Research on Cross-border E-commerce Evaluation Index System Based on Analytic Hierarchy Process

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Abstract: With the development of modern society, the economy has become an important part of people's daily life and one of the important lifelines of the country's development. With the continuous development of globalization, the exchange and integration of international business has deepened, and in the specific operation process, there has been a run-in and innovation, and the development of this field has been continuously promoted. However, the traditional cross-border e-commerce evaluation index system has complicated evaluation operation and poor operability. Therefore, a research on cross-border e-commerce evaluation index system based on analytic hierarchy process is proposed. Based on the basic principles of AHP, the indicators of cross-border e-commerce evaluation are comprehensively considered, and the AHP is applied to determine the weight of cross-border e-commerce evaluation. The special vector of the comparison matrix is used as the weight of the cross-border e-commerce evaluation factor to construct a cross-border e-commerce evaluation index system. Through simulation experiments, it can be proved that the method is simple, practical and operability, and can objectively reflect cross-border e-commerce evaluation indicators.

Keywords: Analytic hierarchy process; E-commerce; Economic indicators

1. Introduction

With the development of modern network technology and information technology, the new e-commerce economy formed by the combination of economy and network technology has become one of the main modes of modern economic operation. With the current economic development situation and the diversification of people's lifestyles, the trend of networking has become one of the main driving forces of economic development [1]. It can be said that the e-commerce economic model has penetrated into people's daily lives. Especially in today's society where the trend of economic globalization is constantly strengthening, the economic ties between countries are closely related, and international e-commerce exchanges are becoming more frequent. In the process of communication, due to the difference of government and operation mode between countries, the advantages and disadvantages coexist, and the traditional cross-border e-commerce evaluation index system has complicated evaluation operation and poor operability. A research on cross-border e-commerce evaluation index system based on analytic hierarchy process is proposed in this paper. Based on the basic principles of AHP, the indicators of cross-border e-commerce evaluation are comprehensively considered, and the AHP is applied to determine the weight of cross-border e-commerce evaluation. The special vector of the comparison matrix is used as the weight of the cross-border e-commerce evaluation factor to construct a cross-border e-commerce evaluation index system. Through simulation experiments, it can be proved that the method is simple and practical, and has strong operability. It can objectively reflect cross-border e-commerce evaluation indicators and better promote the development of cross-border commerce in China [2].

2. Establishment of Evaluation Index System

To achieve the goal of building a cross-border e-commerce evaluation index system, it is necessary to improve and rationalize the indicator system. The selection and determination of evaluation indicators is the basis and key to evaluate the research content, which directly affects the accuracy and results of the evaluation [3]. Therefore, first of all, the status of cross-border e-commerce are thoroughly investigated and analyzed, and evaluation indicators are comprehensively selected from various aspects. The network marketing factor is used as the target layer of the evaluation system, denoted by B [4]. The four factors of international electronic payment factor, electronic customs factor, international e-commerce logistics factor and e-commerce legal factor are used as criterion level evaluation indicators, which are represented by B1, B2, B3 and B4 respectively. The judgment matrix table is thus listed.

Table 1. Judgment Matrix

A	B1	B2	B3	B4
B1	B11	B12	B13	B14
B2	B21	B22	B23	B24
B3	B31	B32	B33	B34
B4	B41	B42	B43	B44

The above factors are obtained by comparing various factors in the table. The Analytic Hierarchy Process (AHP) is a multi-factor decision analysis method combining qualitative and quantitative [5]. First, the problem is layered, and the problem is decomposed into different components according to the nature of the problem and the overall goal to be achieved. According to the interrelationship and subordination of factors, they are divided into different levels to form a multi-level system structure analysis model. Finally, the system analysis is summarized as the lowest level (for decision-making schemes, measures, etc.) relative to the highest level (total target) relative importance weight determination or relative superiority order sorting problem AHP method is as follows [6]. 1 Determining the decision objectives and establishing a hierarchical structure model. The hierarchical structure model is generally divided into three levels: Target level: The highest level, or the ideal result level, refers to the overall goal pursued by the decision-making problem; The criteria level: evaluation criteria or measurement criteria refers to the criteria for judging the merits and demerits of the scheme, also called the factor layer and the constraint layer; The solution layer: also called the countermeasure layer, refers to the feasible solution to the decision problem. 2 Comparing the structure judgment matrix. The decision maker uses Table 1 to judge a certain element of the upper layer of the matrix as the criterion, and compares the next layer of elements to determine the element value [7].

Table 2. The Value of the Element in the Target Significance Judgment Matrix A

Degree of relative importance	Definition	Introduction
1	Equally important	Two goals are equally important
3	Slightly important	Judging by experience. Think that one goal is slightly more important than the other
5	Quite important	Judging by experience. Think that one goal is more important than another
7	Obviously important	Judging by experience. Think that one goal is more important than the other, and that one goal is more important than the other, and this importance must be proven
9	Absolutely important	Strongly feel that one goal is more important than the other

After judging the value of the A element according to the above table, the maximum eigenvalue of the matrix A can be obtained by the eigenvector method. However, the ω_i is solved by the nth power. The calculation is cumbersome when n ≥ 3, so an approximation algorithm can be used. Each row of elements in ω_i is multiplied and opened n times.

$$\omega_i = n\sqrt{\prod_{j=1}^{n} a_{ij}}, \quad i=1, 2, \ldots n \tag{1}$$

The weight a_{ij} algorithm in the above formula is:

$$a_{ij} = n^* / \sum_{i=1}^{n} \omega_i, \quad i=1, 2, \ldots n \tag{2}$$

The sum of each column element in the formula is summed:

$$S_i = \frac{1}{\lambda} w_i \sum_{i=1}^{n} a_{ij}, \quad j=1, 2, \ldots 3 \tag{3}$$

Calculating the economic evaluation parameter λ max value can be obtained:

$$\lambda = \sum_{i=1}^{n} \omega_i S_i \tag{4}$$

When judging the relative importance of each element, the main reason is the subjective judgment of the decision maker, so it is impossible to judge the ratio completely and precisely. It can only be estimated, so compatibility and error analysis must be performed. If the judgment matrix A is completely compatible, it should have λ max>n. If they are incompatible, the relationship of λ max>-n can be used to define the degree of deviation compatibility. If the consistency indicator is CI, then there are:

$$CI = \frac{\lambda_{\max} - 1}{n\_ - 1} \tag{5}$$

The ratio of CI to the randomness index of the given order matrix is called the consistency ratio R, which is a constant of the statistical variation with the order of the matrix. In the analytic hierarchy process, when R>0.1, the consistency test cannot be passed, and the matrix should be re-estimated. When R<0.1 passes the consistency test, it is valid to obtain ω. Through the above method, the following matrix is established according to the above indicators:

$$R = \begin{bmatrix} 1 & 1/3 & 3 & 1/6 \\ 3 & 1 & 4 & 1/5 \\ 1/3 & 1/4 & 1 & 1/8 \\ 6 & 5 & 8 & 1 \end{bmatrix} \tag{6}$$

The matrix was tested for consistency using an approximation algorithm, CI =0.0664, so CR=CI/IR=0.0738<0.1, passed the consistency test. It indicates that the weights

of the corresponding factors are all reasonable. Therefore, comprehensive consideration of various factors affecting the cross-border e-commerce evaluation index system, using the analytic hierarchy process, can combine qualitative analysis and quantitative evaluation indicators, the weights of various factors in the evaluation index system are determined, and the objectivity and accuracy of the weight coefficient are well guaranteed, which makes the evaluation index system more scientific and accurate [8]. The total ranking of influencing factors reasonably reflects the main factors affecting the cross-border e-commerce evaluation index system, and facilitates cross-border e-commerce to take corresponding measures according to the actual situation to improve the operability of cross-border e-commerce. This method is simple, feasible and has strong practicability. It should be noted that due to the limitation of the mathematical sample capacity, the cross-border e-commerce evaluation indicators must be adjusted and revised according to the actual conditions of the project; The economic conditions vary from region to region, and the necessary adjustments should be made when the selection of evaluation indicators and the determination of weights are made [9].

3. Establishment of Evaluation Index System Model

The main factors of cross-border e-commerce evaluation include: network marketing factors, international electronic payment factors, electronic customs factors, international e-commerce logistics factors, e-commerce legal factors [10]. In which, online sales is one of the main factors for cross-border e-commerce evaluation. This is because the way of running e-commerce is to sell goods through network. Therefore, the situation of network marketing directly affects the economic income of the e-commerce economy, especially cross-border e-commerce marketing is a big difference in network marketing. The evaluation of network marketing can be evaluated from the perspectives of foreign customers, foreign economic environment, international market commodities and international marketing. Cross-border e-commerce is mainly aimed at foreign customers' sales, so it is necessary to clarify the market situation of electronic products in external sales. That is, whether the commodity has a profitable customer purchase group, whether it can be compatible with foreign economic operations, and its cross-border e-commerce can meet international standards. Therefore, it is measured whether the network marketing status of the company is normal or not, and whether it meets the current operation of the product at this stage to adapt to the current trend and trend of economic development. The cross-border e-commerce marketing diagram is shown below.

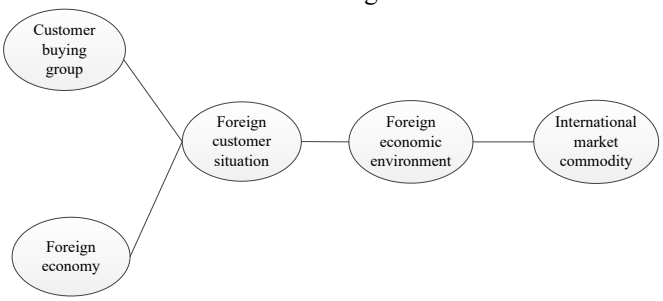

Figure 1. Cross-border e-commerce marketing structure

Electronic payment is the basis for the normal operation of e-commerce. All the stable operation of e-commerce is based on a strong network operation security guarantee [11]. Therefore, in the analysis of the operation evaluation of cross-border e-commerce, it is necessary to pay attention to the actual situation of international electronic payment, and this can reflect the acceptance and use of e-commerce to a certain extent. For international electronic payment factors, it should be intervened from the four major perspectives of international electronic payment security, international electronic payment support conditions, electronic payment tools, and electronic letters of credit. These four angles are cut into the three aspects of electronic payment, security, and security [12]. Electronic letters of credit are the basis for people to rely on e-commerce payments, and the specific network software and security of payment is the basis for ensuring the normal operation of cross-border e-commerce. For cross-border e-commerce, gaining the trust of the people is a key factor in the operation. Therefore, improving the international electronic payment system and ensuring the economic security of consumers is one of the important aspects of evaluating cross-border e-commerce, and it is also one of the pillar evaluation contents. The electronic payment flow chart is shown below.

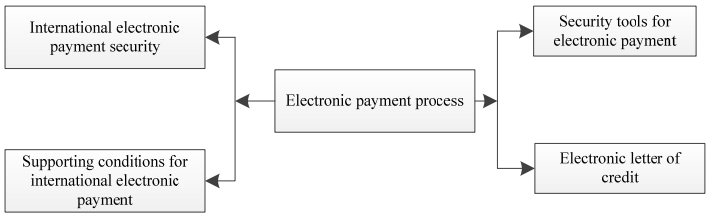

Figure 2. Electronic payment flow chart

Electronic customs clearance is the most complicated and prone to cross-border e-commerce evaluation, so it is an important assessment standard for cross-border e-commerce indicator evaluation system [13]. The evaluation of the electronic customs clearance is mainly carried out through three aspects: electronic customs declaration, cargo inspection and tax collection. The electronic declaration mainly refers to whether the inbound goods meet the entry requirements of the country, and the inspection of the goods is to check the quality and legality of the product, and the collection of taxes and fees is a necessary link for taxation according to law. However, in the inspection of goods, there are often problems of non-conformity. Just as the operation of cross-border e-commerce in China is also plagued by cargo inspection. This is mainly due to the differences in product qualification standards in different countries. China's product testing standards are lower than many developed countries. Therefore, various problems often appear in the inspection of goods, which directly restricts the development of e-commerce in China, and is one of the difficulties that cross-border e-commerce in China is still overcoming at this stage [14]. The tax and fee issue has specific requirements in different countries, but it is affected by the political factors of international relations. There are obvious differences in tax and fee requirements for different cooperative countries. Therefore, in the process of establishing cross-border e-commerce cooperation, we should try to choose countries with policy advantages to strive for greater economic profits. The cross-border e-commerce electronic customs clearance process is shown in the following Figure 3.

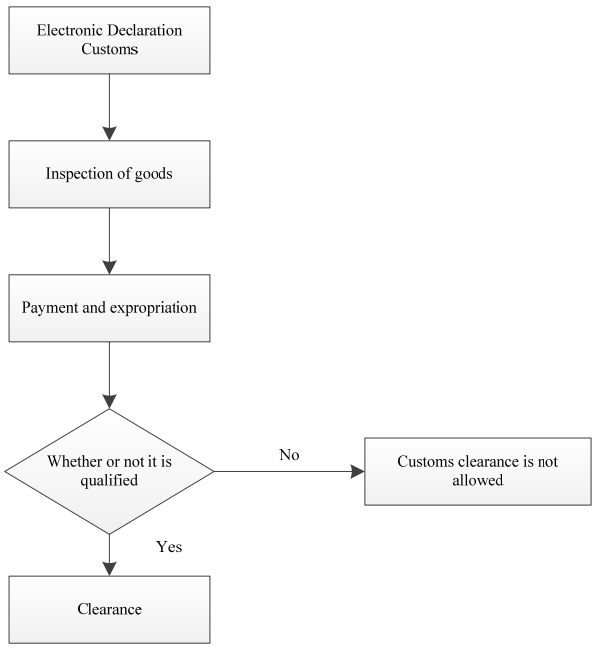

Figure 3. Cross-border e-commerce electronic customs clearance process

Cross-border e-commerce cooperation is an economic model that achieves virtual transactions through electronic means and completes transaction through logistics. Therefore, it is closely related to logistics from the birth of e-commerce [15]. It can be said that the development of modern e-commerce has promoted the rapid development of the logistics economy, just as China's e-commerce enterprises represented by Alipay have promoted the rapid growth of several major logistics enterprises in China. In the process of international e-commerce logistics inspection, it is mainly to construct the index system of international e-commerce logistics technology and

international e-commerce logistics supply chain. These two factors determine whether the products of cross-border electronic transactions can be intact and delivered to the buyer in accordance with the time requirements, thus completing the transaction. Therefore, the evaluation and inspection of logistics technology and supply chain must be included in the construction of the evaluation system to ensure the normal completion of the transaction.

The construction of the cross-border e-commerce rating indicator system must finally be incorporated into a factor that significantly mitigates the non-intuitive transaction process, namely the e-commerce legal issue. The law is the guarantee for the interests of both parties in e-commerce cooperation, but since e-commerce belongs to the emerging economic operation mode, most countries have not yet perfected their legislation. National WTO trade cooperation is also lacking in its regulations, so it is necessary to pay attention to legal issues and legal norms in the process of cross-border e-commerce cooperation. In cross-border e-commerce cooperation, they not only must meet the requirements of the country but also meet the legal requirements of other countries. For content that is expressly provided for in international law, as long as the cross-border cooperation country also has a signature, it should be completed in accordance with the international legal norm model. Avoiding new problems caused by the adoption of national or other national laws and regulations to further ensure the legality and standardization of cross-border e-commerce economic cooperation and protect the legitimate economic interests of both parties.

4. Analysis of Results

After using the Analytic Hierarchy Process (AHP) to perform weight calculation and consistency check on cross-border e-commerce evaluation indicators, the results of each evaluation factor are obtained, as shown in the following table:

Table 3.Test Results of Each Evaluation Factor

A	B1	B2	B3	B4	CR
B1	1.0000	9.0000	9.0000	9.0000	0.6227
B2	0.1111	1.0000	3.0000	3.0000	0.0987
B3	0.1111	0.3333	1.0000	1.0000	0.0363
B4	0.1111	0.3333	1.0000	1.0000	0.0590

According to the weight of each indicator, the weights of international electronic payment factor factors, electronic customs factor factors, international e-commerce logistics factor factors, and e-commerce legal factors are 0.6227, 0.0987, 0.0363, 0.0590, respectively. International electronic payment factors, electronic customs factors, and e-commerce legal factors are ranked in the top three in the index weight ratio, followed by international e-commerce logistics factors, accounting for the fourth. This reflects the practical problems (applicability) to be solved in the construction of cross-border e-commerce evaluation index system, and should consider the factors of international electronic payment factors. But it does not mean that the remaining indicators are not important. The organization shall comprehensively develop all aspects on the basis of weighing the indicators, combining the development of the organization itself with the development environment.

In addition, in order to further prove the scientific and effective evaluation of the cross-border e-commerce evaluation index system based on the analytic hierarchy process. Compared with the traditional cross-border e-commerce evaluation index system, the results are shown in the figure.

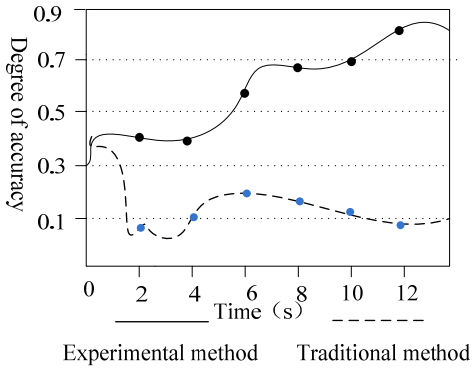

Figure 4. Experimental results

The experimental results show that compared with the traditional cross-border e-commerce evaluation index system efficiency, the proposed cross-border e-commerce evaluation index system based on the analytic hierarchy process is more efficient. And its operation is simple and easy to control, objectively reflecting cross-border e-commerce evaluation indicators.

5. Conclusion

E-commerce as a dark horse in the economic field has made great progress with the trend of network technology and economic globalization, and has become an indispensable part of the current national economic development. Cross-border e-commerce not only involves the interests of enterprises, but also involves the economic image of the country. In order to solve the problem of complex operation and unchanging operation of the traditional cross-border e-commerce evaluation index system, a cross-border e-commerce evaluation index system based on AHP is proposed. The simulation experiment proves that the system is simple, practical and operability, and can objectively reflect cross-border e-commerce evaluation indicators, which can better guide the development of cross-border e-commerce.

References

[1] Zhang le, caoshuang, li shixue, xulingzhong, li qunwei. Improvement of ahp and its application in weight determination [J]. Chinese health statistics.2016,33 (1) :154-155.

[2] Zheng jixing, zhouyuxin. Research on cross-border e-commerce development strategy based on SWOT method and analytic hierarchy process -- a case study of xiaohongshu [J]. Theoretical observation.2017,24 (11):23-25.

[3] Chen limei, wang lulu, liuwei. Research on quality evaluation of e-business professionals based on ahp [J]. Journal of chongqing vocational college of electronic engineering.2016, 25 (4) :120-124.

[4] Zhang wei. Research on AHP AHP in risk management of cross-border e-commerce projects [J]. Enterprise technology development, 2016, 35 (1) :79-80.

[5] Wu qing. Construction of cross-border e-commerce credit evaluation system in the context of big data [J]. Business economics research, 2017 ,23(6) :62-64.

[6] Li daoquan, wuxingcheng, guoruimin. An e-business transaction decision-making model based on analytic hierarchy process [J]. Modern electronic technology, 2017, 40 (10) :68-71.

[7] Hao xun. Application of AHP in the evaluation of enterprise e-commerce websites [J]. Information and computers (theoretical edition), 2017,13 (19) :13-15.

[8] Xiao wen. Research on financial risk control of multinational e-commerce enterprise A [J]. Beijing university of posts and telecommunications, 2018(3):11-13.

[9] Hao fangzi. Business performance analysis of e-commerce enterprises [J]. Qingdao university of technology, 2016,13(2):11-14.

[10] Qian huimin, he jiang. Empirical study on selection of B2C cross-border e-commerce logistics mode [J]. Business research, 2016, 62 (12) :118-125.

[11] Liu zhangfa. Construction of cross-border e-commerce credit evaluation system in the context of big data [J]. China circulation economy, 2016, 30 (6) :58-64.

[12] Zhang xiheng. Study on the construction and realization path of cross-border e-commerce logistics collaboration model [J]. Chang 'an university, 2016,32(2):36-38.

[13] Ye hankun. A study on factors influencing the successful implementation of cross-border e-commerce [J]. Jiangxi university of finance and economics, 2016,42(3):56-59.

[14] Liu jiachen. Research on enterprise value assessment of Internet e-commerce [J]. Capital university of economics and trade, 2017(1)"1265-1269.

[15] Zhang jian, luxinghua. Estimation model simulation of cross-border e-commerce trading volume [J]. Computer simulation, 2018,46 (2):23-25.