

An Empirical Study on the Coordinated Development of Cross-Border E-commerce and Cross-Border Logistics in Guangdong Province



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Abstract: Driven by the robust growth of cross-border e-commerce (CBEC), cross-border logistics in Guangdong Province has witnessed a surge in demand. As an increasing number of CBEC enterprises select Guangdong as their core hub for import and export operations, the need for logistics services has grown exponentially. Using annual data from Guangdong Province from 2014 to 2023, this paper explores the relationship between CBEC and cross-border logistics in Guangdong province, verifies the interplay between the two sectors, and identifies pathways to foster their sound and coordinated development. via cointegration tests and a constructed Vector Autoregression (VAR) model. The research results reveal that, in the long term, the CBEC and the cross-border logistics industries in Guangdong province are interdependent and maintain a stable equilibrium. In the short term, the development of CBEC is more influenced by the internal factors, whereas the cross-border logistics is greatly influenced by the variations of CBEC. Based on these findings, some suggestions are given to promote their coordinated development.

Keywords: cross-border e-commerce (CBEC), cross border logistics, VAR model, coordinated development

1. Introduction

Under the tide of globalization, cross-border e-commerce (CBEC) and cross-border logistics have become increasingly vital, emerging as indispensable forces in the arena of international trade. In recent years, the import and export value of CBEC in Guangdong has experienced rapid growth from 14.8 billion yuan in 2015 to 645.4 billion yuan in 2022, an expansion of nearly 43 times. Concurrently, the foreign trade cargo throughput in Guangdong has also grown substantially, rising from 508 million tonnes in 2014 to 730 million tonnes in 2023, with an average annual growth rate of 4.1%. This parallel surge suggests that the rise of CBEC and the development of cross-border logistics may mutually reinforcing.

To support the development of CBEC and logistics, a series of policies have been introduced,

injecting strong momentum into both sectors. For instance, the implementation of the Plan for Promoting the Coordination of E-commerce and Express Logistics since 2018 has further encouraged the integration of these two sectors.

Meanwhile, advances in science and technology are driving deeper integration between them. Through real-time data and information exchange, businesses are now better able to track market dynamics, optimize resource allocation, and enhance decision-making efficiency. This close collaboration not only fuels mutual growth but also offers consumers a more convenient and efficient shopping experience.

In summary, exploring the coordination between CBEC and cross-border logistics is of great significance for fostering deeper collaboration and achieving high-quality development. Especially for Guangdong, It is not only a major hub of

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international trade, but also one of the most developed regions of CBEC.

There is a substantial body of literature concerning CBEC and cross-border logistics. In the field of CBEC, [Zhang & Pan. \(2021\)](#) emphasize its role in reducing the costs associated with import and export transactions. [Zhu et al. \(2020\)](#) point out the key contribution of CBEC to the expansion of China's foreign trade, a view echoed by [Qin & Bryna. \(2018\)](#), who states that CBEC boosts international trade growth. [Chen et al. \(2023\)](#) compare CBEC with traditional trade models in terms of participants, transaction modes, and outcomes, concluding that the former outperforms the latter across these dimensions. [Xu & Dai. \(2022\)](#) propose strategies to mitigate the impact of the pandemic based on the unique features of CBEC, providing guidance for high-level development of the sector in China. Additionally, [Chen\(2022\)](#) identifies a strong correlation between CBEC infrastructure and penetration rates and broader economic growth.

In terms of cross-border logistics research, [Xiao \(2018\)](#) highlights issues such as long delivery times, lack of process transparency, and customs clearance difficulties. [Wei & Sun. \(2023\)](#) note that high operational costs in China's cross-border logistics negatively affect foreign trade, while different operational models can significantly promote it. [Xiao \(2023\)](#) analyzes current challenges in cross-border logistics and proposes countermeasures to strengthen international logistics corridors. [Giuffrida et al. \(2017\)](#) stress the importance of logistics development in improving the efficiency of CBEC. [Ding et al. \(2022\)](#) identify a positive correlation between logistics performance and export competitiveness, suggesting ways to enhance logistics capabilities in developing countries.

Regarding the relationship between the two sectors, [He \(2021\)](#) analyzes their coordinated development in China and finds that they exhibit mutual granger causality, with short-term trends moving largely in the same direction. [Su \(2022\)](#) evaluates the coordination between CBEC and

logistics in Chongqing, concluding that the two industries show a relatively low level of synergy.

In summary, there remains a scarcity of quantitative studies on the coordination between CBEC and cross-border logistics, especially with a focus on Guangdong. In view of this, this paper takes Guangdong as a case study and empirically investigates the coordinated development of these two industrial sectors by constructing a VAR model. The findings aim to support policy making and facilitate synergistic growth in CBEC and cross-border logistics.

2. Research Design

2.1. Research methodology

In addition to cointegration test and granger causality test, which have been applied to systematically verify the correlation between CBEC and cross-border logistics, in order to further reveal their dynamic interaction mechanism, a VAR model is constructed, impulse response analysis and variance decomposition are used to comprehensively analyse the mutual influence of CBEC and cross-border logistics.

2.2. Selection of indicators

This paper selects the annual indicators of CBEC import and export volume, which can intuitively reflect the scale of CBEC, denoted as KJDS. Referring to [He \(2021\)](#), the annual port foreign trade cargo throughput, denoted as TTL, is selected to reflect the cross-border logistics transport capacity. In addition to the port foreign trade cargo throughput (TTL), the indicators of annual Hong Kong, Macao and Taiwan express business revenue, denoted as KDSR, is also selected to accurately reflect the development level of cross-border logistics.

2.3. Data sources and processing

The annual time series of the CBEC import and export volume (KJDS), the port foreign trade cargo throughput (TTL), and the Hong Kong, Macao and Taiwan express business revenue (KDSR) from 2014 to 2023, is collected from the Ministry of Commerce, Guangdong Provincial Department of Transport,

Guangdong Postal Administration and public information.

In order to remove the heteroscedasticity effects, the data were logarithmically treated to obtain LNKJDS, LNTTL, and LNKDSR.

2.4. Unit Root Test

In order to avoid the emergence of "pseudo-regression", the ADF unit root test is conducted to test the stability of the data series, the test results are shown in [Table 1](#).

Table 1. ADF test results

variant	ADF statistic	P-value	Result
LNKJDS	-0.645816	0.8054	unstable
LNTTL	-3.494916	0.1033	unstable
LNKDSR	-0.558608	0.8341	unstable
DLNKJDS	-8.178388	0.0003	stable
DLNTTL	-4.595452	0.0098	stable
DLNKDSR	-4.972481	0.0084	stable

Note: D denotes first-order difference.

[Table 1](#) shows that LNKJDS, LNTTL and LNKDSR are unstable time series, but after the first-order difference treatment, the data series all become stable, thus the three data series are first-ordered before modeling.

2.5. Cointegration test

Known as a test of time series with the same order, Cointegration test is used to detect whether there is a long-run stable equilibrium among the series. To conduct the cointegration test, the E-G two-step method, which requires a smaller sample size compared to Johansen method, is used. the E-G two-step method is conducted as the following:

Step 1: OLS regression of LNKJDS, LNTTL and LNKDSR to obtain the following regression equation:

$$LNKJDS_t = 3.9332LNTTL_t + 2.0904LNKDSR_t - 12.2806 + \varepsilon_t \quad (1)$$

In the regression results, the coefficient and statistics of LNKDSR indicate that the revenue from Hong Kong, Macao and Taiwan express delivery business in Guangdong can significantly affect the import and export volume of CBEC in Guangdong.

Step 2: Test the residual series ε_t in equation (1). The test results with a -4.634983 t-statistic, indicate that the residual series are smooth at 10% significance level and there is at least one cointegration equation among the three variables. That is, there is at least one long-term linear equilibrium relationship among the three series.

3. VAR modelling

3.1. Lag order selection

The AIC criterion was used as the criterion for determining the lag order of the VAR model and a lag order of 1 was obtained from [Table 2](#).

Table 2. Criteria for Selection of Lag Order

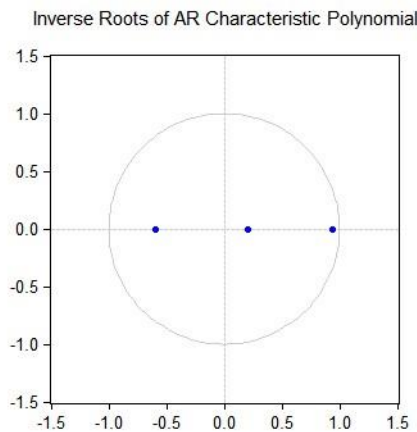
Lag	Logl	LR	FPE
0	11.45490	NA	3.07e-05
1	38.06886	29.57107*	7.47e-07*
Lag	AIC	SC	HQ
0	-1.878866	-1.813124	-2.020736
1	-5.793079*	-5.530113*	-6.360559*

3.2. VAR Modelling builds

In the case of a small sample, a VAR(1) model is build by choosing Bayesian VAR type. The equations of the model are as the following:

$$\begin{bmatrix} LNKJDS_t \\ LNTTL_t \\ LNKDSR_t \end{bmatrix} = \begin{bmatrix} 0.3149 & 0.7938 & 1.0351 \\ 0.0250 & 0.0463 & 0.0768 \\ 0.1163 & 0.2464 & 0.4013 \end{bmatrix} \bullet \begin{bmatrix} LNKJDS_{t-1} \\ LNTTL_{t-1} \\ LNKDSR_{t-1} \end{bmatrix} + \begin{bmatrix} -2.1828 \\ 1.1472 \\ 2.3553 \end{bmatrix} \quad (2)$$

In order to ensure the reliability of the following impulse response and variance decomposition analysis, it is necessary to test the stability of the VAR(1) model. The AR Roots test is depicted in [Figure 1](#), indicating that the model is stable, as all the points are within the unit circle

Figure 1. AR root diagram

3.3. Granger causality tests

As a tool to reveal causality relationship among variables, Granger causality tests are reported in [Table 3](#).

Table 3. Granger causality test results

original hypothesis	F-statistics value	P-value
LNTTL does not Granger Cause LNKJDS	3.91813	0.0951*
LNKJDS does not Granger Cause LNTTL	9.42152	0.0220**
LNKDSR does not Granger Cause LNKJDS	12.9064	0.0115**
LNKJDS does not Granger Cause LNKDSR	0.77613	0.4122

Note: “*”, “**”, “***” represents the rejection of the null hypothesis at the significant level of 10%, 5%, and 1%, respectively.

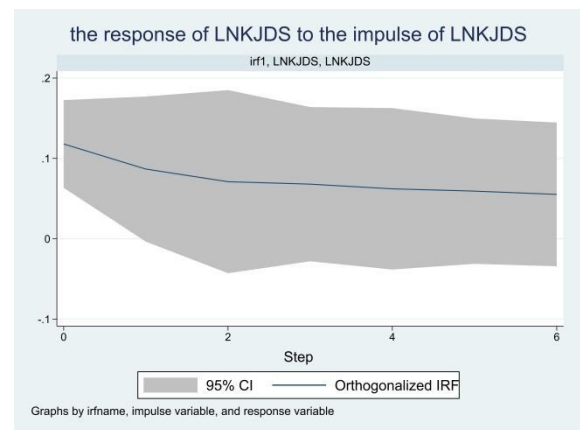
As shown in [Table 3](#), the null hypothesis that "LNKJDS is not the Granger cause of LNTTL" is rejected at the 5% significance level with a lag order of 1, indicating that CBEC serves as a Granger cause of cross-border logistics in Guangdong Province. Similarly, the null hypothesis "LNTTL is not the Granger cause of LNKJDS" is also rejected, which demonstrates that cross-border logistics reciprocally acts as a Granger cause of CBEC.

Therefore, in the long run, CBEC and cross-border logistics in Guangdong exhibit a

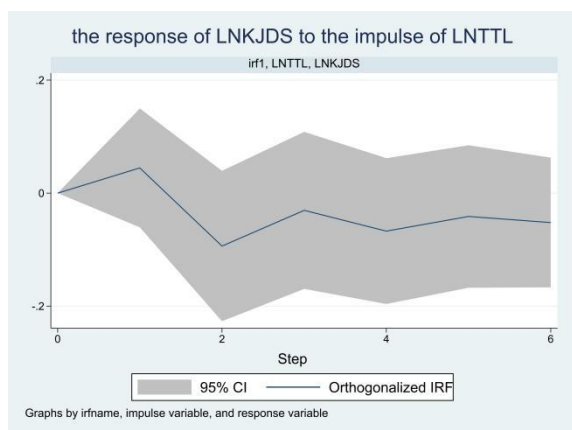
mutually reinforcing dynamic relationship. Specifically, an expansion of CBEC activities will correspondingly stimulate the demand for cross-border logistics services, thereby driving the growth and optimization of the logistics industry. Conversely, improvements in cross-border logistics—such as enhanced transportation efficiency and reduced logistics costs—can further facilitate the development of CBEC, contributing to the expansion of its market scale and the enhancement of its industry influence.

3.4. Impulse Response Analysis

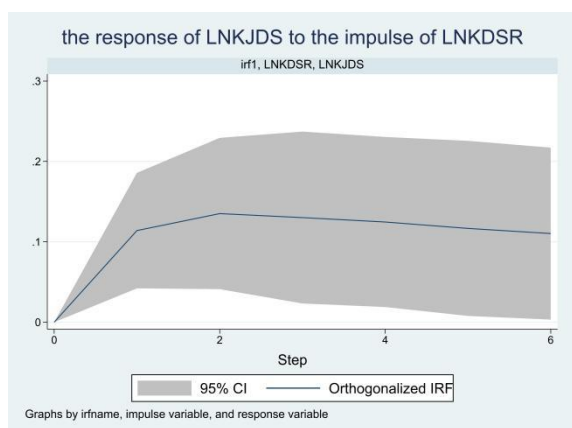
The short-term local dynamic relationship between cross-border e-commerce (CBEC) and cross-border logistics can be clarified through impulse response analysis. The results of this analysis are presented in [Figure 2\(a-i\)](#), where the horizontal axis denotes the time dimension and the vertical axis represents the response degree of variables to a unit shock.

Figure 2(a). LNKJDS to LNKJDS

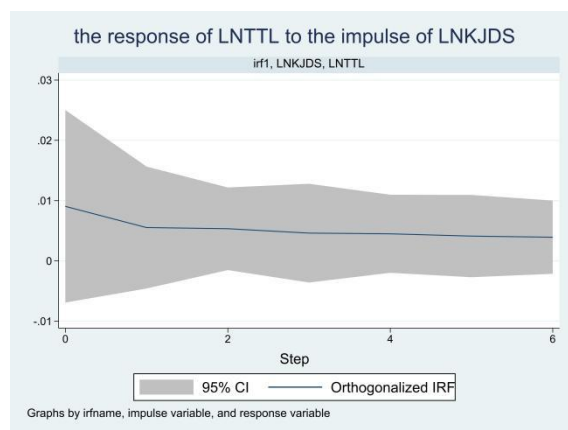
As illustrated in [Figure 2\(a\)](#), LNKJDS exhibits an immediate positive response to its own unit shock, followed by a gradual attenuation over the subsequent periods.

Figure 2(b). LNKJDS to LNTTL

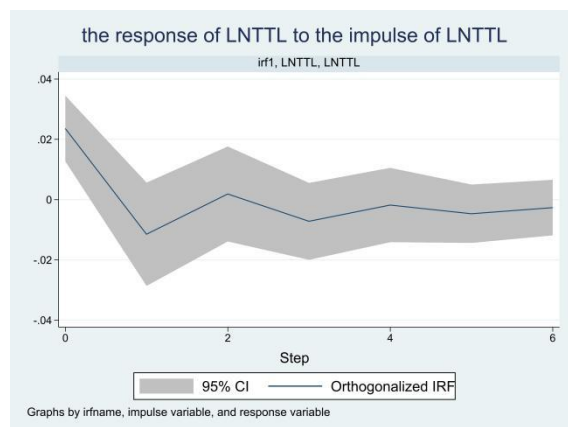
As depicted in **Figure 2(b)**, LNKJDS exhibits an initial positive response to the shock of LNTTL in the first period. Subsequently, this response declines rapidly and reaches a negative peak in the second period, following which the impact of LNTTL on LNKJDS gradually rebounds and tends to fade away.

Figure 2(c). LNKJDS to LNKDSR

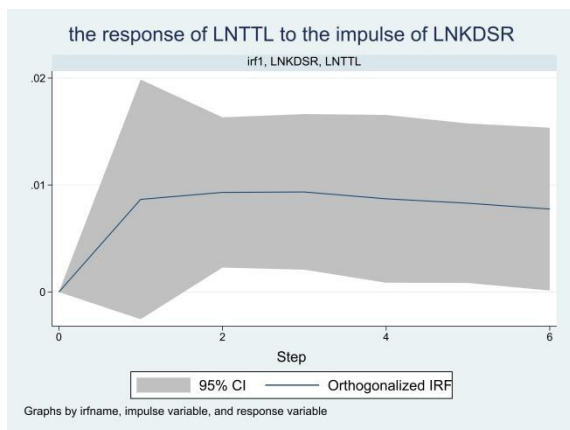
As illustrated in **Figure 2(c)**, LNKJDS shows no immediate response to the shock of LNKDSR at the initial point. Subsequently, its response gradually increases and eventually tends to stabilize at a steady level.

Figure 2(d). LNTTL to LNKJDS

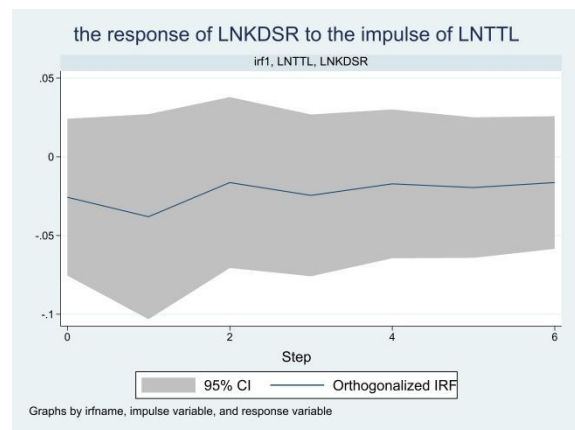
As depicted in **Figure 2(d)**, upon imposing a positive shock on LNKJDS, LNTTL exhibits an immediate positive response. Subsequently, the impact of LNKJDS on LNTTL gradually weakens over time. This finding indicates that cross-border e-commerce (CBEC) in Guangdong can positively facilitate the development of cross-border logistics; however, the magnitude of this promotional effect tends to diminish as time elapses.

Figure 2(e). LNTTL to LNTTL

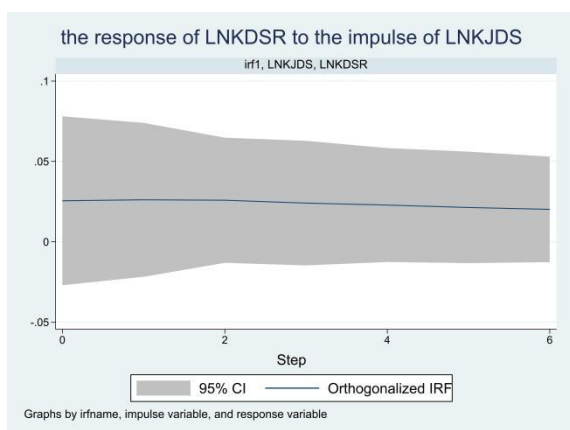
As illustrated in **Figure 2(e)**, LNTTL exhibits an initial positive response to its own unit shock. Subsequently, this response declines rapidly and reaches a negative peak in the second period, following which the impact of LNTTL on itself gradually rebounds and tends to fade away.

Figure 2(f). LNTTL to LNKDSR

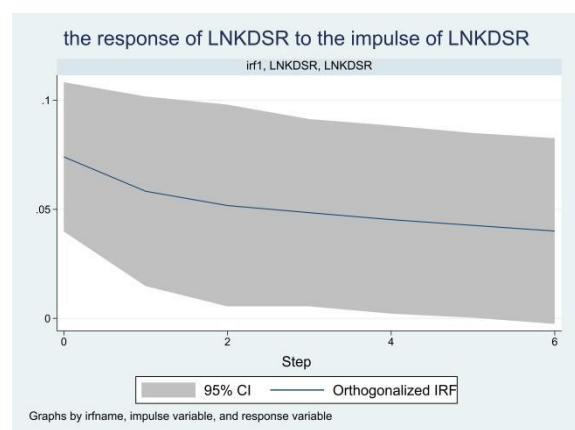
As illustrated in **Figure 2(f)**, LNTTL shows no immediate response to the shock of LNKDSR at the initial point. Subsequently, its response gradually increases and eventually tends to stabilize at a steady level.

Figure 2(h). LNKDSR to LNTTL

As shown in **Figure 2(h)**, LNKDSR exhibits an initial negative response to the shock from LNTTL. Subsequently, this negative response gradually rebounds and eventually tends to dissipate.

Figure 2(g). LNKDSR to LNKJDS

Analogous to **Figure 2(d)**, **Figure 2(g)** shows that when a positive shock is imposed on LNKJDS, LNKDSR exhibits an immediate positive response. Subsequently, the impact of LNKJDS on LNKDSR experiences a slight attenuation but persists for a relatively longer duration compared with Figure 2(d). This result indicates that cross-border e-commerce (CBEC) in Guangdong can positively facilitate the development of cross-border logistics, with the promotional effect being more pronounced on marine logistics than on airline logistics.

Figure 2(i). LNKDSR to LNKDSR

As illustrated in **Figure 2(i)**, LNKDSR exhibits an immediate positive response to its own unit shock, followed by a gradual attenuation over the subsequent periods.

The aforementioned analysis indicates that all cross-border logistics indicators in Guangdong exert a positive impact on CBEC with a slight lag of less than one period. Specifically, the sound development of cross-border logistics in the region can significantly facilitate the rapid growth of CBEC, with the promotional effect being particularly prominent for marine logistics.

A typical illustration is the formal approval of the Guangdong Pilot Free Trade Zone (FTZ) by the State Council in December 2014, encompassing three

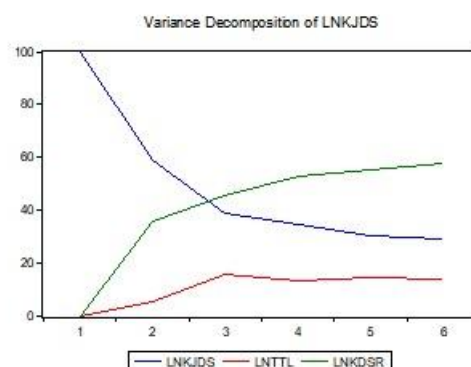
core areas: Nansha New Area (Guangzhou), Qianhai-Shekou Area (Shenzhen), and Hengqin New Area (Zhuhai). Through policy initiatives such as tax incentives and business process optimization, the FTZ has substantially reduced the operational costs of cross-border logistics enterprises and enhanced their operational efficiency, thereby providing strong impetus for the development of cross-border logistics in Guangdong Province. Notably, the establishment of the Guangzhou Nansha FTZ has brought unprecedented development opportunities to the Nansha New Area of Guangzhou Port. Within merely five years, 57 new international shipping routes have been launched, extending trade connections to over 200 countries and regions worldwide, covering more than 400 ports.

According to statistical data, by the end of 2014, Guangzhou Port had 863 berths of various types, among which the number of berths with a capacity of over 10,000 tons reached 71—a remarkable figure. Compared with the previous year, the total number of quay berths increased by 14, including 3 additional 10,000-ton-class berths. By 2015, the construction of port infrastructure continued to maintain rapid progress, driven by the early-stage intensive infrastructure development, favorable policy implementation, and the formation of an efficient facility network. Nevertheless, as time progresses, although cross-border logistics in Guangdong still maintains a promotional role in CBEC development, the marginal effect of this facilitation tends to gradually weaken.

3.5. Analysis of variance decomposition

The variance decomposition analysis analyses the extent to which each structural shock affects the impact of changes in the endogenous variables, and thus evaluates the importance of shocks to different variables. **Figure 3(a-c)** below shows the results of the variance decomposition.

Figure 3(a). Variance Decomposition of LNKJDS



As illustrated in **Figure 3(a)**, LNKJDS is solely influenced by its own fluctuations in the first period. The two cross-border logistics indicators (LNTTL and LNKDSR) begin to exert an impact on CBEC (proxied by LNKJDS) only from the second period onwards. Over time, the self-impact of LNKJDS gradually diminishes and eventually stabilizes at 29%. Among the cross-border logistics indicators, LNTTL has a relatively minor influence on LNKJDS, while the impact of LNKDSR on LNKJDS stabilizes at 58% in the long run.

Figure 3(b). Variance Decomposition of LNTTL

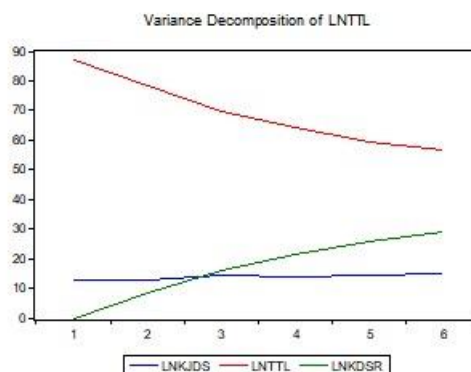
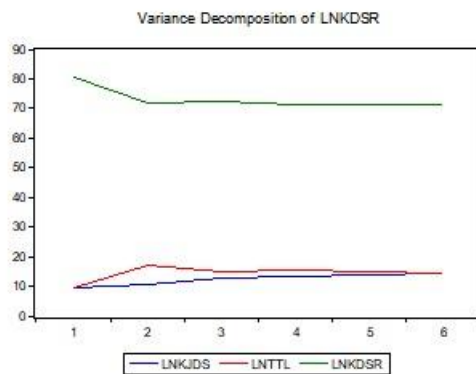


Figure 3(c). Variance Decomposition of LNKDSR

The magnitude of the impact exerted by CBEC (LNKJDS) on Guangdong's cross-border logistics indicators (LNTTL and LNKDSR) is presented in **Figure 3(b)** and **Figure 3(c)**. It is evident that the import and export volume of Guangdong's CBEC has a relatively significant explanatory power for the two cross-border logistics indicators: LNKJDS can account for approximately 15% of the fluctuations in LNTTL and around 14% of the fluctuations in LNKDSR. In summary, the development of Guangdong's CBEC exerts a decent influence on the cross-border logistics sector.

4. Conclusions and Implications

4.1. Conclusions

Based on the aforementioned empirical analysis, the following key conclusions are drawn:

(1) The cointegration test confirms a long-term stable equilibrium relationship between cross-border e-commerce (CBEC) and cross-border logistics in Guangdong. *Ceteris paribus*, a 1% increase in foreign trade cargo throughput drives a 3.93% growth in CBEC import and export volume; similarly, a 1% rise in the express delivery business revenue related to Hong Kong, Macao, and Taiwan leads to a 2.09% expansion in CBEC import and export volume.

(2) The Granger causality test reveals a mutual influence and interactive development mechanism between CBEC and cross-border logistics in Guangdong. However, this causal relationship is not universally observed across all relevant indicators. This finding aligns with the research conclusions of He (2021), implying that the current level of

synergistic development between CBEC and cross-border logistics remains room for improvement. Further deepening of cooperation is required to achieve a more intensive linkage effect

(3) Impulse response analysis indicates that cross-border logistics exerts a positive lagged impact (with a lag of one period) on Guangdong's CBEC import and export volume. In the early stage, the upgrading of cross-border logistics development level exhibits a particularly prominent promotional effect on the CBEC industry, effectively fostering its rapid growth. Conversely, the development of CBEC also plays a positive role in advancing the progress of cross-border logistics

(4) Variance decomposition analysis shows that in the short term, the development of CBEC in Guangdong is primarily driven by its internal fluctuations. Meanwhile, the growth of the CBEC industry exerts a relatively significant influence on the cross-border logistics sector. This observation suggests that the current synergistic development level between CBEC and cross-border logistics in Guangdong needs to be enhanced, as the intensity of mutual influence and the closeness of their relationship remain moderate.

4.2. Implications

Based on the aforementioned research conclusions, combined with the development status and existing bottlenecks of cross-border e-commerce (CBEC) and cross-border logistics in Guangdong, the following targeted policy implications are proposed:

(1) Narrow the development gap and enhance synergistic adaptability.

CBEC development has not only driven the expansion of the cross-border logistics industry but also exposed the latter's inadequate adaptability to the diversified and large-scale demands of CBEC transactions. Currently, most cross-border logistics services in Guangdong remain at the basic level, failing to meet the evolving personalized needs of CBEC. Although the province hosts a large number of small and medium-sized international logistics enterprises, peak-period shipments (e.g., during cross-border shopping festivals) often lead to cargo

backlogs and warehousing pressure, disrupting the normal operation of CBEC enterprises and even the entire supply chain.

Against the backdrop of Guangdong's CBEC entering a period of rapid growth, the inefficiency of logistics express handling and weak adaptability to new demands have become constraints on CBEC development. This mismatch between the two sectors results in a moderate level of synergistic development. To address this, it is necessary to:

Firstly, promote the upgrading of cross-border logistics services, encouraging enterprises to extend service chains to cover customized logistics, cold-chain transportation, and integrated supply chain solutions, so as to align with the high-quality development of CBEC.

Secondly, strengthen the coordination of development planning between CBEC and cross-border logistics, establishing a dynamic adjustment mechanism to synchronize infrastructure investment, service capacity upgrading, and talent training with CBEC development trends.

(2) Improve reverse logistics collaboration to optimize service quality.

Service quality is critical to the sustainable development of CBEC, as it directly affects consumer experience, and reverse logistics plays a pivotal role in service improvement. However, there is a significant gap in reverse logistics efficiency between China and developed countries: while the cost of reverse logistics accounts for only 4% of the total cost in developed countries, it reaches as high as 15% in China's cross-border e-commerce sector.

In Guangdong, most cross-border logistics enterprises are reluctant to engage in reverse logistics business due to profit constraints, whereas CBEC platforms demand low-cost reverse logistics services to enhance their competitiveness. This contradiction between expectations and reality hinders the synergistic development of the two sectors. Corresponding measures should include:

Firstly, encourage logistics enterprises to develop reverse logistics services by providing policy

incentives such as tax breaks and subsidies, reducing their operational costs.

Secondly, promote the establishment of standardized reverse logistics processes and information sharing mechanisms between CBEC platforms and logistics enterprises, simplifying return procedures and improving the efficiency of reverse logistics.

(3) Strengthen logistics infrastructure construction and innovate operational modes.

Infrastructure is the foundation for the high-quality development of cross-border logistics. Guangdong should prioritize the construction and systematic planning of logistics hubs, actively conduct in-depth cooperation and exchanges with international logistics enterprises to introduce cutting-edge concepts and technologies, thereby enhancing the international competitiveness of its cross-border logistics sector.

The Guangdong Provincial Government should formulate and improve policies for the coordinated development of CBEC and cross-border logistics, clarifying development goals, key tasks, and safeguard measures. In terms of financial support, the government should increase funding allocation to encourage enterprises to invest more in infrastructure construction and technological innovation. Meanwhile, cross-border logistics enterprises in Guangdong should actively explore innovative models such as overseas warehouses: establishing overseas warehouses in regions or countries with high logistics demand can significantly improve transportation efficiency, ensure service quality, and reduce cross-border logistics costs.

(4) Establish a mutual trust mechanism to deepen collaborative cooperation.

To enhance the intensity of mutual influence between CBEC and cross-border logistics, it is essential to build a long-term stable cooperative relationship based on mutual trust. Specific measures include:

Firstly, promote CBEC platforms and logistics enterprises to sign mutually beneficial cooperation agreements, involving advance business layout

planning, cost-sharing, and clear definition of rights and obligations, so as to reduce the operational costs of CBEC enterprises and realize win-win results.

Secondly, strengthen government support and guidance for cooperation between the two sectors: improve market supervision to standardize order and protect consumer rights; establish production-marketing docking and information-sharing mechanisms between CBEC enterprises and logistics clusters; and promote data integration to further improve the coordinated development level of the two sectors.

Conflict of Interest

The authors declare that they have no conflicts of interest to this work.

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