Research on Influencing Factors of Cross-Border E-Commerce Development of Industrial Clusters——Take Yongkang Hardware Industry as an Example

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Abstract

As a new force in foreign trade and export, cross-border e-commerce of industrial clusters continues to promote industrial clusters with obvious foreign trade tendency to realize the transformation of digital trade. In order to explore the realistic path to promote the cross-border e-commerce development of industrial clusters, this paper analyzes its development mechanism on the basis of relevant literature, and extracts three dimensions: cluster enterprise factors, industrial cluster factors and local government factors. Take Yongkang City as the research object, which belongs to the first demonstration category among the cross-border e-commerce pilot cities in Zhejiang industrial clusters, and then use the collected data for analysis. The results show that: in the process of cross-border e-commerce development of Yongkang hardware industry cluster, the effect of cluster enterprise factors is not significant; Industrial cluster factors and local government factors can play an obvious role in promoting. At the same time, industrial transformation and upgrading, as an effective intermediary channel, can play part of the intermediary role.

Keywords: industrial clusters, cross border e-commerce, cluster enterprise, local government, industrial transformation and upgrading, Yongkang hardware industry

I. Introduction

With the development of Internet technology and government support, cross-border e-commerce has become an important engine to promote domestic and international double circulation and China's open economic development[1]. Despite the impact of the epidemic, China's cross-border e-commerce transaction volume continued to grow in 2020, an increase of 19.4% compared with 2019, reaching 12.5 trillion yuan. In recent years, the relationship between industrial clusters and cross-border e-commerce has become closer and closer. Cross border e-commerce accelerates the development and innovation of foreign trade parttens of industrial clusters; at the same time, industrial clusters also provide rich resources and mature industrial foundation for cross-border e-commerce. Li Fang (2019) analyzed the synergies between the two and found that the rapid development of cross-border e-commerce in industrial clusters can promote the deep embedding of China's industries into the global value chain and realize the transformation from a large foreign trade country to a strong foreign trade country[2]. Therefore, in the era of "Internet plus", the development of "industrial cluster + cross-border electricity supplier" has become an inevitable trend in the innovation of foreign export trade mode innovation and development[3]. The "2021 Zhejiang Cross-border E-commerce High-quality Development Action Plan" released by zhejiang Provincial Government Affairs Department also clearly points out that it is necessary to continue to promote the development of "Industrial Cluster + Cross-border E-commerce", create and develop high-quality new foreign trade industrial clusters. At present, some industrial clusters cross-border e-commerce show strong market competitiveness, but affected by changes in international trade situation and its own development, China's industrial clusters cross-border e-commerce is still at a low level of development, there are small scale, poor quality, insufficient depth of development and other problems[4]. Therefore, it is of great significance for the optimization of industrial clusters and the introduction of relevant policies and measures to have an in-depth understanding of the influencing factors of the development of cross-border e-commerce in industrial clusters and to clarify the issues that need to be focused on in the future development process. Therefore, it is of great significance for the

optimization of industrial clusters and the introduction of relevant policies and measures to have an in-depth understanding of the influencing factors of the development of cross-border e-commerce in industrial clusters and to clarify the issues that need to be focused on in the future development process.

Based on the existing research findings, most scholars' studies on the development of cross-border e-commerce in industrial clusters only stay at the level of theoretical analysis. Through summary and case analysis, they explore existing problems and propose corresponding solutions, lacking in-depth empirical studies. To this end, this paper constructs a theoretical model of factors affecting the development of cross-border e-commerce in industrial clusters on the basis of relevant research and the actual situation of the Yongkang hardware industry, and then uses the data from the questionnaire survey to comprehensively analyze the effects of various factors. It can not only extend the related research of cross-border e-commerce in industrial clusters in theory, but also provide reference for the development of cross-border e-commerce in industrial clusters in practice.

II. Theoretical Model and Research Hypothesis

2.1 Theoretical model

The biggest feature of cross-border e-commerce in industrial clusters is the integration of cross-border e-commerce and industrial clusters, which not only has the development characteristics of cross-border e-commerce, but also needs to be based on certain industrial clusters. Therefore, when studying the factors that affect its development, it is also necessary to consider these two dimensions.

First of all, the analysis is carried out from the level of cross-border e-commerce. Based on existing studies, it is found that the development of cross-border e-commerce is affected by various factors, such as capital, manpower, government support and development environment, etc. Through observation, it can be found that these influencing factors can be roughly divided into "pull factors" and "push factors". "Pull factors" mainly refer to the core resources and core capabilities possessed by cross-border e-commerce companies [5]; and "push factors" mainly come from the external market environment and support [6]. For cross-border e-commerce in industrial clusters, the "pull factor" of its development mainly comes from the development ability of the cluster enterprises, and the "push factor" mainly comes from the actions of the local government. Then, from the perspective of industrial cluster, industrial cluster theory believes that industrial cluster is not only the evolution of economic spatial structure, but also an important organizational feature to improve industrial structure, and an important way of regional development for enterprises to achieve scale effect by replacing enterprise scale with regional agglomeration [7]. Abundant resource elements, perfect industrial structure and high-density social network in industrial clusters can become the source of competitive advantage in the development of cross-border e-commerce in industrial clusters.

According to the above analysis, the influences on the development of cross-border e-commerce in industrial clusters can be divided into three dimensions: cluster enterprise factor, industrial cluster factor and local government factor. In addition, this paper also considers the role of industrial transformation and upgrading, which refers to the process in which industries obtain value creativity and enhance competitiveness through innovation [8]. In this process, cluster enterprise factors, industrial cluster factors and local government factors will all exert influence to some extent, and the improvement of the overall capacity of clusters brought about by transformation and upgrading can continuously promote the development of cross-border e-commerce of industrial clusters. Therefore, in order to further explore the influence mechanism of various variables on the development of cross-border e-commerce in industrial clusters, this paper takes industrial transformation and upgrading as a mediator variable, and builds a theoretical model of influencing factors on the development of cross-border e-commerce in industrial clusters as shown in Figure 1.
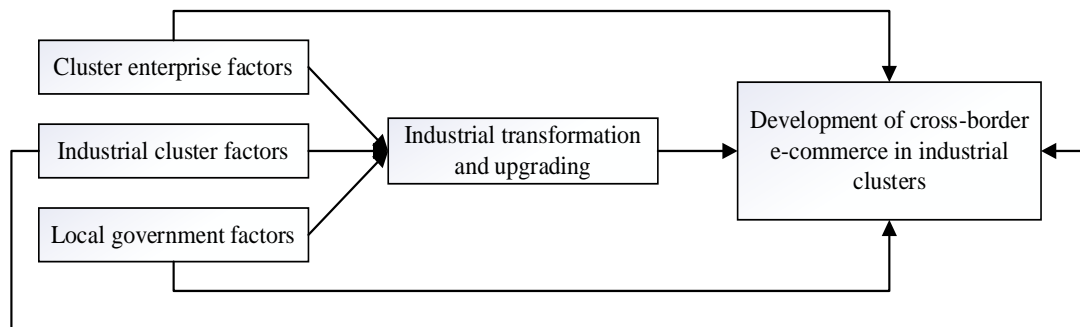
Fig 1: Theoretical model of influencing factors of cross-border e-commerce development of industrial clusters

2.2 Research hypothesis

2.2.1 Cluster enterprise factors

As the most important constituent of industrial clusters, the core capabilities of cluster enterprises affect all aspects of the development of cross-border e-commerce in industrial clusters. First of all, the product competitiveness and service quality of cluster enterprises will directly affect the success or failure of cross-border e-commerce transactions of industrial clusters. Melisande Cardona (2015) et al found in their study that consumers' consumption on cross-border e-commerce platforms is mainly determined by commodity category and price [9]. In addition, the knowledge-intensive nature of cross-border e-commerce also determines its strong dependence on human resources. In particular, small and medium-sized cross-border e-commerce enterprises in clusters have weak talent training ability, and the huge gap between the required talents and the actual level of enterprises has become the most important factor limiting their development [10]. Through case analysis, Li Wenhui (2018) found that advanced technologies, equipment and other resources owned by cluster enterprises can also continuously promote the development of cross-border e-commerce in industrial clusters [11]. To sum up, this paper puts forward the following assumptions:

H1: There is a positive correlation between cluster enterprise factors and cross-border e-commerce development of industrial clusters.

2.2.2 Industrial cluster factors

Scholars have discovered through research that industrial clusters can smoothly connect the upstream and downstream flows of trade and gather resources on a larger scale. Akhmad Hidayatno et al. (2019) found through research that high-concentration industrial clusters can significantly reduce the costs of enterprises in the cluster[12]. It can be seen that although the agglomeration advantages of industrial clusters cannot directly determine the occurrence of cross-border e-commerce business activities, they can provide unique economies of scale for the development of cross-border e-commerce in industrial clusters. Lazzeretti et al. (2016) also found that the geographical proximity of companies can greatly improve the efficiency and effectiveness of knowledge transfer[13]. Hailing Guo (2017) analyzed the case of cross-border e-commerce in industrial clusters in Hebei Province and found that the rich resource elements and perfect industrial structure in industrial clusters can accelerate the construction of cross-border e-commerce industry chains in industrial clusters [14]. In addition, the popularity and market foundation of cluster brands can also invisibly enhance the competitiveness of enterprises and obtain more trade opportunities. To sum up, this paper puts forward the following assumptions:

H2: There is a positive correlation between industrial cluster factors and cross-border e-commerce development of industrial clusters.

2.2.3 Local government factors

In the process of industrial cluster development, the behavior of local government plays a key role, especially in the development of immature emerging industries, the guidance and regulation of local government policy is an important driving force for its rapid rise. Chen N (2017) and others believe that the intensive promulgation of

support policies has continuously released trade benefits and promoted the improvement of cross-border e-commerce infrastructure [15]. A series of regulatory, payment, tax and other policies introduced by the local government not only improve the participation of cross-border e-commerce enterprises, but also continuously improve the industry standards and departmental cooperation efficiency of cross-border e-commerce, creating a healthy development environment for industrial cluster cross-border e-commerce. To sum up, this paper puts forward the following assumptions:

H3: There is a positive correlation between local government factors and cross-border e-commerce development of industrial clusters.

2.2.4 Industrial transformation and upgrading

Fei Hongping (2017) pointed out that industrial transformation and upgrading is usually a process of promoting the innovation and upgrading of industrial cluster technologies and products through vertical integration and horizontal promotion of industries, so as to realize the promotion of status in the global industrial network and division of labor system [16]. In this process, firstly, the technical content of cluster enterprises' products, talent cultivation and management level are all essential elements in industrial transformation and upgrading [17]. Secondly, the characteristics of industrial clusters also determine their future development direction. For example, under the impetus of highly division of labor and professional collaboration of clusters, enterprises can share resources and information, and the overall value creation ability of clusters is constantly improved to promote transformation and upgrading. Finally, the capital, human resources support, policies and regulations of the local government will also affect the supply of technology and capital in industrial transformation and upgrading [18].

Li Tao (2021) points out that the imperfect industrial chain is an important reason hindering the development of Cross-border e-commerce in China. The improvement of the industrial chain is actually a process of industrial transformation and upgrading. Based on the existing industrial chain, the space of upstream and downstream industries should be continuously expanded to optimize the industrial layout [19]. Transformation and upgrading can improve the overall capacity of clusters, form an industrial chain with efficient resource allocation, and bring new vitality to the development of cross-border e-commerce in industrial clusters. It can be seen that industrial transformation and upgrading has the basic attribute of intermediary variable. Under the positive promotion of the above factors, the industry is constantly integrated and optimized, enhancing the value creativity of the whole cluster, and laying a good foundation for the development of cross-border e-commerce of industrial clusters. To sum up, this paper puts forward the following assumptions:

H4: industrial transformation and upgrading plays an intermediary role in the impact of cluster enterprise factors on the development of cross-border e-commerce in industrial clusters.

H5: industrial transformation and upgrading plays an intermediary role in the impact of industrial cluster factors on the cross-border e-commerce development of industrial clusters.

H6: industrial transformation and upgrading plays an intermediary role in the impact of local government factors on the cross-border e-commerce development of industrial clusters.

III. Research Design

3.1 Research method

This paper uses structural equation model (SEM) to study the development of cross-border e-commerce in industrial clusters. Structural equation model is an extended model of multiple linear regression model, which can not only reveal the direct or indirect influence mechanism of influencing factors on the development of cross-border e-commerce of industrial clusters, but also show the direct interaction of various factors, which can ideally test the influencing factor model established above. In this paper, SPSS25.0 software was used to analyze the data quality, and AMOS24.0 software was used to complete the model construction and parameter estimation.

3.2 Research object selection

After years of development and evolution, Yongkang hardware industry has occupied the leading position in China's hardware market, especially in foreign trade, the export scale of hardware products accounts for about 60% of the national market. With its mature industrial cluster and solid e-commerce foundation, Yongkang has become one of the first industrial cluster cross-border e-commerce pilot cities in Zhejiang Province. Through continuous guidance and cultivation in recent years, Traditional trading enterprises in Yongkang have been continuously "e-commerce". At present, the number of enterprises carrying out cross-border e-commerce business in Yongkang has exceeded 11300, with an increase of 334.6% compared with 2016. The proportion of traditional foreign trade enterprises carrying out cross-border e-commerce business has also reached 47.5%. In 2019, Yongkang's cross-border online retail exports reached 6.56 billion yuan, ranking the second among all counties and cities in Zhejiang Province. In addition, Yongkang hardware industrial cluster cross-border e-commerce in Zhejiang Province in 2020 and 2021 industrial cluster cross-border e-commerce assessment has reached the highest acceptance level. It can be seen that the development of cross-border e-commerce in Yongkang hardware industrial cluster has achieved remarkable results, which is representative to a certain extent.

3.3 Questionnaire design

According to the theoretical analysis, most of the factors affecting the development of cross-border e-commerce in industrial clusters are abstract and specific values cannot be obtained, so the concept of dimension is needed to measure. Taking local government factors as an example, when local policies are in the dimension of "relatively perfect", it indicates that they have reached the critical point required for the development of cross-border e-commerce of industrial clusters, which will have a promoting effect on the development of cross-border e-commerce of industrial clusters, and the higher the degree of perfection, the more obvious the promoting effect will be. However, when it is considered to be in the dimension of "imperfect", it indicates that it is lower than the critical point required for the development of cross-border e-commerce of industrial clusters, which will hinder the development of cross-border e-commerce of industrial clusters, and the more imperfect it is, the more obvious the hindering effect will be. Therefore, the questionnaire in this paper adopts Likert's five-point measure to score from 1 (disagree) to 5 (strongly agree) according to the actual situation of cross-border e-commerce in Yongkang hardware industrial cluster.

According to the theoretical model constructed above, the determination of the variable scale is as follows: The cluster enterprise factor scale and local government factor scale are compared and refer to some measurement items used by Lin Chu and Chu Xuejian (2018) [20], Liao Liang and He Guihe (2018) [21]. The scale of industrial transformation and upgrading refers to some of the measurement items of Luo Shiwen and Guo Aimei (2020) [22]. Considering that Yongkang hardware industrial cluster is a manufacturing industrial cluster, industrial transformation and upgrading mainly focuses on the continuous improvement of production efficiency and the research and development of new products. The factors of industrial cluster and the related quantities of the development of cross-border e-commerce of industrial cluster are compiled by themselves and revised and formulated according to the opinions of experts based on relevant literature and the actual situation of cross-border e-commerce of Yongkang hardware industrial cluster.

3.4 Questionnaire pre survey

Before forming a formal questionnaire, this paper first issued 50 initial questionnaires to China Science and Technology Hardware City Group, Yongkang Youlian International Trade Co., LTD., Yongkang Ku Technology Co., LTD., and Yongkang Hengrui Import and Export Co., LTD. For a preliminary survey, to test the reliability and stability of the initial questionnaire. The results show that the factor load of the item "service quality" in the cluster enterprise factors is less than 0.5, and the explanation of variables is too low, so the item about service quality is deleted in the formal questionnaire.

3.5 Formal questionnaire distribution

The questionnaire survey scope of this paper covers eight pillar industries in Yongkang hardware industry (including automobile industry, door industry, cup industry, etc.), and takes the cross-border e-commerce manufacturing enterprises, cross-border e-commerce supporting industries enterprises, business associations and other service institutions as the survey objects, and conducts a questionnaire survey on the staff in them. In this survey, 285 questionnaires were distributed in the form of "offline field interview + online wechat group", and a total of 254 questionnaires were recovered. Among them, respondents who were not in cross-border e-commerce related industries or had data missing were defined as invalid questionnaires. After removing them, a total of 233 valid questionnaires were obtained.

IV. Empirical Analysis

4.1 Descriptive statistical analysis

The sample of this questionnaire survey is as follows: (1) According to the results of the education level survey, 21% of respondents are senior high school or below, 68% are bachelor/junior college students, and 11% are graduate students or above. (2) The survey results of working years in cross-border e-commerce show that those who have been engaged in cross-border e-commerce for less than one year account for 9%, 1-3 years account for 42%, 3-5 years account for 35%, and more than 5 years account for 14%. Since cross-border e-commerce gradually developed after 2015, the working life of most employees in Yongkang cross-border e-commerce is between 1-3 or 3-5 years. (3) According to the survey results of their work units, cross-border e-commerce manufacturing enterprises account for 46%, supporting industries for 33%, industry associations and other service institutions for 15%, and others for 6%. Yongkang hardware industry focuses on manufacturing enterprises, so manufacturing enterprises account for a large proportion of the respondents. (4) The survey results of job types show that operation and sales positions account for 42%, management 23%, technology RESEARCH and development 12%, production 14%, and 9% of other positions. Since employees in operation and sales and management positions can directly understand the situation of cross-border e-commerce of Yongkang Hardware industrial cluster, Therefore, these two types of employees should be selected when issuing questionnaires.

4.2 Reliability and validity test

Firstly, KMO (Kaiser-Meyer-Olkin' Test) and Bartlett's Test were carried out on 24 measurement items in the questionnaire. The test results showed that the KMO was 0.946 (greater than 0.7), the approximate Chi-square value of Bartlett's Test was 3792.234, and the significance level was 0.000. The results of both tests are significant and satisfy the condition of factor analysis. Then we extracted the factors of 24 measurement items and got 5 factors in total, with the explanatory ability reaching 67.768%. As shown in Table 1, the minimum factor load of the measurement items is 0.625, indicating that these measurement items have good explanatory ability. The rightmost column in Table 1 shows the corresponding Cronbach's α of each variable, which are between 0.84 and 0.91, indicating that the reliability effect of each item is ideal.

Table 1 Factor analysis

Variable	Question number	Factor load	Cronbach's alpha
Cluster enterprise factor (F1)	T11 the management level of the cluster enterprises is high.	0.625	0.875
	T12 the employees of the cluster enterprises have a high level of education.	0.743	
	T13 compared with the products of other enterprises, the products of the cluster enterprises have strong competitiveness.	0.773	
	T14 compared with other enterprises, the employees of the cluster enterprises have professional knowledge and business ability.	0.773	
	T15 the cluster enterprises have strong R & D and innovation ability.	0.807	

	T21 the industrial cluster is rich in resource elements.	0.795
	T22 the industrial cluster has certain technical advantages and some core technologies.	0.761
Industrial cluster factors (F2)	T23 the industrial cluster has formed a relatively complete industrial chain, that is, the enterprises in all links are relatively complete.	0.812
	T24 business associations and other service institutions in the industrial cluster can provide effective help to enterprises.	0.779
	T25 the enterprises in the industrial cluster have frequent business exchanges and stable cooperative relations.	0.78
	T26 Yongkang hardware industry cluster brand has a certain influence in the international market.	0.8

0.907 (Industrial cluster factors F2)

Local government factor (F3)	T31 the local government attaches great importance to the development of the industry and has formulated reasonable industrial planning policies.	0.77
	T32 the local government has issued a talent policy to attract a large number of talents for cluster enterprises.	0.782
	T33 the local government can provide tax incentives and other financial benefits to cross-border e-commerce enterprises in the cluster.	0.79
	T34 the local government has high investment in R & D and innovation, and has corresponding patent subsidies.	0.794

0.864 (Local government factor F3)

Industrial transformation and upgrading (M)	M1 compared with the past, the local industrial structure has been continuously optimized and upgraded.	0.798
	M2 continues to introduce advanced production equipment and intelligent technology locally, and the resource utilization capacity is continuously optimized.	0.739
	Compared with the past, the processing degree and technical content of local export commodities are higher and higher.	0.813
	Compared with the previous M4, the process technology and production efficiency of the local industry have been greatly improved.	0.834
	M5 compared with the past, the R & D and updating speed of products in this industrial cluster is faster and faster.	0.837

0.902 (Industrial transformation and upgrading M)

Cross border e-commerce development of industrial clusters (Y)	Y1 the transaction volume of cross-border e-commerce in local industrial clusters is growing.	0.771
	Y2 there are more and more enterprises involved in cross-border e-commerce business in local industrial clusters.	0.762
	Y3 the products of cross-border e-commerce in local industrial clusters are increasingly rich.	0.75
	Y4 the number of cross-border e-commerce express delivery in local industrial clusters is increasing year by year.	0.743

0.843 (Cross border e-commerce development of industrial clusters Y)

Validity test results are shown in Table 2. It can be seen that AVE (Average Variance Extracted) of each variable is within the range of 0.55 to 0.65, indicating that convergence validity is ideal. In addition, any number on the diagonal in Table 2 (the square root of AVE of the corresponding variable) is greater than the number below it in the same column (the correlation coefficient between this variable and other variables), indicating that the correlation within the variable is greater than the correlation between variables, so the discriminant validity also passes the test.

Table 2 Validity analysis

variable	convergent validity	discriminant validity				
	AVE	F_1	F_2	F_3	M	Y
F_1	0.558	0.747				
F_2	0.622	0.433	0.789			
F_3	0.618	0.491	0.737	0.786		
M	0.648	0.157	0.372	0.343	0.805	
Y	0.572	0.094	0.392	0.303	0.318	0.757

4.3 Fitness Analysis

In this paper, AMOS.24 was used to construct the structural equation model for testing, and the suitability of the theoretical model and collected data was judged according to the fitting index, as shown in Table 3. It can be seen that all indicators except CFI (Comparative Fit Index) meet the optimal adaptation standard (> 0.9), and CFI=0.884 also reaches the acceptable atmosphere (> 0.85). Therefore, the theoretical model in this paper can be adapted to the obtained data. Figure 2 is the normalized regression path diagram of this model.

Table 3 Fitness Analysis

Fitting index	χ^2/df	RMSEA	GFI	NFI	CFI	IFI
Model index	1.65	0.062	0.884	0.901	0.954	0.954
Ideal standard	$0<\chi^2/df<3$	<0.08	>0.9	>0.9	>0.9	>0.9
Model adaptation judgment	Yes	Yes	Acceptable	Yes	Yes	Yes

Note: RMSEA in the table is the square root of approximation error; GFI is goodness of fit index; NFI is the standard fitting index; CFI is the comparative fit index; IFI is the modified fitting index.
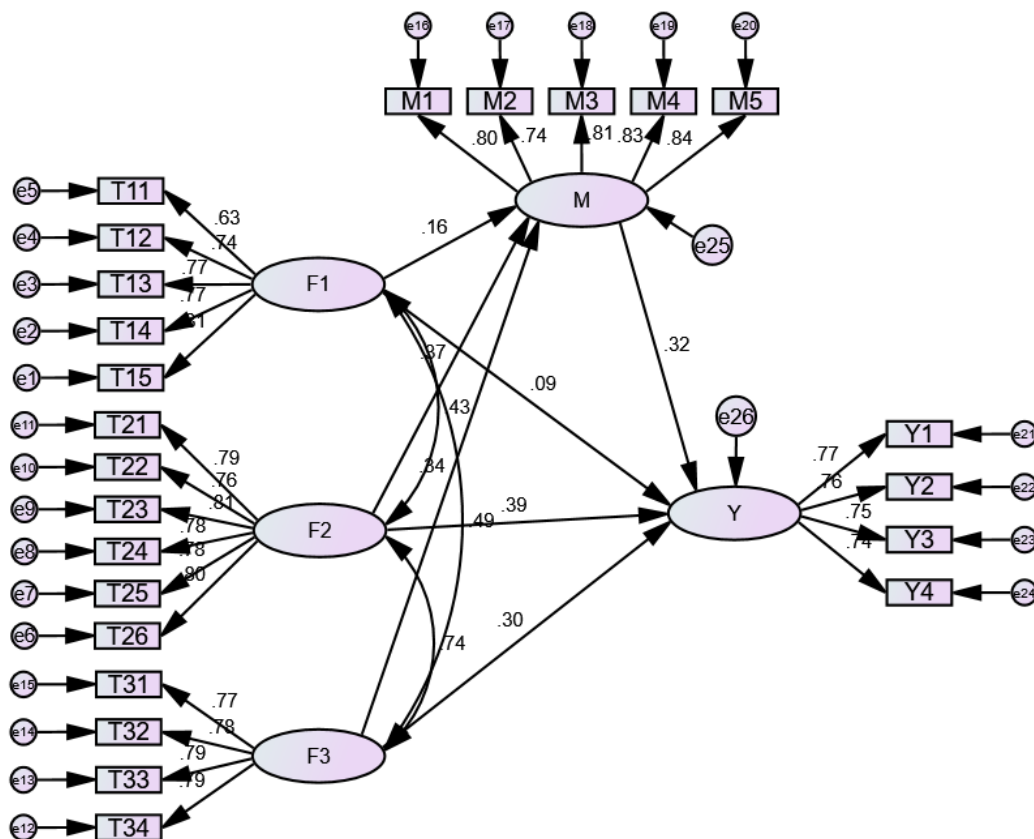

Figure 2   Standardized path coefficient diagram

4.4 Path analysis

As shown in Table 4, factors of cluster enterprises have no significant impact on the development of cross-border e-commerce in industrial clusters (Sig=0.058>0.05), that is, H1 is not established. Through consulting relevant literature and field investigation, it is believed that the reason for this result is that cross-border e-commerce of industrial clusters measures the average development level of the whole cluster, and not all enterprises in industrial clusters can have an impact on the evolution of the cluster. Often, only individual enterprises with obvious advantages in products and technologies can become the key to the sustainable growth of clusters. While developing themselves, they can also drive upstream and downstream enterprises of the industrial chain to jointly achieve technological breakthroughs. Yongkang hardware industrial cluster has a large number of private enterprises, the scale of enterprises are often small, do not have obvious advantages. Therefore, on the whole, cluster enterprise factors play a relatively weak or even insignificant role in the development of cross-border e-commerce in industrial clusters.

The industrial cluster factor ($\beta=0.392$) has a significant impact on the development of cross-border e-commerce in industrial clusters (Sig<0.001). The establishment of H2 indicates that a good industrial cluster environment will promote the healthy development of cross-border e-commerce in industrial clusters. Combined with the field investigation, this paper believes that the reasons for such a result may be reflected in the following aspects: First, with the continuous deepening and refinement of the industrial chain, Yongkang has formed a relatively perfect hardware industry chain, with obvious advantages in industrial agglomeration. Second, Yongkang city has established a dedicated hardware industry cross-border e-commerce pioneer park, introducing rich hardware industry resources and supporting system for cross-border e-commerce to provide comprehensive services for cross-border e-commerce enterprises. Third, Yongkang relies on its cluster brand influence such as "Hometown of China hardware" and the annual China Hardware Expo to expand the visibility of Yongkang hardware in the international market, and also independently developed and built "Shang Hardware" and other e-commerce platforms to better show the hardware products and hardware industry cluster related information.

The influence of local government factors ($\beta=0.303$) on the development of cross-border e-commerce in industrial clusters is significant (Sig<0.001). The establishment of H3 indicates that the strong support of local government will promote the development of cross-border e-commerce in industrial clusters. Based on the field investigation, this paper believes that the reasons for such a result may be reflected in the following aspects: First, the hardware industry is the key cultivation industry of Yongkang city, the government and relevant departments have given certain preferential policies and support measures. Second, Yongkang attaches great importance to the introduction of high-level cross-border e-commerce talents, provides various preferential treatment, and at the same time carries out various training exchanges to provide multi-level training for cross-border e-commerce talents. Third, Yongkang provides financial support to manufacturing enterprises that develop cross-border e-commerce business. At the same time, financial institutions are actively guided to provide unique credit guarantee services for cross-border e-commerce enterprises, allowing them to mortgage with online e-commerce transaction flow, and expanding financing channels for cross-border e-commerce enterprises.

According to the test results in Table 4, it can also be seen that cluster enterprise factors ($\beta=0.157$), industrial cluster factors ($\beta=0.374$) and local government factors ($\beta=0.343$) all have a significant positive impact on industrial transformation and upgrading, and industrial transformation and upgrading can also positively promote the development of cross-border e-commerce in industrial clusters. Therefore, we can preliminarily infer that industrial transformation and upgrading have a mediating effect in the process of industrial cluster factors and local government factors on the development of cross-border e-commerce in industrial clusters.

Table 4 Inspection results of each path

route	Estimate	S.E.	C.R.	Sig
$F_1 \rightarrow Y$	0.094	0.044	1.898	0.058
$F_2 \rightarrow Y$	0.392	0.069	5.206	***
$F_3 \rightarrow Y$	0.303	0.072	3.89	***
$M \rightarrow Y$	0.318	0.06	4.581	***
$F_1 \rightarrow M$	0.157	0.068	2.359	0.018
$F_2 \rightarrow M$	0.374	0.099	3.984	***
$F_3 \rightarrow M$	0.343	0.106	3.455	***

Note: estimate in the table is the value of standard path coefficient; S. E. is the standard error; C. R. is the critical value*** Represents significant at the 1% level.

4.5 Mediating effect test

To further investigate the mediating effect of industrial transformation and upgrading, Bias-Corrected Percentile Method was adopted in this paper. The Confidence Interval did not include 0, indicating that it was significant at the significance level of α=0.05; otherwise, it was not significant. The results are shown in Table 5 below: In model F1→M→Y, the upper and lower bounds of the Confidence Interval of direct effect are 0.192 and -0.005 respectively, including 0. Therefore, the direct effect of this model is not significant, indicating that industrial transformation and upgrading does not play a mediating role in the influence of cluster enterprise factors on the development of industrial cluster cross-border e-commerce, and H4 is not established. In the model F2→M→Y, the Confidence Intervals of indirect effect and direct effect are [0.039, 0.221] and [0.191, 0.621] respectively, both of which do not include 0, and the Z is also greater than the critical value 1.96, indicating that both are significant. Industrial cluster factors can directly affect the development of cross-border e-commerce in industrial clusters (effect accounting for 77%). It can also have an indirect impact through industrial transformation and upgrading (effect accounting for 23%), that is, industrial transformation and upgrading plays a partial intermediary role, and H5 is established. In model F3→M→Y, the Confidence Intervals of indirect effect and direct effect are [0.031, 0.221] and [0.118, 0.554] respectively, both of which do not include 0, and the Z is also greater than the critical value 1.96, indicating that local government factors can directly affect the development of cross-border e-commerce of industrial clusters (effect accounting for 26.52%). It can also have an indirect impact through industrial transformation and upgrading (effect accounting for 73.49%), that is, industrial transformation and upgrading plays a partial intermediary role, and H6 is established.

Table 5 Test of intermediary effect of industrial transformation and upgrading

model	effect	Point estimate	Coefficient phase product		Deviation corrected nonparametric percentile 95% confidence interval		P	effect Proportion /%
			Standard error	Z	lower limit	upper limit		
$F_1 \rightarrow M \rightarrow Y$	Indirect effect				0.01	0.126	0.007	
	Direct effect	-	-	-	-0.005	0.192	0.064	-
	Total effect				0.032	0.256	0.012	
$F_2 \rightarrow M \rightarrow Y$	Indirect effect	0.109	0.044	2.477	0.039	0.221	0.002	23
	Direct	0.360	0.108	3.333	0.191	0.621	0.001	77

	effect							
	Total effect	0.469	0.123	3.813	0.263	0.756	0.000	-
	Indirect effect	0.101	0.047	2.149	0.031	0.221	0.002	26.51
$F_3 \rightarrow M \rightarrow Y$	Direct effect	0.280	0.106	2.642	0.118	0.544	0.001	73.49
	Total effect	0.381	0.122	3.123	0.182	0.659	0.000	-

V. Conclusions

Through the analysis of the survey data of Yongkang hardware industrial cluster, the following conclusions are drawn: In the process of cross-border e-commerce development of industrial clusters, the effect of cluster enterprises is not significant because the scale of cluster enterprises is often small and they do not have significant advantages. However, industrial cluster factors and local government factors both have significant promoting effects, which can be directly generated or indirectly generated through industrial transformation and upgrading. Industrial transformation and upgrading of intermediary variables can continuously improve the competitiveness of the whole cluster, directly promote the development of cross-border e-commerce of industrial clusters, and at the same time can be used as intermediary variables in the process of industrial cluster factors and local government factors.

Based on the above research conclusions, this paper puts forward corresponding suggestions for the development of cross-border e-commerce in industrial clusters. First, we should give full play to the self-driving role of industrial cluster factors: enhance the communication and exchange between cluster enterprises, and create a good competition and cooperation environment; Strengthen the brand construction of cluster and constantly improve the influence of cluster; Establish cross-border e-commerce industrial park to provide all-round supporting support for cross-border e-commerce enterprises. Second, we need to continue to strengthen the role of local governments in driving development: Strengthen industrial policy support and strive to optimize advantageous industries; Improve the cross-border e-commerce talent system and introduce more professionals; We will increase financial and fiscal support and try our best to address the core demands of cross-border e-commerce enterprises, such as financing and payment. Third, to better play the intermediary role of industrial transformation and upgrading: to make full use of resources and capacity advantages within the cluster, optimize the mode of production of the industry, improve production efficiency, and achieve industrial transformation and upgrading.

This paper makes exploratory research on the factors influencing the development of cross-border e-commerce in industrial clusters, but due to the relatively few existing studies on cross-border e-commerce in industrial clusters, and the author's limited grasp of relevant theories. Therefore, there are still some problems in the questionnaire design, such as inaccuracy and incomprehensiveness. In terms of sample selection, the general applicability of the results may need to be further verified. In the future research process, the development status of cross-border e-commerce in China's industrial clusters should be constantly summarized, and the influencing factor model should be improved. At the same time, select some cross-border e-commerce of industrial clusters in different industries and regions as research objects to obtain more comprehensive data about the development of cross-border e-commerce of industrial clusters.

Acknowledgements

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