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University of Ulsan

Intraindustry Specialization and Trade in Intermediate Goods

Shin, Kwang-Shik
Dept. of Economics, University of Ulsan.

〈Abstract〉

Recent empirical studies have found consistent evidence that intraindustry trade is dominated by cross—flows of intermediate goods produced using non—standardized techniques of production by small scale firms on a made—to—order basis. These findings are inconsistent with the prevailing product differentiation—cum—scale economies model that characterized intraindustry trade as the cross—hauling of differentiated consumer goods to satisfy consumer tastes for variety. This paper attempts to provide an explanation of why intermediate goods rather than finished manufactures move so freely across international borders. It also analyzes the effect of intraindustry trade on protectionist pressures.

中間財의 産業內 特化 및 貿易

申 光 湜
經 濟 學 科

〈要 約〉

최근의 實證的 硏究 결과는 産業內 貿易이 주로 中小企業에 의해 주문생산되는 中間財에서 이루어지고 있음을 보인다. 이는 産業內 貿易이 소비자의 다양한 기호를 맞추기 위한 消費財의 상호교환으로 보는 기존의 生産物分化—規模 經濟모델과 상치하고 있다. 본 연구는 왜 産業內 貿易이 최종소비재가 아닌 中間財에서 발생하고 있는가를 理論的으로 설명하고 또한 産業內 貿易이 보호무역정책에 미치는 영향을 分析하고 있다.

I. Introduction

Recent empirical work on the characteristics of intraindustry trade has found no evidence

to suggest that intraindustry trade involves the cross—hauling of differentiated consumer goods by monopolistic competitors as suggested by Krugman (1980) and others. In fact, the empirical findings show that intraindustry trade tends to occur predominantly in intermediate goods that are produced by small scale firms.[1] The purpose of this study is to provide a theoretical explanation for this phenomenon to redress the imbalance between the substantial body of contemporary theoretical research on the characteristics of intraindustry trade and the more modest body of empirical evidence on the same subject. Specifically, we provide a model of intraindustry trade based on specialization in production of intermediate producers goods, postulating scale economies in production of intermediate inputs, costless product differentiation, and demand for increased intermediate input variety by the final goods manufacturers who want to exploit economies of long production runs. Based on these assumptions, we proceed to argue that intraindustry trade in intermediate goods occurs as each nation concentrates on producing a particular subset of the potential products within an industry and ships it to as wide a range of market as possible. The cross—hauling of closely related but different intermediate goods results in increased intermediate goods variety available to final goods producers who in turn are ready to exploit economies of long production runs. As the per unit cost (price) of the final good falls, its output will substantially increase. Since the demand for intermediate goods is derived from that for the final good, the expansion in the output of the final good will increase the demand for intermediate goods making it possible for all market participants to gain in consequence of trade liberalization

II. Theories of Intraindustry Trade

Over the years, many international trade economists have argued that the observed pattern of trade among the industrial countries since World War II cannot adequately be explained by the traditional factor proportions theory. This empirical critique may be summarized by pointing to three prominent aspects of world trade which seem to contradict received theory. First, much of world trade is between countries with similar factor endowments. Second, a large part of this trade flow is intraindustry in character, consisting of two—way trade in similar products. Finally, much of the expansion of trade in the postwar period has taken place without sizable income distribution effects. Neither the extensive trade among the industrial countries nor the prevalence of two—way exchanges of similar products seem to make much sense in terms of standard theory of comparative advantage.

J.M. Finger (1975) found that 40% to 70% of the variation in factor input requirements among products was within 3-digit product groups, at which level of aggregation about 44% of U.S. trade was overlapped trade. Thus if one defines industry in terms of homogeneity of input coefficients, intraindustry trade is inconsistent with the factor proportions theory. But

trade overlap which is measured using established data categories can be reconciled with this theory by allowing for the possibility that the empirical product groups do not correspond with the analytical concept of industry implicit in the factor proportions theory. The point of this argument is that in order to demonstrate the invalidity of factor porportions theory one must show not only that trade overlap exists at a given level of aggregation but also that input requirements do not vary substantially within commodity groups at that level of aggragation. Finger claims that the intraindustry trade which we appear to observe is nothing more than the consequence of the lumping together of economically dissimilar products into the same industrial classification.

On the other hand, a new literature has developed which is intended to explain why cross —hauling of very similar products may take place, taking the existence of intraindustry trade as given. Most of the theoretical efforts has been coached in terms of the monopolistic competition model of Chamberlin by such authors as Krugman (1979, 1980, and 1981), Brander (1981), Helpman (1981), and Lancaster (1980).

A specific example of the model can be found in Krugman(1981). Krugman develops a multiindustry model of trade in which each industry consists of a number of differentiated products. In this model, scale economies in production ensure that each country produces only a limited number of products within each industry, so we have intraindustry specialization and trade which does not depend on comparative advantage. Liberalizing trade within each industry leads each country to expand both its imports and exports, creating the possibility that reciprocal removal of trade barriers can lead to increased sales by producers in both countries. Specifically, producers in both countries will gain from trade liberalization if neither country has too great a comparative advantage and products in the industry are strongly differentiated. In short, his analysis focuses on the opportunities for consuming a greater diversity of commodities as a key benefit of international trade.

However, the results of recent empirical investigations show that this conception bears little resemblance to the actual locus of intraindustry trade. Rather, there is strong and fairly consistent evidence that intraindustry trade is prominantly associated with specialized equipment and machinery and not with moderately differentiated final consumer goods.

The emphasis on consumer preferences for differentiated final products and production processes that use no capital inputs (if at all, much less specialized capital inputs) is an element of misdirection associated with Krugman's formalization of intraindustry trade. The expectation based on the stylized product characteristics of the Krugman theory is that intraindustry trade might commonly be identified with differentiated consumer goods whose production is subject to substantial scale economies because costless product differentiation is likely to occur most commonly in the consumer goods sector. Oligopolistic industries which owe their origin partly to large economies of scale in production, however, are not expected to be heavily involved in intraindustry trade. According to Brander and Krugman (1983), intraindustry trade may both reduce monopoly price and position as well as social welfare under the circumstances of the

simple duopoly rivalry with transport costs. A natural inference is that intraindustry trade and therefore trade liberalization may not be politically viable in a world of oligopoly markets with moderate transport costs. The interests of oligopolistic firms lie in promoting autarky.

Further, one may question why there are no multiproduct firms capturing economies of scope in the Krugman model. To the extent that the differentiated products are produced by similar technology, firms are likely to exploit the economies of scope by producing diverse product lines. In a recent paper, Brander and Eaton(1984) showed that in the product line rivalry between two multiproduct firms adopting the Nash strategy, market division is a sub—game perfect equilibrium. It follows that if we allow the possibility of the emergence of multiproduct firms capturing economies of scope, firms are likely to promote autarky.

Ⅲ. The Model

Consider an economy which consists of two sectors—the intermediate goods sector in which a variety of intermediate inputs are produced under monopolistic competition and the final goods sector in which finished consumer goods are competitively produced. There are two primary factors of production, unskilled and skilled labor, whose endowments are given by L_u and L_s respectively. As technologial progress is largely taking place in the production of more sophisticated and highly specialized materials and machines and much of its production has made—to—order aspects due to the necessity of tailoring products, it would be reasonable to assume that skilled labor is specific to the production of intermediate capital goods. Final consumer goods are assembled from intermediate inputs by unskilled labor. We further assume that all the intermediate goods are produced via some identical production technology which is subject to increasing returns to scale. Because of scale economies in production, only a fraction of a large number of potential producible intermediate goods are actually produced. To the extent that a producer of a variant of intermediate inputs has to commit nonsalvageable assets in order to provide a specific made—to—order product, this capital good will not be forthcoming unless there is enough demand for that product. Only when there is sufficient demand for an intermediate input to permit the exploitation of some scale economies will that intermediate good be profitably produced. As will be seen later, the number n of actually produced intermediate goods will be endogeneously determined. A typical cost function is given by :

$$l_{si} = \alpha + \beta x_i, \text{ where } \alpha, \beta > 0 \text{ and } i = 1, \ldots, n \quad (1)$$

$$\Sigma l_{si} = L_s \quad (2)$$

where x_i is the output of the ith intermediate good and l_{si} is the cost of producing x_i in terms of skilled labor.

The individual intermediate good cost function displays what Balassa refers to as economies of scale in the traditional sense. These scale economies involve considerations of minimum efficient plant size and require total production x_i to be geographically concentrated. Since these economies are internalized by firms and products can be costlessly differentiated, in equilibrium total output of each produced intermediate good will be produced by a single firm in a single location.

The output of finished manufactures is given by:

$$M=[\delta_1 l_u^{\rho}+\delta_2 X^{\rho}]^{1/\rho} \quad ; \ \rho<1 \tag{3}$$

$$X=n^r[\Sigma\,(x_i/n)\theta]^{1/\theta} \quad ; \ r>1, \quad 0<\theta<1 \tag{4}$$

where n is the number of available intermediate goods, x_i is the input of the i th intermediate goods, and X is the flow of productive service from a bundle of intermediate inputs. The elasticity of substitution in production of finished goods between produced inputs and unskilled labor is $1/(1-\rho)$ and that between intermediate inputs is $1/(1-\theta)$.

We assume that each intermediate good contributed to the generation of the productive service flow in totally symmetric fashion. This implies that all intermediate goods will be used in equal amounts x in equilibrium and the total number of intermediate goods used for manufacturing finished products will be nx. The production function of (3) and (4) will thus be simplied to:

$$X=n^r x \tag{5}$$

$$M=[\delta_1 l_u^{\rho}+\delta_2 (n^r x)^{\rho}]^{1/\rho} \tag{6}$$

The production service generating function of (4) or (5) displays constant returns to scale with respect to the amounts of inputs when n is fixed. Yet it exhibits the economies of scale associated with the expansion in the number of intermediate goods used in the fabrication of final consumer goods. This captures not the benefits associated with the larger plant size but rather the economies of long production runs associated with a greater division of labor in the production of intermediate goods. Employing a larger number of more specialized and sophisticated machines and materials would be more productive than doubling amounts of intermediate inputs already in use. As economies of this sort are presumably external to individual firms, they depend on the size of the market for finished consumer goods and they do not require all manufacturing output to be concentrated at a single space.

IV. Equilibrium in the Closed Economy

Equilibrium in the intermediate goods sector in this model will take the form of monopolistic competition where each product will be produced by one firm and free entry will drive profits to zero.

Consider an individual producer of final consumer good who will use intermediate

goods and unskilled labor subject to the production technology of (3) with the number n of available intermediate goods and the competitive return to unskilled labor w_u as parameters. If P_1 and P_2 are prices of some pair of produced inputs whose outputs are x_1 and x_2 respectively, then cost minimization requires:

$$x_1 = x_2 (P_2/P_1)^{1/(1-\theta)} \tag{7}$$

Assuming that n is sufficiently large so that each intermediate good producer acts as if his behavior does not influence that of other intermediate good producers, we can regard (7) as the demand curve facing the producer of x_1 for given P_2, x_2 and w_u with the intraindustry elasticity of substitution $1/(1-\theta)$.

Each intermediate good producer purchases the service of skilled labor in the competitive market and therefore faces a cost function given by:

$$c(x_1) = (\alpha + \beta x_1) w_s \tag{8}$$

where w_s is the wage rate for skilled labor in the competitive market. Profit maximization dictates:

$$P_1 = \theta^{-1} \beta w_s \tag{9}$$

Because of the symmetry assumption, P_1 can be regarded as the price of each intermediate input and therefore will be replaced by $P_x = \theta^{-1} \beta w_s$.

Profits will be driven to zero by the free entry and exit of firms. From the zero profit condition, x is determined as:

$$x = \alpha\theta / \beta(1-\theta) \tag{10}$$

It follows from the full employment condition that:

$$n = L_s/l_s = (1-\theta)/\alpha \cdot L_s \tag{11}$$

$$nx = (\theta/\beta) L_s \tag{12}$$

$$x = n^r x = [(1-\theta)/\alpha \cdot L_s]^r \; [\alpha\theta/\beta\,(1-\theta)] = [(1-\theta)/\alpha]^{r-1} \frac{\theta}{\beta} L_s^r \tag{13}$$

The effective price of the production service flow will be:

$$P_x X = P_x (n^r x) = P_x nx \tag{14}$$

As the number of intermediate goods increases, the effective price for the production service which flows from intermediate goods will fall.

The price for the final product will be:

$$P_m = (P_x X + w_u L_u)/M \tag{15}$$

$$P_m M = P_x nx + L_u w_u = w_s L_s + w_u L_u$$

$$P_m = (w_s L_s + w_u L_u)/[\delta_1 L_u^{\rho} + \delta_2 (n^r x)^{\rho}]^{1/\rho} \tag{16}$$

It is clear that P_m falls with the number of intermediate goods available to the final manufacturers.

V. International Equilibrium and the Pattern of Trade

What will happen when two such economies are allowed to trade freely? The two economies are assumed to be identical in every respect other than sector-specific labor endowments. In free trade equilibrium, the total output of each intermediate good will be concentrated in a single country. Thus if n and n* are both positive, the two countries produce distinct collections of intermediate goods.

In international equilibrium, wage rates will be equalized across countries due to the symmetry of the problem. Therefore it follows that:

$$x=\frac{\alpha\theta}{\beta(1-\theta)}=x^*$$

$$P_x=\theta^{-1}\beta\, w_s=P_x^*=\theta^{-1}\beta\, w_s^*$$

$$\tilde{n}=n+n^*=(1-\theta)/\alpha\cdot(L_s+L_s^*)$$

Thus, $X=n\cdot^{r}x$ and the world output of finished goods is:

$$M=[\delta_1(L_u+L_u^*)^{\rho}+\delta_2(\tilde{n}\cdot^{r}x)^{\rho}]^{1/\rho}$$

As a large number of intermediate goods are now available through the cross-hauling of different manufacturerd inputs, the true price of the production service which stems from intermediate inputs will decline and as a conquence the world price of the final consumer good will also fall.

If we assume that international trade consists entirely of the shipment of intermediate goods, the home country will import $I_x=n^*x(1-g)$ and export $E_x=nxg$, where $g=w_sL_s/(w_sL_s+w_s^*L_s^*)=L_s/(L_s+L_s^*)$.

VI. The Political Economy of Protection

Many of the final consumer goods are produced simply through the assembly of various intermediate inputs by utilizing unskilled labor, whereas specialized machines and materials are produced in a skilled labor-intensive manner. If industrial countries are relatively skilled labor abundant and developing countries are relatively unskilled labor abundant, the pattern of trade based on comparative advantage considerations would be that industrial countries specialize in intermediate goods and export them to developing countries which in turn assemble final consumer goods from intermediate inputs and export those finished products to industrial countries.

Since this pattern of trade clearly distinguishes between winners and losers, trade liberalization in this trade is not likely to be politically viable in industrial countries. It is well known that the structure of protection in industrial countries affords the greatest protection to relatively unskilled labor-intensive branches of industries. The political motive for such a tariff policy has been explained and empirically supported by several studies. J.M. Cheh

(1974) and J. Riedel (1977) tested the labor adjustment cost hypothesis with respect to the U S. and West Germany by analyzing tariff reductions negotiated in the Kennedy Round and concluded that both countries shaped trade policy in such a way as to minimize the short run labor adjustment cost. Ray and Marvel (1984) have found that industrial countries systematically discriminate against exports of finished consumer goods from developing countries in formulating their trade policies.

Now suppose that the intermediate goods sector is subject to some trade restrictions Producers of intermediate goods in each country will oppose any unilateral elimination of their country's restrictions. But a simultaneous removal of restrictions by both countries may increase the welfare of producers in both countries. Under free trade equilibrium, the intermediate goods produced in different countries are closely related to but different from one another. Cross-hauling of those capital goods offers producers of final consumer goods a wider range of more specialized machines and materials and enables them to exploit economies of long production runs. As a result, the price of the final good will decline and its output will substantially increase, making consumers better off. Since the demands for intermediate goods and unskilled labor are derived from that for the final good, both skilled and unskilled labor will be better off as the final good sector expands. As all the market participants are to be made bettr off through intraindustry trade of intermediate goods, they are likely to support trade liberalization.

From (5), it is clear that the production service flow from intermediate goods depends on the intermediate good diversity as well as on physical amount. In free trade equilibrium, $X=\tilde{n}^{r}x$, where $r>1$, $\tilde{n}=n+n^{*}=(1-\theta)/\alpha\cdot(L_s+L_s^{*})$. There is a divergence between the actual prices of intermediate goods and the true price of production service reflecting the value of diversity. $P_x=\tilde{n}^{1-r)}P_x$.

Before trade liberalization, $\ln^{x}=r\ \ln^{n}+\ln^{x}+r\ln[(1-\theta)/\alpha]L_s+\ln\alpha\ \theta/\beta\ (1-\theta)$ and $\ln^{p}x=(1-r)\ln[(1-\theta)/\alpha]\ L_s+\ln\beta\ Ws/\theta$. The demand for production service X can be written as $\ln X=A+B\ln M-\frac{1}{1-\rho}\ln Px$. Hence,

$$\ln^{x}=r\ \ln[(1-\theta)/\alpha]\ Ls+\ln\frac{\alpha\theta}{\beta\ (1-\theta)}=A+B\ln^{M}-\frac{1}{1-\rho}\ln Px$$

$$=A+B\ln^{M}-\frac{1}{1-\rho}\{(1-r)\ln(\frac{1-\theta}{\alpha})\ Ls+\ln\frac{\theta w_s}{\theta}\}$$

$$\ln Ws=k+B(1-\rho)\ln^{M}+(r\rho-1)\ln L_s$$

Trade liberalization amounts to moving to a larger economy with an income $Y+Y^{*}=P_m(M+M^{*})$, $L_u+L_u^{*}$ and $L_s+L_s^{*}$. If we interprete $g=L_s/(L_s+L_s^{*})$ as an index of comparative advantage, $g<1/2$ implies that the intermediate goods sector in the home country is at comparative advantage. Even when this is the case, we can demonstrate that $\ln Ws=B(1-\rho)\ln^{2}+(r\rho-1)\ln g>0$ for $r>1/\rho$.

Ⅶ. Conclusions

In contrast to much of the theoretical literature on intraindustry trade, production of standardized consumer goods are not associated with intraindustry trade. This paper presented a model which is designed to explain why cross—hauling of closely related intermediate producers goods may take place. The analysis emphasized the role of trade liberalization in creating large markets with increased opportunities for specialization. When production of intermediate inputs is subject to scale economies in the traditional sense and increased intermediate input variety leads to economies of long production runs for the final good manufacturers, intraindustry specialization and trade in intermediate goods is indicated.

〈Notes〉

1. See, for example, Marvel and Ray (1986).
2. Marvel and Ray found evidence supporting the errors—in—measurement argument. But the errors—in—measurement argument is not a very fruitful means of dispensing with the phenomenon of intraindustry trade. Dismissing the simultaneous import and export of similar goods among similarly endowed countries as a statistical artifact stemming from measurement problems inherent in defining industry aggregates would be tantamount to claiming that the Heckscher—Ohlin—Samuelson model of trade is quite adequate to the task of explaining trade patterns as long as our analysis is restricted to a level of aggragation that cannot be calculated for most countries.
3. In fact, many empirical studies that used reasonably disaggregated data and accounted for measurement errors in the regression analysis provide evidence that countries simultaneously export and import goods that are very similar and produced by similar methods. See, for example, Grubel and Lloyd (1975), Loertscher and Wolter (1980), and Marvel and Ray (1985). Haddock (1982) also provided a number of examples of within country intraindustry trade.

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