on LNSTI and the influence of LNSTI on LNTT and LNCT.

Table 12 Variable explanation

STI	The sum of GDP of the secondary and tertiary industries	LNSTI	LN(The sum of GDP of the secondary and tertiary industries)
TT	Total Throughput	LNTT	LN(Total Throughput)
CT	Container Throughput	LNCT	LN(Container Throughput)

Due to too much space devoted, so here is the excerpt of this case.

4.2.1 Regression Analysis

Next, OLS regression analysis was used to analyze the quantitative relationship between variables. T-test, F-test and goodness-of-fit test were used to make an overall comprehensive judgment on the model and obtain the results.

Table 13 Regression Analysis

LNSTI	Coef.	Std. Err.	t	P>t
LNCT	0.1753	0.6035	0.2900	0.7750
LNTT	0.9353**	0.4235	2.2100	0.0400
_cons	12.4971***	2.4913	5.0200	0.0000
R-squared	0.8905			
Adj R-squared	0.8783			
F(2, 18)	73.1600			
Prob>F	0.0000			

Note: *** means the impact is significant at the 1% level of significance, ** means the impact is significant at the 5% level of significance, and * means the impact is significant at the 10% level of significance.

Regression results: the R square of the model was 0.8905, and the adjusted R square was 0.8783. It shows that the degree of fit of explanatory variables and control variables selected in this paper to the model is 87.83%, and the goodness of fit is good. The F-test value is 73.1600, which is significant at the significance level of 1%, and the significance test of the whole model is also passed. The influence coefficient of LNCT was 0.1753, which was insignificant at the significance level of 10%, indicating that LNCT did not have a significant influence on the existence of LNSTI. However, LNTT was significant at the significance level of 5%, that is, it had a significant promoting effect on the existence of LNSTI. An increase of 1% in TT caused an average increase of 0.9353% in STI.

4.2.2 Granger Causality Test

Next, Granger causality test is conducted to verify the causal relationship between variables, that is, whether one variable changes before the other variable. The lag order was determined to be 3 according to the corresponding AIC and SC criteria, and the causality test was conducted as follows:

Table 14 Granger Causality Test

Equation	Excluded	chi2	df	Prob>chi2
LNSTI	LNCT	3.5674	3	0.312
LNSTI	LNTT	8.4140**	3	0.038
LNSTI	ALL	10.9890*	6	0.089
LNCT	LNSTI	5.2086	3	0.157
LNCT	LNTT	10.6950**	3	0.013
LNCT	ALL	11.2730*	6	0.080
LNTT	LNSTI	86.5060***	3	0.000
LNTT	LNCT	25.9470***	3	0.000
LNTT	ALL	100.8100***	6	0.000

Note: *** represents significant at 1% level of significance, ** represents significant at 5% level of significance, and * represents significant at 10% level of significance.

At this time, it can be seen that when testing whether LNCT is the Granger cause of LNSTI, the chi-square value is 3.5674, and the corresponding P value is 0.312, which is greater than 0.1. That is, at the significance level of 0.1, LNCT does not have enough probability to cause the change of LNSTI. In other words, the lag term of LNCT has insignificant influence on LNSTI. Similarly, LNTT is the Granger cause of LNSTI, LNTT is the Granger cause of LNCT, and both LNSTI and LNCT are Granger causes of LNTT.

4.2.3 Impulse Response Analysis

The impulse response diagram can reflect the persistent changes that the impact of one variable will drive on the other variable, thus reflecting the dynamic relationship. Next, the impulse response diagram is drawn:

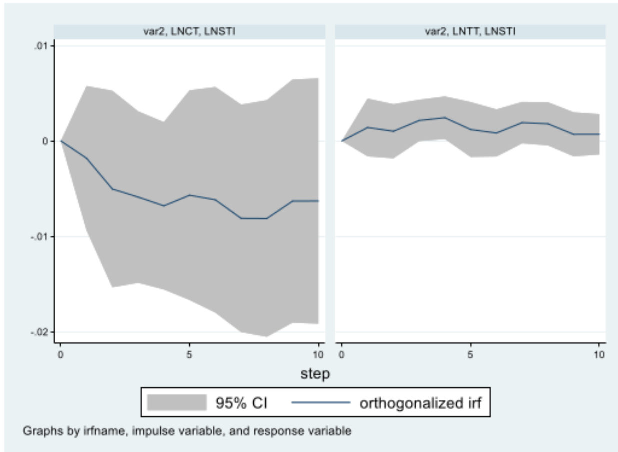


Figure 4 Impulse Response Analysis (LNCT, LNTT vs LNSTI)

As can be seen from the above chart:

When LNCT had a positive impact of one unit standard deviation on LNSTI, the impact response of LNSTI was always below 0. From 0 at the beginning, the negative shock reaction will be generated later. When the negative shock reaction reaches a certain value, the negative shock reaction will slow down.

However, when LNTT had a positive impact of one unit standard deviation on LNSTI, LNSTI always had a positive impact response, which fluctuated above 0.

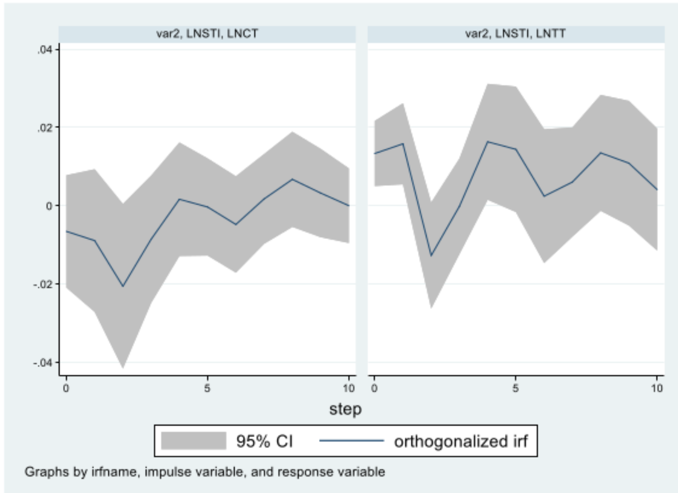


Figure 5 Impulse Response Analysis (LNSTI vs LNCT, LNTT)

It can be seen that when LNSTI gives a positive impact of one unit standard deviation to LNCT, LNCT will have a negative change at first and then a positive change, and the final impact tends to be positive. When LNSTI gives a positive impact of one unit standard deviation to LNTT, LNTT has a positive impact first, then a short-term negative impact, then a positive impact, and fluctuates above 0, and finally tends to 0.

4.2.4 Variance Decomposition

Impulse response can generally see the positive and negative responses of variables, and variance decomposition can see the change of the influence ratio of variables, so as to understand the importance of influencing factors.

Table 15 Variance Decomposition

	LNSTI			LNCT			LNTT		
	LNSTI	LNCT	LNTT	LNSTI	LNCT	LNTT	LNSTI	LNCT	LNTT
1	1.0000	0.0000	0.0000	0.0433	0.9567	0.0000	0.4312	0.0014	0.5674
2	0.9919	0.0051	0.0030	0.0715	0.9278	0.0007	0.6384	0.0020	0.3596
3	0.9574	0.0386	0.0041	0.2302	0.7634	0.0064	0.5988	0.1545	0.2467
4	0.9175	0.0736	0.0089	0.2482	0.7396	0.0122	0.5699	0.1812	0.2488
5	0.8978	0.0910	0.0113	0.2431	0.7434	0.0136	0.5849	0.2166	0.1985
6	0.8930	0.0968	0.0102	0.2407	0.7459	0.0134	0.6288	0.1992	0.1720
7	0.8774	0.1128	0.0098	0.2472	0.7391	0.0137	0.6282	0.1999	0.1720
8	0.8518	0.1374	0.0108	0.2465	0.7387	0.0148	0.6033	0.2345	0.1622
9	0.8394	0.1498	0.0108	0.2589	0.7264	0.0147	0.6125	0.2439	0.1436
10	0.8366	0.1534	0.0101	0.2618	0.7234	0.0148	0.6298	0.2347	0.1355

The proportion of LNSTI's impact on itself was from 100% to 83.66% in the 10th stage, indicating that the proportion of LNSTI's impact on itself was relatively high. The influence ratio of LNCT ranged from 0 in the first stage to 15.34% in the 10th stage, which was higher than that of LNTT. The influence of LNTT accounted for 1.01% in the 10th stage, indicating that the influence of LNCT was relatively high in the short term.

The influence of LNSTI on LNCT and LNSTI on LNTT accounted for 26.18% and 62.98% in stage 10, respectively. The influence of LNSTI on LNTT was also relatively high.

4.3 Case of Hamburg

In this case, the research data of Hamburg from 2000 to 2020 were selected for analysis to understand the impact of LNTT and LNCT on LNGDP and the impact of LNGDP on LNTT and LNCT.

4.3.1 Establishment of OLS Model

The model is as follows:

$$LNGDP_t = \alpha_0 + \alpha_1 LNCT_t + \alpha_2 LNTT_t + \varepsilon_t$$

Among them, α_0 is a constant, representing the average value of the explained variable when the other values are 0. α_i is the coefficient term, representing the influence coefficient of the explanatory variable or the control variable on the explained variable, which shows how the influence direction of the variable is. t represents the time of the data, and ε_t represents other factors not considered in the model. Numerically, it is the difference between the actual value and the true value. LN stands for natural logarithm. In order to reduce the unreasonable coefficients and possible heteroscedasticity problems caused by the differences between the data, the natural logarithm of the values is generally processed.

4.3.2 Constructing the VAR Model

The VAR model is the regression of its own lag period and the lag period of other variables together with the current period of the variable. It is a regression model that affects each other. The model is established as follows:

$$Z_t = \alpha_0 + \sum_{t=1}^{k} A_i Z_{t-i} + \varepsilon_t$$

Among them, $Z = (LNGDP, LNCT, LNTT)$, K represents the lag order, t is the year, and ε_t is the random error term.

4.3.3 Descriptive Statistics

Next, perform descriptive statistics on the variable data, understand the basic distribution of the data, the minimum and maximum values, and the mean value, and judge the degree of fluctuation of the data according to the standard deviation, so as to have a basic understanding of the research data in this paper.

Table 16 Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
LNGDP	21	11.4803	0.1378	11.2624	11.7326
LNCT	21	4.2705	0.1398	3.9140	4.4128
LNTT	21	2.0598	0.2415	1.4586	2.2925

The mean value of LNGDP is 11.4803, the minimum value is 11.2624, and the maximum value is 11.7326. Relatively speaking, the variation range of LNGDP is not large, and the standard deviation is 0.1378, the fluctuation is relatively low, the mean value of LNCT is 4.2705, and the mean value of LNTT is 2.0598.

4.3.4 Unit Root Test

Next, the unit root test is performed to test the stationarity of the data. If the original sequence is not stationary, the difference processing is continued until the data is stable. If the data are in the same order stationary state, the regression analysis of the original sequence data can be continued. If they are all stable in the original sequence, then the cointegration test is not needed to verify the relationship between the data. Is it not a false situation. The unit root test is then performed as follows:

Table 17 ADF test of Variables

	ADF Statistic	1% Critical Value	5%Critical Value	10%Critical Value	Result
LNGDP	-2.176	-4.380	-3.600	-3.240	Unstable
D(LNGDP)	-4.430	-4.380	-3.600	-3.240	Stable
LNCT	-2.226	-4.380	-3.600	-3.240	Unstable
D(LNCT)	-4.579	-4.380	-3.600	-3.240	Stable
LNTT	-1.972	-4.380	-3.600	-3.240	Unstable
D(LNTT)	-4.020	-4.380	-3.600	-3.240	Stable

Note: D represents the first order difference.

Through the unit root test, the ADF test value of LNGDP is -2.176, which is greater than the 10% critical value -3.600, that is, LNGDP is not stable, while the first-order difference of LNGDP is stable, and the ADF test value is -4.430, which is less than 10% The critical value is -3.600, that is, the difference sequence is in a stationary state, and all other variable sequences are inferred. All sequences are in a first-order stationary state, and the next step can be continued.

4.3.5 Cointegration Test

The sequence is not stationary in the original sequence, but is first-order stationary. To perform regression analysis on the original sequence, a cointegration test is required to verify it. First, determine the optimal lag order according to relevant criteria.

Table 18 Choice of lag order

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	63.5317				0.0000	-6.7258	-6.7053	-6.5774
1	107.9390	88.8160	9.0000	0.0000	0.0000	-10.6599	-10.5781	-10.0664*
2	119.7730	23.667*	9.0000	0.0050	3.9e-09*	-10.9748*	-10.8315*	-9.9360
3	128.0920	16.6380	9.0000	0.0550	0.0000	-10.8991	-10.6945	-9.4152

Judging from the asterisks automatically marked by the software, the one that satisfies the criterion is the second order, so the optimal lag order is 2.

Table 19 Cointegration Test

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	15	111.6070	.	49.5603	34.5500
1	20	126.6163	0.7940	19.5417	18.1700
2	23	131.6734	0.4128	9.4275	3.7400
3	24	136.3872	0.3912		
maximum rank	parms	LL	eigenvalue	max statistic	5% critical value
0	15	111.6070	.	30.0185	23.7800
1	20	126.6163	0.7940	10.1142	16.8700
2	23	131.6734	0.4128	9.4275	3.7400
3	24	136.3872	0.3912		

It can be seen that there are two test methods, one is the trace test and the other is the max maximum eigenvalue test. It can be seen that the test results of the two tests are trace statistic or max statistic is a critical value greater than 5% Therefore, the null hypothesis that there is no cointegration relationship is rejected, that is, there is a cointegration relationship between the variables, and the two test results are consistent, indicating that the cointegration test is passed.

4.3.6 Regression Analysis

Next, OLS regression analysis is used to analyze the quantitative relationship between variables, and t-test, F-test and goodness-of-fit test can be used to make an overall comprehensive judgment of the model to obtain the results.

Table 20 Regression Analysis

LNGDP	Coef.	Std. Err.	t	P>t
LNCT	0.0314	0.7627	0.0400	0.9680
LNTT	0.3654	0.4417	0.8300	0.4190
_cons	10.5934***	2.3797	4.4500	0.0000
R-squared	0.4505			
Adj R-squared	0.3898			
F(2,18)	7.3800			
Prob>F	0.0046			

Note: *** means the effect is significant at the 1% significance level, ** means the effect is significant at the 5% significance level, * means the effect is significant at the 10% significance level.

Regression results: The R-square of the model is 0.4505, and the adjusted R-square is 0.3898. The goodness of fit of the model is not high, and the F-test value is 7.3800, and the corresponding p value is 0.0046, which is less than 0.01. Therefore, the entire model is passed The significance test was performed, and the effects of LNCT and LNTT on LNGDP were not significant.

4.3.7 Granger causality Test

Next, the Granger causality test is performed to verify the causal relationship between variables, that is, whether one variable changes before another variable, and the lag order is judged to be 1 according to the corresponding AIC and SC criteria. The causal test is as follows:

Table 21 Granger causality Test

Equation	Excluded	chi2	df	Prob > chi2
DLNGDP	DLNCT	5.7782**	1	0.016
DLNGDP	DLNTT	5.0231**	1	0.025
DLNGDP	ALL	5.7799*	2	0.056
DLNCT	DLNGDP	3.1495*	1	0.076
DLNCT	DLNTT	0.0000	1	1.000
DLNCT	ALL	3.3083	2	0.191
DLNTT	DLNGDP	3.9926**	1	0.046
DLNTT	DLNCT	0.4516	1	0.502
DLNTT	ALL	4.0000	2	0.135

Note: *** means significant at 1% significance level, ** means significant at 5% significance level, * means significant at 10% significance level.

At this point, it can be seen that when testing whether DLNCT is the Granger cause of DLNGDP, the chi-square value is 5.7782, and the corresponding p value is 0.016, which is less than 0.05, that is, at the significance level of 0.05, there is a sufficient probability that DLNCT exists It is the reason that causes the change of DLNGDP, that is, the effect of the lag term of DLNCT on DLNGDP is significant. Similarly, DLNTT is also the Granger cause of DLNGDP, and DLNGDP is the Granger cause of DLNCT, and DLNGDP is also the Granger cause of DLNTT. .

4.3.8 VAR model estimation

Since the estimation of the VAR model involves many lag terms, collinearity is easy to exist when there are many lag terms. Therefore, the VAR model rarely looks at whether a single variable is significant, and is generally analyzed through the subsequent impulse response and variance decomposition.

Table 22 VAR model Synthesis

Equation	Parms	RMSE	R-sq	chi2	P>chi2
DLNGDP	4	0.0243	0.2931	7.8786	0.0486
DLNCT	4	0.0906	0.1492	3.3330	0.3431
DLNTT	4	0.1139	0.1919	4.5130	0.2111

It can be seen that the model with DLNGDP as the explained variable passed the significance test.

4.3.9 Stability Check

Since the impulse response and variance decomposition after the VAR model are based on the stability of the model, it is necessary to verify that the VAR model is stable in advance to ensure that there is no divergence in the subsequent impulse graph.

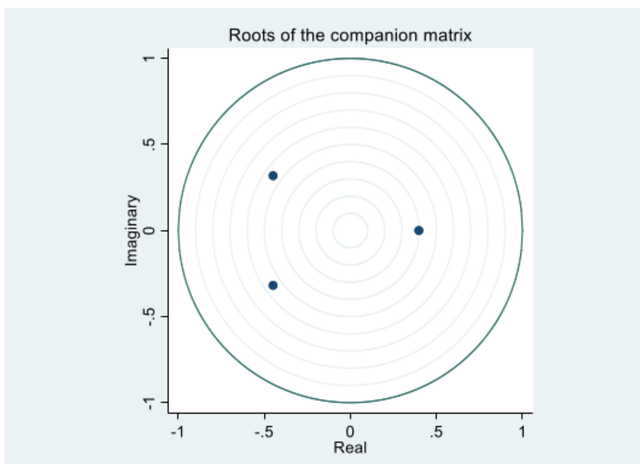


Figure 6 AR root test

It can be seen that all the dots are inside the circle, and there is no point outside the circle. The stability test is passed, and the next step of analysis can be continued.

4.3.10 Impulse Response Analysis

The impulse response graph can reflect what kind of continuous change the impact of one variable will drive another variable, so as to reflect the dynamic relationship, and then draw the impulse response graph:

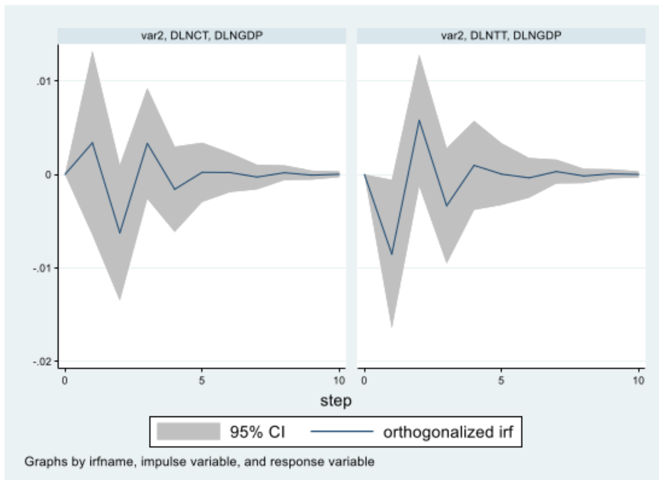


Figure 7 Impulse response analysis (DLNCT, DLNTT vs DLNGDP)

As can be seen from the above chart:

When DLNCT produces a positive shock of one standard deviation to DLNGDP, the shock response of DLNGDP is always below 0, from 0 at the beginning, and then a positive shock response occurs, showing a certain negative shock response, and then again is in a positive shock response and tends to zero.

When DLNTT produces a one-unit standard deviation positive shock to DLNGDP, DLNGDP first produces a negative shock response, followed by a positive shock response, which fluctuates around 0.

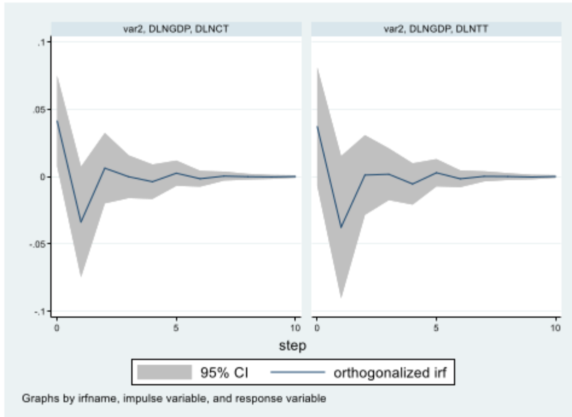


Figure 8 Impulse response analysis (LNGDP vs LNCT, LNTT)

It can be seen that when DLNGDP gives DLNCT a positive shock of one standard deviation, DLNCT produces a change of positive and then negative. When DLNGDP gives DLNTT a positive shock of one standard deviation, LNTT is positive first. impact, followed by a short-term negative impact, which then tends to zero.

4.3.11 Variance Decomposition

Impulse response can generally see the positive and negative responses of variables, and variance decomposition can see the change of the influence ratio of variables, so as to understand the importance of influencing factors.

Table 23 Variance Decomposition

	DLNGDP			DLNCT			DLNTT		
	DLNGDP	DLNCT	DLNTT	DLNGDP	DLNCT	DLNTT	DLNGDP	DLNCT	DLNTT
1	1.0000	0.0000	0.0000	0.2640	0.7360	0.0000	0.1350	0.7801	0.0849
2	0.8582	0.0192	0.1226	0.3662	0.6338	0.0000	0.2196	0.7116	0.0688
3	0.7647	0.0759	0.1594	0.3567	0.6110	0.0323	0.2106	0.6835	0.1059
4	0.7414	0.0889	0.1697	0.3485	0.6119	0.0395	0.2064	0.6851	0.1085
5	0.7388	0.0918	0.1694	0.3478	0.6100	0.0422	0.2075	0.6827	0.1098
6	0.7392	0.0917	0.1692	0.3481	0.6097	0.0422	0.2079	0.6824	0.1097
7	0.7390	0.0917	0.1693	0.3483	0.6095	0.0422	0.2081	0.6823	0.1097
8	0.7389	0.0918	0.1694	0.3483	0.6094	0.0423	0.2080	0.6822	0.1097
9	0.7388	0.0918	0.1694	0.3483	0.6094	0.0423	0.2080	0.6822	0.1098
10	0.7388	0.0918	0.1694	0.3483	0.6094	0.0423	0.2080	0.6822	0.1098

The proportion of DLNGDP's own impact on itself is from 100% to 73.88% in the 10th period, the proportion of its own impact on itself is relatively high, and the proportion of DLNCT's impact is from 0 in the first period to 9.18 in the 10th period. %, while the impact of DLNTT accounted for 16.94% of the 10th period, indicating that the short-term impact of DLNTT is relatively high.

The impact of DLNGDP on DLNCT accounted for 34.83% in the tenth period, and the impact of DLNGDP on DLNTT accounted for 20.80% in the tenth period. The impact of DLNGDP on DLNCT is also relatively high.

5 Discussion

5.1 The law of Interaction between Port and City Economy

5.1.1 Ports Promote urban Economic Development

With the development of port logistics and shipping industry, the functions of ports have changed from single to diversified. There are not only port direct industries, but also a large number of port related industries and attract a large number of port dependent industries. Modern ports are the best combination of production factors. Relying on the logistics advantages of ports, many of the most important ports rely on ports to establish their adjacent industries, and port cities have also become important industrial development bases. The world's important ports are basically important industrial bases.

In the process of urban economic development, the development is unbalanced in different periods, industries and regions. During the same period, economic growth was mainly concentrated in one or a few leading industries or regions. The port logistics industry is an important measure to improve the investment environment and expand investment. The strong support of the port by the government's policies and the rapid development of the port economy have made the port gradually become an important driving force for the development of the city's economy. At the same time, the port is gradually becoming a gathering place for international trade and comprehensive services, and the port-side economy will also develop and progress accordingly, thereby driving the development of the urban economy.

The development of urban economy requires the support of various resources, and the spatial distribution of resources is unbalanced, which requires transportation to adjust the spatial imbalance of resources. As an important node of cargo transportation, port cities play an important role in the sea and land transportation chain. The ports of coastal cities have vast economic hinterlands and can make full use of external resources to develop regional economies. At the same time, modern ports have become channels for coastal port cities to compete globally. Ports play an important role in allocating resources by the market in urban development and regional economic growth, reducing the transportation cost of resources to a large extent. At the same time, it can also reduce the transaction cost in the urban economic development, make the port city form a good development environment, and enhance the competitive advantage of the urban economy. Therefore, the port concentrates various resources to the port city and the surrounding areas of the port, which prompts more related enterprises, multinational companies, suppliers and related industries to concentrate accordingly, forming a perfect related industrial chain. To a large extent, it will promote the rapid development of the urban economy, industrial upgrading, and optimize the industrial layout.

Port logistics can promote the development of the secondary industry and at the same time drive the development of related service industries. Under the general trend of economic globalization, the development of coastal ports and marine transportation industries is an increasingly close integration of the development of ports and cities. The port not only strengthens the city's transportation hub function, but also increasingly becomes the most open and innovative area of the city. And timely launch aging industries to make room for the development of new industries.

The development of port logistics has a direct contribution to the economic development of the city, mainly in terms of the economic benefits gained directly from port production. As the gateway to the outside world for the region, the port's development depends on the hinterland economy, especially the demand for transport resulting from the development of an externally oriented economy, and it is the regional economy that nurtures the port. The port as an important node in the supply chain, once formed, has a large pulling effect on the regional economy. The development of ports and regions has different characteristics at different stages, and grasping the pulse of development between ports is conducive to forming the right development ideas and policies for port logistics and regional economies.

Port logistics development has a great polarising effect on urban economic development. In the process of rapid urban economic development, a certain gap between the rich and the poor will arise, and will inevitably result in the gradual formation of central cities, peripheral cities and rural areas because of the distribution of resources. With the globalisation of the economy and the development of international multimodal transport and the advancement of integrated global logistics services, ports have developed from single transport centres, via distribution centres, into shipping logistics centres. As an important node in the global transport network, the modern port responds to the need to develop in the direction of a full range of value-added services. While developing, it should promote the substantial transfer of industries from the central region to the surrounding areas, thus making the various industrial chains more closely linked throughout the region, generating a clustering effect and strengthening the overall effect, so that various industries can promote each other and develop in a coordinated manner in the common development of the city.

5.1.2 Urban development as a driver for the port

While the port promotes the economic development of the city, the vigorous development of the city also provides experience support and guarantee for the development of port logistics. The city economy provides financial, trade, consolidation and distribution services for the development of the port. The development of the urban economy has led to an increase in demand, and at the same time has led to changes in the type of goods available at the port. Modern ports are the best combination of production factors. With the logistical advantages of ports, many of the most important ports have established port industries based on them, and port cities have become important industrial development bases. The world's major ports are basically important industrial bases. From a single port logistics function, ports have expanded their transport function, developed logistics and port-side industries, and gradually formed a central transport hub facing the sea, with information technology and ecology as the main focus, forming a comprehensive distribution and transport network and enhancing the status and role of ports.

At the same time, the development of the urban economy makes the types of goods in the port change continuously with the development of trade and the progress of the economy. This also changes the port's development strategy, functional responsibilities, service areas and scope, as well as the port's production characteristics and status. The development of port logistics is closely related to the growth of urban economy. With the growth and variety of international trade, the types and quantities of goods to be transported have gradually increased, and the goods transported through ports are developing towards the direction of bulk cargo and container specialization.

The rise and fall of the port logistics industry is closely linked to the development of its urban economy. With the rapid economic development of port cities, the condition of the hinterland is a decisive factor influencing the location of the port. The expansion of the city's economy and the development of economic activities are the driving force and support for the development of the port. The rapid development of port logistics provides a broad development platform for the development of the city's economy. The port industries of coastal cities thus develop, while driving the rapid economic development of the port hinterland. At the same time, the growth of the city's economy will drive to increase the development demand for port throughput, thus promoting the development of port logistics.

The development of urban economy can provide a large number of freight requirements and sources for the development of port logistics and the increase of throughput. The development of urban economy can generate a large amount of supply and demand of materials, and the import and export of supply and demand of these materials are mainly completed through ports. Therefore, the overall development level of the urban economy, the structure of the three major industries and the overall situation of international trade have an important impact on the development of port throughput and port logistics.

The development of urban economy can provide a space guarantee for the development of port logistics. The rapid development of the port city economy has prompted the city's infrastructure to be increasingly improved, including the port's infrastructure and land transportation facilities, which will provide the basic conditions for the sea-land multimodal transport system of port logistics and the rapid transit of import and export goods. Therefore, the vigorous development of port city economy has driven the sustainable and healthy development of port logistics to a certain extent. At the same time, it provides a space and material guarantee for the comprehensive development of the port's integrated logistics and the connection and smoothness of the sea and land transportation network.

Urban economic development can provide relevant services in the development of port logistics. At the same time as the city's economic development, the information industry, service industry and transportation industry within the city also prospered and developed. The city's economic development also attracted foreign talents, foreign investment and capital accumulation. force. Therefore, the smooth flow of capital, logistics and information is necessary for the rapid development of port logistics. The information industry, service industry and transportation industry and other related industry services are closely related to the development of port logistics. Therefore, without the financial and material support of the urban economy, the development of port logistics and its related industries will be restricted to a certain extent.

5.2 Background of Shanghai

5.2.1 Shanghai Port Situation

Shanghai has a vast economic hinterland. Shanghai, where the port is located, is the largest economic, scientific and technological, trade, financial, information and cultural centre in China. It has a strong industrial base, with a complete range of light and heavy industries such as metallurgy, machinery, chemicals, electronics, shipbuilding, instruments and instruments, textiles, light industry and medicine. 60% to 70% of the materials imported and exported in Shanghai are transported through the port. Half of the annual cargo throughput of Shanghai port is for the transit of materials from the economic hinterland outside Shanghai. The hinterland provinces and cities where goods are transhipped through Shanghai port include Jiangsu, Zhejiang, Anhui, Sichuan and Chongqing. These provinces and cities are relatively well-developed agricultural regions in China, and the main characteristics of their economies are: the provinces and cities with developed agriculture and industry, such as Shanghai, Jiangsu and Zhejiang, lack mineral resources and need to transfer large quantities of industrial raw materials and fuels and industrial products. In addition, the volume of foreign trade imports is greater than the volume of exports, and the exported materials are generally industrial goods with higher prices and smaller shipments, lacking bulk goods, while imports are responsible for a large number of mineral products.

As the largest economic, trade and financial center in China, Shanghai has convenient transportation, and forms a modern comprehensive three-dimensional developed transportation network that combines sea, land and air with the port as the center.

5.2.2 Shanghai Urban Industrial Development

After the opening of the port in modern times, Shanghai quickly became the most developed trading port and industrial center in China. In the early days of the founding of New China, Shanghai was a major base for heavy industries such as steel, machinery and electric power.

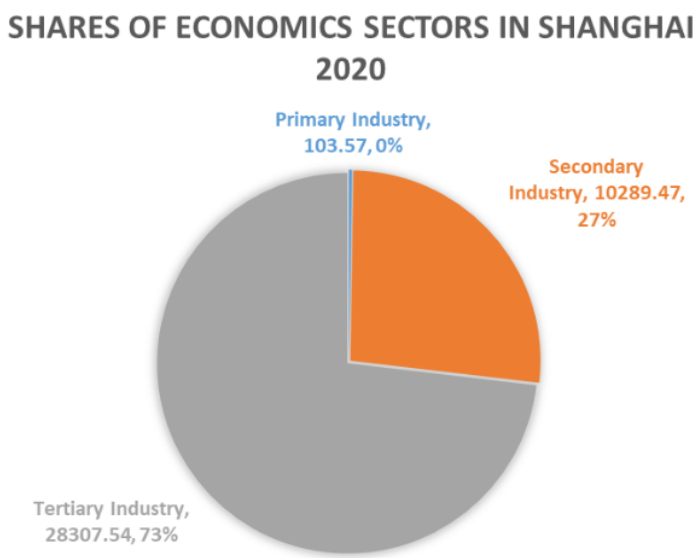


Figure 9 Shares of Economics sectors in Shanghai 2020 (Unit: 10^9 CNY)

Similar to Hamburg, port industries such as steel and petrochemicals largely influence the development of Shanghai's manufacturing sector. 2018 data shows that automotive manufacturing, computer, communication and other electronic equipment manufacturing, chemical raw materials and chemical products manufacturing, and general equipment manufacturing account for more than 55% of the main business income of Shanghai's industrial enterprises above the size of the city. Petroleum, coal and other fuel processing industries came in fifth place, accounting for 3.7% of the total. Both the import of raw materials such as steel and oil and the final export of medium and large machinery and equipment manufactured in Shanghai rely on the fast, efficient and inexpensive transportation network of Shanghai's sea ports. (Wang, 2021)

The development of high value-added industries promoted by Shanghai is similar to the type of industrial clusters mainly built by Hamburg. The focus of industrial development in the two cities is high technology-intensive, high R&D investment and green sustainability, and the scale effect is achieved by building clusters. As Shanghai's traditional advantageous industries, automobiles, high-quality steel products, and fine chemicals will improve efficiency and empower scientific and technological innovation. At the same time, the advanced manufacturing clusters built in Shanghai, and emerging industrial clusters such as integrated circuits, artificial intelligence, biomedicine, aerospace, intelligent manufacturing, and digital economy will be the key industrial areas for future development in Shanghai. According to the "Shanghai Urban Master Plan (2017-2035)", the advanced manufacturing industry will be concentrated in the outer suburbs of the city, with the goal of building a world-class long-term rooted and locked industrial base, through the transformation and exit of low-efficiency land, and giving priority to the protection strategy The development of sex industry clusters.

Table 24 Turnover of each segment of the Hamburg manufacturing industry in 2020

Turnover of each segment of the Hamburg manufacturing industry in 2020					
Industry Segmentation	Gross output value(billion cny)	Percentage(%)	Industry Segmentation	Gross output value(billion cny)	Percentage(%)
Agricultural and sideline food processing industry	337.33	1.00	Rubber and plastic products industry	870.87	2.59
Food manufacturing	728.24	2.17	Non-metallic mineral products industry	744.81	2.22
Wine, Beverage and Refined Tea Manufacturing	110.39	0.33	Ferrous metal smelting and calendering industry	1168.25	3.48
Tobacco product industry	975.73	2.91	Non-ferrous metal smelting and calendering industry	338.99	1.01
Textile Industry	199.6	0.59	Metal Products Industry	909.04	2.71
Textile and apparel industry	240.83	0.72	General equipment manufacturing	3116.61	9.28
Leather, fur, feathers and their products and footwear	131.8	0.39	Special equipment manufacturing	1453.43	4.33
Wood processing and wood, bamboo, rattan, palm and grass products industry	40.93	0.12	Automotive Manufacturing	6666.54	19.85
Furniture manufacturing	284.82	0.85	Manufacturing of railway, marine, aerospace and other transportation	808.3	2.41

			equipment		
Paper and paper products industry	231.49	0.69	Electrical machinery and equipment manufacturing	2230.53	6.64
Printing and recording media reproduction industry	195.88	0.58	Computer, communications and other electronic equipment manufacturing	5518.42	16.43
Culture and education, industrial beauty, sports and entertainment products manufacturing	442.95	1.32	Instrumentation Manufacturing	410.84	1.22
Oil, coal and other fuel processing industries	1096.29	3.26	Other manufacturing	49.8	0.15
Chemical raw materials and chemical products manufacturing	2934.12	8.74	Comprehensive utilization of waste resources	46.3	0.14
Pharmaceutical Manufacturing	1028	3.06	Metal products, machinery and equipment repair industry	252.92	0.75
Chemical fiber manufacturing	17.65	0.05			

Source: Shanghai Statistics Bureau 2021 Shanghai Statistical Yearbook https://tjj.sh.gov.cn/tjnj/20220309/0e01088a76754b448de6d608c42dad0f.html

Shanghai is accelerating the construction of a technological innovation center with global influence. This development strategy coincides with Hamburg's efforts to build Europe's innovation capital. In 2009, Shanghai formally proposed to build four centers of international economy, finance, trade and shipping. In 2017, the "Four Centers" and the Science and Technology Innovation Center were called "Five Centers". (Du, 2015).

Similar to the innovation and development of Hamburg, Shanghai is also committed to building an innovation system. Create an innovation chain by building a national laboratory, encouraging corporate R&D, individual innovation and entrepreneurship, and transformation of university scientific research results. Create a good intellectual property protection mechanism for the construction of science and technology innovation centers, fully protect the legitimate rights and interests of developers and mobilize innovation enthusiasm. To achieve an international level of innovation also requires an open comprehensive service system and an external cultural atmosphere and community environment, including comprehensive support from law, finance, real estate, and education and training (Yang, 2020).

5.3 Background of Hamburg

5.3.1 Port of Hamburg

The Port of Hamburg is located between the North Sea and the Baltic Sea and is an important foreign trade center for Germany. As Germany's largest integrated port, it has resumed operations in the European internal market with as many as 450 million customers. The annual gross output value of the Port of Hamburg is approximately 20 billion euros, directly or indirectly creating more than 260,000 jobs.

The good location of the inland port reduces transport costs and connects the German, Central and Eastern European and Nordic markets to the global transport chain at low cost via feeder vessels, river vessels, railways and trucks. Based on its connection to the North Baltic Sea Canal, the world's busiest man-made waterway, the Port of Hamburg is ideally suited to trade with Scandinavia and the Baltic Sea region.

The Elbe and the Elbe side waterway make it possible for goods to be transported smoothly through the inland river to south-central Germany to the Czech Republic. In addition, rail transport is also a readily available option. Today's railway network is very developed, connecting all corners of east, west, north and south. And, Germany's road network is equally well-connected. Trucks can quickly transport goods to the south or north via the A7 motorway, while the A1 motorway is ideal for connecting eastern and western Europe (Yang, 2020).

5.3.2 Industrial Development of Hamburg City

The overall strategy of Hamburg's modern urban industry focuses on cultivating high-end industrial clusters. and renewable energy (2011) and other eight major industrial clusters, and gradually promote the transformation of the traditional industrial system dominated by port-related industries such as petrochemicals and shipbuilding to a diversified modern industrial system with high added value. After the industrial cluster policy was put forward, the upstream and downstream industrial chain enterprises around the eight types of industrial clusters gathered in Hamburg and gradually formed a scale. (Wang, 2021)

From the specific performance of the industry, Hamburg's media industry cluster is a combination of traditional media and digital media cluster, Gruner + Yar, Axel Springer Group and other old media enterprises and Google, Facebook and other digital IT industry fully integrated. The aviation industry cluster is built around Hamburg Airport and two major European aviation manufacturing companies, Lufthansa and Airbus, to build a complete aviation industry chain including aircraft manufacturing, maintenance and operation. Logistics and offshore related industrial clusters have a rich industrial foundation. Relying on the advantages of Port of Hamburg as a maritime hub, logistics plays functions such as warehousing and transshipment, and continues to upgrade industries such as petroleum refining and petrochemical and Marine equipment manufacturing on the basis of original port-adjacent industries. Hamburg's eight industrial clusters create a lot of jobs. Hamburg has 160,000 medical practitioners and a dense population of hospitals and clinics. There are 79 hospitals in the Hamburg metropolitan area. The medical resources are among the highest in Europe. In conjunction with healthcare, Hamburg currently has about 500 biopharmaceutical and technology research and development companies, fostering an industrial cluster from drug research, pilot testing and application. The creative industry cluster is dominated by film, game, publishing and other industries. The prosperity of these industries has made Hamburg's creative industry become a famous city brand in the world, and the constantly bursting creative economy has become an important driving force for Hamburg's industrial transformation. Hamburg is the Green Capital of Europe. The industrial development of Hamburg actively builds new energy industry, including solar energy, bioenergy, etc.

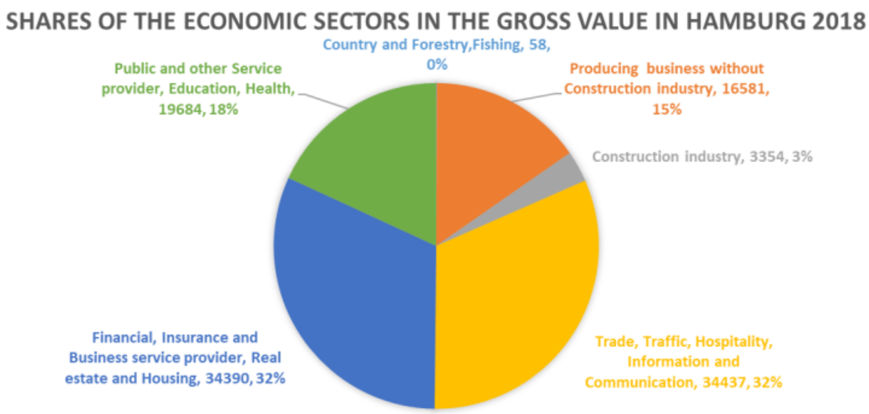


Figure 10 Shares of Economic sectors in gross value in Hamburg 2018 (Unit: 10^6 Euro)

Historically, the burger industry has been closely linked to the maritime industry. Import of raw materials for the domestic market, processing and refining, and export, all of which form the basis of the industrial industry. Hamburg's manufacturing industry is of great strategic importance to the city's economic development. Industry is not only the pioneer of economic development, but also the driving force of technological research.

Hamburg's shipbuilding industry gave a big boost to the development of an industrial metropolis. Some of the major shipyards and many small and medium-sized shipyards were the leading forces of industrial progress at the time. Today, in Hamburg, Blohm + Voss is the world's most advanced ship repair and conversion giant. Blohm + Voss also has a strong reputation for making frigates and cruise ships. At the same time, the cruise industry and green shipping are also driving forces for innovation in the maritime transportation industry. Today, Hamburg's aviation industry plays an important role in the former shipbuilding industry. And she is a child of the shipbuilding industry: more than 80 years ago, in 1933, she had seaplanes in Hamburg, a subsidiary of the traditional Blohm + Voss company.

Due to the considerable growth in global trade, Hamburg is still working on port projects such as the expansion of part of the Elbe waterway in order to cope with the growing demand for maritime transport in the future. In addition to the construction of waterways, the port of Hamburg has expanded to the west and south in search of a larger port area, and many companies with transport needs have moved into the area around the port. The current land use in the port area is based on logistics and warehousing, stevedoring and commerce and industry. The main sectors of commerce and industry include the mineral oil industry, the chemical industry, the timber industry, rubber and plastic products and other raw material-based production industries, as well as manufacturing industries with relatively high added value such as mechanical engineering.

Table 25 Turnover of each segment of the Hamburg manufacturing industry in 2017

Product Type	Total (billion euros)	Percentage (%)
Mineral oil Processing	338.44	53.65
Mechanical engineering	58.78	9.32
Food and Feed Production	35.1	5.56
Manufacture of data processing equipment, electronic and optical products	14.51	2.3
Production of rubber and plastic products	8.66	1.37
Pharmaceutical manufacturing	4.7	0.74
Manufacture of glass and glassware, ceramics, stone, etc.	1.99	0.32
Beverage production	0.81	0.13
Textiles, leather and leather goods and shoe manufacturing	0.08	0.01
Metal production and processing	74.29	11.78
Repair and installation of machinery and equipment	52.1	8.26
Chemical product manufacturing	18.21	2.89
Manufacture of other goods	11.53	1.83
Manufacture of electrical equipment	7.01	1.11
Manufacture of metal products	2.65	0.42
Manufacture of printed matter, reproduction of pre-recorded sound, image and data media	1.49	0.24
Construction wood, wicker and cork (furniture not including)	0.48	0.08

Source: Hamburg Statistical Yearbook Official website of the Hamburg government https://www.statistischebibliothek.de/mir/receive/HHSerie_mods_00000001

Port-side industries are types of industries that are strongly related to port services and geographically close to them, mainly handling, transport, logistics, manufacturing and trade (Li, 2007). The direct transport of goods includes basic port services such as stevedoring, cargo transportation and logistics distribution, while bulk raw materials, heavy machinery manufacturing and global trade are strongly associated with the port.

In Hamburg's regional innovation system, emphasis is placed on the exploration of interconnected and cross-industry themes. By building a cluster bridge (Hamburgs Clusterbrücken - Ansatz) between industries, the Hamburg government promotes the flow of resources among industrial clusters, stimulates maximum utility, and promotes interdisciplinary innovation through cross-cluster cooperation. At the same time, it also effectively compensates for the development imbalance caused by some innovative performance differences. Take the three typical industrial cluster bridge construction projects promoted in 2016 as an example, namely: the cooperation of electronic medical project (eHealth), life science cluster (life science nord) and medical health cluster (gesundheitswirtschaft hamburg) to jointly promote e-health Health care system, carry out medical electronic project. The public health project (HIHeal) is committed to the treatment and research of emerging infectious diseases such as Ebola and MERS through the cooperation of life health and medical clusters. The co-learning-space project provides environment and platform support for the common development of clusters.

5.4 Discussion of the model

5.4.1 Shanghai Case1

1) Regression analysis:

Since the influence coefficient of LNCT is 0.1763, it is not significant at the significance level of 10%, indicating that container throughput has no significant impact on GDP. However, LNTT is significant at the significance level of 5%, that is, total throughput has a significant promotion effect on GDP. Every 1% increase in total throughput will lead to an average increase of 0.9284% in GDP.

Combined with the two results, it shows that port logistics does play a positive role in urban economic growth. But compared with container throughput, port throughput has a more significant impact on economic growth.

The correlation between port throughput and container throughput and urban GDP can not be seen from the regression model.

2) Granger causality analysis:

When testing whether LNCT is the Granger cause of LNGDP, the chi-square value is 3.6074, and the corresponding P value is 0.307, which is greater than 0.1. Namely, at the significance level of 0.1, container throughput is not enough probability to cause GDP changes, and its impact on GDP is insignificant. On the contrary, total throughput is the granger cause of GDP, total throughput is the granger cause of container throughput, Both GDP and container throughput are Granger causes of total throughput.

There is bidirectional causality between port throughput and urban GDP, and there is bidirectional causality between port throughput and container throughput.

3) Impulse response analysis

While total throughput has a positive impact on GDP in this period, it has a steady but limited positive impact. This shows that the impact of external conditions on urban economic growth can bring the same impact on the throughput of the city's port, but the impact is not large, but it still has a certain promoting effect. This is consistent with the conclusion that GDP is the Granger cause of port throughput increase in the above causality test. This is because the urbanization of Shanghai has reached a certain level, and its own scale, through circulation and accumulation, can promote the continued development of the city, so that the contribution rate of urban GDP growth to the development of the port is small.

When CT has a positive impact on GDP in this period, its container throughput is always at a relatively stable low level. This is consistent with the conclusion that GDP is not the Granger cause promoting the increase of container throughput in the above causality test.

The positive impact of port throughput has a certain promoting effect on economic growth, and has a long lasting effect, which is not obvious in the short term, but the result is positive in the long term.

In the long run, the elastic coefficient curves of both port throughput and container throughput on economic growth tend to be flat, indicating that the influence coefficient shows a stable positive trend after the elimination of short-term interference factors. This also indicates that when the development of the port enters the professional stage, it is necessary to build professional wharves to handle different cargoes in different categories, and the berths of the port gradually become deep-water, and part of the port area moves out. During this period, the development of direct and related industries of port logistics constituted good urban infrastructure conditions, thus generating spatial agglomeration attraction and attracting the agglomeration of industries not directly related to ports in port cities. With the agglomeration of different industries in port cities, the industrial system of port cities is gradually improving, and the multiplier effect of employment and consumption expansion on urban economic growth is becoming more and more stable. After the port city enters the stage of diversified economic development, its development degree will depend on the city self-growth effect. However, this effect can not become a strong driving force for the continued development of port cities, which is manifested as the stability of elastic coefficient in the long-term equilibrium relationship between port logistics and urban economic growth.

In addition, it is clear that port throughput has a greater effect on urban economic growth than container throughput.

4) Variance decomposition analysis

For LNGDP, LNCT accounted for 15.45% from 0 in the first period to 15.45% in the 10th period, which was relatively high compared with other variables. However, the proportion of LNCT throughput in the 10th phase was 1.05%, indicating that the short-term impact of container throughput is relatively high.

However, the impact of GDP on container throughput accounted for 26.06% and that of total throughput was 62.82% in the 10th period. The proportion of total throughput affected by GDP is also relatively high.

5.4.2 Shanghai Case2

1) Regression analysis:

The influence coefficient of LNCT is 0.1753, which is not significant at the significance level of 10%, indicating that container throughput has no significant influence on GDP of secondary and tertiary industries. However, LNTT is significant at the significance level of 5%, that is, total throughput can significantly promote the GDP of the second and tertiary industries. Every 1% increase in LNTT will lead to an average increase of 0.9353% in the GDP of the second and tertiary industries.

2) Granger causality analysis

Container throughput has no significant impact on the GDP of the second and tertiary industries, while LNTT is significant at the significance level of 5%, that is, total throughput has a significant role in promoting the GDP of the second and tertiary industries

3) Impulse response analysis:

It indicates that the growth of total throughput has a certain stable long-term positive impact on the GDP growth of the secondary and tertiary industries, which is consistent with the results of regression analysis and Granger causality test. From the experimental point of view, container throughput growth even has a negative effect on the GDP growth of the secondary and tertiary industries.

4) Variance decomposition analysis:

The impact of LNGDP of the second and tertiary industries on LNCT accounted for 26.18% in the 10th period, and the impact of LNGDP of the second and tertiary industries on LNTT accounted for 62.98% in the 10th period. In other words, the GDP of the secondary and tertiary industries has a relatively high proportion of total throughput, much higher than that of container throughput.

5.4.3 Hamburg Case

1) Regression analysis:

Through the experimental results, it can be found that although the whole model has passed the significance test, the fitting degree is not high. LNCT and LNTT both have insignificant impacts on LNGDP, that is to say, container throughput and total throughput both have insignificant impacts on GDP

2) Granger causality analysis:

The experimental results show that LNCT has sufficient probability to cause the change of LNGDP, that is, the lag term of LNCT has a significant impact on LNGDP. LNTT is also the Granger cause of LNGDP, while LNGDP is the Granger cause of LNCT and LNGDP is also the Granger cause of LNTT.

Through this experimental result, it can also be found that there is a bidirectional causality between total throughput and urban GDP, as well as a bidirectional causality between total throughput and container throughput. However, in this case, the relationship between city GDP and container throughput is stronger than in the case of Shanghai. This may be due to different container transportation methods, as well as different countries and regions for container regulations, procedures and other complex factors caused by.

3) Impulse response analysis:

The impact of LNCT and LNTT in the short term will bring great fluctuations to LNGDP, while the long-term impact will gradually decrease. The positive impact of LNCT can have positive feedback in a short time, that is to say, the positive fluctuation of container throughput in the short term can bring about the increase of GDP, which to a certain extent indicates that Hamburg has a good distribution capacity for containers. In the long run, Hamburg, as a port city with a long history of development, has its own regulating function. Moreover, due to the mature development, increased container throughput and total throughput cannot directly contribute a lot to urban GDP growth, so the long-term impact is negligible.

Similarly, because the industries around the city and even the port are not necessarily directly related to the port logistics, that is to say, these industries may not directly increase the workload of the port. The increase of GDP cannot directly increase container Throughput and total Throughput in ports.

4) Variance decomposition:

The impact of LNGDP on LNCT accounted for 34.83% and 20.80% in the 10th stage, respectively. By comparison, it can be found that the impact of GDP on container Throughput is also higher than that of total Throughput.

5.5 Conclusion

The comparison between Shanghai case1 and Shanghai case 2 shows that the impact of GDP on container throughput is much smaller than that of GDP on total throughput. This indicates that although the cargo container rate of Shanghai Port is in the forefront of China, it still does not occupy a large proportion. This is because Shanghai, as an important transshipment port, needs to transport a large number of bulk goods (mineral resources, industrial raw materials and fuels, etc.) from the sea to various cities in its economic hinterland through different transportation modes. These cities are more industrial and productive. But they have huge demands on different resources,

The influence of the secondary and tertiary industries on container throughput and total throughput is relatively higher. Compared with pure GDP, the experiment shows that the sum of GDP of the secondary and tertiary industries has a closer relationship with port throughput. Primary industry and port logistics are usually linked by the transport of agricultural products and fertilizers. The secondary industry requires large quantities of raw materials, fuels, and exports large quantities of manufactured goods. At the same time, the activity of the tertiary industry will also cause the circulation of all kinds of goods. Perhaps because of these reasons, Port performance is more susceptible to the influence of the secondary and tertiary industries. Industrial evolution is the driving factor of urban transformation, which is manifested as the accelerated development of traditional industry, the leading evolution of manufacturing owner-oriented service industry, the leading evolution of traditional service industry to modern service industry, and the capital driven evolution to innovation driven evolution. Therefore, by upgrading and optimizing the industrial structure of the city, port performance can be more effectively improved on the premise of promoting the economic development of the city. Along with industrial transformation, urban spatial reconstruction and structural optimization are all important symbols of successful urban transformation. From the comparison between Shanghai case1 and Hamburg, we can see that the impact of Hamburg's city GDP on container throughput is higher than that of Shanghai, while the impact on total throughput is much smaller than that of Shanghai. For Hamburg, both container throughput and total throughput have little correlation with the city's GDP. For Shanghai, container throughput is not closely related to the city's GDP, but total throughput and GDP can promote each other to a certain extent.

The reason for these differences is, firstly, that the two city ports are at different stages of development. The major international shipping centres in Europe, including Hamburg, were the first to start shipping development and have the longest history of shipping development, and have achieved their status in the international arena earlier. At present they are in the stage of transformation and upgrading of development, and have influence in the international. As an important global gateway connecting overseas, Central and Eastern Europe and the entire Baltic region, Hamburg is the cargo distribution center of Europe. Thus, the Port of Hamburg plays an extremely important role in supplying approximately 500 million consumers in the European internal market.Its shipping development construction has not only focus on the port cargo throughput, container transshipment volume and other indicators and the construction of the hard environment infrastructure of the port, its competitive advantage has been transformed from the construction of port production capacity to the advantages of shipping services and shipping technology. One of the aspirations for the future development of Hamburg is sustainable development, which has been realized. "Smart port logistics" not only provides intelligent solutions for intelligent transportation and cargo transportation, but also meets the requirements of economic and ecological development. The core of smart port is mainly reflected in three aspects: infrastructure, transportation and cargo transportation. This has also led to a different level of development of the port industries in the two cities. Port industries such as port tourism and port finance, for example, can optimise the city's industrial structure and promote the city's economic development without being directly linked to the port's throughput. Therefore, the relationship between total throughput and GDP is not as strong in cities with more port industries.

Second, port performance as well as the city's GDP reacts differently to shocks due to multiple reasons such as different modes of cargo distribution and transportation system and port efficiency. The port of Hamburg uses a combined maritime and rail mode of transport, while Shanghai is mainly road-based (Hai, 2019). The railways have an advantage over trucking in terms of efficiency and faster response to shocks, as they are more punctual, have almost no traffic jams, etc., and carry much more volume than trucks.

In addition, port performance is not only related to the city where the port is located. Ports are closely linked to their hinterlands, which are the basis for their survival and development, and as hubs of land and water transport and windows to the outside world, they play a pivotal role in boosting the economies of their hinterlands. By virtue of its absorption and radiation capacity, the port's influence extends to the economies of the urban agglomerations in its hinterland. The economic hinterland of Shanghai is much wider than that of Hamburg. Amongst them are cities with a high level of agricultural development as well as cities with a relatively high level of industrial development. Different cities have different transport needs for various resources and products. As important transshipment hubs, both ports need to collect and transport the goods needed between the hinterlands, so the cargoes are complex and varied in composition. A large proportion of these goods are associated with the port's hinterland cities rather than being used directly by the port city. Moreover, port hinterlands in different regions are linked to ports to varying degrees, by port logistics as well as by fixed asset investment. In this context, the relationship between the city economy and port performance becomes quite complex and difficult to measure.

6 Conclusions

6.1 Recommendations

From the above analysis it is easy to see that there is an interactive development between port logistics and the city economy. And in different cities, the relationship between the two can change significantly. Through comparison, relevant suggestions can be made for the development of Shanghai, which started late.

6.1.1 Optimization of the Industrial structure of ports and cities

In terms of industry, since the reform and opening up, Shanghai has gradually formed a service-oriented industrial economy led by modern service and advanced manufacturing industries. However, it is still in a critical period of transformation from an optimised and upgraded industry to an innovation-driven one, and the level of development of the industry still needs further improvement. Therefore, it is necessary to quickly realise the high-end of the service industry and cultivate the innovation of the industry, and focus on the rapid improvement of the trade function, so as to drive the deep interaction between the Shanghai port and the industry. The port should also rapidly promote the refinement of the port industry to accelerate the deep integration with the modern service industry.

Focusing on the development of high-end service industries such as financial services, science and technology innovation services, trade services, cultural creativity, tourism and exhibition. New technologies and new service models will be used to promote the development of Shanghai's science and technology service industry. The integration of culture with tourism, commerce and exhibitions is a way to increase the cultural and artistic content of the industry. At the same time, the integration of shipping with finance, trade, commerce, tourism, culture and sports will be rapidly and effectively realised.

In response to the lack of integration between Shanghai's port and industry, on the one hand, we should take the free trade zone and the free trade zone as development opportunities to quickly develop international trade and trade consultancy services, and accelerate the integration of the port and trade services. We will also rely on Shanghai's vast hinterland resources to enhance domestic and international trade links and port transit functions. We will continue to improve the functions of international sourcing and export processing in the bonded port area, and increase the cargo throughput and total port trade volume of Shanghai ports. On the other hand, on the basis of the industrial clusters in the port, the development of modern equipment manufacturing, high value-added advanced manufacturing, high-tech industries and urban industries can be concentrated, so as to further strengthen the links between the port industries and the advanced manufacturing industries in the city. At the same time, with the logistics hub and the "One Belt, One Road" strategy, the company will expand its business in port real estate and shipping finance, while investing in the development of excellent foreign ports and moving into the world shipping market.

6.1.2 Strengthening Links with the hinterland and neighbouring Ports

Promote the development of port industries, revitalise the development of the port logistics industry, enhance the international status of the port cluster, and moreover, form a radiation effect to promote the development of hinterland industries and the overall improvement of the port city economy.

For port enterprises, they should improve the flexibility of capital operation and fully realise the value of capital so that they can maximise their own value. At the same time, social capital should be actively attracted to participate in the construction of the port through capital increase and share allocation. In addition, a variety of financing channels should be explored to obtain long-term low-interest loans from banks to support the development of the port enterprises themselves. Strengthen the docking of related markets, actively integrate into the urban economic market and broaden the radiation range of the port economy. In the development of port logistics and urban economy measures, the industrial advantages of the port city's own region should be brought into play.

With the expansion of container volumes at ports in all regions, the major international shipping centres are doing their best to compete for advanced international shipping centre status. The major international shipping centres are adopting different strategies to attract shipping cargo and capture the cargo volumes of nearby ports. While cooperation and competition is the new trend in the development of the world shipping industry, in the development process of international port cities, they are often faced with the new model of port cluster development, which can greatly help to promote the transformation and upgrading of ports. The port of Shanghai should optimise the development relationship between itself and the neighbouring ports. For international shipping centres abroad, the Port of Shanghai should combine its own characteristics, continue to build the port infrastructure of the Port of Shanghai, strengthen and optimise the soft environment of shipping in the Port of Shanghai, and improve the level of shipping technology and shipping services.

6.1.3 Accelerate Construction of Distribution and Transportation System

In order to increase port cargo throughput and container throughput and to promote the development of an international shipping centre, Shanghai should establish a smooth and efficient collection and transportation system, taking into account the characteristics of its own geographical environment and a variety of transport modes.

The port of Shanghai currently has an uncoordinated port transport ratio, with rail transport accounting for a relatively small proportion and road transport for a larger proportion. (Zhong, 2019) The collection and distribution system is mainly based on roads, and the problems of low transport stability and difficulty in improving transport capacity are becoming increasingly serious. Therefore, the construction of sea-rail intermodal transport should be strengthened and the supporting facilities on the railway side should be upgraded so that the cost of railway transport, especially for important inland cities, can be reduced. In addition, more railway train lines should be established after taking into account factors such as location and route. The highway transport system is currently under enormous pressure and it is time to ease the pressure on the highway system, minimise the intersection of the port's collection and distribution system with the transport network in everyday life and vigorously develop sea-rail intermodal transport. At the same time, a relaxed road transport system with a strong and extensive railway transport system should be established. The final formation of a low-cost, high-efficiency and more comprehensive integrated port collection and transportation system with waterway transport as the main mode and integrated development of railway, road and air transport.

Shanghai as an international shipping centre, its Yangtze River basin inland river has the innate advantage of developing container transport. However, the development of inland and artificial river containers in the Yangtze River basin is still in its infancy. Therefore, we should attach great importance to the development of Shanghai inland river container transport and give full play to the advantages of inland river container. Shanghai inland river container transport has the advantages of less floor space, light pollution, low cost and so on. Have railway and road container transport can not be compared with the environmental benefits and economic benefits. In the development of inland river container transport at the same time, should also be through the construction of inland river container transport channel, increase policy support, optimize the container transport organization and management and other measures, the real sense to achieve the Shanghai international shipping centre inland river container transport high-speed optimization development.

6.1.4 Strengthening Government Policy Support

The Port of Hamburg has, to some extent, implemented a free port policy (Olaf, 2012), which has led to an increase in trade and the international competitiveness of the port. A free port is a port policy that is designed to facilitate the flow of goods and achieve freedom of investment, trade, exchange and capital entry and exit. The establishment of the Shanghai Free Trade Zone is the driving force behind the development of the formation of the Shanghai Free Port. Through the establishment of the Free Trade Zone, the port of Shanghai can gradually develop into a free port by realising the freedom of duty-free and free trade for some goods, and ultimately making Shanghai a free port in the true sense of the word. In addition, shipping support policies are an essential contribution to the development of international shipping centres, which are well recognised in Europe. Most of the world famous international shipping centres adopt free port policy and adopt preferential attraction policy for foreign investment. Shanghai should learn from international shipping centres abroad, broaden the scope of shipping centre policies and strengthen them.

In terms of government governance, corporate autonomy and citizen participation, by strengthening project cooperation between ports and cities, between ports and industries, and between cities and industries. Stimulate cross-sectoral cooperation among micro-economies in the various systems, and strengthen exchanges and cooperation among various associations and groups in Shanghai's ports, industries and cities. Communication at the industry and enterprise levels, in the form of seminars and so on, should be developed together. The administrative efficiency of the system should be improved by gradually diluting or reducing the number of administrative districts, and by establishing special committees to reduce duplication and the communication of redundant information. The public should also be actively involved, and certain assessment indicators and evaluation systems should be set up to collect satisfaction and feedback from residents, so that policy can be actively adjusted in response to the results of the assessment.

Most importantly, the upgrading of the city's overall industrial structure also requires long-term planning by the government. Urban transformation is a systematical project, which requires the government to give full play to its guiding role and formulate advanced and feasible strategic measures.

6.1.5 Attracting Enterprises and High-end talents

Shanghai Port is currently capital intensive and labor intensive (Zhong, 2019). In the future, Shanghai Port should pay attention to the construction of soft shipping environment and the construction of high-end shipping service industry, and it is necessary to strengthen the construction of shipping talents. At present, Shanghai is short of comprehensive shipping talents with strategic thinking, as well as professionals involved in international maritime arbitration, international maritime law, shipping finance, shipping insurance and so on. High-end shipping service talents are the key to maximize the utility of shipping hard and soft environment resources and adjust all shipping factors to fit the development. The government should actively encourage and guide domestic and foreign high-end shipping service talents to settle in Shanghai, attract more domestic and foreign trade and business for the development of Shanghai International shipping center, and promote the steady development of Shanghai international shipping center.

At the city level, attracting more enterprises and talents is beneficial and necessary for the development of the city in all aspects. The government should attach great importance to the construction of talent team and encourage the implementation of industry-university-research cooperation in running schools. Meanwhile, the government should implement professional preferential and incentive policies to attract excellent domestic and foreign enterprises and talents to Shanghai. On the basis of making full use of the advantages of the original industries, we will cultivate strategic emerging industries, and finally realize the sustainable utilization of urban resources and healthy transformation and upgrading.

6.2 Final Conclusion

This paper analyzes the relationship between city economy and port capacity under the premise of urban industrial transformation by vector autoregressive model. Taking Shanghai and Hamburg as examples, the experimental results were analyzed qualitatively and quantitatively. Both Shanghai and Hamburg follow the trend of global industrial development and cultivate different industrial clusters at different stages. From the perspective of industrial transformation, in recent years, relying on the convenient location conditions of the port, manufacturing, petrochemical and other traditional port industries are the main industries of Hamburg and Shanghai, and the port area is mainly focused on logistics and storage, loading and unloading, industry and commerce. On the basis of consolidating the development of existing industries, the two port cities actively promote industrial transformation and upgrading. In the direction of industrial development, both cities cultivate and develop key industrial clusters, focusing on high-tech intensive, high R&D investment and green and sustainable development. Some of these new industrial clusters are not yet major contributors to GDP, but they are creating a lot of jobs. On the other hand, Hamburg builds connections between different industrial clusters, thus forming new industrial growth points. Shanghai, though a latecomer, has a similar policy of fostering industrial clusters as Hamburg. In addition, Shanghai's development model also combines government leadership with streamlining administration and delegating power (Wang, 2021). Because the development plans of the two cities are similar, but the development history and social environment are not the same, so it is of comparative significance to a certain extent. Through the comparison between Shanghai and Hamburg, it can be found that the relationship between city economy and Port Capacity may change and weaken when the urban industry transformation reaches a certain extent. As Shanghai and Hamburg have certain similarities in urban development and industrial transformation planning, this paper can provide enlightenment for the future development of Shanghai city and port.

Port logistics is an important driving force of urban economic development. Port logistics promotes the upgrading of industrial structure and optimization of industrial layout. Port promotes the development of port city economy and regional economy through various industrial activities and logistics activities. On the one hand, this is because the port itself directly increased social benefits and brought about the increase and growth of national income. On the other hand, it affects the economic development of related industries, especially the secondary and tertiary industries, through the forward and backward connection, and then promotes the optimization and upgrading of the economic industrial structure. Through the comparison between the cases of Shanghai and itself, it can be analyzed that the upgrading of industrial structure can stimulate port capacity more effectively while developing urban economy. As a result of the experiment, Shanghai Total Throughput and GDP can promote each other, so the increased port capacity can also reverse accelerate the development of urban economy, forming a virtuous cycle.

Through the comparison of the three experiments, we can get the following suggestions for the future development of Shanghai:

1) Optimize the industrial structure of the city and develop and expand the port industry. It is necessary to promote the optimization and transformation of industrial layout and structure. This can be reached by accelerating the development of producer services such as modern logistics and promoting the integrated development of manufacturing and service industries business, tourism, sports and other industries. On the other hand, improving the industry surrounding business, sports and health care, education and medical and other living function supporting environment as soon as possible. At the same time, strengthen the community public service function, optimize the construction of transportation infrastructure, so that the city becomes a strong support for industrial development. On the basis of these operations, the integrated development of shipping and financial industry, trade, business, tourism, sports and other industries can be prevailed.

2) Strengthen the connection with the port hinterland and surrounding ports. No city and port exist alone from the hinterland, the collection and transportation of goods and hinterland economy cannot be separated from the surrounding ports and cities. As a leading port in the Yangtze River Delta region, Shanghai Port should strengthen the cooperation and linkage with the Yangtze River Delta port group. Shanghai needs to formulate development strategies according to its own characteristics, integrate and promote resource sharing with surrounding cities and ports, so as to achieve complementary advantages and dislocation development.

3) Accelerate the construction and renewal of infrastructure required by the collection and distribution system. In order to improve the logistics transportation efficiency of Shanghai Port, it is necessary to strengthen the large-scale construction of infrastructure, enrich the frontier unloading and loading business of container ports, optimize the allocation of continuous berths in various terminals, and improve the collection and distribution system, so as to make up for the port congestion caused by the lack of water depth in the original port channel. It is also essential to develop multimodal transportation including sea-rail intermodal transportation, and form an integrated port transportation system with comprehensive development and low cost and high efficiency. At the same time, Shanghai should also push forward the construction of

the railway with port drainage and the information sharing platform involving ocean and river transportation to promote the integrated development of the Yangtze River region.

4) Shanghai should rationally make use of its own advantages and strengthen the government's policy support. Strengthen the construction and management of port logistics areas in the free trade zone, including port bonded warehousing centers, exhibition centers, duty-free shopping centers, etc., so as to expand the value-added logistics service capacity. Secondly, it is necessary to innovate and develop high-end shipping services, and build a professional service system to meet the increasingly high freight requirements. Port and shipping enterprises should be encouraged to cooperate more closely in various forms to coordinate with the high-quality development of industries in the Yangtze River Delta region and create a better business environment. Through the above methods, Shanghai can attract more international shipping elements to gather, promote international cooperation and trade exchanges, and further enhance the international competitiveness of the port.

5) Shanghai should stick to the direction of sustainable city development with global core competitiveness and become a sustainable and resilient city. To achieve this goal, Shanghai should attract more enterprises and talents. To achieve this goal, the government should formulate reasonable policies and plan the city properly to make it attractive enough for emerging industries and high-end talents.

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