On the Emergence of Intra-Industry Trade

Shimomura, Koji
Zeng, Dao-Zhi
Kikuchi, Toru

On the Emergence of Intra-Industry Trade

Toru Kikuchi* Koji Shimomura† Dao-Zhi Zeng‡§

November 3, 2005

*Toru Kikuchi, Graduate School of Economics, Kobe University, 2-1 Rokkodai-cho, Nada-ku, Kobe 657-8501, Japan; e-mail: kikuchi@econ.kobe-u.ac.jp

†Koji Shimomura, Research Institute for Economics and Business Administration, Kobe University, 2-1 Rokkodai-cho, Nada-ku, Kobe 657-8501, Japan; e-mail: simomura@mail.rieb.kobe-u.ac.jp

‡Dao-Zhi Zeng, Graduate School of Management, Kagawa University, Saiwai-cho 2-1, Kagawa 760-8523, Japan; e-mail: zeng@ec.kagawa-u.ac.jp

§This note is an outgrowth of a paper present at Kobe COE Conference on International Trade, held in Kobe. We are deeply indebted to Fumio Dei, Elhanan Helpman, Jota Ishikawa, Masao Oda, Nicolas Schmitt, Makoto Yano, Laixun Zhao, and two anonymous referees who provided many stimulating and insightful comments.

Abstract

This note explores the determinants of intra-industry trade by extending the standard Chamberlinian-Ricardian monopolistic competition trade model (e.g., Krugman, 1979) to have a continuum of industries (e.g., Dornbush et al. 1977). It will be shown that the degree of cross-country technical differences *among industries* plays an important role as a determinant of trade *within each industry*.
Keywords: Intra-industry trade; cross-country technical differences; technical standardization

JEL Classification: D43, F12.

1 Introduction

Over the past several decades a vast literature has developed on the emergence of intra-industry trade (i.e., two-way trade of differentiated products). Among several competing models of intra-industry trade, Chamberlinian monopolistic competition models of trade have been extensively investigated since the seminal work of Krugman (1979). Helpman's (1981) seminal integration of the monopolistic competition trade model into a neoclassical framework, which has been extended and made popular by Helpman and Krugman (1985), has led to the widely-held belief that neoclassical and new trade theories are complementary in nature.[1] Those models are very successful in explaining the emergence of intra-industry trade.

To focus on the role of increasing returns and imperfect competition, a standard one-factor model assumes cross-country technical homogeneity: each firm in the monopolistically competitive sector incurs an identical fixed cost ($w\alpha$) and a constant marginal cost ($w\beta$), where w is the wage rate. As a result, there has been little investigation of the role of technical heterogeneity among countries. However, the Ricardian comparative advantage, which plays a basic role in traditional international-trade context, is worthy of more attention. To address this point, Kikuchi (2004) explored cross-country technical heterogeneity in both fixed costs and marginal costs as a determinant of trade patterns. Within a two-country, two-industry frame-

[1]See Krugman (1995) and Bernhofen (2002) for the comprehensive surveys of the relevant literature.

work, he showed that the manufacturing sector is agglomerated in a country and intra-industry trade is very unlikely in a trading equilibrium.

The present note takes Kikuchi (2004) as its point of departure, and extends his analysis to include a continuum of industries as did Dornbush et al. (1977). In each industry, both fixed costs and marginal costs can differ between countries. It will be shown that the equilibrium specialization pattern is determined by the technology index. It will also be shown that trade patterns, particularly the emergence of intra-industry trade, are crucially dependent on the shape of the technology index schedule, which is taken from Dornbush et al. (1977). That is, if technical standardization occurs and the share of similar industries becomes larger between countries, the possibility of intra-industry trade rises.

This note is closely related to Venables (1999), which explored the division of industries between countries in a multi-industry framework with cross-country technical differences. However, he used a framework in which there are both transport costs and linkages through intermediate inputs: his focus was on the interaction between technical differences and agglomeration forces via input-output linkages. In contrast, in this note we assume away such aspects (e.g., sources of agglomeration forces such as input-output linkages) and focus on the interaction between cross-country technical differences and trade patterns.

The next section develops a Chamberlinian-Ricardian model with a continuum of industries. Section 3 deals with the determinants of trade patterns. Section 4 discusses some implications of the analysis.

2 The Model

Suppose that there are two countries in the world, Home and Foreign. Home (Foreign) is endowed with L ($\tilde{L}$) units of labor and the only source of income in a long-run equilibrium is the wage, w ($\tilde{w}$). We assume that there is a continuum of manufacturing industries with mass M.[2] Industry specific variables will be indexed by industry label i. Consumers preferences are represented by a nested function with CES subutilities:

$$U = \int_0^M [X(i)]^{(1/M)} di,$$

where $X(i)$ is the quantity index (subutility) of industry i: they purchase equal values of the output of all industries. Each industry is modeled as a Dixit-Stiglitz (1977) monopolistically competitive industry and the quantity index is defined as

$$X(i) = \left(\sum_{k=1}^{n^i} (d_k^i)^{(\sigma-1)/\sigma} + \sum_{\tilde{k}=1}^{\tilde{n}^i} (d_{\tilde{k}}^i)^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)},$$

where n^i ($\tilde{n}^i$) is the number of products produced in industry i in Home (Foreign), d_k^i ($d_{\tilde{k}}^i$) is the consumption of the k ($\tilde{k}$)-th differentiated product produced in industry i in Home (Foreign), and σ is the elasticity of substitution between every pair of products.

The price index of industry i can be obtained as:

$$P(i) = \left(\sum_{k=1}^{n^i} (p_k^i)^{1-\sigma} + \sum_{\tilde{k}=1}^{\tilde{n}^i} (p_{\tilde{k}}^i)^{1-\sigma} \right)^{1/(1-\sigma)}, \qquad (1)$$

[2]Under the assumption of a finite number of manufacturing industries, one can obtain qualitatively different results on trade patterns. See, Kikuchi et al. (2005).

where p^i_k ($p^i_{\tilde{k}}$) is the price of the k ($\tilde{k}$)-th differentiated product produced in industry i in Home (Foreign). Note that the Home's total revenue in a long-run equilibrium is wL, which will be equally expended in each industry. Solving consumers' maximization problem yields the following demand functions for Home consumers:

$$d^i_k = \frac{(p^i_k)^{-\sigma}}{\sum_{j=1}^{n^i}(p^i_j)^{1-\sigma} + \sum_{\tilde{j}=1}^{\tilde{n}^i}(p^i_{\tilde{j}})^{1-\sigma}} \frac{wL}{M}, \tag{2}$$

$$d^i_{\tilde{k}} = \frac{(p^i_{\tilde{k}})^{-\sigma}}{\sum_{j=1}^{n^i}(p^i_j)^{1-\sigma} + \sum_{\tilde{j}=1}^{\tilde{n}^i}(p^i_{\tilde{j}})^{1-\sigma}} \frac{wL}{M}. \tag{3}$$

Assuming that the products are transported free between countries, then the prices of each product in two countries are equal. Therefore, the demand functions for Foreign consumers are

$$\tilde{d}^i_k = \frac{(p^i_k)^{-\sigma}}{\sum_{j=1}^{n^i}(p^i_j)^{1-\sigma} + \sum_{\tilde{j}=1}^{\tilde{n}^i}(p^i_{\tilde{j}})^{1-\sigma}} \frac{\tilde{w}\tilde{L}}{M},$$

and

$$\tilde{d}^i_{\tilde{k}} = \frac{(p^i_{\tilde{k}})^{-\sigma}}{\sum_{j=1}^{n^i}(p^i_j)^{1-\sigma} + \sum_{\tilde{j}=1}^{\tilde{n}^i}(p^i_{\tilde{j}})^{1-\sigma}} \frac{\tilde{w}\tilde{L}}{M},$$

respectively.

Differentiated products are supplied by monopolistically competitive firms. There is cross-country technical heterogeneity: each Home (Foreign) firm in industry i has both α^i ($\tilde{\alpha}^i$) units of labor as a fixed input and β^i ($\tilde{\beta}^i$) units of labor as a marginal input. With the number of firms being very large, the elasticity of demand for each product becomes σ. Thus, each product is priced at a markup over marginal cost:

$$p_k^i = \frac{\sigma\beta^i w}{\sigma - 1}, \quad p_{\tilde{k}}^i = \frac{\sigma\tilde{\beta}^i\tilde{w}}{\sigma - 1}.$$

Using these pricing equations, the summation in equation (2) takes the form

$$\sum_{k=1}^{n^i}(p_k^i)^{1-\sigma} + \sum_{\tilde{k}=1}^{\tilde{n}^i}(p_{\tilde{k}}^i)^{1-\sigma} = n^i\left(\frac{\sigma\beta^i w}{\sigma - 1}\right)^{1-\sigma} + \tilde{n}^i\left(\frac{\sigma\tilde{\beta}^i\tilde{w}}{\sigma - 1}\right)^{1-\sigma}.$$

Substituting this into the demand function yields the profit function of each Home firm[3]

$$\begin{aligned}
\pi^i =&(p^i - \beta^i w)x - \alpha^i w \\
=&\frac{1}{\sigma - 1}\beta^i w(d_k^i + \tilde{d}_k^i) - \alpha^i w \\
=&\frac{(1/\sigma)\left(\dfrac{\sigma\beta^i w}{\sigma - 1}\right)^{1-\sigma}}{n^i\left(\dfrac{\sigma\beta^i w}{\sigma - 1}\right)^{1-\sigma} + \tilde{n}^i\left(\dfrac{\sigma\tilde{\beta}^i\tilde{w}}{\sigma - 1}\right)^{1-\sigma}}\frac{wL + \tilde{w}\tilde{L}}{M} - \alpha^i w.
\end{aligned} \tag{4}$$

Similarly, the profit function of each Foreign firm is

$$\tilde{\pi}^i = \frac{(1/\sigma)\left(\dfrac{\sigma\tilde{\beta}^i\tilde{w}}{\sigma - 1}\right)^{1-\sigma}}{n^i\left(\dfrac{\sigma\beta^i w}{\sigma - 1}\right)^{1-\sigma} + \tilde{n}^i\left(\dfrac{\sigma\tilde{\beta}^i\tilde{w}}{\sigma - 1}\right)^{1-\sigma}}\frac{wL + \tilde{w}\tilde{L}}{M} - \tilde{\alpha}^i\tilde{w}. \tag{5}$$

Now turn to the specialization pattern of industry i. In the long-run trading equilibrium with zero transport costs, we need non-positive profits in

[3]Hereafter, the subscript k is often dropped for simplicity.

industry i in each country, with profits being equal to zero if production takes place. Thus, by setting profits equal to zero for both countries ($\pi^i = \tilde{\pi}^i = 0$), we would like to test whether the co-existence of both countries' firms is consistent with equilibrium.

First, let us draw attention to the condition that, if both countries' firms in industry i co-exist, profits must be identical for each country's firms, i.e.,

$$\pi^i = \tilde{\pi}^i. \tag{6}$$

This is the condition that must be satisfied if $\pi^i = \tilde{\pi}^i = 0$ is to hold. Substituting (4) and (5) into (6), we obtain

$$\frac{\dfrac{wL + \tilde{w}\tilde{L}}{\sigma M}[(\sigma-1)/\sigma]^{\sigma-1}}{n^i\left(\dfrac{\sigma\beta^i w}{\sigma-1}\right)^{1-\sigma} + \tilde{n}^i\left(\dfrac{\sigma\tilde{\beta}^i\tilde{w}}{\sigma-1}\right)^{1-\sigma}} = \frac{\alpha^i w - \tilde{\alpha}^i\tilde{w}}{(\beta^i w)^{1-\sigma} - (\tilde{\beta}^i\tilde{w})^{1-\sigma}}. \tag{7}$$

Inserting the RHS of (7) into the profit function yields

$$\begin{aligned}
\pi^i =& \frac{(\beta^i w)^{1-\sigma}(\alpha^i w - \tilde{\alpha}^i\tilde{w})}{(\beta^i w)^{1-\sigma} - (\tilde{\beta}^i\tilde{w})^{1-\sigma}} - \alpha^i w,\\
\tilde{\pi}^i =& \frac{(\tilde{\beta}^i\tilde{w})^{1-\sigma}(\alpha^i w - \tilde{\alpha}^i\tilde{w})}{(\beta^i w)^{1-\sigma} - (\tilde{\beta}^i\tilde{w})^{1-\sigma}} - \tilde{\alpha}^i\tilde{w}.
\end{aligned}$$

It is important to note that, given (6) holds, profits are independent of both the total number of firms and market size.

Before turning to the case of co-existence, note that the equilibrium number of firms for the case in which only one country's firms exist is

$$\begin{aligned}
n^{iT}_{\{\tilde{n}^i=0\}} =& \frac{(wL + \tilde{w}\tilde{L})}{\sigma M\alpha^i w},\\
\tilde{n}^{iT}_{\{n^i=0\}} =& \frac{(wL + \tilde{w}\tilde{L})}{\sigma M\tilde{\alpha}^i\tilde{w}},
\end{aligned}$$

where T denotes a trading equilibrium value.

Using these results, we can obtain the necessary condition for the co-existence of firms. Let us define a technology index for industry i:[4]

$$A(i) \equiv \left(\frac{\tilde{\alpha}^i}{\alpha^i}\right)^{1/\sigma}\left(\frac{\tilde{\beta}^i}{\beta^i}\right)^{(\sigma-1)/\sigma}. \tag{8}$$

In the free-trade equilibrium the profit must be zero: $\pi^i = \tilde{\pi}^i = 0$. Simple calculations show that the equations are satisfied only if the technology index, $A(i)$, is equal to the relative wage rate $\omega \equiv w/\tilde{w}$.

Proposition 1 *If $A(i) > (<)\ \omega$, only Home (Foreign) firms produce the differentiated products in industry i. Intra-industry trade in industry i (i.e., the co-existence of both countries' firms) occurs only if $A(i) = \omega$.*

[Proof] Suppose that $A(i) > \omega$. In this case, both countries' firms cannot co-exist. To see that the case where only Home firms are active is an equilibrium, note that

$$\tilde{\pi}^i_{\{n^i=n^{iT},\, \tilde{n}^i=0\}} = \left(\frac{\beta^i w}{\tilde{\beta}^i \tilde{w}}\right)^{1-\sigma}\alpha^i w - \tilde{\alpha}^i\tilde{w} = \tilde{\alpha}^i\tilde{w}\left[\left(\frac{\omega}{A(i)}\right)^{\sigma} - 1\right].$$

[4]Since the elasticity of substitution between varieties differs quite a lot across sectors (e.g., Broda and Weinstein, 2004), the index should allow for different elasticities in different sectors as follows:

$$A(i) \equiv \left(\frac{\tilde{\alpha}^i}{\alpha^i}\right)^{1/\sigma^i}\left(\frac{\tilde{\beta}^i}{\beta^i}\right)^{(\sigma^i-1)/\sigma^i}.$$

In order to make analysis tractable, however, we concentrate on the technical differences and downplay the differences in substitutability between sectors. This kind of extension needs further consideration.

This becomes negative if $A(i) > \omega$ since $\sigma > 1$. Therefore, Foreign firms have no incentive to enter given that n^{iT} Home firms are active. On the other hand, the case in which only Foreign firms are active cannot support a free trading equilibrium. This is because that

$$\pi^i_{\{n^i=0,\, \tilde{n}^i=\tilde{n}^{iT}\}} = \left(\frac{\tilde{\beta}^i \tilde{w}}{\beta^i w}\right)^{1-\sigma} \tilde{\alpha}^i \tilde{w} - \alpha^i w = \alpha^i w \left[\left(\frac{A(i)}{\omega}\right)^{\sigma} - 1\right]$$

is positive, and hence, Home firms have an incentive to enter the world market. Therefore, only Home firms produce the differentiated products in industry i in the free trade equilibrium. The case of $A(i) < \omega$ can be proven analogously. [Q.E.D.]

3 Trade Patterns

To obtain the world trading equilibrium, we index industries in order of diminishing Home comparative advantage.

$$\frac{dA(i)}{di} \leq 0,$$

where $A(i)$ is defined in (8). This schedule is drawn in Figure 1 as the downward sloping locus AA. Now assume that there is a flat segment in the AA schedule: a partition of industries (from $\underline{m}$ to $\bar{m}$) is assumed to have the equal level of the technology index. We can interpret this as follows: (a) due to closer economic integration, production technologies have become standardized between countries, or alternatively, (b) even though firms in each industry produce differentiated products, production technologies of these industries have become standardized due to increased information flow between industries.[5]

We should notice that the interpretation (a) does *not* imply an equalization of technological parameters (i.e., $\alpha = \tilde{\alpha}$ and $\beta = \tilde{\beta}$). Let us assume that, for the partition of industries, (1) Foreign technology is inferior in the sense that it requires more labor, and (2) the ratio of fixed cost to marginal cost is identical between countries: $\tilde{\alpha}^i = \gamma\alpha^i$ and $\tilde{\beta}^i = \gamma\beta^i$, where $\gamma \geq 1$. In this case, from (8), $A(i) = \gamma$ holds for the partition of industries.[6] Since the technology index is defined as a *quotient*, the schedule could be flat even if cross-country productivity differences remain. The required condition for the flat segment is not the equalization of technological parameters, but the equalization of the ratio α/β (i.e., the relative importance of fixed cost to marginal cost).

[5] We will discuss the two possibilities in the next section.

[6] An equalization of technological parameters corresponds to the case where γ=1 holds.

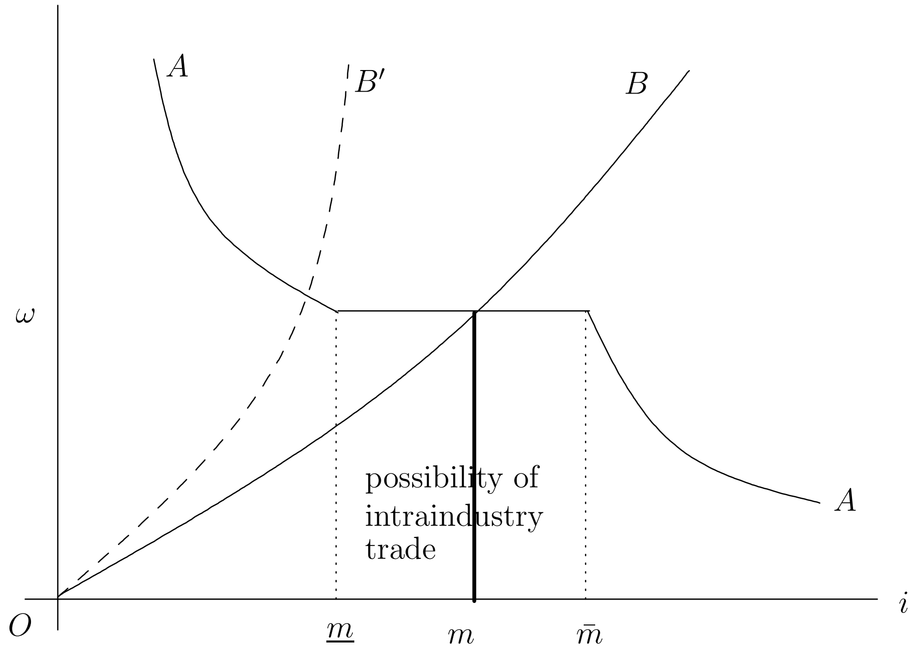

Figure 1: Intraindustry trade

Let m denote a hypothetical dividing line between Home- and Foreign-produced commodities, equilibrium in the market for Home products requires that Home labor income wL equals world spending on Home-produced products:

$$wL = \frac{m}{M}(wL + \tilde{w}\tilde{L}).$$

This schedule is drawn in Figure 1 as the upward sloping locus OB and is obtained by rewriting the equation in the form:

$$\omega = \frac{m}{M - m}\,\frac{\tilde{L}}{L}.$$

The equilibrium relative wage is obtained as the intersection of schedules AA and OB. Now assume that the intersection is obtained at the flat segment in the AA schedule. Thus, the following condition holds.

$$\omega = A(i), \quad \underline{m} \leq i \leq \bar{m}.$$

In this case, from Proposition 1, firms within these industries can be located in both countries. Therefore, intra-industry trade within these industries will occur.

Proposition 2 *Given that there is a flat segment in the AA schedule and the OB schedule cuts that segment, intra-industry trade occurs between countries.*

Using Figure 1, let us examine the effect of an increase in the relative size of Foreign. An increase in $\tilde{L}/L$ shifts schedule OB upward. If the new intersection occurs in the flat segment of AA, this shift only changes the portion of intra-industry trade and the relative wage remains unchanged. If the upward shift is sufficiently large (like OB') and the new intersection occurs in the downward-sloping segment of AA, no intra-industry trade occurs in the trading equilibrium and the Home relative wage rises. Our model suggests that the share of intra-industry trade is smaller between countries that are dissimilar in size. This finding is consistent with empirical work by Helpman (1987).

We should notice the limitation of Proposition 2. It is clear from Proposition 1 that intra-industry trade occurs as a result of equalization of the technology index and the relative wage rate. Thus, given that intra-industry trade prevails in some industries, when a very small shock changes the technological parameters, production and trade structure also have to be changed drastically (i.e., intra-industry trade ceases). In other words, a flat segment of the AA schedule, on which the existence of intra-industry trade crucially depends, is a knife-edge case.

4 Discussion

In the last section, we have shown, given that there is a flat segment in the AA schedule, intra-industry trade occurs between countries. Here, we provide two cases in which there is a flat segment.

4.1 Economic Integration and Technological Spillover across Countries

In the literature of endogenous growth, it is often assumed that closer economic integration can be achieved by increasing trade in goods or increasing flow of ideas across borders.[7] This implies that a firm in a given industry acquires technical information from the activities of firms in its own industry operating in other countries. According to this line, suppose that, at least in some industries, production technologies have become standardized (i.e., the ratio α/β is equalized between countries) by increased economic integration (see Figure 2).

Before closer integration occurs, cross-country information flow is limited and there are no flat segment in the AA schedule: no intra-industry trade

[7] Rivera-Batiz and Romer (1991).

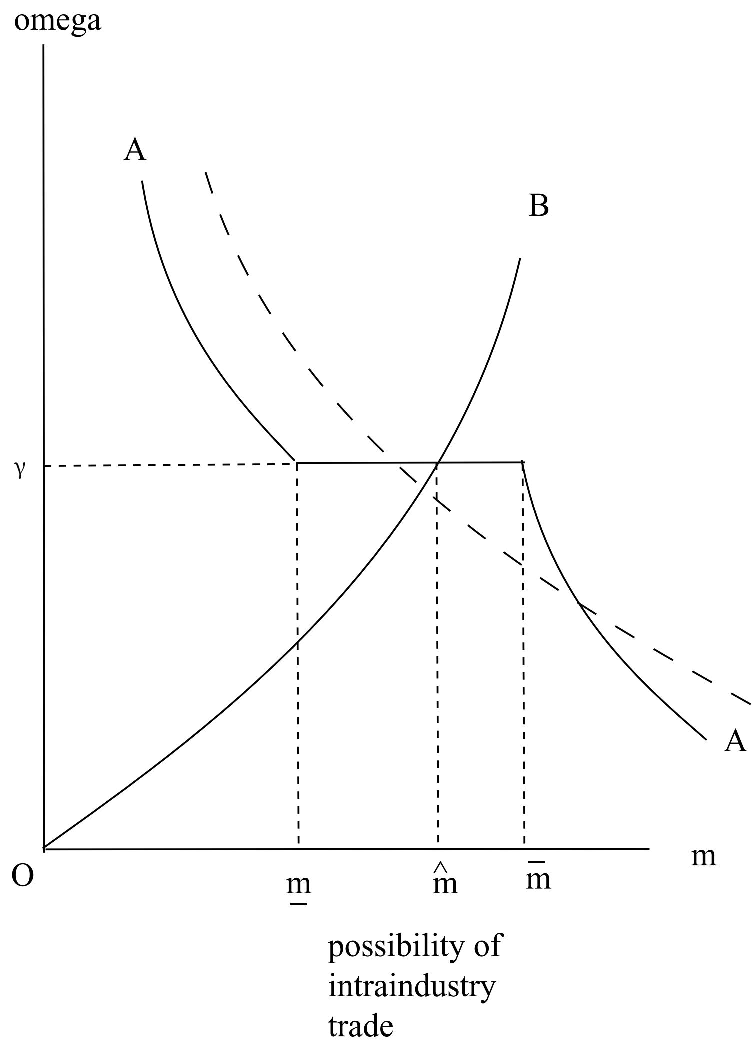

FIGURE 2

occurs between countries. Then, cross-country technological spillover changes the shape of the technology index schedule: with some range, both $\tilde{\alpha} = \gamma\alpha$ and $\tilde{\beta} = \gamma\beta$ hold, then the value of the technology index $A(i)$ becomes γ over those industries.[8] This type of technological spillover due to integration gives rise to intra-industry trade between countries.

4.2 Technological Spillover across Industries

There is another case for the existence of the flat segment: inter-industry technological spillover *within* each country.[9] In this case, although products in different industries are highly differentiated each other, production technologies of these industries have become standardized due to increased information flow between industries.[10] Thus, the following hold:

$$\alpha^i = \alpha^j, \;\; \beta^i = \beta^j,$$
$$\tilde{\alpha}^i = \tilde{\alpha}^j, \;\; \tilde{\beta}^i = \tilde{\beta}^j,$$

[8] See Section 3.

[9] According to this point, most of the literature of learning by doing assumes that firms learn more from the experiences of other domestic producers than they do from firms located abroad. See, for example, Bardhan (1970). Martin and Ottaviano (1999) also examines the case of local spillovers which occurs as the benefit of interactions with producers of other goods.

[10] One of the major examples of technical standardization is the intensive use of new types of communications network such as the Internet. David (2000) argued that the development of Internet technology has opened the door to an entirely new class of organization-wide data-processing applications and has standardized the potential for collective and cooperative forms of work organization.

$$\underline{m} \leq i, j \leq \bar{m}.$$

Note that, as same as the case of economic integration, the value of the technology index need not to be 1 (as Figure 1): even if standardization across industries occurs, productivity differences between countries may remain. In this case, Ricardian productivity differences play an important role in determining the relative wage. On the other hand, this case also emphasizes that a rise in the number of standardized industries may also bring to the fore Chamberlinian determinants of trade.

If there is only one monopolistically competitive industry in the economy, intra-industry trade is obtained as a result of identical technologies between countries and wage rate equalization.[11] In our model, however, wage rates need not be equalized to obtain intra-industry trade. This is more plausible for the explanation of the intra-industry trade between developed and developing countries.

Several remarks are in order. First, we should note that these results are crucially dependent on the assumption of monopolistically competitive industries. If firms in each industry produce *homogeneous* products as in Dornbush et al. (1977), there are few incentives of intra-industry trade between countries. In our model, intra-industry trade occurs since each firm produces *differentiated* products and those firms are distributed between countries.

Second, intra-industry trade emerges as a result of the equalization of the relative wage rate and the technology index, which is also supported by the

[11]Krugman (1979, p. 476).

existence of the flat segment of the AA schedule. The shape of technology index schedule, which reflects the structure of productivity differences *between industries*, plays a more important role as a determinant of trade *within each industry.*

References

[1] Bardhan, P. K. (1970) *Economic Growth, Development, and Foreign Trade,* Wiley, New York.

[2] Bernhofen, D. M. (2002) 'Intra-Industry Trade in Homogeneous Products,' in Lloyd, P. J., and H.-H. Lee (eds.) *Frontiers of Research in Intra-Industry Trade,* Palgrave Macmillan.

[3] Broda, C., and D. Weinstein (2004) 'Globalization and the Gains from Variety,' NBER Working Paper No. 10314.

[4] David, P. A. (2000) 'Understanding Digital Technology's Evolution and the Path of Measured Productivity Growth,' in Brynjolfsson, E., and B. Kahin (eds.) *Understanding the Digital Economy,* Cambridge, MIT Press, pp. 49–95.

[5] Dixit, A. K. and J. E. Stiglitz (1977) 'Monopolistic Competition and Optimum Product Diversity,' *American Economic Review,* Vol. 67, pp. 297–308.

[6] Dornbush, R., S. Fischer, and P. Samuelson (1977) 'Comparative Advantage, Trade and Payments in a Ricardian Model with a Continuum of Goods,' *American Economic Review,* Vol. 67, pp. 823–829.

[7] Helpman, E. (1981) 'International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition: A Chamberlim-Heckscher-Ohlin Approach,' *Journal of International Economics* 11, pp. 305–340.

[8] Helpman, E. (1987) 'Imperfect Competition and International Trade: Evidence from Fourteen Industrial Countries,' *Journal of the Japanese and International Economies,* Vol. 1, pp. 62–81.

[9] Helpman, E., and P. R. Krugman (1985) *Market Structure and Foreign Trade,* Cambridge, MIT Press.

[10] Kikuchi, T. (2004) 'A Note on Chamberlinian-Ricardian Trade Patterns,' *Economics Bulletin,* Vol. 6, No. 7, pp. 1–8.

[11] Kikuchi, T., K. Shimomura and D.-Z. Zeng (2005) 'On Chamberlinian-Ricardian Trade Patterns,' Discussion Paper No. 2502, Graduate School of Economics, Kobe University.

[12] Krugman, P. (1979) 'Increasing Returns, Monopolistic Competition, and International Trade,' *Journal of International Economics,* Vol. 9, pp. 469–479.

[13] Krugman, P. (1995) ‘Increasing Returns, Imperfect Competition and the Positive Theory of International Trade,’ in Grossman, G., and K. Rogoff (eds.) *Handbook of International Economics,* Vol. 3, North-Holland, pp. 1243–1277.

[14] Martin, P., and G. I. P. Ottaviano (1999) ‘Growing Locations: Industry Location in a Model of Endogenous Growth,’ *European Economic Review,* Vol. 43, pp. 281-302.

[15] Rivera-Batiz, L. A., and P. Romer (1991) ‘Economic Integration and Endogenous Growth,’ *Quarterly Journal of Economics,* Vol. 106, pp. 531-555.

[16] Venables, A. J. (1999) ‘The International Division of Industries: Clustering and Comparative Advantage in a Multi-industry Model,’ *Scandinavian Journal of Economics,* Vol. 101, pp. 495–513.