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Research on the Relationship between Cross-border E-commerce and Traditional International Trade Models——Complementary effect or substitution effect

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Abstract

The rapid development of cross-border e-commerce has had a profound impact on the traditional international trade pattern. However, whether the relationship between the two is one of substitution or complementarity has not yet reached a consensus in existing research. This paper focuses on the core issue of "complementary effect or substitution effect", and by using the data of China's traditional goods trade from 2009 to 2024 and the transaction data of cross-border e-commerce from 2015 to 2024, conducts a preliminary investigation into the relationship between the two through trend synergy analysis and Spearman's rank correlation test. The research findings show that during the sample period, there is a significant positive correlation between the transaction volume of cross-border e-commerce and the total import and export volume of traditional goods trade. This result indicates that the rapid growth of cross-border e-commerce has not been accompanied by a systematic contraction of traditional trade. At the macro total volume level, the two tend to have a complementary and synergistic relationship. Their complementarity may stem from the incremental expansion brought about by cross-border e-commerce lowering trade thresholds, as well as its buffering and supplementary role in traditional channels under external shocks.

Keywords

Cross-Border E-Commerce; Complementary Effect; Substitution Effect; Spearman Correlation Coefficient

1. Introduction

Over the past decade or so, cross-border e-commerce has gradually evolved from a trade experiment into a channel force that cannot be ignored. It relies on online platforms to facilitate transactions, shortening the multi-layered distribution chain in traditional trade and making cross-border buying and selling more direct and frequent. This trend not only changes the way foreign trade enterprises operate, but

also prompts us to rethink a fundamental question: What exactly is the relationship between cross-border e-commerce and traditional international trade?

At first glance, cross-border e-commerce bypasses some traditional intermediate links and seems to be replacing the original trade channels. On the other hand, it has activated a large number of fragmented orders that are difficult for traditional trade to cover, driving the rise of supporting services such as overseas warehouses and cross-border payments, which are more like supplements and extensions. The two effects often interweave in practice, and the situations faced by enterprises of different products, markets and scales may be completely different. If the two are generally regarded as a simple waxing and waning or advancing in tandem, it is not sufficient to grasp the essence of the issue.

Therefore, this paper chooses to approach from the perspectives of "complementary effect" and "substitution effect", attempting to conduct a relatively systematic analysis of the relationship between cross-border e-commerce and traditional international trade models, with the aim of providing a train of thought and discussion framework for subsequent research.

2. Literature Review and Theoretical Analysis

2.1. Literature review

Existing research has accumulated some basic consensus on the relationship between cross-border e-commerce and traditional international trade. Most studies suggest that the impact of cross-border e-commerce on traditional trade is not a one-way efficiency improvement, but involves deeper structural changes. E Libin、Huang Yongwen (2014)[1] positioned cross-border e-commerce as a "new way of international trade" at an early stage, emphasizing its organizational logic that differs from traditional trade.Hu Qiuhua (2017)[6]、Tong Bing (2018), based on the background of the new normal of the economy, pointed out that the impact brought by cross-border e-commerce has the significance of structural adjustment, rather than merely supplementing the scale of trade. After confirming the structural nature of the impact, some studies began to explore exactly through what path this impact occurred. Li Ying (2015) and Kang Xun (2015) made a review from the perspectives of de-intermediation, reduction of transaction costs and information transparency, while Shen Ming (2016) and Chen Fangli (2016) further discussed the reshaping of traditional trade processes by cross-border e-commerce. From the perspective of the comparison and relationship judgment between cross-border e-commerce and traditional international trade models, Sun Yanling and Su Pei (2019) compared cross-border e-commerce and traditional foreign trade models from multiple dimensions, while Yang Meizhi and He Zhishan (2019) focused on analyzing the impact of cross-border e-commerce on traditional foreign trade models. However, in terms of the nature of the relationship, these studies have not reached a consistent conclusion: some tend to believe that cross-border e-commerce is replacing some

functions of traditional trade, while others emphasize that the two can coexist in different markets and products.

Overall, existing research has reached a basic consensus on confirming the structural impact of cross-border e-commerce on traditional trade, and has also contributed to the identification of specific mechanisms such as de-intermediation, cost reduction, and market expansion. However, whether the substitution effect is dominant, the complementary effect is dominant, or each has its own advantages and disadvantages, the discussion in the existing literature is still insufficient, and some studies just touch upon it briefly. Based on this, this paper attempts to start from the two dimensions of substitution effect and complementary effect to make some preliminary sorting and discussion on the relationship between cross-border e-commerce and traditional international trade models, hoping to provide a relatively clear reference for the subsequent research on this issue.

2.2. Theoretical analysis

The substitution effect refers to the situation where the growth of cross-border e-commerce transactions is accompanied by a relative contraction in the share of traditional trade. If cross-border e-commerce mainly diverts the existing demands of traditional trade, then under the condition of relatively stable total trade volume, there may be a waxing and waning relationship between cross-border e-commerce and traditional trade. From the perspective of total data, if the growth rate of cross-border e-commerce remains consistently higher than that of traditional trade and the proportion of traditional trade shows a trend of decline, it constitutes an initial signal of a substitution effect.

The complementary effect refers to the fact that the transactions realized by cross-border e-commerce are more of an increase rather than a transfer of existing volume. If cross-border e-commerce helps small and medium-sized entities that were previously unable to enter international trade achieve exports or imports, then the growth of cross-border e-commerce can be parallel to that of traditional trade, and the two do not necessarily form a squeeze. From the perspective of total data, if cross-border e-commerce and traditional trade show synchronous growth and the growth rate directions are roughly the same, it can be regarded as an initial signal of complementary effects.

The Spearman correlation coefficient is a non-parametric statistical method used to measure the consistency of the ranking directions of two variables. Its value ranges from -1 to 1. A positive coefficient indicates that the growth trends of cross-border e-commerce and traditional trade move in the same direction, supporting the explanation of the complementary effect. A negative coefficient indicates that the two are moving in opposite directions, and it is more inclined to the judgment of substitution effect. It should be noted that the correlation coefficient reflects a statistical covariant relationship and cannot be directly equated with a causal

relationship, but it can provide a relatively objective reference for trend analysis.

This article will subsequently use China's international trade import and export data from 2009 to 2024 and cross-border e-commerce transaction data from 2015 to 2024. Through trend chart analysis and Spearman correlation coefficient, a preliminary investigation will be conducted on the relative strength of the above two effects.

3. Research Design and Data Sources

3.1. Research design

To investigate the direction and intensity of the correlation between cross-border e-commerce transaction volume and the total volume of traditional goods trade, this paper calculates the Spearman rank correlation coefficient between the two groups of variables. The specific steps are as follows：

Firstly, the cross-border e-commerce transaction volume and the total volume of traditional goods trade for each year from 2015 to 2024 are ranked respectively to obtain two sets of ranks. Then, calculate the degree of correlation between the two groups of ranks based on the Spearman correlation coefficient formula.

The expression of the Spearman correlation coefficient is： $r_s = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$

Among them, d_i is the difference in the rank of the two groups of variables in the i-th year, n is the sample size, and the coefficient values range from [-1,1]. The closer the absolute value of the coefficient is to 1, the stronger the correlation. The closer to 0, the weaker the association.

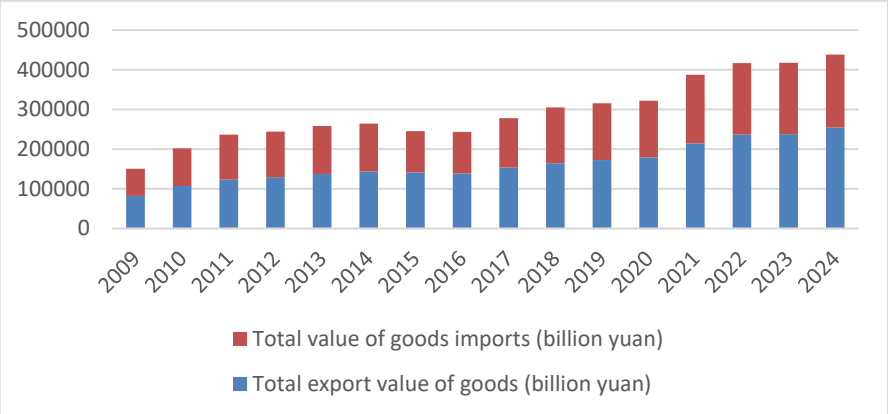
3.2. Data sources

This article involves two types of core variables: the scale of traditional goods trade and the scale of cross-border e-commerce transactions. The traditional goods trade data adopts the annual data of China's total import and export volume of goods trade from 2009 to 2024. The cross-border e-commerce data adopts the annual data of the total transaction volume of cross-border e-commerce from 2015 to 2024. The data sources are the publicly released statistical information by the National Bureau of Statistics, the General Administration of Customs and the Ministry of Commerce. As a new form of trade, the establishment of official statistical standards for cross-border e-commerce lags behind relatively. China only gradually established a relatively standardized statistical system for cross-border e-commerce around 2015. There was a lack of comparable official data for previous years. Therefore, the cross-border e-commerce data in this article starts from 2015. Traditional goods trade data extends forward to 2009 to provide a longer-term trend reference for subsequent analysis.

4. Empirical Analysis

4.1. Analysis of the Overall Trend of Traditional International Trade

Figure 1. China's import and export volume of international trade goods from 2009 to 2024

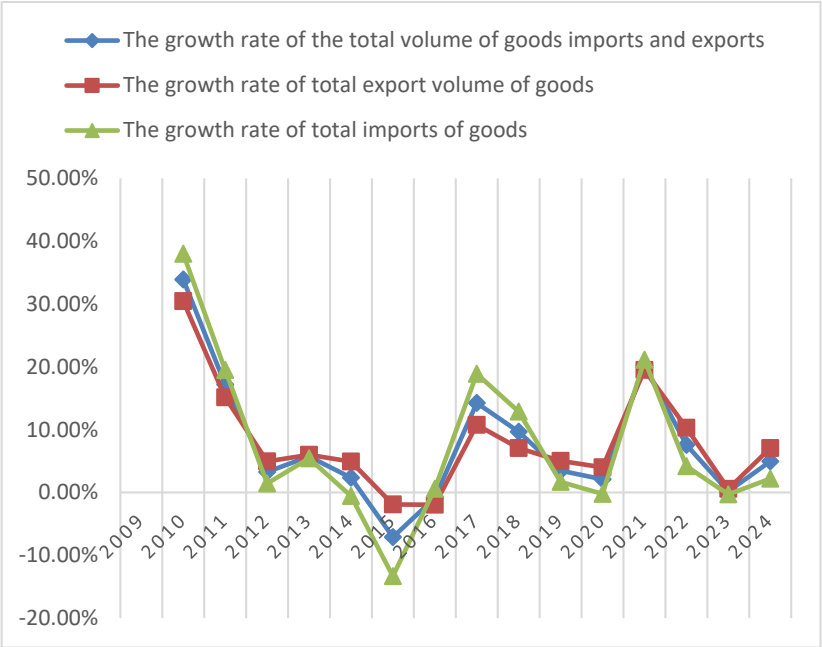


As can be seen from Figure 1, from 2009 to 2024, the total volume of China's goods imports and exports has shown a clear long-term growth trend. The total amount started at a relatively low level in 2009 and has been rising year by year since then, reaching approximately 44 trillion yuan by 2024. Over the past fifteen years, the scale has expanded significantly. This overall trend indicates that China's traditional goods trade maintained a basic pattern of continuous expansion during the inspection period. But the growth process is not uniform. The period from 2009 to 2014 was a relatively stable upward period. There was a slight decline from 2015 to 2016. It has returned to the growth track since 2017. The growth rate further accelerated after 2020. The pullback from 2015 to 2016 was related to external factors such as the overall slowdown of world trade and the decline in commodity prices. However, the acceleration after 2020 was in line with factors such as the emergence of China's export substitution effect against the backdrop of a tight global supply chain and the sharp increase in demand for epidemic prevention materials and durable consumer goods.

Although both exports and imports have generally shown a growth trend, there are obvious differences in the pace and extent. In terms of exports, starting from approximately 8 trillion yuan in 2009, it resumed growth after experiencing minor fluctuations from 2015 to 2016. The growth rate significantly increased after 2020 and is expected to reach about 25.5 trillion yuan in 2024. Export growth picked up significantly in the later period, reflecting that China's manufacturing industry has maintained a strong competitive edge in the global division of labor. Especially against the backdrop of the recovery of external demand and the concentration of some production capacity in China after 2020, exports have gained a strong upward impetus. In terms of imports, they rose from approximately 7 trillion yuan in 2009 to about 12 trillion yuan in 2014. However, they declined from 2015 to 2016. Although there was a recovery later on, the growth rate was significantly slower than that of exports. The import volume remained basically stable in 2022-2023 and

rebounded to approximately 18.5 trillion yuan in 2024. The relatively weak growth rate of imports is, on the one hand, related to the changes in domestic demand structure and the fluctuations in the prices of some bulk commodities. On the other hand, it also reflects the enhanced import substitution capacity of China in some fields. The growth rate of exports has consistently outpaced that of imports, leading to a continuous expansion of the scale gap between the two since 2017, and the trade surplus has been gradually increasing. This structural feature implies that in the second half of the observation period, the growth momentum of China's traditional goods trade came more from the export end, while the contribution of the import end was relatively limited.

Figure 2. The growth rate of China's international trade in goods imports and exports from 2009 to 2024



In terms of growth rate, the growth of China's goods trade from 2009 to 2024 was not a steady upward trend but experienced several relatively obvious ups and downs. In 2010, the growth rates of all three were at a high level and then dropped quickly. From 2015 to 2016, the growth rate bottomed out, with the growth rate of imports once dropping to approximately -0.14. It rebounded in 2017, but gradually declined from 2018 to 2020. In 2021, driven by the base effect, the growth rate rose again, but then continued to decline. By 2023, the growth rates of the three indicators had basically approached zero, and it was not until 2024 that they slightly rebounded. From the perspective of the fluctuation differences between imports and exports, the fluctuation range of the growth rate of imports is significantly greater than that of exports, reflecting that imports are more sensitive to changes in domestic demand and external shocks, while the growth rate of exports is relatively stable, demonstrating a certain degree of external demand stickiness. The years

2010, 2015, 2017 and 2021 were several key turning points, which also indicated that the growth pace of traditional goods trade itself was not stable. This fluctuation feature provides a reference background for understanding the relationship between cross-border e-commerce and traditional trade: In years when the growth rate of traditional trade is declining, if cross-border e-commerce can still maintain a relatively fast growth rate, it may indicate that the substitution effect is at play. If the growth rates of the two change simultaneously, it is more likely to be explained by the complementary effect.

Overall, China's traditional goods trade demonstrated strong growth resilience and export competitiveness from 2009 to 2024. However, the relatively weak import side and the continuous expansion of the trade surplus also pointed to the problems of insufficient domestic demand pull and unbalanced trade structure. The above-mentioned trends constitute an important background for the subsequent analysis of the relationship between cross-border e-commerce and traditional trade in this article. Against this backdrop, whether the growth of cross-border e-commerce is an increment superimposed on traditional trade or a partial replacement of traditional trade channels is a question that requires further discussion.

4.2. Trend synergy analysis

Figure 3. A comparison of the total import and export volume between cross-border e-commerce and traditional international trade in goods

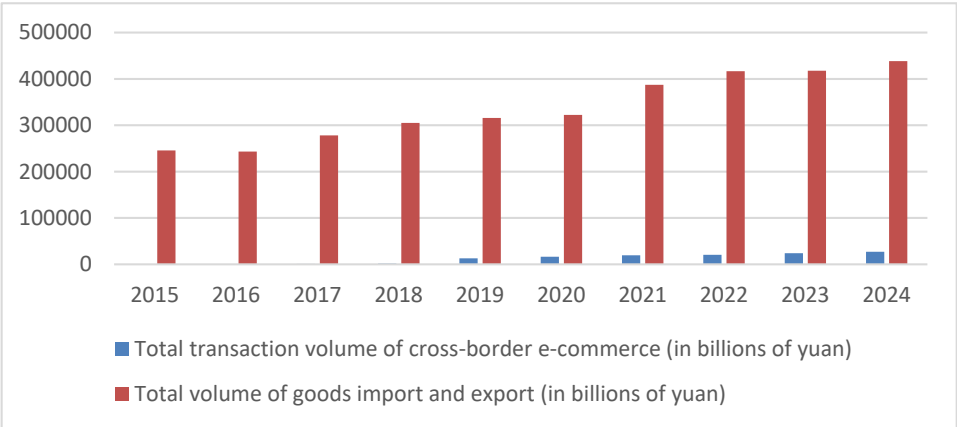
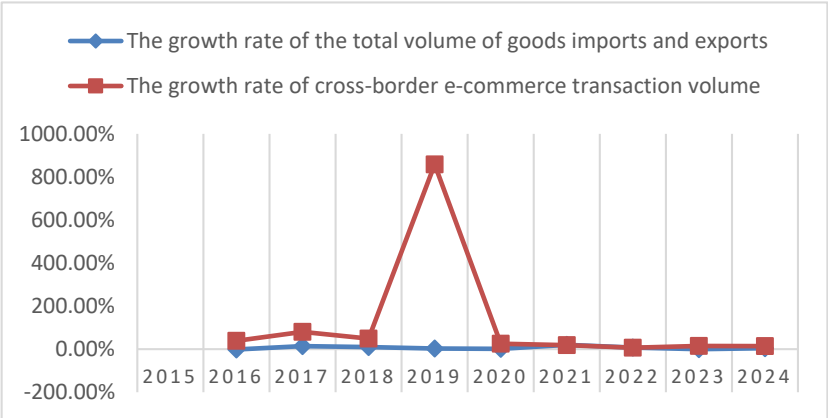


Figure 4. A comparison of the growth rates of cross-border e-commerce and traditional international trade in goods imports and exports



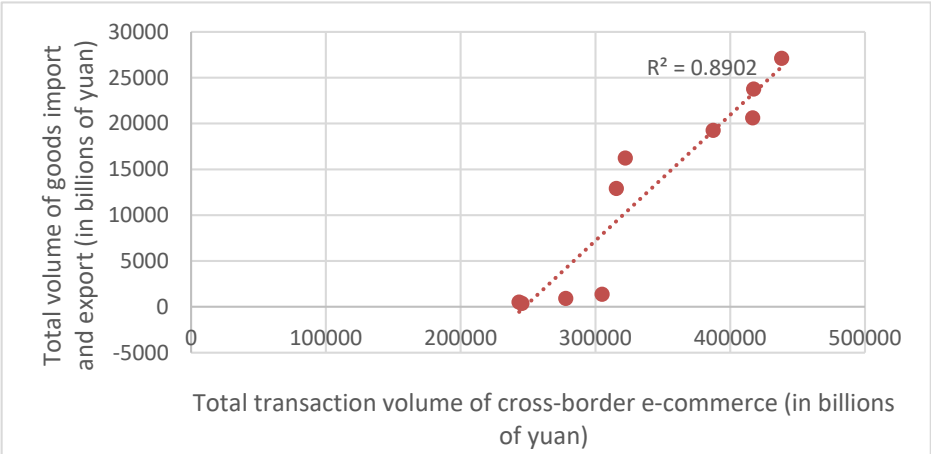
By combining the data trends in Figures 3 and 4, it is possible to initially observe the linkage characteristics of cross-border e-commerce and traditional goods trade in terms of scale and growth rate. It can be clearly seen from the clustered bar chart in Figure 3 that the total volume of traditional goods trade imports and exports has always occupied an absolute dominant position during the observation period, and the overall trend shows an "upward oscillation". The scale trend of cross-border e-commerce transaction volume shows distinct phased characteristics: from 2015 to 2018, it was the initial development period, with an extremely small volume, not in the same order of magnitude as traditional trade. In 2019, there was a significant leap, jumping from a scale of hundreds of billions to trillions of yuan. Since then, it has continued to grow steadily to 2.71 trillion yuan in 2024. It can be clearly seen from the chart that the transaction volume of cross-border e-commerce soared in 2019. However, this leap was not brought about by the development of cross-border e-commerce itself, but was closely related to the adjustment of the customs statistics system. At the end of 2018, the General Administration of Customs issued Announcement No. 194, establishing a unified statistical system for cross-border e-commerce retail imports and exports starting from 2019, which has brought a large number of transactions that were not previously included in the statistics into the statistics. The "9710" and "9810" regulatory methods added in 2020 have further expanded the coverage. Therefore, there is a certain degree of incomparability in the data around 2019. Understanding this as an expansion of statistical coverage might be more prudent than simply regarding it as a market explosion. Since 2019, a relatively clear trend can be observed: the total volume of traditional trade and cross-border e-commerce has remained consistent in direction, both showing an expanding trend year by year. Traditional trade grew from approximately 302.7 trillion yuan to 411.1 trillion yuan, while cross-border e-commerce increased from about 12.9 trillion yuan to 27.1 trillion yuan. In terms of graphical representation, there is no substitutive feature where one side rapidly rises while the other continuously contracts. The two seem more like they are jointly expanding their scale, which provides a preliminary indication of the possible complementary and collaborative relationship between them.

The compound line graph in Figure 4 further presents the dynamic relationship between the growth rates of the two. Given that the extreme values caused by the statistical breakpoints in 2019 (with a year-on-year increase as high as 857.9%) were mainly due to institutional factors, the following text examines the two periods of 2016-2018 and 2020-2024 respectively. During the natural growth period of cross-border e-commerce from 2016 to 2018, although its growth rate was at a high level of 38.7% to 80.6%, it showed a certain degree of synchronization with the fluctuation direction of the growth rate of traditional trade. The growth rate of traditional trade turned from -0.9% to 14.1% and then dropped to 9.5%, while the growth rate of cross-border e-commerce also went through a process of first rising and then falling. At this point, both are operating against the backdrop of an overall recovery in foreign trade, and their directions are not in opposite directions. From 2020 to 2024, as the statistical standards tend to stabilize, the signs of coordinated growth rates will become more pronounced. In 2021, the growth rate of traditional trade soared to 20.3%, and the growth rate of cross-border e-commerce also reached a stage high of 18.6%. In 2022, both slowed down simultaneously, dropping to 7.6% and 7.1% respectively. In 2024, both saw a slight recovery together. This characteristic of same-direction fluctuations at least indicates that the growth rate changes of cross-border e-commerce are not independent of the overall trade environment; they are also influenced by common factors such as fluctuations in external demand and economic cycles.

In 2023, traditional trade witnessed a slight negative growth of -0.6%, while cross-border e-commerce still achieved a positive growth of 15.3%. This was the only time there was a discrepancy in direction after the statistical criteria were stabilized. One possible understanding of this differentiation is that when traditional trade channels are under pressure, cross-border e-commerce, with its high transaction flexibility and fragmented orders, has taken on some transactions that are difficult to complete through traditional models, thereby playing a certain buffering and supplementary role to a certain extent. This speculation still requires more rigorous metrological tests to support it. Based on the intuitive information in Figures 3 and 4, this paper initially holds that the relationship between cross-border e-commerce and traditional goods trade is closer to a kind of synergistic growth with buffering and supplementary nature during the observation period.

4.3. Correlation analysis

Figure 5. The fitting curve of the total import and export volume of cross-border e-commerce and traditional international goods trade



To further investigate the correlation direction between the transaction scale of cross-border e-commerce and the total volume of traditional goods trade, this paper has drawn a scatter plot of the two and conducted a linear fitting, as shown in Figure 5. The horizontal axis in the graph represents the total transaction volume of cross-border e-commerce, and the vertical axis represents the total import and export volume of traditional goods trade. The orange scattered dots represent the sample distribution of each year, and the dotted line is the trend line fitted by the least square method. From the fitting results, it can be seen that the trend line shows a clear positive slope direction, and the determination coefficient R^2 reaches 0.8902. This figure indicates that the changes in cross-border e-commerce transaction volume can explain approximately 89% of the variations in the total volume of traditional goods trade, and the two show a strong positive linear correlation within the sample period. The scattered points are closely distributed on both sides of the trend line as a whole, and no obvious discrete outliers have appeared. The fitting effect is relatively ideal. Judging from the intuitive graph, as the transaction scale of cross-border e-commerce expands, the total volume of traditional goods trade also shows a synchronous upward trend, which is in line with the common expansion features observed in Figures 3 and 4 previously. Within the existing sample range, the scale changes of cross-border e-commerce and traditional trade show a strong co-directionality. This positive correlation, from a quantitative perspective, initially proves that the relationship between the two is more inclined towards complementarity and synergy.

A higher R^2 undoubtedly indicates a stronger degree of statistical association, but the scatter plot fitting itself can only reflect the correlation and cannot directly infer the causal direction. The expansion of the statistical scope for cross-border e-commerce around 2019 enabled the later data to include both the original transactions and the newly included ones, which might have to some extent magnified the synchronization between the two.

Table 1. Correlation Analysis between Cross-border E-commerce Transaction Volume and

the Total Import and Export Volume of Traditional International Goods Trade

Correlation	Spearman correlation coefficient	sample capacity	P
Cross-border e-commerce and goods trade	0.9435	10	0.00004163

From a statistical perspective, the results in Table 1 contain two layers of direct information. On the one hand, the relevant direction is positive. The coefficient value of 0.9435 is positive and extremely close to 1, indicating that within the sample period, the rank ranking of the two columns of data is highly consistent. In the years when the scale of cross-border e-commerce ranks higher, the scale of traditional trade also ranks higher. In years with lower ranks, both are also relatively low. This rank synergy is consistent with the co-directional fluctuations previously observed from the growth rate line chart. On the other hand, it is highly statistically significant, with a P-value of approximately 0.00004. Even at a significance level of 1%, it is sufficient to reject the null hypothesis of "rank independence of the two variables", and it has statistical credibility.

Based on the previous graphs, Figure 3 shows the intuitive feature of cross-border e-commerce and traditional trade expanding in the same direction from the trend of the total volume bar chart. Figure 4 reveals the characteristic of the two fluctuating in the same direction in most years from the fluctuation direction of the growth rate line chart. The scatter plot suggests the possibility of a linear positive correlation between the two with a goodness of fit of R^2=0.8902. The Spearman coefficient 0.9435 further verifies the robustness of this positive correlation from the perspective of non-parametric rank correlation. It does not rely on specific numerical values or distribution patterns; merely based on rank ranking, the high degree of synergy between the two still holds.

By putting together the analysis results of the previous several charts, one can try to make a preliminary response to the core question raised in the thesis title - whether cross-border e-commerce and traditional international trade are complementary or substitutive. Current data indicates that the complementary effect is stronger, and the relationship between the two is more inclined towards complementary synergy.

From the opposite perspective, if the substitution effect is a dominant relationship, then it should be observed that after cross-border e-commerce grows larger, the scale of traditional trade is either compressed or no longer grows. However, the actual data do not exhibit this characteristic of "one rising while the other falls". Even though traditional trade saw a slight decline of -0.6% in 2023, cross-border e-commerce still grew by 15.3%, seemingly showing a hint of substitution. However, if the substitution logic holds true, behind such a high growth rate of cross-border e-commerce, the decline in traditional trade is likely to be more than 0.6 percentage points. A more economic explanation might be that the overall trade environment that year was not good, and traditional channels were somewhat impacted. However, cross-border e-commerce, due to its flexible and fragmented

characteristics, managed to secure some orders that might have been lost. This is more like a buffer rather than a scramble.

5. Conclusion

5.1. Key findings

This article centers on the core issue of "Research on the Relationship between Cross-border E-commerce and Traditional International Trade Models - Complementary Effect or Substitution Effect". Based on a review of the overall trend of China's goods trade from 2009 to 2024, it focuses on using the data of cross-border e-commerce and traditional trade from 2015 to 2024. Through trend synergy analysis and correlation tests, A preliminary empirical investigation was conducted on the relationship between the two. The following main conclusions are drawn：

First, based on the results of trend analysis and statistical tests, during the observation period of this paper, there is a significant positive correlation between the transaction volume of cross-border e-commerce and the total import and export volume of traditional goods trade: the total volume expands simultaneously, the growth rate fluctuates in the same direction, and the order is highly coordinated. This discovery clarifies a fundamental fact: at the macro total volume level, the rapid growth of cross-border e-commerce has not been accompanied by a systematic contraction of traditional trade, and the two are not in an opposing relationship of one rising and the other waning. On the contrary, the years when cross-border e-commerce grows rapidly are often also the years when traditional trade performs well. While traditional trade is under downward pressure, cross-border e-commerce can still maintain positive growth, to a certain extent, playing a role in stabilizing the total volume of trade.

Secondly, based on empirical evidence, the preliminary judgment of this paper on the core issue of the title is that during the sample period, the relationship between cross-border e-commerce and traditional international trade is mainly complementary. This complementarity may stem from two aspects: First, cross-border e-commerce has lowered the trade threshold, incorporating transactions that were previously difficult to achieve due to high costs and narrow channels into the trade system. In essence, this has expanded the overall boundaries of foreign trade. Secondly, when traditional channels are blocked by external shocks, cross-border e-commerce, with its fragmented and highly flexible characteristics, provides alternative channels, partially hedging against the downside risks of traditional trade. However, this conclusion requires an important limitation: complementarity at the total level does not rule out the possibility of substitution in some local fields. Some product categories with a high degree of standardization and easy online transactions may indeed have undergone a shift from traditional channels to cross-border e-commerce. It is only that the scale of this local

substitution is covered by a larger volume of complementary growth in the macro total, which cannot be identified from the data and analysis in this article.

Thirdly, from a theoretical perspective, the findings of this paper are roughly in line with the expectations of the trade creation effect and transaction cost theory. Cross-border e-commerce has actually lowered the entry threshold for international trade by reducing information search costs, eliminating intermediate links and simplifying customs clearance procedures. In this sense, the complementarity of cross-border e-commerce to traditional trade is not an accidental empirical phenomenon, but a concrete manifestation of the expansion of trade boundaries caused by changes in transaction costs. From a practical perspective, this conclusion implies that cross-border e-commerce and traditional trade are not a policy trade-off of "choosing one over the other", but rather two growth poles that can develop in a coordinated manner. The increment brought by cross-border e-commerce is essentially a contribution to China's total foreign trade volume rather than a simple encroachment on traditional channels.

5.2. Recommendations

Based on the judgment of "complementarity first" in the above conclusion, this paper attempts to put forward the following suggestions：

First, promote the deep integration of cross-border e-commerce and traditional trade rather than their isolated development. Specifically: First, encourage traditional foreign trade enterprises to utilize cross-border e-commerce platforms to expand their customer base and explore new markets, thereby lowering the threshold and cost of their digital transformation. Second, support the connection between cross-border e-commerce platforms and traditional foreign trade supply chains, enabling cross-border e-commerce orders to more smoothly enter the existing production, warehousing and logistics systems. Third, in the customs clearance and supervision process, explore the "one warehouse with multiple functions" model, enabling the same warehouse node to not only serve traditional bulk trade but also handle fragmented cross-border e-commerce orders, thus avoiding redundant construction.

Second, attach importance to the buffering function of cross-border e-commerce during the downward cycle of trade. This article finds that when the growth rate of traditional trade slows down, cross-border e-commerce often demonstrates greater resilience. This feature suggests that the policy level can more proactively incorporate cross-border e-commerce into the foreign trade risk response system. Suggestion: First, improve the cross-border e-commerce export credit insurance products and design more flexible underwriting plans based on the characteristics of small and frequent orders. Second, set up public overseas warehouses in major target markets to reduce the inventory costs and logistics uncertainties for small and medium-sized enterprises. Third, establish a cross-border e-commerce export

data monitoring and early warning mechanism to promptly identify changes in external demand and provide faster information feedback for policy adjustments.

Third, improve the statistical system to provide a data foundation for more accurate research and policy evaluation. During the research process of this paper, the problem of data breakpoints caused by the adjustment of statistical standards in 2019 was repeatedly encountered. This is not only a technical challenge for this study, but also reflects that there is still room for improvement in the statistical system of cross-border e-commerce. Suggestion: First, gradually unify the statistical standards for B2C and B2B cross-border e-commerce to reduce the interference in trend judgment due to data non-comparability. Second, increase the frequency of data release, such as adding cross-border e-commerce statistics by industry and country, so that researchers and decision-makers can more clearly see the structural impact of cross-border e-commerce on traditional trade.

Fourth, pay attention to possible local substitution and prevent structural risks. Although the conclusion of this article tends to be complementary, this does not mean that we can completely let down our guard against the substitution effect. With the continuous increase in the penetration rate of cross-border e-commerce, some industries and practitioners that rely on traditional channels may face transformation pressure. It is suggested that the policy level pay attention to these structural changes: First, provide transformation support to traditional trade enterprises and practitioners that are significantly affected by cross-border e-commerce substitution, such as skills training and job transfer subsidies; Second, in the negotiations of free trade agreements, the potential impact of digital trade rules on traditional channels of goods trade should be considered in advance.

5.3. Limitations

At this point in the paper, I am not sure if my research findings are correct. Due to the availability of data and my personal research capabilities, this paper has the following deficiencies that need to be improved in future research：

First, the observation period is relatively short and the sample size is limited. Cross-border e-commerce data only covers the period from 2015 to 2024. The valid sample period is 10 years, and the comparable data after the statistical scope stabilizes is actually only 6 years. The overly short observation period makes it difficult for this paper to capture the substitutive or complementary dynamics over a longer period of time. The robustness of the conclusion awaits the test of a longer time series.

Second, the interference from the adjustment of statistical standards has not been completely stripped away. The reform of the customs statistics system in 2019 led to data breakpoints. Although this article repeatedly pointed out this impact in the analysis, it has not yet been dealt with through measurement means and the errors brought about by the system have not been stripped away. At present, it is difficult

for me to precisely estimate to what extent this institutional factor has magnified the synchronization between the two.

Third, the analytical methods remain at the descriptive level. This article mainly relies on chart trend observation and simple correlation tests. It has not yet introduced control variables or established regression models, and thus is unable to identify the net effect between cross-border e-commerce and traditional trade. Although it is recognized that correlation does not equal causality, this article has indeed failed to cross this threshold at present.

Fourth, aggregate analysis may mask structural differences. The complementary conclusion drawn at the macro aggregate level does not imply that there are no substitutions in all sub-sectors or regions. Some highly standardized and easily online product categories may indeed have undergone a channel shift from traditional trade to cross-border e-commerce. However, these local substitution effects have been overshadowed by a more significant complementary growth in the total data.

Fifth, trade in services was not taken into consideration. In this study, when examining the relationship between cross-border e-commerce and traditional trade, traditional trade was limited to goods trade. This handling is mainly based on two considerations: First, among the current transaction objects of cross-border e-commerce, the proportion of service trade that can be digitally delivered is relatively low, and physical goods still constitute the absolute main body, with the most direct correspondence to goods trade. Secondly, the logistics, payment, marketing and other service links related to cross-border e-commerce are scattered under multiple items such as transportation, telecommunications and computer information services in the current service trade statistics system (such as the BOP standard), making it difficult to separate them and conduct targeted relationship tests. Therefore, taking goods trade as the main object of analysis is based on the dual considerations of variable correspondence and data availability. In the future, as the statistics of service trade become more detailed, the service sections related to cross-border e-commerce can be further separated and their relationships verified with the traditional service trade of the corresponding categories.

The above-mentioned deficiencies also provide directions for subsequent research that can be strived for. In terms of data samples, with the gradual improvement of the statistical system for cross-border e-commerce and the accumulation of annual data, future research can extend the observation window to 15 years or even longer. This not only covers more complete economic cycle fluctuations but also helps to observe the dynamic evolution of cross-border e-commerce from its infancy to maturity and its relationship with traditional trade. In terms of data processing, subsequent research can attempt to introduce a regression breakpoint design, taking 2019 as the breakpoint, to examine whether there have been significant structural changes in the relationship between the two variables before and after

the adjustment of the caliber. In terms of method improvement, when the data conditions are met, a multiple regression model including control variables such as GDP growth rate, exchange rate fluctuations, external demand index, and tariff level can be established to explore the causal relationship between cross-border e-commerce transaction volume and traditional international goods trade through more complex and standardized empirical analysis methods. In terms of trade types, in the future, service trade can be included in the research scope, and the effect relationship can also be explored by subdividing specific industries or regions.

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