Producer Services, Trade, and Wages

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Abstract

In this paper, I incorporate the organizational choice of firms into the factor endowments model in a tractable way. Manufactures require skilled-labor, unskilled-labor, and producer services. They choose whether to produce services in-house or to outsource service production to competitive service providers. A technology gap between manufacturers and services providers determines the organization of firms. I examine the impact of a change in the organization of firms on the structure of trade, the volume of trade, and the welfare of countries at trade equilibrium.

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1 Introduction

International outsourcing has increased its importance in the recent years. In clothing and footwear sectors, firms in developed countries specialize in management and design activities, and they entirely depend on foreign subcontractors for the rest of production activities. The fragmentation of production processes occurs at the international level since there is a difference in factor endowments across countries. Firms in developed countries retain skilled-labor intensive activities such as management, and outsource unskilled-labor intensive production to low-wage countries.

The fragmentation of production processes is also closely related to the choice of organization of firms. Firms could do all of production activities in-house. Nonetheless, firms outsource some of production activities because they can obtain a cost advantage. Even at the domestic level, outsourcing could take place if there is a cost difference between in-house production and outsourcing.

The present paper incorporates firms' decisions on their organizations into the factor endowments model and examines the effects of the organizational choice on the structure of trade, the volume of trade, and the welfare of countries. The idea is that a change in the organizational form accompanies an improvement in production efficiency. Monopolistic competitive manufacturers require skilled-labor, unskilled-labor, and producer services. I focus on producer services such as management and design. The costs of producing these producer services are firm-specific fixed costs. Manufacturers choose whether to produce services in-house or purchase services from competitive services providers. The organizational choice is determined according to a technology gap between manufacturers and service providers. Manufacturers switch to outsourcing from in-house production if service providers become more efficient than manufacturers.

In trade equilibrium, comparative advantage determines the inter-sector pattern

of trade. A skilled-labor abundant country exports producer services and imports manufactured goods since services are relatively more skilled-labor intensive than manufactured goods. The organizational choices of firms affect the structure of trade in producer services. In market equilibrium, manufacturers choose identical organizational forms since they are symmetric. In trade equilibrium with integrated production, some firms make foreign direct investment and intra-firm trade in producer services takes place. If firms choose outsourcing in equilibrium, some manufacturers purchase producer services from overseas providers and thus international outsourcing occurs.

The organizational change of firms does affect the welfare of countries and the volume of trade. If manufacturers switch to outsourcing from in-house production, the welfare of countries increases at free trade equilibrium. The improvement in production efficiency of services allows the entry of new manufacturers, which leads to a rise in the welfare of countries due to more varieties of manufactured goods. The trade volume of producer services increases as well since the entry of new manufacturers raises import demand for services at trade equilibrium.

The basic structure of the model is similar to that of Helpman and Krugman (1985). They developed the factor endowments model with a monopolistic competitive sector and a competitive sector. In their setting, a competitive sector produces a final good. In contrast, a competitive sector produces intermediate services to the production of the monopolistic competitive sector in the present setting. The structure of the present model allows us to use the familiar box diagram with transformation schedules and indifference curves in order to examine trade patterns, trade structures, and gains from trade. In addition, the possibility of outsourcing was not explicitly explored in their work, although they showed multinational firms emerge at trade equilibrium.

Feenstra and Hanson (1996) and Jones (2000) developed frameworks to examine

the effects of the fragmentation of production processes. They showed the fragmentation takes place at the international level due to a factor endowments difference or a technology gap between countries. The present paper is related to Feenstra and Hanson (1996) and Jones (2000) in that it is based on the factor endowments model, but their interests differ from the present paper's since they did not explore the effects of firms' organizational choices.

Grossman and Helpman (2002) developed a model with monopolistic competitive sectors and examined the endogenous determination of the organization of firms. They focused on the bilateral relation between producers and input suppliers, and they explicitly examined the effects of transaction costs on the organizational choice of firms. In the present paper, the maker for producer services is competitive and the technology gap between manufacturers and service providers is a determinant of the organization of firms. This simple setting allows us to incorporate the organizational choice of firms into the factor endowments model and examine its effects on the structure of trade and the welfare of countries.

The rest of this paper is organized as follows. In Section 2, I develop a model in which manufacturers choose whether to produce services in-house or outsource service production to service providers. Using the familiar diagram with transformation schedules and indifference curves, I show that market equilibrium in a closed economy is the first best optimum regardless of the organization of firms. In Section 3, I show trade patterns and gains from trade at free trade equilibrium by constructing the box diagrams with transformation schedules and indifference curves. I also explore the impact of a change in the organizational from on the structure of trade, the volume of trade, and the welfare of countries. In Section 4, I close the paper with concluding remarks.

2 The Model

Manufacturers produce manufactured goods called M. They require skilled labor, unskilled-labor, and producer services. Among producer services, we focus on services such as management and design. Let S denote these producer services. The costs of producing S are firm-specific fixed costs, and thus it is a source of economies of scale. For the simplification of the analysis, I assume that a manufacturer requires one unit of S. The total cost for a manufacturer is represented by the following cost function,

$$C_{\mathsf{M}} = c_{\mathsf{M}}(w_{\mathsf{H}}, w_{\mathsf{L}})x + g$$

where x is the output of M and c_{M} is the marginal cost that depends on wages of skilled-labor w_{H} and those of unskilled- labor w_{L}. The fixed cost for one unit of S is denoted by g and its size depends on the organizational form of manufacturers. Manufacturers choose whether to produce S or to outsource its production. The production of S requires skilled-labor and unskilled labor. The unit cost of in-house production for S is

$$c_{\mathsf{S}} = c_{\mathsf{S}}(w_{\mathsf{H}}, w_{\mathsf{L}}).$$

If manufacturers choose outsourcing, the cost to purchase one unit of S is p_{S}. I assume that the market for S is competitive, and service providers have the unit cost function $\alpha c_{\mathsf{S}}(w_{\mathsf{H}}, w_{\mathsf{L}})$. Notice that $\alpha > 0$ is the parameter to measure the technology gap between manufacturers and service providers. The competitive condition for the service market is as follows.

$$p_{\mathsf{S}} = \alpha c_{\mathsf{S}}(w_{\mathsf{H}}, w_{\mathsf{L}}).$$

If $\alpha < 1$ holds, service providers have a cost advantage as compared with manufacturers. Then, manufacturers would choose outsourcing. Instead, manufacturers would produce S in-house if their technology is equivalent or superior to service providers' and thus $\alpha \geq 1$ holds. Hence, the fixed cost g for manufacturers is determined as follows.

$$\begin{aligned} g &= c_{\mathsf{S}}\left(w_{\mathsf{H}}, w_{\mathsf{L}}\right) \quad \text{if } \alpha \geq 1 \\ &= p_{\mathsf{S}} \qquad\qquad\qquad \text{if } \alpha < 1 \end{aligned}$$

The organizational form of manufacturers depends on the technology gap between manufacturers and service providers in the production of S.

Let us turn to the condition for factor market equilibrium. We assume that the factor markets are competitive. Since manufacturers have constant returns to scale technology in the use of two types of labor, we can derive the unit requirement of factor i for manufacturing, a_{iM} $(i = H, L)$. The technology for S is also constant returns to scale, but its factor demand depends on the organizational form. Let a_{iS} denote the unit requirement of factor i in S if manufacturers produce S in-house. If manufacturers outsource the production of S, service providers require αa_{iS} units of factor i to produce one unit of S. Suppose the supplies of skilled-labor and unskilled-labor are fixed, and they are denoted by H and L respectively. We can derive their equilibrium conditions as follows,

$$a_{\mathsf{HM}} X + b_{\mathsf{HS}} n = H \tag{1}$$

$$a_{\mathsf{LM}} X + b_{\mathsf{LS}} n = L \tag{2}$$

where $b_{\mathsf{iS}} = a_{\mathsf{iS}}$ if $\alpha > 1$ and $b_{\mathsf{iS}} = \alpha a_{\mathsf{iS}}$ if $\alpha \leq 1$ $(i = H, L)$. Notice that n is the number of manufacturers and $X = nx$ is the aggregate output of M. If outsourcing

takes place at market equilibrium, n is the aggregate output of S as well as the number of manufacturers. Given the factor prices, these two resource constraints determine the number of manufacturers n and the aggregate output of M, X. These constraints imply that *there is a negative relation between* n and X *for given factor supplies.* In fact, we can show that transformation schedules are bwowed-out if there is a difference in the factor intensity between M and S. Using the standard procedure developed in Jones (1965), we can derive the relative change in the factor market equilibrium conditions,

$$(\lambda_{HM} - \lambda_{LM})\hat{X} - \hat{n} = \hat{H} - \hat{L} + \frac{\delta_H + \delta_L}{(\theta_{HM} - \theta_{HS})}(\hat{c}_M - \hat{c}_S) + (\lambda_{HM} - \lambda_{LM})\hat{a} \quad (3)$$

where $\hat{b} = dz/z$, λ_{ij} is the fraction of the total supply of factor i ($i = H, L$) used in j ($j = M, S$), and θ_{ij} is the share of factor i in the marginal cost c_j.[1] Some empirical evidences suggest producer services are highly skilled-labor intensive in their production.[2] Thus, suppose that S is relatively more skilled-labor intensive than M.

$$\frac{a_{HS}}{a_{LS}} > \frac{a_{HM}}{a_{LM}}$$

Then, this factor intensity ranking implies that both $\lambda_{HM} - \lambda_{LM}$ and $\theta_{HM} - \theta_{HS}$ are negative. Since the aggregate elasticity $\delta_H + \delta_L$ is positive, there is the positive relation between X/n and c_M/c_S given factor endowments and production technologies. This relation implies smoothly bowed-out transformation schedules (see Figure 1).

Now let us examine the impact of outsourcing on the production efficiency. Suppose $\alpha = 1$ holds initially and thus manufacturers produce S in-house. If there is a small reduction in α, then manufacturers switch to the outsourcing of S. The

[1] See Appendix A for the derivation.

[2] For example, Mincer (1991) states 'service industries are the major employer of educated workers,' and OECD (2001) notes 'among services subsectors, educational attainment is highest in producer and social services and lowest in personal services.'

equation (3) suggests that the reduction in α raises the relative output of S, n/X for given relative marginal costs and factor endowments. Thus, the effect of outsourcing is illustrated as the shift-out of the transformation schedule (see Figure 2).

Turning to the demand side, we expect to draw indifference curves in the space of n and X. If each manufacturer produce a differentiated product, consumers would have preferences over diversity and they could choose the best diversity in manufactured goods. Let us consider the following CES utility function,

$$u = \left(\sum_{i=1}^{n} d_i^{\frac{\sigma_X - 1}{\sigma_X}} \right)^{\frac{\sigma_X}{\sigma_X - 1}}, \ \sigma_X > 1$$

where d_i is the demand for a manufactured good i. Using this sub-utility function, Dixit and Stiglitz (1977) examined whether or not market equilibrium is a social optimum under the market structure of monopolistic competition. Assuming consumers demand the same amount of each good, we can rearrange the utility function as follows,

$$u = n^{\frac{1}{\sigma_X - 1}} D \tag{4}$$

where $D = nd$ is aggregate consumption. This function suggests that there is a substitutability between n and D. In fact, indifference curves in the space of D and n are convex toward an origin since the marginal rate of substitution (MRS) is decreasing.

$$\frac{u_D}{u_n} = (\sigma_X - 1)\frac{n}{D} \tag{5}$$

Thus, the first best optimum is attained at a point in which an indifference curve is tangent to the transformation schedule in the space of D (or X) and n (see Figure 3). The optimum condition is that the MRS equals the relative marginal costs. Dixit and Stiglitz (1977) showed that the first best optimum allows more varieties than

market equilibrium and thus market equilibrium is not a social optimum.[3] However, I show that this result does not hold in the present setting.

Lemma 1 *The marginal rate of substitution equals the relative marginal costs in monopolistic competition equilibrium. Thus, market equilibrium is the first best optimum.*

Proof: We need to show that the optimum condition holds at market equilibrium,

$$\frac{u_{\mathsf{D}}}{u_{\mathsf{n}}} = \frac{c_{\mathsf{M}}}{g} \tag{6}$$

where $g = c_{\mathsf{S}}$ if $\alpha \geq 1$, and $g = p_{\mathsf{S}} = \alpha c_{\mathsf{S}}$ if $\alpha < 1$. In market equilibrium, the zero profit condition for manufacturers holds,

$$p_{\mathsf{X}} X = c_{\mathsf{M}} X + gn \tag{7}$$

where p_{X} is the price of a manufactured product. The profit maximization leads to the first order condition for manufacturers.

$$p_{\mathsf{X}}(1 - 1/\sigma_{\mathsf{X}}) = c_{\mathsf{M}} \tag{8}$$

Solve (8) for p_{X} and substitute it to the zero profit condition (7). Then we have

$$\frac{\sigma_{\mathsf{X}}}{\sigma_{\mathsf{X}} - 1} c_{\mathsf{M}} X = c_{\mathsf{M}} X + gn. \tag{9}$$

[3]Dixit and Stiglitz (1977) consider two differnct types of social optima, the first best optimum and the second best optimum. The first best optimum requires pricing below average cost because lum sum transfers that cover losses are available. The second best optimum requires each firm must have nonnegative profits since lump sum subsidies are not available. They show market equilibrium is identical to the second best optimum under the CES subutility function.

Rearranging the zero profit conditions (9), we can derive

$$\frac{c_{\mathsf{M}}}{g} = (\sigma_{\mathsf{X}} - 1)\frac{n}{X}. \tag{10}$$

Clearly, the marginal rate of substitution (5) equals the right hand side of (10) since $D = X$ holds in market equilibrium. Thus, we have the desired result (6). Q.E.D.

Let us exercise comparative statics. Equation (10) indicates that the MRS depends on the elasticity of substitution, σ_{X}. Suppose there is a fall in the elasticity σ_{X}, which reduces the MRS for given D/n. In Figure 3, the new indifference curve becomes flatter at point E. As a result, the equilibrium point moves north-west along the transformation schedule until the new indifference curve is tangent to the transformation schedule. The new equilibrium allows more varieties and requires smaller aggregate outputs. This reallocation of production resources leads to a change in income distribution. At the new equilibrium point, the relative marginal cost $c_{\mathsf{M}}/c_{\mathsf{S}}$ is smaller that that at point E. The fall in the relative marginal cost of M raises the wage premium for skilled-labor since M is relatively more unskilled-labor intensive.[4] Notice that the elasticity σ_{X} is related to market power due to the profit maximization condition (8).

$$\frac{p_{\mathsf{X}} - c_{\mathsf{M}}}{p_{\mathsf{X}}} = \frac{1}{\sigma_{\mathsf{X}}}$$

Hence, I could restate the result as follows.

Proposition 1 *Suppose S is relatively more skilled-labor intensive than M. A rise in monopoly power in the manufactured good market leads to an increase in the wage premium for skilled labor.*

[4]There is a negative relation between $c_{\mathsf{M}}/c_{\mathsf{S}}$ and $w_{\mathsf{H}}/w_{\mathsf{L}}$ since we can derive $c_{\mathsf{M}} - c_{\mathsf{S}} = (\theta_{\mathsf{HM}} - \theta_{\mathsf{HS}})(w_{\mathsf{H}} - w_{\mathsf{L}})$ where $\theta_{\mathsf{HM}} - \theta_{\mathsf{HS}} < 0$.

Next, let us turn to the effects of outsourcing on this economy. Outsourcing of the production of S shifts the transformation schedule as it is shown in Figure 2. For the given relative output X/n, the relative marginal cost $c_{\mathsf{M}}/c_{\mathsf{S}}$ is higher at the new transformation schedule than that at the original one. This implies that the equilibrium with outsourcing allows more varieties than the equilibrium with integration. Whether aggregate output rises or not depend on the substitutability between varieties and aggregate consumption. The MRS (5) suggests that the marginal rate of substitution between n and D equals one. This property of the utility function leads to the result that the equilibrium is determined at point E' in Figure 4. Thus, there is no impact of outsourcing on aggregate output. A change in relative wages also depends on the substitutability between varieties and aggregate consumption. In fact, there is no change in relative wages if the elasticity of substitution between n and D equals one. Outsourcing induces a fall in the relative costs of S, which reduces the relative wages for skilled-labor. The decline in the costs of S leads to the new entry of manufacturers, which expands the relative demand for S and thus the relative demand for skilled-labor. This positive effect on relative wages for skilled-labor is exactly offset by the negative impact of the decline in relative costs of S if the elasticity equals one. Thus, there is no impact of outsourcing on relative wages in the closed economy.

Proposition 2 *The outsourcing of services production benefits consumers by allowing more varieties of manufactured goods. In the CES utility function, the elasticity of substitution between varieties and aggregate consumption equals one, and thus there is no impact of outsourcing on aggregate outputs and relative wages.*

Proof: See Appendix B.

3 Trade Equilibrium

Consider two countries, Home and Foreign. The countries are identical except for relative factor endowments. Thus, there is no difference in production technology for M and S between countries. This implies that Home manufacturers would choose the same organizational form as Foreign manufacturers in market equilibrium. First consider the case in which manufacturers are integrated since in-house production of S is more efficient than outsourcing. Then, I proceed to the case in which outsourcing is chosen as the organizational form. I will examine how the difference in the organization form affect the structure of trade, the volume of trade, and the welfare of countries.

3.1 Integrated Production

Suppose $\alpha \geq 1$ and thus manufacturers choose the in-house production of S in market equilibrium. Without the loss of generality, we assume that Home is relatively more skilled-labor abundant than Foreign. For given factor prices, the ratio of the aggregate output to the number of manufacturers X/n in Home is smaller than that in Foreign due to the Rybczynski theorem. This suggests that, in the state of autarky, Home's relative marginal costs of S is smaller than Foreign's, and thus Home has a comparative advantage in producing S. This point is easily shown by constructing a box diagram. Consider free trade equilibrium in which countries incompletely specialize in production and thus factor prices are equalized between countries. In the free trade equilibrium, the output of each manufacturer is also equalized. (Otherwise, the free entry conditions would be violated.) Keeping these points in mind, we can construct a box diagram in Figure 5. The vertical axis measures the number of manufacturers (varieties). The horizontal axis measures aggregate output of M. Point O is the origin for Home and point O^* is the one for

Foreign. In the free trade equilibrium, production for each country is determined at point E where the transformation schedules are tangent to each other.

In the free trade equilibrium, the number of Home manufacturers is EG and the aggregate output of M at Home is OG. Notice that the slope of the diagonal equals $1/x$, which is the inverse of the output of each manufacturer in the free trade equilibrium. Thus, FG is the number of Home firms that produce M as well as S at Home. EF is the number of Home firms that make FDI at Foreign. They produce S at Home and exports S to their subsidiaries to produce M at Foreign. Thus, some of Home manufacturers make FDI at Foreign, and as a result, intra-firm trade in S takes place at the equilibrium. In Foreign, the number of Foreign manufacturers is DE at the equilibrium. The aggregate output of M at Foreign is O^*D, which consists of the outputs of Home multinationals as well as those of Foreign firms.

Since S is more skilled-labor intensive than M, Home has a comparative advantage in producing S and exports S to Foreign. International trade in S takes place within multinational firms since firms choose to produce S in-house at market equilibrium.

Proposition 3 *Suppose two countries differ only in their relative factor endowments and Home is relatively more skilled-labor abundant than Foreign. Assume that* $\alpha \geq 1$. *In the free trade equilibrium, intra-firm trade in* S *takes place since some of Home manufacturers make FDI at Foreign.*

Now we turn to consumption patterns. The line that is tangent to each country's transformation schedule at point E determines the level of each country's GDP. Thus, $OI\ /OO^*$ is the relative size of Home in terms of GDP. Home's aggregate consumption of M is given by OJ since each country's expenditure on M is proportional to its GDP due to the homotheticity of preferences. Aggregate consumption OJ is greater than aggregate output OG and thus Home imports M by GJ. Foreign ex-

ports M by DH since aggregate output O^*D is greater than aggregate consumption O^*H.

We need to confirm the composition of trade in M. Each manufacturer produce a different variety due to economies of scale. Since consumers in both countries demand the total varieties produced in the world, the consumption point of Home is point H and that of Foreign is point J at the free trade equilibrium. We can illustrate gains from trade by the shifts of indifference curves. The indifference curve that goes through point H (J) indicates the level of utility for Home (Foreign) consumers at the trade equilibrium. Since countries have identical preferences, indifference curves are tangent with each other at point I on the diagonal OO^*. This implies that, in the state of autarky, the Home (Foreign) equilibrium is determined at point A (A^*). Thus, the upward (downward) shift of the indifference curve shows gains from trade for Home (Foreign).[5]

It is also possible to explore the impact of trade on income distribution within countries. The slope of the transformation schedule is flatter at point E than that at point A. Thus, free trade reduces the relative marginal costs $c_{\mathsf{M}}/c_{\mathsf{S}}$ at Home and this leads to a rise in the wage gap between skilled-labor and unskilled-labor. In Foreign, the wage gap declines since the relative marginal costs of M goes up.

3.2 Outsourcing

Suppose that $\alpha = 1$ initially and manufacturers produce S in-house. If there is a small fall in α, service providers are more efficient than manufacturers in the production of S. Thus, manufacturers outsource the production of S at market

[5]The slope of the Home indifference curve at point H does not equal that of the Foreign indifference curve at point J. Thus, countries' indifference curves do not have the same slope at the free trade equilibrium. At first glance, this seems to be unusual because two countries have identical preferences. However, this is not. In Appendix C, I show that the free trade equilibrium meets the optimum condition for an economy with a public good.

equilibrium. We assume that other things do not change. Thus, Home is relatively more skilled-labor abundant than Foreign and they are symmetric in preferences and technologies. The change in the organizational form shifts the world transformation schedule as in the case of the closed economy (see Figure 2). At the free trade equilibrium with outsourcing, the world indifference curve is tangent to the world transformation schedule. The outward shift of the transformation schedule raises the equilibrium number of manufacturers in the world but it does not affect the world production of M at the equilibrium.[6] Thus, the box diagram expands vertically as compared to that in the trade equilibrium with integrated production (see Figure 6).

The new origin for Foreign is $O^{*\prime}$. The vertical axis now measures the aggregate output of S since each manufacturer buys one unit of S in the market. Notice that the change in the organizational form does not affect the aggregate output of M at each country.[7] The pattern of production is determined at point $E^{\prime}$ where transformation schedules are tangent with each other. The aggregate output of S at Home is $E^{\prime}G$. Home exports S by $E^{\prime}F^{\prime}$ and they are used by Foreign manufacturers. $F^{\prime}G$ is the output of S that is purchased by manufacturers producing at Home. The aggregate output of M at Home is OG and the output of each manufacturer equals the inverse of the diagonal $OO^{*\prime}$ at the trade equilibrium. In Foreign, the output of S is $D^{\prime}E^{\prime}$ that is used as inputs for Foreign manufacturers. The aggregate output of M is $O^{*\prime}D^{\prime}$, which is produced by using S imported from Home as well as S purchased from Foreign service providers.

The change in the organizational form does not affect the inter-industry pattern

[6]This point is confirmed in Proposition 2 by regarding a world economy as a "closed economy".

[7]Proposition 2 shows that the change in the organizational form does not affect the relative wages at the equilibrium for the closed economy. This result is preserved for the trade equilibrium since it replicates the equilibrium for a world economy. Since the relative wages do not change, aggregate output of M at each country is the same as that in the trade equilibrium with integrated manufacturers.

of trade. Home still has a comparative advantage in producing S and thus Home exports S to Foreign at the free trade equilibrium. In contrast to the equilibrium with integrated manufacturers, trade in S does not accompany FDI. International trade in S takes place between service providers at Home and manufacturers at Foreign. In other words, international outsourcing occurs at the equilibrium. Although trade patterns between countries are determined by the principle of comparative advantage, the structure of trade in S crucially depends on the choice of the organizational form of firms.

Proposition 4 *Suppose two countries differ only in their relative factor endowments and Home is relatively more skilled-labor abundant than Foreign. Assume that $\alpha < 1$. In the free trade equilibrium, service providers at Home exports S to manufacturers at Foreign and international outsourcing takes place.*

Let us turn to the consumption pattern at the trade equilibrium with outsourcing. Since the relative wages do not depend on the organizational form of manufacturers, the relative GDP of each country is the same as in the trade equilibrium with integrated production.[8] Thus, the common tangency line that determines the relative size of each country intersects with the diagonal $OO^{*\prime}$ at point I'. The aggregate consumption of Home is OJ that exceeds its aggregate output of M, and thus Home imports M by GJ. Foreign exports M by $D'H'$ because its aggregate consumption is smaller than its aggregate output. Since consumers in either country demand the total varieties produced in the world, Home consumption at the trade equilibrium is determined at point H'. In the trade equilibrium with integrated production, Home consumption is determined at point H. Thus, the upward shift of the Home indifference curve indicates gains from outsourcing for Home. Similarly, we can show that outsourcing benefits Foreign since its origin O^* shifts to

[8] At the trade equilibrium, the relative GDP of Home is $(wH + L)/(w\overline{H}+\overline{L})$ where $\overline{H} = H+H^*$ and $\overline{L} = L + L^*$. Clearly, it is constant if there is no change in the relative wages $w = w_{\mathsf{H}}/w_{\mathsf{L}}$.

$O^{*\prime}$. In fact, outsourcing benefits both countries equally, since outsourcing expands the equilibrium varieties of manufactured goods consumed in either country without affecting each country's aggregate consumption.

Proposition 5 *Outsourcing benefits both countries equally by expanding varieties of manufactured goods at free trade equilibrium.*

Finally, let us examine the impact of a change in the organizational form on the volume of trade in S. Suppose manufacturers initially choose in-house production of S. Thus, FDI leads to intra-firm trade in S at the free trade equilibrium. If service providers become more efficient, then manufacturers switch to outsourcing of S and international outsourcing takes place at the free trade equilibrium. How does this organizational change affect the volume of trade in S? The balance of trade equation for Home is

$$EX_{\mathsf{S}} = (p_{\mathsf{X}}/g)IM_{\mathsf{M}},$$

where EX_{S} is the export volume of S and IM_{M} is the import volume of M. If there is a change in the organization form from integration to outsourcing, the terms of trade for Home worsen. The inverse of the terms of trade for Home p_{X}/g are

$$\frac{p_{\mathsf{X}}}{p_{\mathsf{S}}} = \frac{\sigma_{\mathsf{X}}}{\sigma_{\mathsf{X}} - 1}\frac{c_{\mathsf{M}}}{g},$$

where $g = c_{\mathsf{S}}$ if $\alpha \geq 1$ and $g = p_{\mathsf{S}} = \alpha c_{\mathsf{S}}$ if $\alpha < 1$. Outsourcing of S deteriorates the terms of trade for Home since the relative wages are independent of the change in the organizational form. The import volume of M does not change either. Thus, as a result of outsourcing, the volume of Home exports in S rises.

Proposition 6 *International outsourcing increases the volume of trade in S at free trade equilibrium as compared to intra-firm trade within multinationals.*

4 Concluding Remarks

I develop a general equilibrium model with monopolistic competitive manufacturers that require skilled-labor, unskilled-labor, and producer services. The costs of producing producer services are firm-specific fixed costs. Manufacturers choose whether to produce services in-house or to outsource its production. There is a technology gap between manufacturers and service providers in the production of services, and the choice of the organizational form is determined according to this technology gap. For given factor endowments, the change in the organizational form is illustrated by the shift of the transformation schedule. Market equilibrium attains a first best optimum regardless of the organization of manufacturers.

In trade equilibrium, comparative advantage determines the pattern of trade in services and manufactured goods. The organizational form does affect the structure of trade in services. If manufacturers are integrated, they make FDI and intra-firm trade in services takes place. If outsourcing is chosen by manufacturers, they buy services from oversea providers, and international outsourcing occurs. In free trade equilibrium, consumers in every county benefit from a change in the organizational form from integration to outsourcing since the varieties of manufactured goods expand. International outsourcing raises the volume of trade in producer services as compared to intra-firm trade since a rise in the efficiency of services production induces the entry of manufacturers and it raises import demand for producer services.

Some implications to be added.

Appendix A: The Relation between the Number of Manufacturers and Aggregate Output of M

Taking derivatives of the factor market equilibrium conditions (1) and (2), we have the relative change in these equilibrium conditions,

$$\lambda_{HM}\hat{X} + \lambda_{HS}\hat{n} = \hat{H} - \lambda_{HM}a_{HM} - \lambda_{HS}a_{HS} - \lambda_{HS}\hat{n} \tag{A1}$$

$$\lambda_{LM}\hat{X} + \lambda_{LS}\hat{n} = \hat{L} - \lambda_{LM}a_{LM} - \lambda_{LS}a_{LS} - \lambda_{LS}\hat{n} \tag{A2}$$

where $\hat{n} = 0$ if $\alpha > 1$ and $\hat{n} \neq 0$ if $\alpha \leq 1$. The relative change in the unit requirement of each factor in sector j is derived as follows, (see Jones (1965) for the derivation)

$$a_{Hj} = -\sigma_j\theta_{Lj}(w_H - w_L), \; a_{Lj} = \sigma_j\theta_{Hj}(w_H - w_L) \tag{A3}$$

where σ_j is the elasticity of substitution in sector j ($j = M, S$). Using (A1), (A2), and (A3), we have the following equation,

$$(\lambda_{HM} - \lambda_{LM})\left(\hat{X} - \hat{n}\right)' = \hat{H} - \hat{L} + (\delta_H + \delta_L)(w_H - w_L) + (\lambda_{HM} - \lambda_{LM})\hat{n} \tag{A4}$$

where $\delta_H = \lambda_{HM}\theta_{LM}\sigma_M + \lambda_{HS}\theta_{LS}\sigma_S$ and $\delta_L = \lambda_{LM}\theta_{HM}\sigma_M + \lambda_{LS}\theta_{HS}\sigma_S$. Taking derivatives of the marginal cost function of sector j , we have the relative change in c_j ($j = M, S$),

$$\hat{c}_j = \theta_{Hj}w_H + \theta_{Lj}w_L \tag{A5}$$

where θ_{ij} is the share of factor i in the marginal cost of sector j. Using (A5), we derive the change in the relative marginal costs.

$$\hat{c}_M - \hat{c}_S = (\theta_{HM} - \theta_{HS})(w_H - w_L) \tag{A6}$$

Substituting (A6) into (A4), we derive the equation (3).

Appendix B: Proof for Proposition 2.

Suppose $\alpha = 1$ and thus manufacturers produce S in-house. If α declines by $d\alpha < 0$, then α become less than one. Then, manufacturers switch to the outsourcing of S. Thus, we assume that $\alpha = 1$ initially and examine the effects of a reduction in α on resource allocation and income distribution. Taking the derivative of the optimum condition for the market equilibrium (6), we have

$$(\hat{D} - \hat{n}) = -\sigma_{\mathsf{D}}(\hat{c}_{\mathsf{M}} - \hat{p}_{\mathsf{S}}), \tag{B1}$$

where $\sigma_{\mathsf{D}} > 0$ is the elasticity of substitution between varieties and aggregate consumption, and $\sigma_{\mathsf{D}} = 1$ if the utility function is given by (4). Using the competitive condition for the service market $p_{\mathsf{S}} = \alpha c_{\mathsf{S}}$ and (A5), we can derive

$$\hat{c}_{\mathsf{M}} - \hat{p}_{\mathsf{S}} = (\theta_{\mathsf{HM}} - \theta_{\mathsf{HS}})(\hat{w}_{\mathsf{H}} - \hat{w}_{\mathsf{L}}) - \hat{n} \tag{B2}$$

Substituting (B1) into (B2), we have the relation between the "relative demand" D/n and the relative wages $w_{\mathsf{H}}/w_{\mathsf{L}}$.

$$-\frac{1}{\sigma_{\mathsf{D}}}(\hat{D} - \hat{n}) = (\theta_{\mathsf{HM}} - \theta_{\mathsf{HS}})(\hat{w}_{\mathsf{H}} - \hat{w}_{\mathsf{L}}) - \hat{n} \tag{B3}$$

At market equilibrium, relative demand D/n equals relative supply X/n. Thus, solving (A4) and (B3) simultaneously for $\hat{w}_{\mathsf{H}} - \hat{w}_{\mathsf{L}}$, we can obtain a change in equilibrium relative wages,

$$-\frac{\sigma_{\mathsf{D}} + \sigma_{\mathsf{S}}}{\sigma_{\mathsf{S}}}(\delta_{\mathsf{H}} + \delta_{\mathsf{L}})(\hat{w}_{\mathsf{H}} - \hat{w}_{\mathsf{L}}) = \hat{H} - \hat{L} + (1 - \sigma_{\mathsf{D}})(\lambda_{\mathsf{HM}} - \lambda_{\mathsf{LM}})\hat{n} \tag{B4}$$

where $\sigma_S = (\delta_H + \delta_L)/(\lambda_{HM} - \lambda_{LM})(\theta_{HM} - \theta_{HS}) > 0$ is the elasticity of substitution on the supply side. In the present setting, $\sigma_D = 1$ and thus the change in α does not affect the relative wages. From (A3), the unit requirement of factor i in sector j does not change either, $da_{ij} = 0$. Using this condition, (A1), and (A2), we can show that $db = -db > 0$ and $dX = 0$.

Appendix C: Proof for the Optimality of Free Trade Equilibrium.

Let D (D^*) denote aggregate consumption of Home (Foreign) and $\overline{n}$ be the total number of varieties at the free trade equilibrium. Deriving $U_n/U_D = D/(1-\sigma_X)\overline{n}$, and $U_n^*/U_D^* = D^*/(1-\sigma_X)\overline{n}$, we can show that the following condition holds at the free trade equilibrium.

$$\frac{U_n}{U_X} + \frac{U_n^*}{U_X^*} = \frac{c_S}{c_M}, \tag{D1}$$

In the free trade equilibrium, the number of varieties consumed is the same between countries, and thus we may regard the equilibrium number of varieties as the consumed amounts of a public good. We can regard X as a private good since the sum of the aggregate consumption of each country equals the total supply of M in the equilibrium. In fact, (D1) is equivalent to the condition for a social optimum in an economy with two agents, one private good, and one public good.

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