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Diversified Boundaries of the Firm

Koichiro KIMURA*

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Abstract: We analyze diversification of boundaries of local firms in developing countries under the economic globalization. The globalization has an aspect of homogenization of the world economy, but also has another aspect of diversification through international economic activities. Focusing on boundary-level of the firm, this article shows that the diversification from a comparison with boundaries of foreign firms in developed countries is brought by a disadvantage of technology deficit and a home advantage as local firms.

Keywords: diversification, technology gaps, home advantage, boundaries of firms
JEL classification: D21,O12

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* Research Fellow, Inter-disciplinary Studies Center, IDE. E-mail: Koichiro_Kimura@ide.go.jp. This is written to deepen discussions on a relation between the globalization and growth of firms in developing countries, based on Kimura (2011a). The author do appreciate comments from the participants of the 2012 meeting of the Association of American Geographers, US, and the members of the East Asian study project (FY2009-11) at Waseda University, Japan.

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INSTITUTE OF DEVELOPING ECONOMIES (IDE), JETRO
3-2-2, WAKABA, MIHAMA-KU, CHIBA-SHI
CHIBA 261-8545, JAPAN

1. Introduction

Whether the economic globalization homogenizes the world economy or differentiates it? The globalization has influenced economic growth in the world, especially in developing countries. Therefore, many studies have discussed its influence on growth of developing countries not only in economics but also in various branches of social sciences (Ritzer, 2010).

When we look at growth of developing countries from the viewpoint of international economics, it has been recognized that growth depends on technology diffusion from developed countries to developing countries through international activities, such as trade and foreign direct investment (FDI). That is, if technologies diffuse, then developing countries can grow, however, if do not, then they cannot (Rivera-Batiz and Romer, 1991; Grossman and Helpman, 1991; Young, 1991). Therefore, it means that technological homogenization between developed and developing countries is a growth condition in developing countries.

However, looking at actual growth, we can find that firms in developing countries have been growing though remaining technology gaps. The fact can be seen in diversification of boundaries of local firms in China's cell phone industry (Kimura, 2006, 2010, 2011b). Boundaries of the firm mean make-or-buy choices of each stage or component on value chains (Grossman and Hart, 1986; Hart and Moore, 1990). On a value chain of cell phones (development, manufacturing, sales stages), foreign firms in the Chinese market, such as Nokia, Motorola, Samsung, and so on, develop new types of products by themselves. On the other hand, Chinese local firms tend to outsource the development stage to outside independent design houses, however integrate a part of the sales stage through establishing own sales networks.

A reason to outsource the development stage is that local firms face a disadvantage of technology deficit. Because they do not have enough experiences or learning effect for product development through learning-by-doing (LBD) due to latecomers, so they have to cost much more money and time to develop new types than foreign firms. Consequently, average costs of products developed by local firms could be higher than those by foreign firms. Therefore, outsourcing is a rational choice for local firms. On the other hand, a reason to integrate a part of the sales stage is that they have a home advantage as local firms in the Chinese market. Because the sales stage strongly relates to human element, so they have the home advantage to find reliable distribution partners, control sales staff, and understand demand trends and business customs in China.

As a result, they have offset the technological disadvantage by the home advantage and expanded their market share in the Chinese growing market of cell phones.

In this way, the diversification is brought by the disadvantage and the advantage. Not only in China's cell phone industry, this characteristic is shared with other manufacturing industries in China (Marukawa, 1996, 2007; Ohara, 1998, 2000; Shanghai Caijing University Ketizu, 2006). Therefore, we generalize the case as a simple model. To do it, the model of boundary selection developed by Antràs and Helpman (2004) and Antràs (2005) is used here. They modeled multi-nationalization of firms in developed countries through make-or-buy choices of manufacturing in home (developed countries) or abroad (developing countries). Therefore, we incorporate characteristics of firms in developing and home countries to consider the case of China's cell phone industry.

The remainder of the article is organized as follows: In the next section, the model is set up. After that, entry conditions are analyzed in Section 3. Findings are presented in the concluding section.

2. Model

An economy in which there exists a developed country (North) and a developing one (South) is considered relative to Antràs and Helpman (2004) and Antràs (2005). Suppose that there is a North firm N and a South one S in each country and that both firms are competing in a market in the South. The North firm exports or invests in the South and enters the South market.[1] In addition, suppose that both firms input only labor and produce goods for final goods y.

Consumers have a simple demand function for the final goods as follows:

$$y = \lambda\, p^{-1/(1-\alpha)},\ 0 < \alpha < 1, \tag{1}$$

p is the price of the final goods, and α is price elasticity of demand. $\lambda > 0$ is a coefficient given exogenously.

Behaviors of firms are then set. Suppose that both firms run businesses by combining a headquarters service x_h and a technology service x_t. The headquarters service indicates various activities for manufacturing and selling final goods. The technology

[1] It is assumed that there is no difference in entry between modes, export, or investment.

service indicates product development. The headquarters service is provided only by assemblers of the final goods both in the North and South. The technology service is provided by the North firm which produces the final goods in the North and by the South firm or an independent supplier in the South. The North firm makes the technology service by itself, and the South firm may make the technology service by integrating suppliers, or it outsource them from independent suppliers rather than integrating them. Optimal selections of make-or-buy of the technology service for the South firm are analyzed under certain situations in the next section.

2.1. Behavior of the North Firm

The North firm produces the technology service by itself. Therefore, two inputs, x_h and x_t, are combined based on a Cobb-Douglas production function producing the final goods:

$$y = \sigma_z \, x_h^{1-z} \, x_t^z, 0 < z < 1, \tag{2}$$

z is elasticity of production of the technology service. $\sigma_z = z^{-z} \, (1\text{-}z)^{-(1-z)}$. The final goods industry becomes a technology service-intensive industry when $z > 1/2$. It becomes a headquarters service-intensive one when $z < 1/2$. The following revenue function of the North firm R^N may be derived from Eqs. (1) and (2):

$$R^N = \lambda^{1-\alpha} \, \sigma_z^{\alpha} \, x_h^{\alpha(1-z)} \, x_t^{\alpha z}.$$

When it bears a wage rate w^N in the North to produce every unit of production, the North firm chooses x_h and x_t to maximize a profit function as follows:

$$\pi^N = \lambda^{1-\alpha} \, \sigma_z^{\alpha} \, x_h^{\alpha(1-z)} \, x_t^{\alpha z} - a w^N x_h - w^N x_t \tag{3}$$

where b >1 is an away disadvantage. As discussed in the previous section firms in home markets have the home advantage, therefore we introduce the away disadvantage to express the advantage of the South firm.

2.2. Behavior of the South Firm

Unlike in the North, the South firm does not make the technology service by itself from

the first. Therefore the South firm makes a decision of boundary selection $k \in (M, B)$ as to whether the firm makes M or buys B. If the firm follows the Grossman-Hart-Moore model, the South firm will integrate a supplier and make x_t by itself in order to avoid a hold-up problem when the firm needs to invest in human capital for x_t to increase the value of final goods.

Next, the influence $\beta_k \in (0, 1)$ on gains between the South firm and a supplier is explained. On shares between these two entities, suppose that both sides can receive gains of each outside option and half of the rest, based on the Nash bargaining solution. The outside option is a gain which each side can receive when negotiations fail. When bargaining fails in cases where the South firm buys x_t (that is, does not integrate a supplier), the outside option of the south firm for the technology service is zero. On the other hand, even when bargaining fails in cases where the south firm makes the technology service, the firm can receive δ as an outside option. Suppose $0 < \delta < 1$. Then the south firm which integrates the technology service can keep δ^α against sales. In the case that the south firm makes x_t, the share is R^S and is the total amount of sales in the South. This shows that the supplier has become a part of firms in the South as a department of production of the technology service. Consequently, their shares decrease more than in existence as an independent firm.[2] When firms in the South buy x_t, the supplier can keep the outside opportunity of the technology service as an independent firm. In summary, the relation between both sides is as follows:

$$\beta_M = \delta^\alpha + \frac{1}{2}(1 - \delta^\alpha) > \frac{1}{2}(1 - \delta^\alpha) = \beta_B.$$

While the above is based on a general mechanism of boundary selection, the influence of technology gaps to the mechanism can be connected. It can be assumed that technology levels required to produce the technology service are high due to technological difficulties of production of core components for the final goods and transfer from North to South. Therefore the South firm needs to accumulate experiences to master the technology by itself. In first using the technology, productivity of the South firm is lower than that of the North firm because of the lack of experiences. Hence, even

[2] In this article, the relation between firms in the South and suppliers is based on the relation between firms manufacturing low-technology goods and firms manufacturing high-technology goods, as in Antràs (2005). He also supposes that low-tech and high-tech firms receive half after (excluding outside opportunity) respectively.

if the South firm integrates the supplier to improve the quality of the core component, it cannot receive the effects of human capital investment in as much an amount as does the North firm. Consequently, it can be assumed that the average cost in the South becomes higher by $b_k > 1$ when the South firm makes a choice to produce the technology service by itself, where $w^N > w^S$. Therefore, while the wage rate in the South is lower than that in the North (depending on the degree of technology gaps), the labor cost in the South possibly exceeds that of the North.

Hence, the South firm's and the supplier's revenues are, respectively, as follows:

$$R_f^S = \beta_k \, \lambda^{1-\alpha} \, \sigma_z^{\alpha} \, x_h^{\alpha(1-z)} \, x_t^{\alpha z}, \qquad (4)$$
$$R_s^S = (1-\beta_k) \, \lambda^{1-\alpha} \, \sigma_z^{\alpha} \, x_h^{\alpha(1-z)} \, x_t^{\alpha z}.$$

When the South firm makes the technology service, the supplier receives the above revenue as a department of the South firm. Moreover, the South firm's and the supplier's profits are, respectively, as follows:

$$\pi_f^S = \beta_k \, \lambda^{1-\alpha} \, \sigma_z^{\alpha} \, x_h^{\alpha(1-z)} \, x_t^{\alpha z} - b_k w^S x_h, \qquad (5)$$
$$\pi_s^S = (1-\beta_k) \, \lambda^{1-\alpha} \, \sigma_z^{\alpha} \, x_h^{\alpha(1-z)} \, x_t^{\alpha z} - w^S x_t.$$

It is also the same in profit. When the South firm makes the technology service, the supplier receives the above profit as a department of the South firm. In addition, it can be assumed that the supplier also employs workers at lower wage rates than those in the North firm because the South firm and the supplier locate in the South despite integration or disintegration by the South firm.

3. Equilibrium

In this section, optimal prices for the North and the South firms from the profit functions in the previous section are developed, and boundary selection of the South firm is analyzed. Possibilities of softening of an entry condition are also considered.

From Eq. (3), the optimal price for the North firm is as follows:

$$p^N = \frac{a^{1-z} w^N}{\alpha}. \qquad (6)$$

The price depends on the wage rate and price elasticity of demand in the North.

Next, from Eq. (5), the optimal price for the South firm is as follows:[3]

$$p^S(\beta_k) = \frac{b_k^{1-z} w^S}{\alpha \beta_k^{1-z}(1-\beta_k)^z}. \tag{7}$$

The North firm does not need to make a decision regarding boundary selection. Hence the optimal price depends on the wage rate in the North. On the other hand, the South firm is required to choose boundaries minimizing the optimal price. The South firm then must choose β_k depending on z and consider an influence of $b_M > 1$ on the optimal price when it chooses integration.

First consider influences of z on boundaries selection $k \in (M, B)$. The South firm chooses β_k to minimize the optimal price under a certain z. Looking at β_k in Eq. (7), the South firm can be seen to minimize the optimal price when it chooses the smaller β_k if z is bigger, and conversely, the larger one if smaller. In cases where the industry is a technology service-intensive one, the supplier's investment in human capital becomes bigger than the South firm's because significance of the core component to the value of the product is higher. On the other hand, in cases where the industry is a headquarters service-intensive one, the South firm's investment becomes bigger than the supplier's because the significance of the headquarters service to the value of the product is higher. Buying is the optimal boundary in cases of the technology service intensive-industries; making is optimal in cases of headquarters service-intensive industries.

Next, entry conditions faced by the South firm may be set based on optimal prices. It is assumed here that North and South firms compete in the South market under a Bertrand competition.[4] Consequently, the South firm's optimal price should be lower than that of the North because rational consumers do not intend to buy homogenous goods at

[3] Differentiating the profit function of the South firm with respect to headquarter service x_h, results in an optimal amount of that profit. Similarly, differentiating the profit function of the South firm with respect to technology service x_t, results in an optimal amount of profit. Substitute these derivatives of the South firm and the supplier and solve for x_h and x_t. When these optimal amounts are substituted into the price function $p = \lambda^{1-\alpha}\sigma^{\alpha-1}x_h^{(\alpha-1)(1-z)}x_t^{(\alpha-1)z}$ derived from Eqs. (1) and (2), Eq. (7) results.

[4] If a Cournot model of competition is assumed, then optimal boundary selection based on differences of optimal production volume depending on technology level of firms in the South can be considered. However, this article focuses on entry conditions and whether or not firms in the South can enter in comparison with the cost level of firms in the North and South. This is considered based on a Bertrand competition model considering comparison between prices of firms in the North and the South.

higher prices. It would not be realistic to expect that both North and South firms, that is, firms in developed and developing countries, make homogenous goods and compete in the same market together because the South firm tends to avert competition with the North firm directly in the same market. However, to consider influences of existences of the North firm on the South firm's boundary selection explicitly, competition between both the North and the South firms may be assumed. Then, under the Bertrand competition, the entry condition becomes $p^N / p^S > 1$. Therefore, the following condition from Eqs. (6) and (7) arises:

$$\omega \geq A(\beta_k) \tag{8}$$

where ω and $A(\beta_k)$ are defined as follows:

$$\omega \equiv \frac{w^N}{w^S}$$

$$A(\beta_k) \equiv \frac{b_k^{1-z}}{a^{1-z}\beta_k^{1-z}(1-\beta_k)^z}$$

Thus, the South firm must choose boundaries in which $A(\beta_k)$ is equal to or smaller than ω. Depending on circumstances, the South firm may not be able to set boundaries or enter into markets.

3.1. Technology Service-Intensive Industry

Based on the entry condition, the South firm's boundaries selection in a technology service-intensive industry can be considered. Depending on the extent of the wage ratio ω, the firm may decide to run business by purchasing the core component or not to enter business at all. The condition is as follows:

$$\omega = \frac{1}{a^{1-z}\beta_B^{1-z}(1-\beta_B)^z}. \tag{9}$$

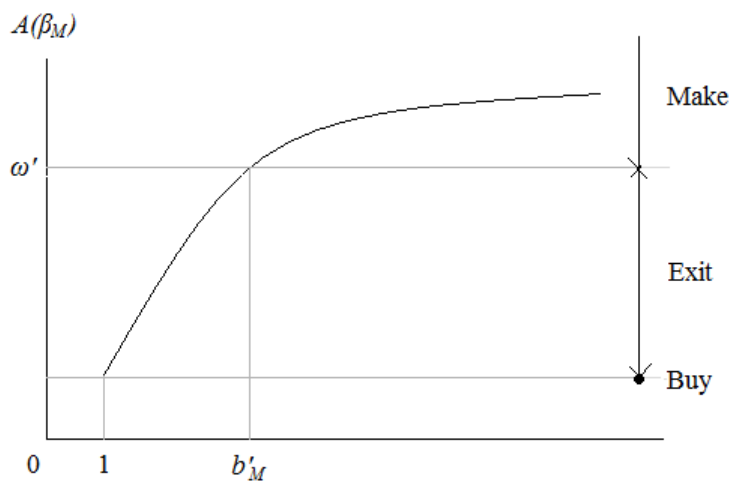
As shown in Eq. (9), in the industry the South firm chooses to buy, $a_B = 1$. The South firm does not need to bear a cost increase of production brought by making on its own. However, $\beta_B < 1/2$ and $1/2 < z < 1$; therefore the right side of Eq. (9) is larger than 1

depending on b. Therefore, depending on ω and b, the firm may decide to enter through purchasing or not to enter. Even if the right side of Eq. (9) becomes larger than 1, the South firm can enter through buying if the wage ratio is large enough to compensate for it.[5] On the other hand, if the ratio is not large enough, then the firm cannot enter at all.

3.2. Headquarters Service-Intensive Industry

The South firm's boundary selections in the headquarters service-intensive industry are considered next. The firm chooses among making, buying (despite the fact that making is an optimal selection) and non-entry depending on the wage ratio ω and b_k. This condition is seen in Eq. (8). Even if the industry is the headquarters service-intensive, the firm is required to choose boundaries in consideration of the burden of $b_M > 1$ to make by itself. This situation is described in Fig. 1. The South firm cannot clear the entry condition if the wage ratio ω is getting bigger when the productivity disparity b_M is getting bigger. As shown in the figure, if b_M is at the same level of b'_M, then the wage ratio must be more than the level of ω'. This is the condition for the South firm to integrate the supplier.

Fig. 1: Relation between $A(\beta_M)$ and b_M



When the South firm has to bear excessive costs, b_M, even if integration is optimal, then there is a possibility that the South firm can clear the entry condition by choosing to buy. Because the South firm has to bear $b_M > 1$, even if integration ($\beta_M > 1/2$)

[5] According to Rattner (2011), the per-hour wage at factories of GM in 2009 was 55 dollars in US, 7 in Mexico, 4.50 in China, and 1 dollar in India. Hence, even productivity in emerging countries is lower than that in US, the wage differences can compensate the productivity differences.

is optimal in the headquarters service-intensive industry ($z < 1/2$), the South firm can decrease b_M to $b_B = 1$ by choosing to buy ($\beta_B < 1/2$). Consequently, when $A(\beta_M) < \omega$, the South firm can clear the entry condition. The new entry condition is similar to that in Eq. (9). However, $A(\beta_M)$ gets bigger in comparison with boundary selection which is optimal for choosing to buy because the South firm chooses $\beta_B < 1/2$ despite the fact that $z < 1/2$. When the South firm cannot clear the new "compromising" condition, then the firm chooses non-entry.

However, if the South firm can use the home advantage, on the other hand, the North firm faces the away disadvantage, the entry conditions can be mitigated by a^{1-z}. Therefore, the South firm can increase possibilities to entry and grow, depends on the advantage.

4. Conclusion

This article has shown that firm boundaries in developing countries are likely to be diversified. In first considering the case that the final goods for consumption are from a technology service-intensive industry, the optimal boundaries for the South firm are that it buys the technology service from an independent supplier. The South firm then does not need to bear the increase of average cost due to integration. If only the wage ratio offsets inefficiency, the South firm can clear the condition for entry.

Considering the case of a headquarters service-intensive industry, making of the technology service in-house is the optimal boundary selection for the South firm. They must take on the increase in cost burden due to technology gaps. If the increase becomes so large that it cannot be covered by the wage ratio, the South firm cannot clear the entry condition. However, there is a possibility that it can enter by switching from making to buying the technology service. In addition, if the South firm can use the home advantage, then the entry conditions can be mitigated.

Except for the case where the South firm is making the technology service in a headquarters service-intensive industry, the South firm's boundaries are differentiated from those of the North firm. Specifically, a South firm can be seen to exert the home advantage in its South market. There is a possibility that firm boundaries in developing countries can become diversified in each developing country to exert the home advantage of each.

Finally, in the case of homogenization of boundary-levels of North and the South

firms, previous studies have assumed that boundaries become homogenized when technologies differ, and this was confirmed by research in this article. If the cost increase due to technology gaps is small when the South firm makes the technology service (that is, if technologies diffuse enough), then the South firm can be expected to choose similar boundaries to those of the North firm and can catch up. If the North firm has already chosen optimal boundaries, and it is not difficult for the South firm to follow the model, it is a rational decision for the South to choose similar boundaries of the North firm because the South firm can avoid learning by mistake. Therefore, when integration of suppliers is not difficult, then boundaries of the South firm converge to those of the North firm. However, when integration is difficult, then there is a possibility of diversification of boundaries of the South firm. Looking at growth of firms in developing countries from boundary levels, there is a possibility that boundaries are diversified depending on ways used to offset technology gaps.

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