Economic benefit evaluation model of E-commerce based on DEA

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Received 28 October 2014, www.cmnt.lv

Abstract

E-commerce, a new business transaction mode, becomes the key drive of regional economic growth. Without time-space limitations and with different trade mode, higher cost efficiency of commodity circulation and informationization degree of transactions, E-commerce plays an important role in enterprise, industrial and even regional economic development. Based on microscopic and macroscopic perspectives, economic benefit evaluation model of enterprise E-commerce, economic benefit evaluation model of industrial E-commerce and economic benefit evaluation model of regional E-commerce were established using DEA. A deep analysis was conducted to applications of the established models, including economic evaluation before and after E-commerce, economic evaluation of different regions within the same time period, and economic evaluation of same region at different time periods of E-commerce promotion. Meanwhile, three pieces of improvement advices were given to facilitate continuous E-commerce development and increase economic benefit of regional E-commerce.

Keywords: DEA model, E-commerce, economic benefit, evaluation model

1 Introduction

E-commerce is a kind of business communication generated with the rapid network development, is characteristic of high efficiency and economic returns as well as quick fund flow, because it goes over complicated procedures in common business process. E-commerce is now an important component of national economy and social informatization. E-commerce development is a big move to drive industrialization based on informatization, change economic growth mode, improve quality and efficiency of national economic operation, and take a new road to industrialization. It is of important significance to achieve the ambitious goal of building well-off society in an all-around way. Recently, China's E-commerce develops quickly due to IT development and popularity. It has achieved initial success and facilitated development of national economy informatization. However, China's E-commerce has smaller range of application, lower application level and poorer policy environment compared to those in developed countries. E-commerce is the commercial development trend in future and its economic benefit will affect stability and speed of regional economic development directly. Increasing economic benefit of regional E-commerce shall be the key goal of enterprises and the strategic goal of regional economic development. Therefore, it has important practical significance to establish and measure the economic benefit evaluation model of E-commerce. To avoid effect from other macroscopic factors, this paper established the economic benefit evaluation model of enterprise E-commerce firstly, which was expanded to regional E-commerce later.

2 Effect of E-commerce on enterprise and regional economic development

2.1 EFFECT OF E-COMMERCE ON ENTERPRISE AND REGIONAL ECONOMIC DEVELOPMENT

Firstly, E-commerce offers enterprises more opportunities. Different from traditional physical transactions in fixed place and time, E-commerce can make transactions wherever and whenever by taking full use of Internet. Compared to traditional transaction mode, E-commerce not only brings enterprises new vitality, bigger market and more trade opportunities, but also creates a free and fair competitive environment in international market. Enterprises can search business partners around the whole world and larger development space through Internet.

Secondly, E-commerce reduces transaction cost of enterprises, including marketing cost, purchase cost and office cost. Network marketing activity is superior to traditional advertisement. It can achieve 10 times better promotion effect and contribute far higher sales volume at only 1/10 cost of traditional advertisement. Additionally, the online customer support service can reduce telephone counseling significantly, thus saving considerable expenses and personnel investment. E-commerce can lower purchase cost of enterprises. Traditional raw material purchase is a complicated process. With the

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Internet, enterprises can search cheapest supplier in the global market. Based on information sharing with suppliers, they can reduce losses caused by intermediate information loss. On the other hand, raw material purchase and product manufacturing can be combined organically into an integrated information transfer and processing system. E-commerce also can reduce office cost of enterprises. Cost for information transfer on network is lower than that through letter, telephone and fax. Moreover, the different transaction mode of E-commerce from the traditional one further reduces information sharing cost, including agency fee, advertisement and printing expenses, file processing fee, shop rent, etc.

Thirdly, E-commerce can improve production quality of enterprises.

1) It reduces product inventory. Long production cycle requires traditional enterprises to keep more inventories, thus resulting in their lagged response to market demand and higher operation cost.

2) It shortens the lead time of enterprises. Product design, development, manufacturing and marketing may involve many affiliated enterprises. Such independent cooperation can be changed into information-sharing collaboration in E-commerce.

3) It reduces intermediate links of product transaction. Business messages can be standardized by Internet and thereby can be delivered around the world and processed by computer automatically. E-commerce overcomes shortcomings of traditional trade mode, including high cost, frequent mistakes and slow processing. It shortens the whole transaction time significantly and changes the mode of whole social economic operation.

2.2 EFFECT OF E-COMMERCE ON REGIONAL ECONOMIC DEVELOPMENT

Online shoppers in China reached 0.24 billion by December, 2012, increasing by 48.07 million (24.8%) than that in 2011. The rate of online shopping increased to 42.9%. Although netizen growth slows down gradually, online shopping still presents strong growth momentum. The absolute user growth in 2012 exceeded that in 2011, 4% up compared to same period last year. Online shopping with mobile phone increased by 6.6% and the online shoppers with mobile phone was 2.36 times that by the end of 2011. The total E-commerce trading value quadrupled and the average growth of online retail sales was 80% in the past five years (Table 1 and Table 2). In Table 1, China's total E-commerce trading value in 2010 was 2.22 billion RMB, which increased to 97.78 billion RMB in 2013, increasing by 43 times. This is expected to reach 250 billion RMB in 2015. The mobile E-commerce trading value in 2010 was 1,800 billion RMB, which increased to 10,600 billion RMB in 2013. This is expected to reach 15,700 billion RMB in 2015. In Table 2, China's internet trades in 2008 was only 128.1 billion RMB, which, however, increased by more than 13 times in 2013, showing an annual average growth of higher than 60%. Such growth is expected to slow down, but still will keep at high growth rate. It is estimated that China's internet trades will reach 3,600 billion RMB in 2016. Correspondingly, the proportion of internet trades in total retail sales of consumer goods increased from 1.1% in 2008 to 7.7% in 2013. It is expected to reach 10.8% in 2016. To sum up, E-commerce is vital to China's regional economic development.

TABLE 1 E-commerce Trades in China

Year	2010	2011	2012	2013	2014e	2015e
E-commerce trading value in China	22.2	114.6	482.7	977.8	1686.5	2574.2
Mobile E-commerce trading value	4.8	6.3	8.4	10.6	13.0	15.7

Data source: iResearch statistics and predicted data, unite: 100 million RMB

TABLE 2 Online shopping development in China

Year	2008	2009	2010	2011	2012	2013	2014e	2015e	2016e
Online transactions (100 million RMB)	1281	2630	4610	7847	13040	18500	24500	30200	36000
Growth rate (%)	138.4	105.2	75.3	70.2	66.2	41.9	32.4	23.3	19.2
Proportion in total retail sales of consumer goods (%)	1.1	2.0	2.9	4.3	6.2	7.7	9.0	10.0	10.8

Data source: iResearch statistics and predicted data.

E-commerce Report of China (2013) reveals that China has become the largest online retail market in the world. As a new business mode, E-commerce propels transformation and upgrading of traditional economy by proving new service, market and economic organization form. It has become one important component of China's strategic emerging industry. The continuous rapid growth of E-commerce is manifested by both numbers and the industrial prosperity. It also increases benefits and efficiency of other industries. In capital market, JUMEI, Jingdong and Alibaba have been listed or prepare to be listed in the United States. They create rich mystery one by one. New industrial inventions are created from time to time. Recently, E-commerce is penetrating into traditional industry, agriculture, service industry to drive the transformation and upgrading of agriculture and traditional service industry. E-commerce industry and E-commerce economy are becoming links and core of modern industrial system. It is even called as the "potential quaternary industry".

3 Economic benefit evaluation model of E-commerce

3.1 DEA MODEL

DEA has been widely used in macroscopic and microscopic benefit model. Enterprise benefit is measured by input and output. Suppose is input, which has m

influencing factors; is output, which includes n products. Under certain conditions, some input will bring some output. Let h represent the economic benefit measurement index and be the weighting function of input and output. Enterprise benefit can be expressed as:

$$h = \frac{v_1 y_1 + v_2 y_2 + ... + v_n y_n}{u_1 x_1 + u_2 x_2 + ... + u_m x_m}.$$

This can be simplified into:

$$h = \frac{\sum_{i=1}^{n} v_i y_i}{\sum_{j=1}^{m} u_j x_j}.$$

(u, v) will change upon big environmental changes. Different combinations will contribute different outputs. Therefore, the enterprise benefit is changed into:

$$h' = \frac{v'_1 y'_1 + v'_2 y'_2 + ... + v'_n y'_n}{u'_1 x'_1 + u'_2 x'_2 + ... + u'_m x'_m}.$$

This can be simplified into:

$$h' = \frac{\sum_{i=1}^{n} v'_i y'_i}{\sum_{j=1}^{m} u'_j x'_j}.$$

Therefore, h of an enterprise or different enterprises in specific period can be known. Suppose there are p time points and q enterprises for comparison. The matrix about h can be gained:

$$W = \begin{vmatrix} h_{11} & h_{12} & ... & h_{1p} \\ h_{21} & h_{22} & ... & h_{2p} \\ ... & ... & ... & ... \\ h_{q1} & h_{q2} & ... & h_{qp} \end{vmatrix}.$$

Changing the environment and the matrix is changed into:

$$W' = \begin{vmatrix} h'_{11} & h'_{12} & ... & h'_{1p} \\ h'_{21} & h'_{22} & ... & h'_{2p} \\ ... & ... & ... & ... \\ h'_{q1} & h'_{q2} & ... & h'_{qp} \end{vmatrix}.$$

The regional economic development can be reflected by h of various local enterprises. The regional input and output can be acquired by calculating h of all local enterprises, thus establishing the evaluation model of regional economic benefit. Similarly, economic benefit of a specific industry in one region can be evaluated by calculating h of local enterprises within the industry. There are a lot of industries in one region and one industry covers many enterprises. The regional economic benefit can be

calculated from economic benefits of local industries. Suppose there are k industries in one region and each industry selects g enterprises for economic benefit measurement. Then, the matrix of evaluation model of regional economic benefit is:

$$W* = \begin{vmatrix} h*_{11} & h*_{12} & ... & h*_{1g} \\ h*_{21} & h*_{22} & ... & h*_{2g} \\ ... & ... & ... & ... \\ h*_{k1} & h*_{k2} & ... & h*_{kg} \end{vmatrix}.$$

3.2 MODEL APPLICATION

Economic benefits of enterprise E-commerce and regional E-commerce can be analysed through historical data. Economic indexes of enterprise E-commerce can be acquired from three comparisons.

1) h of an enterprise before and after E-commerce. If h of the enterprise in five years before adopting E-commerce is smaller than 1.2, but h after adopting E-commerce is higher than 1.2, E-commerce brings it higher economic benefits. The difference between these two h can be used to estimate specific economic benefits of E-commerce.

2) h of product involved in E-commerce and h of product uninvolved in E-commerce. If there is no difference between these two h, E-commerce fails to bring the enterprise huge economic benefit. If h of product involved in E-commerce is larger than that of product uninvolved in E-commerce, E-commerce brings the enterprise actual benefit, which is reflected by difference between these two h.

3) Continuous economic benefit of enterprise E-commerce, that is, annual h of the enterprise after adopting E-commerce within the test period. If h of the enterprise increases continuously with the development of its E-commerce, E-commerce contributes great economic benefit. Difference of these annual h reflects the specific economic benefits of enterprise E-commerce. The greater the difference is, the huger the economic benefit will be.

Economic benefits of industrial E-commerce also can be analysed from three comparisons.

1) h of an industry before and after E-commerce. If h of the industry in five years before adopting E-commerce is smaller than 1.5, but h after adopting E-commerce is higher than 1.5, the industry wins economic benefits from E-commerce. The difference between these two h can be used to estimate specific economic benefits of E-commerce.

2) h of industry involved in E-commerce and h of industry uninvolved in E-commerce. If there is no difference between these two h, E-commerce fails to bring the industry huge economic benefit. If h of industry involved in E-commerce is larger than that of industry uninvolved in E-commerce, E-commerce can contribute actual benefit, which is reflected by difference between these two h. Since different enterprises have different economic benefits, enterprises can only be compared and

ranked relatively according to their h.

3) Continuous economic benefit of industrial E-commerce, that is, annual h of the industry after adopting E-commerce within the test period. If h of the industry increases continuously with the development of its E-commerce, the industry benefits a lot from E-commerce. Difference of these annual h reflects the specific economic benefits of industrial E-commerce. The greater the difference is, the huger the economic benefit will be.

Economic benefits of regional E-commerce also can be analysed from three comparisons.

1) h of local industries before and after E-commerce. If h of local industries in five years before adopting E-commerce is smaller than 1.4, but h after adopting E-commerce is higher than 1.4, the region wins economic benefits from E-commerce. The difference between these two h can be used to estimate specific economic benefits of E-commerce.

2) h of local industries involved in E-commerce and h of local industries uninvolved in E-commerce. If there's no difference between these two h, E-commerce fails to bring the region huge economic benefit. If h of local industries involved in E-commerce is larger than that of local industries uninvolved in E-commerce, E-commerce can contribute actual benefit which is reflected by difference between these two h. Since different industries have different economic benefits, industries can only be compared and ranked relatively according to their h.

3) Continuous economic benefit of regional E-commerce, that is, annual h of the region after adopting E-commerce within the test period. If h of the regional economy increases continuously with the development of E-commerce, the region benefits a lot from E-commerce. Difference of these annual h reflects the specific economic benefits of regional E-commerce. The greater the difference is, the huger the economic benefit will be.

4 Suggestions to increase economic benefit of E-commerce

The economic benefit evaluation model of E-commerce is established based on input and output analysis. In fact, (u, v) is another important influencing factor. Different (u, v) shall be supported with different $X(x_1, x_2, ..., x_m)$ and $Y(y_1, y_2, ..., y_n)$ to get the final maximum h. To increase economic benefit of E-commerce, it is suggested to:

1) Choose optimal input. Enterprise, industrial and regional input shall pay attention to proportion of input factors, for example, capital/human resources ratio. According to the production function, human resources can replace capital and capital, in return, can replace human resources. However, different combinations consume different costs even though they contribute same output. Similarly, it is necessary to choose optimal proportion of input factors in order to achieve maximum benefit at lowest cost.

2) Choose optimal output. One enterprise can produce various products. One industry can have enterprises of different types and scales. One region can cover industries of different types. Same input factors will generate different output combinations in different enterprises, industries and regions. For instance, an enterprise can produce product A and B. It has different output combinations (e.g. 10 A and 15 B) under different allocations of same human resources and capital. Since different output combinations have different benefits, output also can be maximized.

3) Perfect E-commerce market. Although E-commerce has achieved rapid development and the E-commerce market is perfecting continuously, it still has many challenges. Firstly, internet security shall be enhanced. Customer information on websites is stolen frequently in recent years, which highlights the security issues of Internet-based E-commerce. Secondly, key attention shall be paid to the credit and management of e-sellers. With the continuous expansion of E-commerce, trade disputes caused by E-commerce increases. How to deal with these disputes becomes a burning question to perfect E-commerce market.

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