On Big-Data-Based Credit Evaluation for Cross-Border E-Commerce

Hua Tian¹, Ruiqi Zhou²

¹School of Economics & Management, Nanjing Institute of Technology, Nanjing 211167, China
²Business School, East China University of Science and Technology, Shanghai 200237, China

Abstract

With the steady progress in the strategic deployment of “One Belt, One Road”, the cross-border e-commerce industry is facing new opportunities and challenges. Credit evaluation is the key to cross-border e-commerce negotiation. Given the high informatization of cross-border e-commerce, it is necessary to establish a credit evaluation system for cross-border e-commerce negotiation in the big data context. This paper processes the data and information in cross-border e-commerce negotiation based on big data and establishes a cross-border e-commerce negotiation index system, and at the same time, it also describes the construction process of the cross-border e-commerce negotiation credit evaluation mode qualitatively and quantitatively by the fuzzy comprehensive evaluation method. This model can be used to provide rating services for cross-border e-commerce enterprises. It is of great guiding significance to the protection of e-commerce enterprises in China, improvement of cross-border trade and promotion of the sustainable and healthy development of the cross-border e-commerce industry in this country.

Keywords: Cross-border e-commerce, Big data, Credit evaluation, Fuzzy comprehensive evaluation method, Evaluation model.

1. INTRODUCTION

E-commerce trade in China has been fully developed, prompting e-commerce enterprises to seek broader markets. In recent years, the cross-border e-commerce field has been developing rapidly, with B2B- and B2C-based trade forms dominating the market (Mokhtarian, 2004). Now a group of e-commerce enterprises represented by Alibaba are taking actions in the cross-border e-commerce trade to expand their national influences and also to respond positively to the national “One Belt, One Road” strategy. Based on the Internet, cross-border e-commerce is featured by openness and virtuality of information. Due to lack of authentic and complete information, cross-border e-commerce negotiation is a very difficult process (Brousseau, 2005), badly in need of a model to do comprehensive credit rating of cross-border enterprises. Therefore, in order to improve the cross-border e-commerce trade environment, it is necessary to study how to perform credit evaluation for cross-border e-commerce negotiation.

Credit evaluation requires a lot of data as the basis. These data need to be multi-dimensional, multi-level and multi-channel raw data from multinational enterprises (Pugh et al., 2015). It is difficult to extract relevant data from the massive data, but the big data technology, which is trending right now, is just able to do that. Big data makes it possible to carry out credit evaluation for cross-border e-commerce (Chen and Zhang, 2014). This technology can be used to mine, clean, match and integrate data resources and utilize its structured or semi-structured track data to convert data resources into valid data for credit evaluation. So in this way, it helps provide data support for the credit evaluation for cross-border e-commerce negotiation (Costa, 2014).

This paper attempts to study the credit evaluation model and system for cross-border commerce negotiation in the context of big data (Pudaruth and Li, 2009). First, it introduces the development of e-commerce in China, and then, based on the legitimacy, integrity and validity principles of big data, it constructs a big-data-based information index system. In the calculation of credit indices, the analytic hierarchy process is adopted. In the construction of the model, the fuzzy comprehensive evaluation method is applied in order to effectively avoid fuzzy boundaries and quantification problems of credit evaluation indices. At last, by reproducing clear calculation steps and processes, this paper summarizes how to establish the cross-border e-commerce evaluation model. Based on the complete raw data acquired through the big data technology, this paper can give ratings of
the e-commerce enterprises in the cross-border commerce negotiation, which is of some positive significance to the sustainable and healthy development of cross-border e-commerce and the construction of the enterprise credit system in China.

2. STATUS QUO OF THE CROSS-BORDER E-COMMERCE CREDIT EVALUATION SYSTEM

The e-commerce industry has created huge economic benefits, but at the same time legal disputes have been increasing year by year. National authorities are issuing relevant laws and regulations to better regulate the e-commerce industry within the country, but due to limited scope of application, these laws and regulations are rarely able to effectively regulate and guide cross-border e-commerce (Yang et al., 2014).

2.1 Development status quo of cross-border e-commerce

China’s import and export trade in recent years has been showing a continuously upward trend and has reached the world’s leading level. At the same time, the contribution of e-commerce trade to China’s foreign trade is also increasing year by year, indicating that it is playing an increasingly important role. According to relevant data disclosed by National Bureau of Statistics, the total volume of cross-border electronic transactions in China from 2011 to 2015 is shown in Figure 1.

![Figure 1. Total volume of cross-border e-commerce transactions in China from 2011 to 2015](image)

From the figure, it can be seen that the total volume of cross-border e-commerce trade increased from 1.6 trillion RMB in 2011 to 5.3 trillion RMB five years later, indicating that the cross-border e-commerce industry is in a good development trend in China (Karabutov, 2009). In the global e-commerce industry, the United States ranks the first in cross-border e-commerce online spending, followed by the United Kingdom and Germany. Many developing countries such as Brazil also keep an annual growth rate of over 20% in the e-commerce field. On the global scale, the e-commerce field is very promising (Molak and Huk, 2012).

Under the influences of the international and domestic economic situation, the cross-border e-commerce field has a very large demand. Led by e-commerce enterprises like Alibaba Group, China has been playing a leading role in the international cross-border e-commerce trade (Bieron and Ahmed, 2012).

2.2 Technological support for cross-border e-commerce

E-commerce cannot develop without the help of computer and Internet technologies. Its technological support is shown in the following three aspects:

(1) Big data technology. Cross-border e-commerce generates large amounts of data, including commodity information, trading decisions and distribution information, which can be analyzed and utilized to provide reference and guidance for business transactions. Big data is a computer technology that extracts valid data from massive amounts of data. Using this technology in cross-border e-commerce will provide a reliable and scientific database for e-commerce credit rating.

(2) Platform technology. Platform technology mainly refers to the third-party e-commerce trade platform. Take
Ali Baba and DHgate for example. Sellers and consumers carry out cross-border e-commerce trade on the platform, and with the increasing number of users and the needs for higher security level, the enterprise’s platform technology also needs to be constantly updated to strengthen network security, reduce e-commerce credit disputes and improve cross-border e-commerce trade credit.

(3) Credit authentication technology. CA security certification system, certified financial enterprise certificate and server certificate are common certificates of corporate credit and recognition. In cross-border transactions, the third-party certification technologies are used to facilitate cross-border payments, such as Alipay, TenPay, etc., which have improved the credit of Chinese cross-border e-commerce enterprises in the payment process.

2.3 Problems in the cross-border e-commerce in China

Due to China’s late accession into the WTO and the particularity of the socialist economic form, the credit evaluation in the banking system and even the social system in China is quite backward. This has resulted in a serious imbalance between supply and demand in the cross-border e-commerce credit rating market and high-quality credit evaluation services are rarely provided.

Table 1. shows the hierarchical division of the credit data of enterprises and individuals in China:

<table>
<thead>
<tr>
<th>Hierarchy</th>
<th>Institution</th>
<th>Data content</th>
</tr>
</thead>
<tbody>
<tr>
<td>First level</td>
<td>People’s Bank of China</td>
<td>Business and personal credit data</td>
</tr>
<tr>
<td>Second level</td>
<td>Government agencies</td>
<td>Society credit data</td>
</tr>
<tr>
<td>Third level</td>
<td>Professional credit agency</td>
<td>Commercial credit data</td>
</tr>
</tbody>
</table>

From the table, it can be seen that the database of the People’s Bank of China has the largest scale and the most complete data, but there is no consistent standard for different data layers and information cannot be shared in real time, resulting in information isolation. The databases of professional credit agencies are small and unable to provide professional credit evaluation data support for enterprises (Dunin-Barkovskii, 2004). The establishment of a credit evaluation system for cross-border e-commerce trade requires a strong database as the support, so efficient acquisition and analysis of financial and other data and information of cross-border enterprises is a challenge in the establishment of the credit evaluation model for cross-border e-commerce negotiation and also a difficult problem for the cross-border e-commerce trade currently in China.

3. CONSTRUCTION OF THE BIG-DATA-BASED CREDIT INDEX SYSTEM

3.1 Principles for determination of credit indices in the big data context

Big data technology is not just simple collection of data, but rather a special treatment of data under the guidance of certain principles (Chen et al., 2015). In the context of big data, there are mainly three principles for determination of the credit evaluation indices:

(1) Legitimacy

Big data security and privacy are the key issue in cross-border e-commerce. Regarding the protection of data privacy, different countries have their own privacy laws. Therefore, during the acquisition of credit data, legal disputes should be avoided in accordance with the provisions of local and national laws and privacy data should be collected and used only after being authorized. Avoiding the risks in big data privacy is a prerequisite for the legitimacy of cross-border e-commerce (Peissig et al., 2010).

(2) Integrity

Information isolation is a prominent problem in cross-border e-commerce. So a more complete index system should be constructed to systematically sort out information and achieve both internal and external business data integration and mining through data sharing and cooperation and exchanges.
(3) Validity

Effective credit evaluation indices must be built on valid big data. Regarding the value density of data, there is a classic “20-80 Rule”, which means only 10%-20% of the massive data sources are useful. In cross-border e-commerce trade, attention should be paid to the validity of data so that the data mined would meet the index requirements for credit evaluation as far as possible.

3.2 Construction of the big-data-based index system

The breadth and depth of data mining are the key to the application of the big data technology in cross-border e-commerce. In general, sources of cross-border e-commerce data mainly include: third-party data, e-commerce platform transaction data and network track data. Figure 2 shows the big-data-based credit evaluation index system framework for cross-border e-commerce (Chen et al., 2016).

![Figure 2. Framework of the credit evaluation index system for cross-border e-commerce](image)

Third-party data are from industry and commerce, taxation, quality inspection and other government departments as well as financial institutions like banks. These include qualification certification indices, financial indices, financial services records and customs clearance records. Among these, customs clearance records are the index specially designed to distinguish cross-border e-commerce from other ordinary business activities.

E-commerce platform transaction data are dynamic data of business activities, including product quality, service quality, transaction scale and transaction security. In cross-border e-commerce trade, old customers’ evaluation on product quality and service quality can provide better guidance for new customers and help them conclude transactions. Business scale and transaction security, on one hand, shows the business capacity of an e-commerce enterprise, and on the other hand, gives good credit to the enterprise.

Network track data means in the mobile Internet era, the credit rating of an enterprise can be done through customer satisfaction, active sharing of customers, management of personal credit and influences of official accounts, which is highly credible. For example, Zhima Credit launched by Alibaba Group is to record users’ identities, behavior preferences, credit history and performance capabilities, etc. to evaluate individual credit.

4. CONSTRUCTION OF THE CROSS-BORDER E-COMMERCE CREDIT EVALUATION MODEL BASED ON THE FUZZY THEORY

Provided that the evaluation indices for the model are determined, this section studies how to construction a
credit evaluation model based on the fuzzy theory. Credit evaluation involves many aspects, and many evaluation indices have fuzzy boundaries and cannot be easily quantified, so the fuzzy comprehensive evaluation theory is used here to convert qualitative evaluation into quantitative evaluation, which can effectively solve the problem of fuzzy evaluation indices.

4.1 Basic steps of the fuzzy comprehensive evaluation method

The basic idea of the fuzzy theory is to quantify the fuzzy and qualitative concept. The first step is to define the set of indices (factors) for the evaluation target; the second step is to determine the weight of each factor and their membership relationships so as to obtain a fuzzy evaluation matrix; after normalization of the weight vectors, the fuzzy evaluation results are obtained.

The fuzzy comprehensive evaluation method is to evaluate each index individually and give a unique evaluation value that is different from the values in the set of objects and not affected by the set (Gu, Y. J. et al., 2008).

4.2 Construction of the credit evaluation model for cross-border e-commerce negotiation based on the fuzzy comprehensive evaluation method

Under the guidance of the credit evaluation index framework, this paper starts to establish the credit model for cross-border negotiation.

4.2.1 Classification of evaluation indices

First the cross-border e-commerce indices are classified into the following types: cross-border business index (A); dynamic credit index for cross-border trade (B); financial index (C); and historical credit index (D).

According to the four types, this paper obtains the following sets of credit evaluation indices.

\[ A = \{A_1, A_2, A_3\} = \{\text{internal situation of the enterprise, enterprise management, cross-border market}\}; \]
\[ B = \{B_1, B_2, B_3\} = \{\text{cross-border transaction information, service quality, cross-border transaction security}\}; \]
\[ C = \{C_1, C_2, C_3, C_4\} = \{\text{profitability, operation capability, repaying capability, development potential}\}; \]
\[ D = \{D_1, D_2\} = \{\text{credit records in government departments, credit records in relevant social agencies}\}. \]

According to the credit evaluation index framework, the indices can be further broken down.

4.2.2 Determination of index weights by hierarchical analysis

Index weight is the key to the evaluation model calculation. Applying hierarchical analysis in the calculation of index weights can easily and conveniently satisfy the needs of quantitative and qualitative analysis.

According to different evaluation indices and the relationships between layers, the decision matrix is obtained. For an index \( X_m \) in the upper layer, there will be an index \( X_{mj} \) (\( j = 1, 2, 3, \ldots, n \)) corresponding to it. By comparing the relative importance of the indices \( X_{mi} \) and \( X_m \) in the lower layer and assign values to them, this paper obtains the decision matrix \( S \):

\[
\begin{pmatrix}
X_1 & X_{11} & X_{12} & \cdots & X_{1n} \\
X_2 & X_{21} & X_{22} & \cdots & X_{2n} \\
\vdots & \vdots & \ddots & \cdots & \vdots \\
X_m & X_{m1} & X_{m2} & \cdots & X_{mn}
\end{pmatrix}
\]
In the matrix, $a_{ij}$ is the ratio between $X_{mi}$ and $X_{mj}$, which is a constant.

The weight index method that uses hierarchical analysis is shown in Table 2.

### Table 2 AHP weight scale method

<table>
<thead>
<tr>
<th>Scale</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Two factors are equally important</td>
</tr>
<tr>
<td>3</td>
<td>One factor is slightly more important than the other</td>
</tr>
<tr>
<td>5</td>
<td>One factor is more important than the other</td>
</tr>
<tr>
<td>7</td>
<td>One factor is much more important than the other</td>
</tr>
<tr>
<td>9</td>
<td>One factor is far more important than the other</td>
</tr>
<tr>
<td>2,4,6,8</td>
<td>The intermediate value of the adjacent judgment</td>
</tr>
</tbody>
</table>

4.2.3 Construction of the cross-border e-commerce model

The credit ratings of cross-border e-commerce enterprises are first defined, as shown in Table 3:

### Table 3 Classification of credit in e-commerce enterprises

<table>
<thead>
<tr>
<th>Credit rating</th>
<th>Score range</th>
<th>Credit condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>91-100</td>
<td>Excellent credit</td>
</tr>
<tr>
<td>AA</td>
<td>81-90</td>
<td>Good credit</td>
</tr>
<tr>
<td>A</td>
<td>71-80</td>
<td>Well credit</td>
</tr>
<tr>
<td>BBB</td>
<td>61-70</td>
<td>General credit</td>
</tr>
<tr>
<td>BB</td>
<td>51-60</td>
<td>Poor credit</td>
</tr>
<tr>
<td>B</td>
<td>41-50</td>
<td>Bad credit</td>
</tr>
<tr>
<td>CCC</td>
<td>31-40</td>
<td>Very bad credit</td>
</tr>
<tr>
<td>CC</td>
<td>21-30</td>
<td>Very poor credit</td>
</tr>
<tr>
<td>C</td>
<td>0-20</td>
<td>No credit</td>
</tr>
</tbody>
</table>

Therefore, the credit of cross-border e-commerce enterprises can be classified into 9 different ratings {AAA, AA, A, BBB, BB, B, CCC, CC, C}.

Based on this, a fuzzy relation matrix of three-level index evaluation set $v$ is established:

$$
\mathbf{P}_k = \begin{pmatrix}
  p_{k11} & p_{k12} & \cdots & p_{k1n9} \\
  p_{k21} & p_{k22} & \cdots & p_{k2n9} \\
  \vdots & \vdots & \ddots & \vdots \\
  p_{kn1} & p_{kn2} & \cdots & p_{knn9}
\end{pmatrix}
$$

(2)

In the matrix, $p_{kijw}$ stands for the membership relationship of the k-th Level 1 index, the i-th Level 2 index and the j-th Level 3 index with the comments $v_w$ which are w levels lower.
By multiplying the weight index by the membership relationship of the index, this paper obtains the evaluation result:

$$W = (Z_A, Z_B, Z_C, Z_D) \left\{ \begin{array}{c} E_A \\ E_B \\ E_C \\ E_D \end{array} \right\} = (Z_A, Z_B, Z_C, Z_D) \left\{ \begin{array}{cccc} e_{A1} & e_{A2} & \cdots & e_{A9} \\ e_{B1} & e_{B2} & \cdots & e_{B9} \\ e_{C1} & e_{C2} & \cdots & e_{C9} \\ e_{D1} & e_{D2} & \cdots & e_{D9} \end{array} \right\} = (e_1, e_2, \ldots, e_9). \quad (3)$$

After being normalized, the following is obtained: $\overline{W}=(\overline{e}_1, \overline{e}_2, \ldots, \overline{e}_9)$.

Next, the 3-grade 9-level method is used. Different levels correspond to different scores. The average values are used to construct the e-commerce credit evaluation model, which are 95, 85, 75, 65, 55, 45, 35, 25 and 10, respectively.

Finally, the credit evaluation model for cross-border e-commerce negotiation based on the fuzzy comprehensive evaluation method is obtained:

$$S = 95\overline{e}_1 + 85\overline{e}_2 + 75\overline{e}_3 + 65\overline{e}_4 + 55\overline{e}_5 + 45\overline{e}_6 + 35\overline{e}_7 + 25\overline{e}_8 + 10\overline{e}_9 \quad (4)$$

Where, $\overline{e}_1$ stands for the Level AAA comprehensive evaluation score of the cross-border e-commerce enterprise in the four credit evaluation index systems - cross-border operation, dynamic transaction information, financial status and historical credit record. In this way, by summation, the credit score for cross-border e-commerce negotiation can be obtained to determine the credit rating of the enterprise.

### 4.3 Case application

Now this section focuses on the actual application of the evaluation model. Company A is engaged in the design, development and sales of wireless routers and other products; in order to expand its market, the company decides to expand its business in the overseas market and cooperate with an Indian wireless router e-commerce company. There are two candidate companies B and C. Market research and big data analysis are carried out on the cross-border operations, dynamic cross-border transaction credit, financial indices and historical credit indices of Company B and C, and only data on the AAA, AA, A and BBB levels are chosen as reference.

First, after normalization of data, the weight vectors of Company B and C are respectively:

$$Z_B = [0.2 \ 0.3 \ 0.4 \ 0.1]$$

$$Z_C = [0.5 \ 0.3 \ 0.1 \ 0.1]$$

The membership relationships of weight vectors are:

$$E_B = [0.8 \ 1.2 \ 1.0 \ 2.0]^T$$

$$E_C = [1 \ 1.1 \ 0.9 \ 0.5]^T$$

$$\overline{W}_B=(\overline{e}_1, \overline{e}_2, \ldots, \overline{e}_9)=(0.16 \ 0.36 \ 0.4 \ 0.2)$$

$$\overline{W}_C=(\overline{e}_1, \overline{e}_2, \ldots, \overline{e}_9)=(0.5 \ 0.33 \ 0.09 \ 0.05)$$

By substituting Formula (1) into it, this paper obtains:

$$S_B = 95 \times 0.16 + 85 \times 0.36 + 75 \times 0.4 + 65 \times 0.2=79.2$$

$$S_C = 95 \times 0.5 + 85 \times 0.33 + 75 \times 0.09 + 65 \times 0.05=85.55$$
The model calculation results show that the credit evaluation score of Company C is higher than that of Company B. Therefore, this model suggests Company A in China should work with the Indian Company C.

5. CONCLUSIONS

This paper takes the difficult problems in the current cross-border e-commerce trade as the starting point, and in the context of the big data technology, this paper takes the fuzzy comprehensive evaluation method and the hierarchical weight analysis method as the theoretical basis and studies the credit ratings of enterprises in cross-border e-commerce negotiation. This paper has the following conclusions and significance:

(1) The raw data of enterprises provided by the big data technology for cross-border e-commerce trade negotiation are the key to credit evaluation. It is an inevitable trend that the big data technology will be applied in the cross-border e-commerce trade.

(2) The credit index evaluation system established by this paper takes multiple factors to enterprise credit into account, which is of great reference value to credit rating.

(3) The fuzzy comprehensive evaluation method converts the traditional qualitative analysis of credit rating to quantitative analysis, which is more scientific and reliable. The calculation results are of guiding significance to the credit evaluation in cross-border e-commerce negotiation.

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