Impact of e-Commerce on International Trade—Based on a Iceberg Cost Model

HE Yong, LI Jun-yang, WU Xue-pin, and JIANG Jiao-jiao

Abstract—**There are a few empirical studies on the impact of e-commerce on international trade. This study focus on how e-commerce affects international trade. In this paper, we introduce e-commerce to international trade model with the help of Paul Krugman(1991)'s iceberg cost, and we find that e-commerce does have impact on international trade, which affects the output, prices, imports and exports of merchandise trade, the total global merchandise trade, and enterprise's profits etc. in the end.**

Index Terms—**International trade, e-Commerce, Iceberg cost, Impact.**

I. INTRODUCTION

Thousands of years ago, International trade emerged. With the international division of labor and expansion of global market, International trade has been further developed. From 1999 to 2009, World merchandise exports increases from 5712 billion Dollars to 12490 billion Dollars, World merchandise imports increases from 5921 billion Dollars to 12682 billion Dollars, and World exports of commercial services increases from 1394.6 billion Dollars to 3350.2 billion Dollars, World imports of commercial services increases from 1367 billion Dollars to 3142.6 billion Dollars(World Trade Organization, 2010).

Since the mid-20th century, E-commerce emerged, and has grown quickly. The global E-commerce volume has increased from 3888 billion Dollars in 2005 to 16135.7 billion Dollars in 2009, in which, Europe, the United States and other developed countries get the largest market share(Minnistry of Commerce of the People's Republic of China, 2010). With the development of E-commerce, many B2B E-commerce enterprise has grown up, e.g. Alibaba, Globalsources,etc.. These sites create a convenient online trading platform, bringing tens of thousands international traders and domestic traders doing business together.

As a new channel, E-commerce is changing the mode of trade, affecting the cost, efficiency and value of trade, and has more and more impact on international trade.

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II. PREVIOUS STUDIES

Before entering the 21st century, Some scholars perceived E-commerce would have an impact on international trade. At the begining of E-commerce period, Some scholars did research on it from the perspectiveof Internet or Intranet, J.A. Quelch, L.R. Klein(1996) discussed the different opportunities and challenges that the Internet offers to large and small companies worldwide, They also examined the impact on global markets and new product development, the advantages of an intranet for large corporations, and the need for foreign government support and cooperation. With the develpoment of e-commerce, scholars studied the impact of E-commerce on International trade directly, e.g. P. Fariselli, C. Oughton, C. Picory, et al. (1999) had explored three inter-related issues: globalisation; the role of small and medium sized enterprises; and electronic commerce.

In recent years, many scholars did empirical research on the impact of e-commerce to international trade. Because of the limit of data and rational logic, most of those empirical research are done by the data of Internet connectivity, web hosts , Internet user, etc.. e.g. S. Moodley (2002) used the data of the South African wood furniture sector to explore the link between Internet connectivity and access to global markets, G.R.G. Clarke, S.J. Wallsten(2006) and G.R.G. Clarke(2008) also found that the access to Internet does affect export performance of firms in developing countries; C. Freund, D. Weinhold(2002) and C. Freund, D. Weinhold(2004) find a significant effect of the Internet on trade in recent years form the evidence of the increase in the growth of web hosts in a country leads to the increase in export growth; S. Bojnec, I. Ferto(2009) investigated the impact of the number of Internet users on the bilateral manufacturing export growth among OECD countries and found that the Internet stimulates manufacturing export, they(2010) supported their viewpoint again with the evidence from food industry trade between developed Organisation for Economic Cooperation and Development countries.

The previous studies shows that E-commerce does have impact on international trade form making trade more convenient and reducing transaction costs, etc.. But those studies don't show how E-commerce influences international trade. In this paper, we would try to introduce E-commerce to theoretical model of international trade, which can help us to research the impact mechanism of E-commerce to international trade and expand the theoretical model of international trade.

III. RESEARCH ON THE IMPACT MECHANISM OF E-COMMERCE TO INTERNATIONAL TRADE

International trade theory has a long histry, which has experienced Adam. Smith's "international division of labor theory ", David. Ricardo's "comparative advantage theory ", and Heckscher&Ohlin's "factor endowment theory ". but in recent years, the greatest impact on international trade theory is undoubtedly the "Economies of Scale and Trade Theory" raised by Paul Krugman and Helpman Elhanan.

A. Paul Krugman's iceberg form of transport cost

Paul Krugman introduced "increasing returns to scale" , " Monopolistic competition" and etc. to international trade theory and established his new theory of international trade. In 1991, he considerd that transportation costs for manufactured goods would be assumed to take Samuelson's "iceberg" form, in which transport costs are incurred in the good transported. Specifically, of each unit of manufactures shipped from one region to the other, only a fraction arrives. This fraction, which is an inverse index of transportation costs, is the final parameter determining whether regions converge or diverge(P. Krugman, 1991). On his basis, We introduce the factor of E-commerce to international trade model through studying P. Krugman's iceberg cost.

In the period of 1990s, Krugman considered many kinds of cost, but transport costs were the major costs in international trade, so he used iceberg cost to represent it. In 2000s, the environment of trade has changed a lot, the cost of trade is influenced by many factors. The main factors is the search cost of finding buyer or seller, the cost of negotiation, and etc.. If we think the transportation costs as logistics costs, then, the cost of other non-logistics business flow could be thought as the costs of commerce.

So, without the consideration of trade barriers and other factors, iceberg cost should be decided by logistics costs (C_L) and cost of commerce (C_B), as follows:

$$g = f(C_L, C_B) \qquad (1)$$

Use g to represent the fraction of iceberg cost, then, we could get the following equation

$$g = \frac{P}{P+C}, \text{ so, } g = \frac{P}{P+C_L+C_B}, \text{ and } g < 1 \qquad (2)$$

Recently, As technology advances, the transport costs reduced gradually, the costs of commerce has undergone tremendous change. With the development of global E-commerce, international trade becomes more convenient, the connection between buyers and sellers more closely, the negotiations between them are easier, and the volume of trade are rising dramatically.

As an external factor, the development of E-commerce will cause reverse change of the costs of commerce:

$$C_B = f(E), \text{ and } \frac{\partial C_B}{\partial E} < 0 \qquad (3)$$

B. The basic model of international trade

We consider a model of two countries with a enterprise. In this model, one country is called own country, the other is called foreign country, the enterprise is In the position of the two threshold, both countries need product Z which can only be bought from the enterprise. The diagram of this model is :
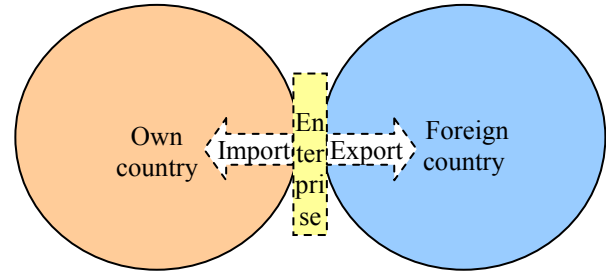

Fig.1. Diagram of international trade model

Part of product Z are imported to own country, and the others are exported to foreign country. So, the enterprise produce Z according to the demand of own country(D_D) and the demand of foreign country(D_F).Assumed that marginal cost of production is constant, and the price of Z remain the same in own country and foreign country, and both market are facing the same demand curves:

$$Q = a - bP, \text{ and } a > 0, b > 0 \qquad (4)$$

There is iceberg cost in both import and export of Z, represented by g_D and g_F, so, the actual marginal cost of Z in own country is c/g_D, that of Z in foreign country is c/g_F, if the fixed cost of enterprise is represented by F, the quantity of product sold in own country and foreign country are represented by Q_D, Q_F, then, the profit of enterprise (π) can be expressed by the following equation:

$$\pi = P(Z)(Q_D + Q_F) - c\left(\frac{Q_D}{g_D} + \frac{Q_F}{g_F}\right) - F \qquad (5)$$

C. Equilibrium solution and the impact of E-commerce on international trade

Enterprise can adjust the output of Z in the pursuit of the maximization of profit, then, we can get it by the first-order inverse of π :

$$\frac{\partial \pi}{\partial Q_D} = \frac{\partial P(Z)}{\partial Q_D}Q_D + P(Z) - \frac{c}{g_D} = 0 \qquad (6)$$

$$\frac{\partial \pi}{\partial Q_F} = \frac{\partial P(Z)}{\partial Q_F}Q_F + P(Z) - \frac{c}{g_F} = 0 \qquad (7)$$

The equilibrium solution can be obtained from (6) and (7):

$$\begin{cases} Q_D = \dfrac{a}{3} + \dfrac{bc}{3g_F} - \dfrac{2bc}{3g_D} \\[2mm] Q_F = \dfrac{a}{3} + \dfrac{bc}{3g_D} - \dfrac{2bc}{3g_F} \end{cases} \qquad (8)$$

The total output of Z (Q) is:

$$Q = Q_D + Q_F = \frac{2a}{3} - \frac{bc}{3g_F} - \frac{bc}{3g_D} \qquad (9)$$

Form the equilibrium solution of output, we could find that both the quantity of Z imported to own country (Q_D) and the quantity of Z exported to foreign country (Q_F) are

directly related to g_D and g_F. With the rise in g_D, Q_D will increase, but Q_F will decrease; otherwise, with the decline in g_D, Q_D will decrease, but Q_F will increase. The impact of g_F is On the contrary.

With the development of E-commerce, C_B will reduce Significantly. If the enterprise only apply E-commerce in own country, g_D will rise, and g_F is unchanged, in this moment, Q_D increases, but Q_F decreases. If only apply E-commerce in foreign country, the result will be opposite. If the enterprise apply E-commerce in both own country and foreign country, then, both g_D and g_F will rise, the change of Q_D and Q_F are determined by g_D / g_F, in this case, one point is clear, that is the total output of Z (Q) Will increase substantially.

Substitute equation (8) into equation (4), the price of Z is:

$$P = \frac{a}{3b} + \frac{c}{3g_F} + \frac{c}{3g_D} \qquad (10)$$

From equation (10), we could find that the price of Z will decrease if the enterprise apply E-commerce in both own country and foreign country which cause both g_D and g_F rise.

Imports of merchandise trade (S_D) and exports of merchandise trade (S_F) are:

$$\begin{cases} S_D = \frac{1}{9}(\frac{a^2}{b} + \frac{2ac}{g_F} - \frac{ac}{g_D} + \frac{bc^2}{g_F^2} - \frac{2bc^2}{g_D^2} - \frac{bc^2}{g_D g_F}) \\ S_F = \frac{1}{9}(\frac{a^2}{b} + \frac{2ac}{g_D} - \frac{ac}{g_F} + \frac{bc^2}{g_D^2} - \frac{2bc^2}{g_F^2} - \frac{bc^2}{g_D g_F}) \end{cases} \quad (11)$$

From equation (11), If the enterprise only apply E-commerce in own country, g_D will rise, and g_F is unchanged, in this moment, S_D increases. If only apply E-commerce in foreign country, S_F increases. If the enterprise apply E-commerce in both own country and foreign country, then, both g_D and g_F will rise, the change of S_D and S_F are also determined by g_D / g_F.

As the sum of Imports of merchandise trade and exports of merchandise trade, S is:

$$S = -\frac{bc^2}{9}(\frac{1}{g_D} + \frac{1}{g_F} - \frac{a}{2bc})^2 + \frac{a^2}{4b} \qquad (12)$$

From above equation, while $\frac{1}{g_D} + \frac{1}{g_F} < \frac{a}{2bc}$, if both g_D and g_F rise, S will decrease, that's because the price of Z is sentive to g_D and g_F, and declines rapidly. On the contrary, g_D and g_F decline, S will increase, that's because the increase of cost will lead to fast rise of price, but the quantity of trade change slightly, then S increases.

while $\frac{1}{g_D} + \frac{1}{g_F} < \frac{a}{2bc}$, S reach the maximum $\frac{a^2}{4b}$.

while $\frac{1}{g_D} + \frac{1}{g_F} > \frac{a}{2bc}$, both g_D and g_F rise, S increases, that's because the decrease of cost lead to rapid increase in quantity, and the influence of quantity is more than that of price, in this situation, E-commerce plays a significant role in international trade.

Substitute equation (8), (9) and (10) into equation (5), the profit of enterprise is:

$$\pi = \frac{1}{9}(\frac{2a^2}{b} - \frac{2ac}{g_D} - \frac{2ac}{g_F} + \frac{5bc^2}{g_D^2} + \frac{5bc^2}{g_F^2} - \frac{5bc^2}{g_D g_F}) - F \qquad (13)$$

Assume $k_D = 1 / g_D$ and $k_F = 1 / g_F$, equation (13) can be changed to:

$$\pi = \frac{2a^2}{9b} + \frac{1}{9}(-2k_D ac - 2k_F ac + 5k_D^2 bc^2 + 5k_F^2 bc^2 - 5k_D k_F bc^2) - F \qquad (14)$$

Then, the first derivative of π with request to k_D is:

$$\frac{\partial \pi}{\partial k_D} = \frac{1}{9}(-2ac + 10k_D bc^2 - 5k_F bc^2) \qquad (15)$$

The second derivative of π with request to k_D is:

$$\frac{\partial \pi \partial \pi}{\partial k_D \partial k_D} = \frac{10}{9}bc^2 > 0 \qquad (16)$$

From (15) and (16), the second derivative of π with request to k_D is always positive. The Coordinate graph of π to k_D is a concave curve. So, with the increase of k_D, π decreases in the begining, then increases after it reaches the bottom of the curve. While $\partial \pi / \partial k_D = 0$, π reaches the bottom, $k_D = k_F / 2 + a / 5bc$. In other words, E-commerce reduces the cost of commerce, pushes g_D to rise, and causes the profits of enterprise decrease gradually in the begining, grows fast later. g_F has the similar effect as g_D. So, we can conclude that applying E-commerce in both own country and foreign country will affect corporate profits adversely in early period, but after a certain stage of development, it will promote the rapid growth of corporate profits.

IV. CONCLUSION

Generally, E-commerce does have impact on international trade, which affects the output of product, prices of product, profits of enterprise, imports and exports of merchandise trade, and the total global merchandise trade, etc.. With the development of E-commerce, the change of the quantity of product sold in own country and foreign country, Imports of merchandise trade and exports of merchandise trade are determined by the extent of impact of E-commerce on different marketplace; the total output of product will

increase substantially; the sum of Imports of merchandise trade and exports of merchandise trade has three different situation; and the profits of enterprise decrease gradually in the begining and grow rapid after a certain stage of E-commerce's development.

REFERENCES

[1] P. Fariselli, C. Oughton, C. Picory, et al., "Electronic commerce and the future for SMEs in a global market-place: Networking and public policies," Small Business Economics, vol. 12, no. 3, pp. 261-275, 1999.

[2] J.A. Quelch, L.R. Klein, "The Internet and international marketing," Sloan Management Review, vol. 37, no. 3, pp. 60-75, 1996.

[3] Minnistry of Commerce of the People's Republic of China, China's E-commerce Report (2008-2009), Beijing: Tsinghua University Press, Sep. 2010.

[4] World Trade Organization, International Trade Statistics 2010, 2010.

[5] S. Moodley, "Global market access in the Internet era: South Africa's wood furniture industry," Internet Research - Electronic Networking Applications and Policy, vol. 12, no. 1, pp. 31-42, 2002.

[6] C. Freund, D. Weinhold, "The effect of the Internet on international trade," Journal of International Economics, vol. 62, no. 1, pp. 171-189, 2004.

[7] S. Bojnec, I. Ferto, "Impact of the Internet on manufacturing trade," Journal of Computer Information Systems, vol. 50, no. 1, pp. 124-132, 2009.

[8] S. Bojnec, I.Ferto, "Internet and international food industry trade," Industrial Management & Data Systems, vol. 110, no. 5, pp. 744-761, 2010.

[9] G.R.G. Clarke, S.J. Wallsten, "Has the internet increased trade? Developed and developing country evidence," Economic Inquiry, vol. 44, no. 3, pp. 465-484, 2006.

[10] G.R.G. Clarke, "Has the internet increased exports for firms from low and middle-income countries?" Information Economics and Policy, vol. 20, no. 1, pp. 16-37, 2008.

[11] C. Freund, D. Weinhold, "The Internet and international trade in services," American Economic Review, vol. 92, no. 2, pp. 236-240, 2002.

[12] P. Krugma, "Increasing returns and economic geography," Journal of Political Economy, vol. 99, no. 3, pp. 483-499, 1991.