

RESEARCH ON THE DEVELOPMENT EVALUATION INDEX OF CROSS-BORDER E-COMMERCE IN LIAONING PROVINCE BASED ON ANALYTIC HIERARCHY PROCESS

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ABSTRACT. *In order to study the evaluation system of cross-border e-commerce development in Liaoning Province, this paper introduces the analytic hierarchy process and establishes a cross-border e-commerce evaluation index model. Through the expert assessment, the contrast weights of the two indicators were determined and the consistency test was carried out. The first-level indicator that has the greatest impact on the development of cross-border e-commerce in Liaoning Province is government policy, followed by cross-border e-commerce and cross-border logistics. Finally, scientific suggestions were made for the analysis results.*

Keywords: Cross-border e-commerce, Analytic hierarchy process (AHP), Evaluation index

1. **Introduction.** According to the monitoring data of the China Electronic Commerce Research Center, the overall cross-border transaction volume (including retail and B2B) in China reached 7.6 trillion yuan in 2017 [13], and the growth rate was objective. At the first meeting of the 13th People's Congress of Liaoning Province, it was clearly stated that the Dalian Cross-border E-Commerce Comprehensive Experimental Zone and the Shenyang Cross-border E-Commerce Comprehensive Experimental Zone were established as one of the government's key tasks in 2018. Based on the existing research results, this paper attempts to find out the key influencing factors and make relevant suggestions by constructing the evaluation system of cross-border e-commerce development in Liaoning Province.

L. E and Y. Huang pointed out that cross-border e-commerce can not only promote the development of foreign trade, but also promote the transformation and upgrading of foreign trade industry [1]; L. Xiong et al. used TOE framework to quantitatively evaluate and classify the development level of cross-border e-commerce in major cities of China [2]; J. Yang et al. argued that the key to identifying cross-border e-commerce transactions in cross-border e-commerce is the cross-border marketing capability [6]; X. Zhang and T. Ma proposed to establish overseas warehouses as an effective way to solve China's cross-border logistics problems [3]; E. Gomez-Herrera et al. analyzed the status of cross-border e-commerce in Europe, analyzed its development advantages and problems, and put forward some suggestions [4]; Á. Valarezo et al. explored the personal factors affecting cross-border e-commerce [5]; in summary, there are few studies in the field of cross-border e-commerce development evaluation at home and abroad, and a unified comprehensive evaluation model has not been established. The indicator system and empirical research in Liaoning Province are not many. The characteristics of the analytic hierarchy process

are quantitative analysis of non-quantitative things and objective description of people's subjective judgments, which is a simple and practical quantitative evaluation method.

2. Evaluation Methods and Steps.

2.1. Level analysis method review. Pittsburgh University professor Thomas L. Saaty in 70s first proposed the analytic hierarchy theory. Its theoretical results were first practiced in the related industries in the United States and then popularized in western society. It was introduced into China in 80s, and then applied in energy, project evaluation and so on.

The analytic hierarchy process (AHP) mainly decomposes the total objective to be multiple indicators, and determines the comparative weight of each level by 22 methods, such as expert evaluation and questionnaire. Consistency checking of judgement matrix reduces subjective interference factors and improves accuracy. Therefore, it is widely applied to quantitative problems with complex objectives.

2.2. Evaluation steps.

Step one: create an index system for the evaluation of the development of cross-border e-commerce in Liaoning Province, with the standard layer and the sub standard layer.

Step two: list the index factor $B = B_n$ of the target layer to the standard layer, and the n is a non zero positive integer. The standard layer to the index layer factor set $B_i = (C_{i1}, C_{i2}, C_{i3}, \dots, C_{ik}), i = 1, 2, \dots, n$.

Step three: determine the weight of each index. The weight of each index refers to the relative weight value of two elements on the next layer relative to the previous layer. Use the 1-9 scale method to assign a value, as shown in Table 1.

TABLE 1. 1-9 scale meaning

Standard value	Notes
1	The factor a_i and the factor a_j are of the same importance
3	The factor a_i is slightly more important than factor a_j
5	The factor a_i is more important than factor a_j
7	The factor a_i is significantly more important than factor a_j
9	The factor a_i is absolutely more important than factor a_j
2, 4, 6, 8	The factor a_i is more important than factor a_j in the middle of adjacent judgment

Step four: according to the "Analytic Hierarchy Process to Determine the Weight of Evaluation Indicators and Excel Calculations" published by M. Cao, an Excel calculation template was established for consistency testing [7]. The test coefficient $CR = CI/RI$, when $CR < 0.1$, the consistency test passed, indicating that the judgment matrix is reliable. When $CR \geq 0.1$, the consistency test fails, and the judgment matrix is not reliable. Among them, $CI = (\lambda \max - n)/(n - 1)$, $\lambda \max$ software can calculate the RI value, see Table 2 [8].

TABLE 2. Average random consistency index RI standard value

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.12	1.24	1.36	1.41	1.46	1.49

3. The Application of Analytic Hierarchy Process (AHP) on the Evaluation Index of the Development of Cross-Border e-Commerce in Liaoning Province.

After extensive consultation with relevant disciplines, the opinions of many experts were collected. In addition, the company, government, universities, consulting agencies and other units were investigated and the evaluation index system for cross-border e-commerce development in Liaoning Province was finalized. The criteria layer of the indicator system includes six first-level indicators such as cross-border e-commerce companies, cross-border logistics, and cross-border payments. The sub-criteria layer includes 18 second-level indicators. See Figure 1.

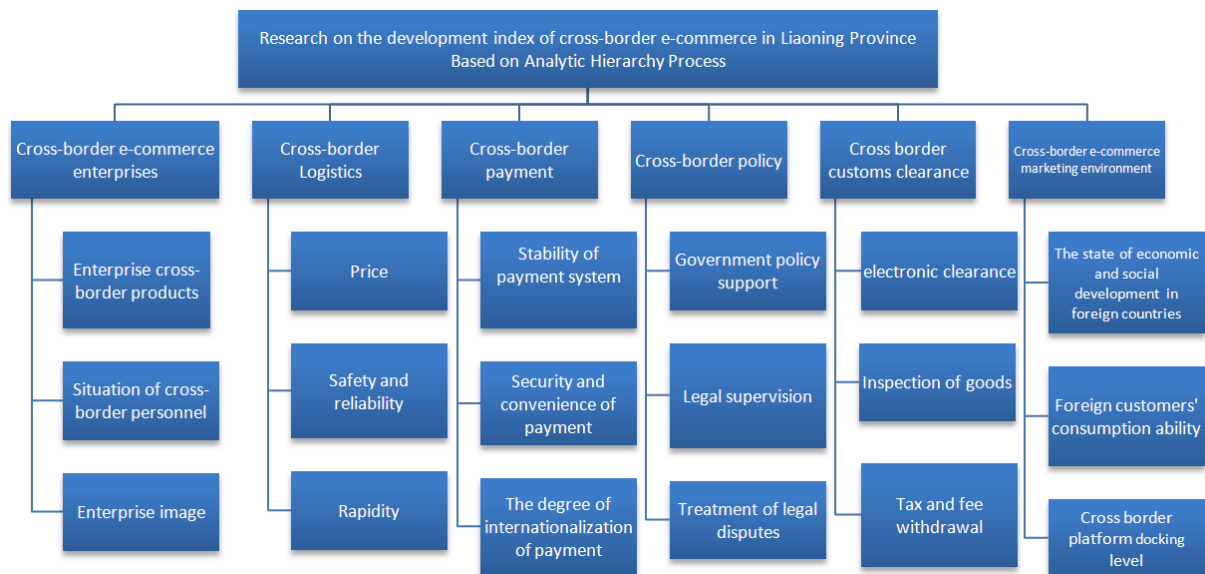


FIGURE 1. Research model for the evaluation index of cross-border e-commerce development in Liaoning

The use of expert survey methods, invited six experts to determine the weight of indicators at each level. First, the 6 experts were divided into 3 groups. Each group judged the relative importance of each level of the indicators. Second, the ratio between the two factors is determined by the evaluation method of the matrix scale. Finally, the results of each group are discussed in a collective discussion to determine the final weight comparison. The target level contrast matrix is A. Cross-border e-commerce enterprises, cross-border logistics, cross-border payment, cross-border policies, cross-border customs clearance, and cross-border marketing environment judgment matrixes are B₁, B₂, B₃, B₄, B₅, and B₆.

(1) The judgment matrix of the comparison of each index of the standard layer is A,

$$A = \begin{bmatrix} 1 & 1 & 3 & 1 & 5 & 3 \\ 1 & 1 & 2 & 1/3 & 4 & 2 \\ 1/3 & 1/2 & 1 & 1/3 & 1/3 & 1/2 \\ 1 & 3 & 3 & 1 & 5 & 3 \\ 1/5 & 1/4 & 3 & 1/5 & 1 & 1/3 \\ 1/3 & 1/2 & 2 & 1/3 & 3 & 1 \end{bmatrix}$$

$$\lambda_{\max}(A) = 6.4760, \quad a_1 = (0.2609, 0.1829, 0.0634, 0.3134, 0.0642, 0.1152)$$

$$RI = 1.24 \quad CR = 0.0952/1.24 = 0.0768 < 0.1 \quad \text{Consistency test passed}$$

$$B_1 = \begin{bmatrix} 1 & 6 & 5 \\ 1/6 & 1 & 1/3 \\ 1/5 & 3 & 1 \end{bmatrix} \quad B_2 = \begin{bmatrix} 1 & 5 & 1 \\ 1/5 & 1 & 1/6 \\ 1 & 6 & 1 \end{bmatrix}$$

$$B_3 = \begin{bmatrix} 1 & 1/5 & 1/4 \\ 5 & 1 & 3 \\ 4 & 1/3 & 1 \end{bmatrix} \quad B_4 = \begin{bmatrix} 1 & 5 & 6 \\ 1/5 & 1 & 3 \\ 1/6 & 1/3 & 1 \end{bmatrix}$$

$$B_5 = \begin{bmatrix} 1 & 2 & 1 \\ 1/2 & 1 & 1/3 \\ 1 & 3 & 1 \end{bmatrix} \quad B_6 = \begin{bmatrix} 1 & 5 & 1 \\ 1/5 & 1 & 1/3 \\ 1 & 3 & 1 \end{bmatrix}$$

$$\lambda_{\max}(B_1) = 3.0940 \quad b_1 = (0.7172, 0.0881, 0.1947)$$

RI = 0.52 CR = 0.0904 < 0.1 Consistency test passed

$$\lambda_{\max}(B_2) = 3.0037 \quad b_2 = (0.4443, 0.0836, 0.4721)$$

RI = 0.52 CR = 0.0036 < 0.1 Consistency test passed

$$\lambda_{\max}(B_3) = 3.0858 \quad b_3 = (0.0936, 0.6267, 0.2797)$$

RI = 0.52 CR = 0.0825 < 0.1 Consistency test passed

$$\lambda_{\max}(B_4) = 3.0940 \quad b_4 = (0.7172, 0.1947, 0.0881)$$

RI = 0.52 CR = 0.0904 < 0.1 Consistency test passed

$$\lambda_{\max}(B_5) = 3.0183 \quad b_5 = (0.3874, 0.1692, 0.4434)$$

RI = 0.52 CR = 0.0176 < 0.1 Consistency test passed

$$\lambda_{\max}(B_6) = 3.0290 \quad b_6 = (0.4806, 0.1140, 0.4054)$$

RI = 0.52 CR = 0.0279 < 0.1 Consistency test passed

(2) Calculate the comprehensive weight of each layer element to the total target of the system in Table 3.

According to the analysis results, among the six criteria layers of cross-border e-commerce development evaluation in Liaoning Province, 31.34% are cross-border policies, 26.09% are cross-border e-commerce enterprises, and 18.29% are cross-border logistics, ranking the top three in the criteria layer. The proportion of the top three in the 16 criteria levels is that the government's policy support rate is 22.48%, the cross-border enterprise's 18.71%, and the cross-border logistics speed is 8.63%. The above indicators have a significant impact on the development of cross-border e-commerce in Liaoning Province.

Cross-border policies and government support for cross-border policies respectively occupy the largest weight of the guidelines and sub-criteria layers. This shows that cross-border policies are the core of cross-border e-commerce development. In 2016, Dalian became the first cross-border e-commerce comprehensive pilot zone in Northeast China. In 2017, the State Council approved the establishment of the China (Liaoning) Free Trade Zone [11]. These measures are an important factor in promoting the industrial upgrading of Liaoning Province and the positive development of cross-border e-commerce. At the same time, the government should continue to increase support for cross-border e-commerce import and export. Actively implement cross-border e-commerce retail export tax rebate policy. Encourage the development of cross-border electronic payments, promote cross-border foreign exchange payment pilots, and support domestic banks in launching overseas operations [18]. Cross-border e-commerce in the operation process involves customs, taxation, logistics, foreign exchange management, third-party payment agencies and other fields. It should establish a system of joint supervision of multiple departments. Formulate corresponding legal standards to safeguard consumer interests [16].

Cross-border e-commerce and enterprise cross-border products occupy the second weight of the criteria layer and the sub-criteria layer, respectively. Cross-border e-commerce is the product of economic globalization and an important way to allocate resources across the world. It helps companies to deal directly with global suppliers and consumers and

TABLE 3. Comprehensive weight

Target layer	Standard layer	Weight	Substandard layer	Weight	Comprehensive weight
Research on the development evaluation index of cross-border e-commerce in Liaoning Province based on AHP	Cross-border e-commerce enterprises	0.2609	Enterprise cross-border products	0.7172	0.1871
			Situation of cross-border personnel	0.0881	0.0230
			Enterprise image	0.1947	0.0508
	Cross-border logistics	0.1829	Price	0.4442	0.0812
			Safety and reliability	0.0836	0.0153
			Rapidity	0.4721	0.0863
	Cross-border payment	0.0634	Stability of payment system	0.0936	0.0059
			Security and convenience of payment	0.6267	0.0397
			The degree of internationalization of payment	0.2797	0.0177
	Cross-border policy	0.3134	Government policy support	0.7172	0.2248
			Transnational legal dispute handling	0.1947	0.0610
			Legal supervision	0.0881	0.0276
	Cross-border customs clearance	0.0642	Electronic Declaration Customs	0.3874	0.0249
			Inspection of goods	0.1692	0.0109
			Tax and fee withdrawal	0.4434	0.0285
	Cross-border marketing environment	0.1152	Economic and social conditions in foreign countries	0.4806	0.0554
			Foreign customers' consumption ability	0.1140	0.0131
			Cross-border platform docking level	0.4054	0.0467

reduce transaction costs. Consumers can also enjoy a wide range of overseas goods. However, the issue of counterfeit goods in the field of cross-border e-commerce has seriously affected consumer confidence in buying. In this regard, it is necessary to strengthen the sampling inspection of goods and actively implement the full traceability of products [14].

Cross-border e-commerce and cross-border logistics accompany each other, and problems such as the long “transportation and distribution cycle” and “high logistics cost”

in the cross-border logistics field seriously restrict the development of cross-border e-commerce [17]. In order to deal with logistics issues, companies such as Alibaba, Jingdong, and Netease have started overseas warehouse operations. By setting up warehouses overseas, not only logistics costs can be reduced, but also overseas markets can be easily implemented. At the same time, overseas warehouses provide one-stop services such as warehousing, sorting, packaging, and distribution, which greatly reduces overall logistics time [3].

Although more and more cross-border payment methods are available, problems such as system instability, Alipay account theft, phishing websites, and the popularity of third-party payment software may affect the domestic consumer shopping experience [12]. Paypal, which is popular with European and American customers, not only conducts services such as Internet payment, mobile payment, offline payment, and credit payment, but also provides consumers with services such as collection and payment, cross-border e-commerce and fund pooling. Currently, in the Shanghai Free Trade Zone's Eastern Payment and Cross-border Communication Platform, Harbin China-Russia cross-border e-commerce online payment platform is trying to establish a one-stop comprehensive service system for cross-border payment.

Cross-border e-commerce goods have the characteristics of small size, variety, high frequency, and high speed. With regard to traditional customs declaration methods, procedures are cumbersome. Once the customs clearance is not smooth, it will inevitably cause a backlog of goods. First of all, we should optimize the customs clearance process, simplify the classification and record management of cross-border e-commerce export commodities, and adopt convenience measures such as centralized declaration, inspection, release, and 24-hour receipt of import and export commodities. The "list check and release, summary declaration" method should be promoted, and the customs will quickly release the electronic list according to the enterprise declaration. E-commerce companies can first clear the list according to the list, regularly summarize the list, and reduce the daily large number of customs declaration work.

The cross-border marketing environment is more complicated than domestic marketing. The politics, economy, infrastructure, and humanities and customs of society at home and abroad are not the same. Strengthen exchanges between the two sides in various fields, achieve complementary advantages, and improve the level of docking [15].

4. Conclusion. Based on the development of cross-border e-commerce in Liaoning Province, this paper uses analytic hierarchy process to construct 18 indicators including six aspects of cross-border e-commerce, cross-border logistics, cross-border payment, cross-border policies, cross-border customs clearance, and cross-border marketing environment. The evaluation index system for the development level of cross-border e-commerce in Liaoning Province was constituted, and the weights of various criteria and sub-criteria layers were calculated. The research results show that cross-border policies, cross-border e-commerce, and cross-border logistics have higher weights. Cross-border e-commerce in Liaoning Province should pay attention to these factors in practice in order to promote the development of cross-border e-commerce.

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