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Asymmetric Globalization and Specialization

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Abstract

This paper constructs a theoretical framework to analyze the impact of international openness of the relatively big globalizers on specialization. In contrast to the conventional positive effect of market size on specialization, we show market expansion induced by asymmetric globalization may decrease the level of specialization in terms of components. In addition, the number of components produced in the big globalizers may also decrease, a case distinct from the conventional home-market effects.

Keywords: global market size; asymmetric globalization; specialization; home market effects

JEL classification: F12; L11

1. Introduction

The process of globalization has many facets, and one of the most important is probably international openness through trade. By integrating a relatively closed economy into the world trade system, the consequence of globalization can be regarded as the phenomenon of 'market size' expansion, or market thickening in the sense of McLaren (2000). Then, following the conventional wisdom of the theorem of Adam Smith (1776), "That the Division of Labour Is Limited by the Extent of the Market", we should observe its impact on the economic organization at either the firm level or industrial level[1], such as the degree of production fragmentation or vertical disintegration.

In modern economic theory, by using Dixit and Stiglitzs' (1977) monopolistic competition structure, many studies reexamine the relationship between globalization and specialization, e.g., Ethier (1979, 1982). The conventional wisdom that a rise in the size of the world market increases the number of specialized firms in the global economy is addressed by the Dixit-Stiglitz-Ethier (henceforth DSE) framework. However, the positive relationship between globalization and specialization under the DSE framework is based on the assumption of constant demand elasticity of labor, meaning that the firm size is implicitly unaffected by the global market size. Eckel (2003, 2008) extends the DSE model by considering variable demand elasticity, and in a more general framework he proves that whether the specialization increases or decreases depends on the shape of the cost function after globalization. However, all the existing studies are based on the presumption that there is even expansion in world market size through globalization, termed "symmetric globalization". In other words, it is assumed that the newly open economy is identical to each of the small countries in the global economy.

In fact, the ongoing process of globalization does not follow the pattern of uniform expansion in the world market size. In the 1990s, we do observe that the winners of the great globalization push are in general small countries, for example, New Zealand, Chile, Dubai, Finland, Ireland, the Baltic Republics, Slovenia, Slovakia, Singapore, Taiwan, Hong Kong, and South Korea. Because small countries are more flexible and can adapt more easily to rapidly changing markets, they are winners in the globalizing world. However, since roughly 2000, the newly emerging countries or 'winners' are big globalizers with large populations such as Brazil, Russia, India, and China (henceforth BRIC). The four BRIC countries are highly populous, comprising more than 2.8 billion people or 41.43% of the world population in 2014, with Brazil having 0.206 billion, Russia 0.143 billion, India 1.295 billion and China 1.364 billion.[2] More importantly, the emergence of China in the world trade systems has triggered a dramatic change in the supply chain networks of many industries. As addressed in the IMF reports (2012), the rise of China has changed the supply chain network in Asia as it has become a center of Asia's supply chain. Similarly, China's output share in the world market has been rising dramatically, and it has become the top exporting country in recent years in many industries, like consumer electronics,

[1] See Stigler (1951) for the implications of Smith's (1776) theory in economic organization, especially the division of labor within a firm and vertical disintegration under industrial level. For an explicit model on the positive impacts of market size on labor division within a firm see Chaney and Ossa (2013).

[2] Statistics are retrieved from the dataset of World Development Indicators, World Bank.

smartphones etc. as illustrated in Table 1. As shown in the table, among the world's top ten brand companies after 2013, China's smart phone companies have increased from four to seven in just three years, corresponding with a dramatic rise in the global market share from 16.5% in 2013 to 33.6% in 2015. A similar pattern can be observed for the LCD television firms. China's LCD TV firms listed in the world's top ten have increased from three brand companies to four, corresponding with a significant rise in market share from 15.6% to 18.7% during the same period.

The phenomenon of big globalizers and their impacts on specialization and the corresponding distribution of firms between the big vs. small countries is of interest and deserves further analysis. The existing literature considering the expansion of more identical countries into the global trade system, like Eckel (2003, 2008), fits the case of small-globalizer countries before the 1990s (i.e., symmetric globalization). [3] As an extension, we will consider the case of asymmetric globalization, i.e., a relatively big globalizer integrating into the world market, and explore its effects on the degree of specialization and the distribution of firms between countries. More specifically, we prove that asymmetric globalization does not necessarily cause more specialization in term of the number of firms producing intermediate goods. In addition, while the small countries' number of firms is always reduced, the big globalizer's does not necessary increase. In the case of endogenous sunk cost and high labor elasticity, big globalizer's number of firms can also decline as a result of globalization.

The rest of this paper is organized as follow. Section 2 establishes a modified DSE model and solves for the equilibrium. Section 3 conducts the comparative statics to elaborate the impacts of asymmetric globalization. Section 4 concludes the paper.

2. The model

We assume that the consumer goods are assembled costlessly by using a diversity of horizontally differentiated intermediate goods. Hence, the production function of consumer goods can be specified as follows:

$$X = n^{\frac{1}{\rho}-\frac{\sigma}{\sigma-1}} \left(\sum_{i=1}^{n} Q_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} . \tag{1}$$

The variable X represents the aggregate output of the consumer goods. Q_i is the

[3] In Eckel (2003)'s two country model, the globalization is modeled by the expansion of the world-wide labor supply. The model was simplified and extended in Eckel (2008) to the case of identical k countries, and the globalization is modeled by the increase in k.

input of intermediate goods *i*, and there are *n* types of intermediate goods or components, each produced by only one firm. In addition, $\sigma > 1$ represents the elasticity of substitution between the various intermediate goods inputs. The parameter $\rho \in (0,1)$ indicates how *n* increases the output of the consumer goods for any volume of intermediate inputs, namely the productivity-raising effect of specialization.[4]

The labor is the sole input for the production of intermediate goods. The labor requirements are assumed as follows:

$$L_i = L_i(Q_i)\,. \tag{2}$$

We impose symmetry on all intermediate goods. Hence, the indices can be omitted.

Suppose that there are internal economies of scale in the production of intermediate goods. The assumption implies that $L(vQ) < vL(Q)$, where v is a constant. Define the elasticity of labor requirements as follows:

$$\frac{\partial L}{\partial Q}\frac{Q}{L} = \gamma(Q)\,. \tag{3}$$

The increasing internal returns to scale implies $0 < \gamma < 1$. The elasticity γ will play an important role in our analysis. It can explain how internal returns to scale alter when the output of consumer goods rises. Through the first derivative of γ, we can express different functional forms of the labor requirements. The elasticity γ is increasing in Q ($\gamma' > 0$) when labor requirements are linear, which implies that there are exogenous fixed labor requirements and constant marginal labor requirements. The elasticity γ is a constant, and $\gamma' = 0$ when labor requirements are iso-elastic. In the case of endogenous sunk costs, Equation (2) becomes concave and the elasticity γ is decreasing in Q ($\gamma' < 0$).[5] In addition, prices are equal to the average costs, because there is free entry in all industries (upstream and downstream). Meanwhile, all income is labor income.

Apart from Eckel's (2008) model of many (said *k*) identical countries in the world trade system, we assume that there are a group of identical small countries and a big country in the global economy. Let $\bar{L}$ be the sum of all the smalls' labor endowment, and $\alpha\bar{L}$ the one big globalizer with $\alpha > 1$. Thus, the labor endowment of the global economy is $(\alpha+1)\bar{L}$. A rise in α would lead to a rise not only in the size of the global market but also in the relative size of the big country with respect to the smalls. Therefore, an increase in α indicates more asymmetric of the globalization.[6] Under free trade, the global product markets are integrated into a

[4] For a similar setup refer to Eckel (2008) and references therein.

[5] See Dasgupta and Stiglitz (1980), Leahy and Neary (1996), Spence (1984) and Eckel (2003, 2008) for the same notion.

[6] Obviously, the country size distribution is $1/(\alpha+1)$ the labor share for the smalls and $\alpha/(\alpha+1)$ for the big economy. Let *k* denote the number of the identical smalls. Thus, $l \equiv \bar{L}/k$ be the size of

single world market, and the demand for consumer goods in the single market is given by $X=[(\alpha+1)w\bar{L}]/p$, where p denotes the price of X and w represents the (economy-wide) wage rate.[7] The market clearing condition of the global consumer goods X market is $pX=nC$, where $C=wL(Q)$ is the production cost of an individual supplier. Combining global demand for X and the market clearing condition obtains:

$$nL(Q)=(\alpha+1)\bar{L}\,. \tag{4}$$

The demand for intermediates can be derived by using the production function of the final goods X. Making use of Shephard's lemma on the cost function $C^X=(\sum_{i=1}^{n}q_i^{1-\sigma})^{\frac{1}{1-\sigma}}n^{\frac{\sigma}{\sigma-1}-\frac{1}{\rho}}X$ yields the demand for each individual intermediate good as $Q_j=n^{(\frac{\sigma}{\sigma-1}-\frac{1}{\rho})(1-\sigma)}(\frac{p}{q_j})^{\sigma}\frac{(\alpha+1)w\bar{L}}{p}$, where $p=n^{\frac{\sigma}{\sigma-1}-\frac{1}{\rho}}(\sum_{i=1}^{n}q_i^{1-\sigma})^{\frac{1}{1-\sigma}}$ is the price of the final goods and q_j is the price of the intermediate goods j. Note that p is also the price index of intermediate goods as long as the final assembly of all intermediate goods is costless. Thus, we can get the price elasticity of demand for intermediates as follows:

$$\frac{d\ln Q_j}{d\ln q_j}=-\sigma+(\sigma-1)\frac{d\ln p}{d\ln q_j}\,. \tag{5}$$

The first term on the right-hand side of equality of Equation (5) is the direct substitution effect as in Ethier (1982) and Dixit and Stiglitz (1977). The second term is the price-index effect as in Yang and Heijdra (1993) and Eckel (2008). In a symmetric Nash equilibrium, the relative effects of an individual intermediate good's price on the price index of all intermediate goods depend on the market share of intermediate goods, that is, $d\ln p/d\ln q_j=1/n$. Substituting $d\ln p/d\ln q_j=1/n$ into Equation (5) can obtain the price elasticity of demand for intermediates as follows:

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each country in the smalls. Then, the size of the big is $\alpha\bar{L}=\alpha.l.k$, and the global size is $(\alpha+1)\bar{L}=(\alpha+1)lk$. While Eckel (2003, 2008) focus on the specialization effect of global expansion in k, we emphasis in the increase in α, which involves not only a global market expansion but also the asymmetric globalization i.e., the relative size of the big become even larger. As shall be proved later, the Eckel's globalization effect on firm size and on degree of specialization still holds. However, the specialization effect on the big and smalls are different.

[7] The market clearing condition is straightforward, for X is the only consumption good and labor income is the sole income in the model. Obviously, the expenditure share of income on the consumption good X is one.

$$\frac{d\ln Q_j}{d\ln q_j} = -\sigma + \frac{1}{n}(\sigma - 1). \tag{6}$$

In the popular DSE framework, e.g. Ethier (1982) and Dixit and Stiglitz (1977), it is assumed that each firm is too small to affect equilibrium price, thus $d\ln p / d\ln q_j = 0$, referred to as the case of DSE benchmark hereafter. However, by (6), $d\ln p / d\ln q_j = 0$ would lead to $d\ln Q_j / d\ln q_j = -\sigma$. This is only true if $1/n$=0, or if the number of firms n is extremely large.

Firms in the intermediate goods industry compete on price. The condition for profit maximizing is marginal revenue being equal to marginal cost. Also, free entry ensures that the condition of zero profit holds. Thus, the first-order condition (FOC) can be derived as follows:[8]

$$\gamma(Q) = \frac{1 - \frac{1}{n}}{\frac{\sigma}{\sigma - 1} - \frac{1}{n}}. \tag{7}$$

Equation (7) exhibiting $\gamma(Q)$ depending on the number of firms (n) is different from the FOC in the conventional case. In addition, we have a wider range of cost functions by relaxing the DSE assumption.[9] The second-order condition (SOC) for profit maximizing is:[10]

$$\gamma'(Q)\frac{Q}{\gamma(Q)} > -\frac{\frac{1}{n}(\sigma - 1)}{[\sigma - \frac{1}{n}(\sigma - 1)]^2}. \tag{8}$$

If the DSE assumption holds, then the right-hand side of Equation (8) approaches zero, and $\gamma' > 0$. If $1/n>0$, as will be shown later, we can discuss the cases of linear cost function ($\gamma' > 0$), iso-elastic cost function ($\gamma' = 0$) or endogenous sunk cost function ($\gamma' < 0$). The equation system of (4) and (7) solves the equilibrium firm size (Q) and the degree of specialization (n).

3. The Impact of Asymmetric Globalization

Asymmetric globalization raises not only the number of countries integrated in the world market but also the degree of asymmetry between country size, which can

8 For the proof, please see the Appendix.
9 Yang and Heijdra (1993) and Eckel (2008) also indicate this result.
10 For the proof, please see the Appendix.

be captured by the level of α in the model. By doing the comparative statics analysis on the equation system of (4) and (7), we are now ready to analyze the impact of asymmetric globalization, represented by an increase in α, on the degree of specialization (n) and the number of firms in both the big globalizer, $\alpha n/(\alpha+1)$, and the smalls $n/(\alpha+1)$.

The impact of α on Q and n can be derived as follows:[11]

$$\frac{d\ln Q}{d\ln\alpha}=\frac{\alpha}{\alpha+1}\cdot\frac{1}{\Delta}, \tag{9}$$

$$\frac{d\ln n}{d\ln\alpha}=\frac{\alpha}{\alpha+1}\cdot\frac{1-\frac{1}{n}}{\frac{1}{n}\Delta}[\sigma-\frac{1}{n}(\sigma-1)]\gamma'(Q)\frac{Q}{\gamma}, \tag{10}$$

where

$$\Delta=\frac{1-\frac{1}{n}}{\frac{1}{n}}[\sigma-\frac{1}{n}(\sigma-1)]\gamma'(Q)\frac{Q}{\gamma}+\gamma(Q)>0.$$[12]

As mentioned before, four cases can be distinguished depending on the assumptions of perceived demand ($1/n\geq 0$) and cost functions (γ'), that is, (1) $1/n=0\wedge\gamma'>0$ (benchmark), (2) $1/n>0=0\wedge\gamma'>0$ (Linear cost function), (3) $1/n>0=0\wedge\gamma'=0$ (iso-elastic cost function) and (4) $1/n>0=0\wedge\gamma'<0$ (endogenous sunk cost function).

(1) $\frac{1}{n}=0\wedge\gamma'>0$ (benchmark):

The mathematical results for the benchmark case are

$d\ln Q/d\ln\alpha=0$, $d\ln n/d\ln\alpha=\alpha/(\alpha+1)\in(0,1)$, and $d\ln(\frac{n}{\alpha+1})/d\ln\alpha=0$, $d\ln(\frac{\alpha n}{\alpha+1})/d\ln\alpha=1$. The first two results illustrate that firm size (Q) remains unchanged and the degree of specialization (n) increases as a result of asymmetric globalization (increase in α). In addition, as reflected in the last two results, although the total number of firms n increases in the global market, it comes only from the enlarged big globalizer ($d\ln(\alpha n/\alpha+1)/d\ln\alpha=1$), the number of firms in the existing smalls remains unchanged ($d\ln(n/\alpha+1)/d\ln\alpha=0$).

[11] For the proof, please see the Appendix.

[12] Equation (8) implies that $\Delta>0$.

(2) $\frac{1}{n} > 0 \wedge \gamma' > 0$ (Linear cost function):

In the case of linear cost function with fixed sunk cost, the marginal cost is constant and the average cost is decreasing with respect to firm size *Q*, leading to a rising elasticity of demand for labor $\gamma' > 0$. Mathematically, the globalization effect on the firm size and firm numbers are respectively $\frac{d \ln Q}{d \ln \alpha} = \frac{\alpha}{\alpha + 1} \cdot \frac{1}{\Delta} > 0$ and $\frac{d \ln n}{d \ln \alpha} = \frac{\alpha}{\alpha + 1} \cdot \frac{(\Delta - \gamma)}{\Delta} \in (0,1)$. That is, the market size expansion leads to an increase in not only firm size, *Q*, but also the degree of specialization, *n* or number of firms producing intermediate goods.

However, the number of firms in the smalls declines, even though the global number of firms increases after the asymmetric globalization, as reflected by $d \ln(\frac{n}{\alpha + 1}) / d \ln \alpha = -\frac{\alpha}{\alpha + 1} \cdot \frac{\gamma(Q)}{\Delta} \in (-1, 0)$. In contrast, the number of firms in the big globalizer increases and obviously should outweigh the decrease in the number of firms of the smalls, as reflected by $d \ln(\frac{\alpha n}{\alpha + 1}) / d \ln \alpha = 1 - \frac{\alpha}{\alpha + 1} \cdot \frac{\gamma(Q)}{\Delta} \in (0,1)$.[13] The result may explain what we observe in Table 1, that is, the phenomenon of a dramatic increase in China's global market share at the expense of the "Other" category in the global market of consumer electronics of LCD TV and Smart Phones, which are characterized by constant marginal cost and decreasing average cost with respect to firm size.

The economic intuition for this case follows. The globalization-induced market scale effect increases the average firm size of Q and the global number of firms *n* in the industry characterized by constant marginal cost. However, due to constant labor supply in the smalls, increase in the firm size accompanied by more demand for labor (due to the rising elasticity of labor demand) can only be reached by decreasing the number of firms. For the big globalizer, its relatively abundant labor will support more firms even with the enlarged firm size.

(3) $\frac{1}{n} > 0 \wedge \gamma' = 0$ (Iso-elastic cost function):

In this case, the firm size effect and specialization effect are respectively $\frac{d \ln Q}{d \ln \alpha} > 0$

[13] Note that full employment condition and identical firm size assure the firm number distribution equals labor share of each country.

and $\frac{d\ln n}{d\ln\alpha} = 0$. The rationale behind the result is as follows. While the market size expansion leads to larger firm size due to internal economies of scale, the property of constant elasticity also makes each firm's labor input increase by the same proportion as the increase in its output level, which in turn equals the proportional increase in global labor supply induced by globalization. Thus, the total number of firms remains unchanged.

Accompanying the result of unchanged firm number, or no specialization impact, is a decrease in the smalls' number of firms offset by the increase in the big globalizer's number of firms. That is, there is a negative impact on the smalls' number of firms, as reflected by $d\ln(\frac{n}{\alpha+1})/d\ln\alpha = -\frac{\alpha}{\alpha+1} \in (-1,0)$, and a positive impact on the big globalizer's as indicated by $d\ln(\frac{\alpha n}{\alpha+1})/d\ln\alpha = \frac{1}{\alpha+1} \in (0,1)$.

(4) $\frac{1}{n} > 0 \wedge \gamma' < 0$ (Endogenous sunk costs):

This is the case with endogenous sunk costs, the case when a firm adjusts its fixed input like R&D devoted to process innovation for different output scale.[14] Mathematically, the impacts on firm size Q and specialization n are respectively $\frac{d\ln Q}{d\ln\alpha} = \frac{\alpha}{\alpha+1}\cdot\frac{1}{\Delta} > 0$ and $\frac{d\ln n}{d\ln\alpha} = \frac{\alpha}{\alpha+1}\cdot\frac{(\Delta-\gamma)}{\Delta} < 0$. That is, firm size will be enlarged, but the number of firms decreases. Obviously, the feature of internal scale economy explains the positive effect of market size on firm size. Higher sunk cost due to firm size increase causes higher demand for more labor input in each firm, and thus reduces the number of firms at equilibrium.

Accompanying the decrease in the total number of firms are reduced firm numbers in the smalls, as reflected by $d\ln(\frac{n}{\alpha+1})/d\ln\alpha = -\frac{\alpha}{\alpha+1}\cdot\frac{\gamma(Q)}{\Delta} < 0$. However, the effect on the big globalizer is not deterministic, as shown below:

$$\frac{d\ln(\frac{\alpha n}{\alpha+1})}{d\ln\alpha} = 1 - \frac{\alpha}{\alpha+1}\cdot\frac{\gamma(Q)}{\Delta} \begin{matrix} > \\ = \\ < \end{matrix} 0 \quad \text{if} \quad \begin{matrix} \Delta < \gamma(Q) < (\frac{\alpha+1}{\alpha})\Delta \\ \gamma(Q) = (\frac{\alpha+1}{\alpha})\Delta \\ (\frac{\alpha+1}{\alpha})\Delta < \gamma(Q) < 1 \end{matrix}.$$

That is, the number of intermediate producers of the big globalizer $(\alpha n/(\alpha+1))$

[14] See Eckel (2008) and Leahy and Neary (1996) or Spence (1984) for the specifications that lead to decreasing elasticity of labor demand.

may rise, remain unaltered or decline, depending on the level of labor elasticity. The elasticity of labor requirements $\gamma(Q)$ plays an important role in determining the number of intermediate producers of the bigger country. More specifically, the larger the $\gamma(Q)$ is, the smaller the number of intermediate producers of the bigger country is, and *vice versa*. More interestingly, if the $\gamma(Q)$ is greater than a certain level, then the big-globalizer's number of firms will drop, a result against our common belief based on the conventional home-market effect.

Table 2 summarizes the comparative statics results of all the four cases.

As depicted in the table, we can summarize the main findings as in the following: Firstly, except the case of an extremely large number of firms (benchmark case), asymmetric globalization will always enlarge the firm size because of the increasing internal returns to scale. Secondly, unlike the convention wisdom of Smith's theorem, the market expansion induced by asymmetric globalization can reduce specialization, should the sunk cost be endogenous to the firm size. In fact, these two effects duplicate the results of Eckel (2003, 2008)'s symmetric globalization. That is, global market expansion always leads to larger firm size, while the degree of specialization decreases when the sunk cost is endogenous.

Thirdly, asymmetric globalization always reduces the firm numbers in the existing smalls, except the benchmark case in which the globalization does not affect the firm size. Finally, in most situations, asymmetric globalization always leads to more firms in the big globalizer, which is consistent with the so-called home-market effect in neo-trade theory. However, the opposite occurs if there exists an endogenous sunk cost and the elasticity of labor demand is large enough. In this case, the number of firms in the big globalizer decreases along with the declining specialization in the global market.

4. Concluding remarks

In the most recent decade, the world trade system has witnessed the process of asymmetric globalization, indicating a dramatic global market expansion. The convention wisdom of positive relation between market size and specialization, originated by Smith's (1776) theorem, is revisited in this study. By considering asymmetric globalization in a general equilibrium model, we prove that the global market expansion induced by a big globalizer may or may not enhance production specialization, depending on the structure of the cost function. While most cases are consistent with the conventional wisdom, the opposite results occur when there is an endogenous sunk cost. In this case, the specialization diminishes after asymmetric globalization. In addition, if in this case the elasticity of labor demand is large enough, globalization also reduces the firm numbers in the big globalizer, as in the smalls.

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Appendix: The mathematical proof

The profit of individual intermediate goods firm is as follows:

$$\pi = qQ(q) - wL[Q(q)].$$

The first-order condition (FOC) is:

$$\frac{d\pi}{dq} = Q + Q\frac{d\ln Q}{d\ln q} - \frac{w}{q}L'Q\frac{d\ln Q}{d\ln q} = 0. \qquad (A.1)$$

Substituting Equations (3) and (6) and the zero profits condition ($qQ = wL$) into Equation (A.1) can obtain:

$$\frac{d\pi}{dq} = -Q(\sigma-1)\left(\frac{\sigma}{\sigma-1} - \frac{1}{n}\right)\left(\frac{1-\frac{1}{n}}{\frac{\sigma}{\sigma-1}-\frac{1}{n}} - \gamma\right) = 0. \qquad (A.2)$$

FOC ($d\pi / dq = 0$) requires that the last term in parentheses of Equation (A.2) is equal to zero. Thus, we have:

$$\gamma(Q) = \frac{1-\frac{1}{n}}{\frac{\sigma}{\sigma-1}-\frac{1}{n}}. \qquad (A.3)$$

Equation (A.3) is the same as Equation (7).

The second-order condition (SOC) requires that $d^2\pi / dq^2 < 0$. By use of Equations (A.3) and (4), the SOC can be reduced to

$$\frac{d^2\pi}{dq^2} = \gamma(Q)(\sigma-1)(\frac{\sigma}{\sigma-1}-\frac{1}{n})\frac{Q}{q}\frac{d\ln Q}{d\ln q}\{\gamma'\frac{Q}{\gamma(Q)}+\frac{\frac{1}{n}(\sigma-1)}{[\sigma-\frac{1}{n}(\sigma-1)]^2}\}<0.$$

Because of $d\ln Q/d\ln q<0$, this proves Equation (8).

Logarithmic differentiation of Equations (7) and (4) can obtain the system equations as follows:

$$\begin{bmatrix} (n-1)[\sigma-\frac{1}{n}(\sigma-1)]\gamma'(Q)\frac{Q}{\gamma} & -1 \\ \gamma(Q) & 1 \end{bmatrix}\begin{bmatrix} \frac{d\ln Q}{d\ln\alpha} \\ \frac{d\ln n}{d\ln\alpha} \end{bmatrix}=\begin{bmatrix} 0 \\ \frac{\alpha}{\alpha+1} \end{bmatrix} \qquad (A.4)$$

Equations (9) and (10) can be derived by Cramer's rule.

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Table1 Nationality Distribution of the Top Ten Brand Companies in the Global Market Unit: Number of firms (global market share %)

Industry	Smart Phone①					LCD TV②				
Country / Year	USA	Japan	Korea	China	Other	USA	Japan	Korea	China	Other
2013	1 (16.6%)	1 (4.1%)	2 (36.8%)	4[a] (16.1%)	2 (5.5%)	0	4 (18.1%)	2 (34.3%)	3[d] (15.6%)	1 (4.1%)
2014	1 (16.4%)	1 (3.9%)	2 (33.2%)	6[b] (29.9%)	0	1 (3.0%)	2 (13.2%)	2 (34.4%)	3[e] (14.1%)	1 (3.2%)
2015	1 (17.5%)	0	2 (30.1%)	7[c] (33.6%)	0	1 (3.4%)	2 (8.4%)	2 (33.4%)	4[f] (18.7%)	1 (3.8%)

Data Sources:

① Trendforce Statistics: http://press.trendforce.com.tw/press/20150120-2552.html, http://iknow.stpi.narl.org.tw/post/Read.aspx?PostID=12063

② Statista Inc: http://www.statista.com/statistics/267095/global-market-share-of-lcd-tv-manufacturers/

Footnotes: a. The four companies are Lenovo, Huawei, Coolpad, ZTE.

b. Lenovo+Motorola, Huawei, Xiaomi, Coolpad, TCL, ZTE.

c. Huawei, Xiaomi, Lenovo, TCL, OPPO, BBK/VIVO, ZTE.

d. TCL, Hisense, Skyworth.

e. TCL, Hisense, Skyworth.

f. TCL, Hisense, Skyworth, Changhong.

Table2 Asymmetric Globalization Effect (summary)

Effects of α / Cases	Firm Size $\frac{d\ln Q}{d\ln\alpha}$	Specialization $\frac{d\ln n}{d\ln\alpha}$	Number of Firms of the Small $\frac{d\ln(\frac{n}{\alpha+1})}{d\ln\alpha}$	Number of Firms of the Big $\frac{d\ln(\frac{\alpha n}{\alpha+1})}{d\ln\alpha}$

Benchmark $\frac{1}{n}=0\wedge\gamma'>0$	0	+ $\frac{\alpha}{\alpha+1}\in(0,1)$	0	+ 1
Linear cost function $\frac{1}{n}>0\wedge\gamma'>0$	+ $\frac{\alpha}{\alpha+1}\cdot\frac{1}{\Delta}$	+ $\frac{\alpha}{\alpha+1}\cdot\frac{(\Delta-\gamma)}{\Delta}\in(0,1)$	- $-\frac{\alpha}{\alpha+1}\cdot\frac{\gamma(Q)}{\Delta}\in(-1,0)$	+ $1-\frac{\alpha}{\alpha+1}\cdot\frac{\gamma(Q)}{\Delta}\in(0,1)$
Iso-elastic cost function $\frac{1}{n}>0\wedge\gamma'=0$	+ $\frac{\alpha}{\alpha+1}\cdot\frac{1}{\Delta}$	0	- $-\frac{\alpha}{\alpha+1}\in(-1,0)$	+ $\frac{1}{\alpha+1}\in(0,1)$
Endogenous sunk costs $\frac{1}{n}>0\wedge\gamma'<0$	+ $\frac{\alpha}{\alpha+1}\cdot\frac{1}{\Delta}$	- $\frac{\alpha}{\alpha+1}\cdot\frac{(\Delta-\gamma)}{\Delta}$	- $-\frac{\alpha}{\alpha+1}\cdot\frac{\gamma(Q)}{\Delta}$	$1-\frac{\alpha}{\alpha+1}\cdot\frac{\gamma(Q)}{\Delta}\gtreqless 0$