The Regional Electronic Commerce Development Level Evaluation Technique based on ELECTRE-IV Method

ZHAI Shan-shan

College of Humanities and law, Northwest Polytechnical University, Xi'An 710072, China

Abstract

E-commerce has become an effective method to enhance economic competiveness and win the resource allocation advantages for different regions, as well as a key standard to assess the economic power of one region. A novel evaluation technique based on ELECTRE-IV method is proposed to the regional electronic commerce development level. Experimental results suggest that this proposed approach is correct, feasible and efficacious.

Keywords

Regional Electronic Commerce; Development Level Evaluation; ELECTRE-IV Method

1. Introduction

E-commerce is the most significant field that is influenced by contemporary information revolution most widely and impacts on the operation way and efficiency of social economic activities a lot. The research on the assessment method of e-commerce could build a data and index system that fully meets the demand of government to establish policy of e-commerce, understand the development level and the influence of e-commerce on social economic development.

2. Related Works

The study on the assessment of e-commerce started from the knowledge economy and information economy. Machlup and Porat are the first researchers. The former calculated the knowledge industry of the USA by final demand method (also called expenditure method) and the latter studied the assessment of American information economy. Although their research is not specifically for the assessment of e-commerce, it is significant to the research and blazes a new trail for the research. The development of e-commerce could be described as the Sigmoid Function of Innovation Diffusion Theory put forward by Rogers, i.e. the different phases of the development reflected by readiness, intensity and influence. Many index systems in related research are actually based on it in the world.

The research on the assessment of e-commerce in China started in 2000, but there is still no authentic or comprehensive official statistics of e-commerce so far. Some semi-official or nonofficial organizations conducted the assessment of e-commerce from different angles and did the computation of the development level from local perspectives. CNNIC has begun to conduct the regular computation survey on e-commerce from the angle of netizens since 2000; State Economic and Trade Commission, Chinese Academy of Social Science and Peking University co-launched the research of 'Computation and Survey on the Intensity of Internet in Chinese Enterprises and the Development level of E-commerce' in 2001. The survey proposed to understand the development level of e-commerce from the angle of Chinese enterprises with the respondents oriented as the large and medium sized enterprises. The CII China E-commerce Index Report released by State Statistics Bureau made a comprehensive assessment of the development level of e-commerce in different regions of China with comprehensive index and class index. The indexes in the assessment system are mainly focused on the measurement of infrastructure (readiness of the development of e-commerce) and the contents related with e-commerce are not systematic or comprehensive enough.

Due to the different respondents, the focus and assessment method of the development level of e-commerce in academics is also different. In terms of focus, it is mainly about the research on the performance evaluation of e-commerce, adoption of the assessment of e-commerce, evaluation of e-commerce system and the evaluation of enterprise e-commerce website. Judged from current material, the studies on the development on the development level of regional e-commerce are few. Zeng Hong mentioned the importance of assessing the development of regional e-commerce of China and highlighted the importance of the assessment and construction of index system in his thesis E-commerce Computation Index System Construction, but did not put forward the detailed assessment method. Jiang Yuchao and Yu Liping suggest that the computation of e-commerce needs to consider the supply-demand computation, trade composition and trade flow, not mentioning the intensity of e-commerce development in their thesis China Regional E-commerce Assessment System Construction, not sufficient to assess the development level of e-commerce in one region objectively. In terms of assessment method, most researches are

based on statistical research, questionnaire survey or enterprise interview. For example, Liu Min used questionnaire survey and interview to conduct the empirical research on the e-commerce development level of Shaanxi enterprises in the book Assessment and Method of E-commerce Development; Lou Cequn and Gui Xuewen conducted the quantitative and qualitative analysis on the development of enterprise e-commerce by interview and internet watch in the book Wuhan City E-commerce Development Report.

3. Improved ELECTRE Method

The respective evaluation: When using this individual method, the attribute weights of criteria and alternatives applied by each member in the group can be different. Suppose that the union of criterion sets used by the decision maker $i=1, \ldots, n$ is $C=\{c_1, c_2, \ldots, c_t\}$, its weight vector is $W^i = \left(w_1^i, w_2^i, \ldots, w_p^i\right)$, $\sum_{q=1}^{p} w_q^i = 1$, and $w_q^i \geq 0$, if the member i adopts the criterion p, $w_p^i = 0$. Following the steps of ELECTRE-II, it can get the individual ranking of alternatives by each decision maker in the group. After all the members sort the alternative sets, the ELECTRE-II method can be used to gather these individual rankings to form the group sequencing.

Firstly, suppose that the weight of the decision made by the decision maker $i=1,\ldots,n$ in the group decision is $w_i \in \{w_1, w_2, \ldots, w_n\}$, and the decision committee can obtain the weights of decision makers by the AHP method (Yasar et al., 2009). If the individual ranking of the member i shows that the alternative x_k is better than the alternative x_l ($x_k\phi_i x_l$), and the set of all decision makers i satisfying the condition $x_k\phi_i x_l$ is written as $I^+(x_k, x_l)$, the set of members i satisfying the condition $x_k\sim_i x_l$ is $I^=(x_k, x_l)$ and the set of members i satisfying the condition $x_k \prec x_l$ is $I^-(x_k, x_l)$. Calculate the harmony indexes

$$I_{kl} = \left(\sum_{i \in I^+(x_k, x_l)} w_i + \sum_{i \in I^=(x_k, x_l)} w_i \right) \bigg/ \sum_{i=1}^{n} w_i \quad (1)$$

$$\hat{I}_{kl} = \sum_{i \in I^+(x_k, x_l)} w_i \bigg/ \sum_{i \in I^-(x_k, x_l)} w_i \quad (2)$$

Determine the high, medium and low thresholds α^*, α^0 and α^-, $0.5 < \alpha^- < \alpha^0 < \alpha^* < 1$. Given $d_i^0 < d_i^*$ and define D_i^h, D_i^m and D_i^l. Define the strong outranking relation and the weak outranking relation:

$$x_k O_s x_l \Leftrightarrow \begin{cases} \hat{I}_{kl} \geq 1, and & 1\ I_{kl} \geq \alpha^*, (y_{ki}, y_{li}) \in D_i^m \\ & or, 2\ I_{kl} \geq \alpha^0 (y_{ki}, y_{li}) \in D_i^l \end{cases}$$

$$(3)$$

$$x_k O_w x_l \Leftrightarrow \begin{cases} \hat{I}_{kl} \geq 1, and & 1\ I_{kl} \geq \alpha^0, y_{ki} - y_{li} < d_i^0 \\ & or, 2\ I_{kl} \geq \alpha^-, y_{ki} - y_{li} < d_i^- \end{cases} \quad (4)$$

The forward strong and weak relation graphs Gs and Gw of alternative sets were constructed by the outranking relations of all the alternatives obtained by the above formulas.

Firstly, make sort ascending by the directive diagram, calculate the sort v′(xi) of each alternative and draw the ranking table. Then mirror the forward strong and weak relation graphs to get the sort descending diagram, calculate the order v0(xi) of alternatives' sort descending by using the same method and draw the sort descending table. Combined with the results of sort ascending and sort descending, by the formulas

$$v^* = \max_{x_j \in X} v^0(x_j) \quad (5)$$

$$v(x_j) = 1 + v^* - v^0(x_j) \quad (6)$$

$$\overline{v}(x_j) = [v'(x_j) + v(x_j)] / 2 \quad (7)$$

Calculate the mean sort $\overline{v}$ of alternatives and draw the mean ranking table of alternative sets, and the group can get the final sort of alternative sets by the rule that the smaller the $\overline{v}$ is, the higher the rank of the alternative.

4. Experimental Results

The design of the e-commerce development level assessment index system is the frame and key, so it is significant to construct a scientific and reasonable index system in order to get scientific and objective results. By clinging to the principles above, the index system designed is implemented based on the three phrase of Sigmoid Function put forward by OECD. Finally, the research establishes an assessment system consisted of 3 first-grade indexes: enterprise intensity, individual intensity and trade scale and 7 secondary indexes. (Table 1).

Table 1 Regional E-commerce Development Level Assessment Index

First-grade index	Secondary index	Explanation or definition
Enterprise intensity	Manufacturing industry	Quantity of enterprises using e-commerce with over 10 employees in manufacturing industry/ total enterprise number
	Logistics industry	Quantity of enterprises using e-commerce with over 10 employees in logistics industry/ total enterprise number
	Other industries	Quantity of enterprises using e-commerce with over 10 employees in other industries/total enterprise number

Individual intensity	Average online shopping trade amount	Importance of e-commerce in residents' life
	Employee salary level	Average salary of e-commerce employees/average salary of non-agricultural employees, reflecting income distribution
Trade scale	E-commerce trade proportion	Proportion of e-commerce trade amount to GDP
	Individual online shopping amount proportion	Individual e-commerce yearly consumption/ total consumption of individuals

According to the weights and the index values, the study shows the result of ECDI of A province from 2008 to 2012, the whole and development of different elements (table 2).

Table 6 Growth of the whole and elements

Project	2008	2009	2010	2011	2012
ECDI	45. 27	55. 33	68. 67	89. 45	114. 39
ECDI growth(%)	–	22. 23	24. 11	30. 26	27. 87
Enterprise intensity	12. 12	12. 80	15. 41	26. 31	31. 15
Enterprise intensity growth (%)	–	5. 60	20. 39	70. 71	18. 40
Individual intensity	7. 93	9. 68	15. 26	18. 87	23. 89
Individual intensity growth (%)	–	22. 14	57. 60	23. 69	26. 57
Trade scale	25. 22	32. 85	38. 00	44. 27	59. 35
Trade scale growth (%)	–	30. 25	15. 69	16. 50	34. 06

In conclusion, the index system the research built mainly assesses the development of regional e-commerce. Although the index composition is relatively simple, the operability is relatively strong. The author assesses the development of e-commerce of Fujian Province according to time. It shows that the compound growth rate of ECDI of Fujian reaches 26.08% during 2008 to 2012; among the three elements, trade scale has the largest "contribution". The index increases by 69.12 in 4 years, and only the trade scale up by 34.13, occupying the 49.38% of the absolute growth; the rapidest growth is the individual intensity, up from 7.93 in 2008 to 23.89 in 2012, with the compound growth rate of 31.76%.

5. Conclusions

The assessment of the development level of e-commerce is a key part of e-commerce management by constructing index system and collecting data to make the comprehensive assessment of the whole process of e-commerce based on the result. In the construction of regional economy, e-commerce level stands for the level of economic development of the region, so the qualitative and quantitive assessment of the development level of regional e-commerce is of great significance.

References

[1] Bonato P. Wearable sensors systems and their impact on biomedical engineering. IEEE Engineering in Medicine and Biology Magazine, 2003, 22(3): 110-119

[2] Li HT, Mu XY, Yang YN, et al. Low power multimode electrochemical gas sensor array system for wearable health and safety monitoring. IEEE Sensors Journal, 2014, 14(10): 3391-3399

[3] Haider MR, Islam SK, Mahfouz MR. A low-voltage low-power injection-locked oscillator for wearable health monitoring systems. Analog Integrated Circuits and Signal Processing, 2011, 66(2): 145-154

[4] Olawale YA. Cost and time control of construction projects: Inhibiting factors and mitigating measures in practice. Construction Management and Economics, 2010, 28(5): 509-526

[5] Creedy, GD, Skitmore M, Wong JKM. Evaluation of risk factors leading to cost overrun in delivery of highway construction projects. Journal of Construction Engineering and Management, 2010, 136(5): 528-537

[6] Peter ED, Love ZI. A project management quality cost information system: for the construction industry. Information & Management, 2003, (40): 649-661

[7] Lurie PM. Mediation: An engineer's tool to control project cost. Journal of Professional Issues in Engineering Education and Practice, 2006, 132(4): 322-323

[8] H Xu, CH Zhang, YA Tan, J Lu: An improved evolutionary approach to the Extended Capacitated Arc Routing Problem. Expert Systems with Applications. 38(4): 4637-4641, 2011

[9] E Szmidt and J Kacprzyk, A consensus-reaching process under intuitionistic fuzzy preference relations. International Journal of Intelligent Systems 18 (2003) 837-852

[10] WZ Wang and XW Liu, Intuitionistic Fuzzy Geometric Aggregation Operators Based on Einstein Operations. International Journal of Intelligent Systems 26 (2011) 1049-1075

[11] XF Wang, Fuzzy number intuitionistic fuzzy arithmetic aggregation operators. International Journal of Fuzzy Systems 10 (2008) 104-111

[12] ZJ Wang, KW Li and WZ Wang, An approach to multiatribute decision making with interval-valued intuitionistic fuzzy assessments and incomplete weights. Information Sciences 179 (2009) 3026-3040

[13] ZJ Wang, KW Li and JH Xu, A mathematical programming approach to multi-attribute decision making with interval-valued intuitionistic fuzzy assessment information. Expert Systems with Applications 38 (2011) 12462-12469

Shan-shan ZHAI was born in 1981. She is the Ph.D candiadate at Northwest Polytechnical University, Xi'An, P.R. China. Her research interests include Regional Electronic Commerce and Development Level Evaluation.