

International Outsourcing and Long-Run Growth in a Variety Expansion Model

Ken-ichi Hashimoto

Graduate School of Economics, Kobe University, Kobe, Japan
Email: hashimoto@econ.kobe-u.ac.jp

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ABSTRACT

We develop a North-South trade model including the opportunity for outsourcing in a variety expansion framework and derive the effect of an increase in outsourcing on long-run growth. We find that the effect of increased outsourcing on the growth rate of product variety is contingent on the labor size of the Northern and Southern economy. In particular, if the relative labor size of South to North is smaller, outsourcing the production of intermediate goods to Southern economy can have negative effects on economic growth.

Keywords: Outsourcing; Long-Run Growth; North-South Trade; Variety Expansion Model

1. Introduction

Many developed countries have opened up to trade and are increasingly outsourcing production. Firms shift the production of some components abroad and assemble the components into final goods at home. According to empirical work by Feenstra and Hanson [1] and Crinò [2], the share of international outsourcing by US firms was 11.61% in 1990 and 18.1% in 2002. According to surveys, as reported by Ito *et al.* [3], 21% of manufacturing industries in Japan use offshoring. Since outsourcing influences the structure of labor markets, the effects are an important contemporary economic issue in offshoring economy.

In their pioneering work, while Glass and Saggi [4] develop a North-South trade model including the opportunity for outsourcing, they only employ a quality ladder approach¹. They demonstrate that increased outsourcing always encourages long-run growth. In this paper, endogenous technical progress drives productivity growth in the form of variety expansion. A study closest to ours is Naghavi and Ottaviano [7], who consider the endogenous determinants of offshoring in a variety expansion model. They compare the growth rate of offshoring economy with that of no offshoring economy. Turning to our model, we focus on the property of offshoring economy only and examine the effect of increased international outsourcing on long-run growth in offshoring economy. Thus, this paper adopts the exogenous opportunity of international outsourcing, where firms cannot offshore more than a certain share in the same way as Glass and Saggi [4] and Rodrigues-Clare [8], and reexamines their

results using a variety expansion framework of Grossman and Helpman [9] in which Northern country engages in innovative R & D and Southern country engages in imitative R & D².

Our contribution to the literature is to present a North-South trade model incorporating international outsourcing opportunities and show how it can be used to shed light on the relationship between international outsourcing and long-run growth. We show that the effect of increased outsourcing on long-run growth depends upon the structure of North and South; *i.e.*, population size, the productivity of research and development (R & D), etc. Our main finding is that the increased outsourcing of production in the North proves to encourage (discourage) long-run growth when the population size of the South is larger (smaller).

2. The Model

2.1. Households

Assume two countries, North (N) and South (S), with L_N and L_S being the respective number of consumers in each country. The utility function is:

$$U_i = \int_0^{\infty} e^{-\rho t} \ln X_i(t) dt, \quad X_i(t) = \left(\int_0^n x_i(j)^\alpha dj \right)^{1/\alpha}, \\ 0 < \alpha < 1$$

where ρ is the rate of time preference, $x_i(j)$ is the de-

¹For a static analysis of the effect of increased outsourcing, see Feenstra and Hanson [5] and Arndt [6].

²For a different approach to long-run growth, Rodrigues-Clare [8] analyses the increased offshoring in a process innovation framework of Eaton and Kortum [10].

mand of household i ($i \in N, S$) for variety j of the mass varieties $n = n_N + n_S$. Given instantaneous utility, the demand function of $x_i(j)$ is given by $x_i(j) = \sigma_j E_i / p(j)$

where $\sigma_j \equiv p(j)^{-\alpha/(1-\alpha)} \int_0^n p(j)^{-\alpha/(1-\alpha)} dj$,

E_i is consumption expenditure in country i , and $p(j)$ is the price of $x(j)$. The aggregate demand function of $x(j)$ is then:

$$x(j) = \sigma_j \frac{E}{p(j)} \tag{1}$$

where

$$x(j) = x_N(j)L_N + x_S(j)L_S \text{ and } E = E_N L_N + E_S L_S.$$

Using these equations, it is easy to establish that utility-maximizing total expenditure obeys the familiar Euler equation $\dot{E}_i/E_i = r - \rho$, where r is the rate of interest determined in the global financial market. The Euler equation for country i can then be easily arranged into:

$$\dot{E}/E = r - \rho \tag{2}$$

2.2. Firm Sectors

Local monopolists holding patents for the goods produce differentiated products. To obtain patents, a firm must first succeed in R & D. Economies where product innovation takes place are in the North and their imitation takes place in the South. First, consider the production of North. The production in the R & D sector takes the following form:

$$\dot{n} = a_N R_N n \tag{3}$$

where a_N is the productivity of innovative R & D, R_N is the number of R & D workers and the presence of n captures knowledge spillover in innovative R & D. We assume the random imitation of Northern products. More specifically, a given Northern product is assumed to be copied with an instantaneous probability of $h = \dot{n}_S/n_N$ during a time interval dt , given that the range of Southern goods increases by \dot{n}_S during dt . Let V_N denote the expected present value of profits earned by Northern monopoly firms that succeed in innovative R & D.

$$rV_N = \pi_N + \dot{V}_N - hV \tag{4}$$

Now define $\varphi = n_N/n$ as the share of Northern goods in all variety goods. Using this definition, we can rewrite the Poisson rate of imitation h as

$$h = \frac{\dot{n}_S}{n_S} \frac{1-\varphi}{\varphi}.$$

We assume free entry in the R & D sector. Therefore, given the R & D technology, the following condition holds:

$$V_N a_N n = w_N \tag{5}$$

where w_N is the wage rate in the North.

Final output $x(j)$ is produced with two intermediate goods z_N and z_S . The intermediate good z_i is produced in country $i = N, S$. One worker is required to produce one unit of intermediate goods (z_N, z_S) . More specifically, if a firm produces $x(j)$ units of final output goods, its marginal cost (MC) becomes:

$$MC(j) = (1-\gamma)w_N + \gamma w_S$$

where w_S denotes the wage rate in the South, and γ is the share of intermediate goods from the South and the remaining $1-\gamma$ is the share of intermediate goods from the North. Then the total cost (TC) of $x(j)$ is given by:

$$TC(j) = [(1-\gamma)w_N + \gamma w_S]x(j).$$

Hence, unit cost is the same for all differentiated products in the North. Given the price elasticity of demand $1/(1-\alpha)$, the representative Northern producer sets the price:

$$p_j = p_N = \frac{1}{\alpha} [(1-\gamma)w_N + \gamma w_S], j \in (0, n_N) \tag{6}$$

and earns profit:

$$\pi_N = (1-\alpha)\sigma_N E \tag{7}$$

Turn now to the South. The production function of the imitative R & D sector takes the following form:

$$\dot{n}_S = a_S R_S n_S \tag{8}$$

where a_S is the productivity of imitative R & D, R_S is the number of R & D workers and the presence of n_S captures knowledge spillover in imitative R & D. Let V_S denote the expected present value of profits earned by Southern monopoly firms that succeed in imitative R & D, as defined by:

$$rV_S = \pi_S + \dot{V}_S \tag{9}$$

We assume free entry in the R & D sector. Therefore, given the R & D technology, the following condition holds.

$$V_S a_S n_S = w_S \tag{10}$$

Final output firms that succeed in imitative R & D can produce goods with labor inputs with a marginal cost of w_S . The Southern firms charge the monopoly price. We assume wide gap equilibrium where the Southern monopoly price does not exceed the marginal cost of production in the North. We then have:

$$p_j = p_S = \frac{1}{\alpha} w_S, j \in (0, n_S) \tag{11}$$

and the profits of Southern firms are:

$$\pi_S = (1-\alpha)\sigma_S E \tag{12}$$

2.3. Labor Market Conditions

In the North, there are two sources of labor demand: innovative R & D and intermediate goods. In the R & D sector, $R_N = \dot{n} / na_N$ workers are employed. In the manufacturing of intermediate goods, labor demand is $n_N z_N$. Using Shepard's lemma, we obtain $z_N = \partial TC_N / \partial w_N$.

$$L_N = \frac{1}{a_N} \frac{\dot{n}}{n} + (1-\gamma)n_N x_N \tag{13}$$

Conversely, in the South there are three sources of labor demand: imitative R & D, the manufacture of Southern production goods, and intermediate goods exported to the North. In the imitative R & D sector, $R_S = \dot{n}_S / n_S a_S$ workers are employed. Labor demand is $n_S x_S$ for Southern manufacturing production and $n_N z_S$ for the intermediate production exported to the North. Using Shepard's lemma, we obtain $z_S = \partial TC_N / \partial w_S$.

$$L_S = \frac{1}{a_S} \frac{\dot{n}_S}{n_S} + n_S x_S + \gamma n_N x_N \tag{14}$$

2.4. Steady State Equilibrium and the Effect of Increased Outsourcing

We now consider the market equilibrium conditions. In the steady state, $\dot{n}/n = \dot{n}_S/n_S = g$ is satisfied. We then have following equations (see the Appendix for their derivation):

$$L_N = \frac{g}{a_N} + (1-\gamma) \frac{1}{1-\gamma+\gamma\omega} \frac{\alpha}{1-\alpha} \frac{\rho\phi+g}{a_N} \tag{15}$$

$$L_S = \frac{g}{a_S} + \frac{\alpha}{1-\alpha} \frac{\rho+g}{a_S} + \gamma \frac{1}{1-\gamma+\gamma\omega} \frac{\alpha}{1-\alpha} \frac{\rho\phi+g}{a_N} \tag{16}$$

where $\omega (\equiv w_S / w_N)$. From (15) and (16), we can explicitly solve for the growth rate as follows.

$$g = \frac{a_S}{1/(1-\alpha) - (a_S/a_N)(\gamma/(1-\gamma))} \times \left[L_S - \frac{1}{a_S} \frac{\alpha}{1-\alpha} \rho - \frac{\gamma}{1-\gamma} L_N \right] \tag{17}$$

It can be easily confirmed that the long-run growth rate depends on the population size of the North-South countries, the parameter for the share of production outsourced, and the remaining parameters. We assume the following parameter conditions for positive rates of growth ($g > 0$).

$$L_S > \frac{1}{a_S} \frac{\alpha}{1-\alpha} \rho + \frac{\gamma}{1-\gamma} L_N, \frac{1}{1-\alpha} \frac{a_N}{a_S} > \frac{\gamma}{1-\gamma}$$

Now consider the effect of increased outsourcing on long-run economic growth. An increase in internationally outsourcing is interpreted as an increase in the ratio of

foreign production of outsourced intermediate goods to domestically produced intermediate goods. This shift in production from home to foreign arises with changes in the economic environment, e.g. changes in local contents requirement or quotas on the usage of foreign inputs, and is described by an increase in γ ³. The purpose of this paper is not to discuss the desirable level of outsourcing share but to show the relationship between the proportion of outsourcing and the rate of economic growth. From (17), the impact on long-run growth is:

$$\frac{dg}{d\gamma} = \Phi \left[L_S - \frac{1}{a_S} \frac{\alpha}{1-\alpha} \rho - \frac{a_N}{a_S} \frac{1}{1-\alpha} L_N \right]$$

where

$$\Phi \equiv \frac{1}{(1/(1-\alpha) - (a_S/a_N)(\gamma/(1-\gamma)))^2} \frac{a_S^2}{a_N} \frac{1}{(1-\gamma)^2} > 0$$

Then we have obtain the following results:

$$\frac{dg}{d\gamma} > 0 \text{ for } L_S > \frac{1}{a_S} \frac{\alpha}{1-\alpha} \rho + \left(\frac{a_N}{a_S} \frac{1}{1-\alpha} \right) L_N$$

$$\frac{dg}{d\gamma} \leq 0 \text{ for } L_S \leq \frac{1}{a_S} \frac{\alpha}{1-\alpha} \rho + \left(\frac{a_N}{a_S} \frac{1}{1-\alpha} \right) L_N$$

This is formally stated in the following proposition.

Proposition 1: Increased outsourcing in Northern country to Southern country (γ) raises (resp. lowers) the growth rate of product variety if the labor in Southern country is larger (resp. smaller): $L_S > (\text{resp. } <) \alpha\rho/a_S(1-\alpha) + [a_N/a_S(1-\alpha)]L_N$.

Intuitively, the effect is as follows. An increase in outsourcing suggests more of the labor force in the North is devoted to the innovative R & D sector, and this increases economic growth. In contrast, outsourcing has a negative effect on economic growth through a decrease in the labor employed in imitative R & D sector in the South. Thus, increased outsourcing can have a negative effect on long-run growth depending on the labor endowment in the Northern-Southern country. If the relative labor size of South to North is smaller, the negative effect overweighs. **Figure 1** depicts the graphical result.

3. Conclusion

This paper constructs a North-South trade model with outsourcing opportunity in a variety expansion framework and examines the effect of increased outsourcing on the economic growth. In the literature of quality ladder based growth model, Glass and Saggi [4] find that the

³Weakening local contents requirements or relaxing import quotas on intermediate goods are considered for a policy to have positive effect on outsourcing opportunities. This approach for modeling outsourcing opportunities is followed by Glass and Saggi [4].

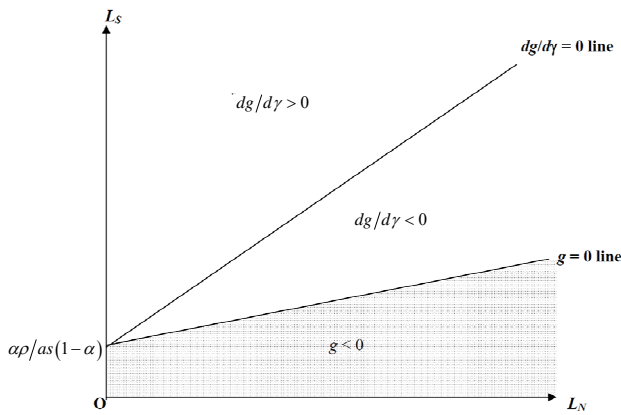


Figure 1. The effect of outsourcing.

effects of outsourcing have positive on growth rate. In a variety expansion growth model, however, we show that the effect of an increase in outsourcing on long-run growth is contingent on the labor size of the North-South economy. The mixed results of an increase in outsourcing do not appear in the quality-ladder based growth model.

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Appendix

Using $\dot{V}_N/V_N + \dot{n}/n = \dot{w}_N/w_N$ from (2), (4), (5) and (7) we have

$$\dot{E}/E - \dot{w}_N/w_N + \dot{n}/n + h + \rho = (1 - \alpha)\sigma_N E a_N n/w_N .$$

In the steady state, E/w_i is satisfied to be constant and $\dot{n}/n = \dot{n}_S/n_S = g$. Then, using (1), (6), $\phi = n_N/n$, $h = g(1 - \phi)/\phi$, and $\omega \equiv w_S/w_N$, we obtain:

$$g/\phi + \rho = \frac{1 - \alpha}{\alpha} a_N [1 - \gamma + \gamma\omega] \frac{1}{\phi} n_N x_N . \tag{A1}$$

Substituting (A1) into (13) gives (15).

Similarly, using $\dot{V}_S/V_S + \dot{n}_S/n_S = \dot{w}_S/w_S$ from (2), (9), and (10) and the steady state conditions, we have

$$g + \rho = (1 - \alpha)\sigma_S E a_S n_S/w_S .$$

Then from Equations (1) and (11), we obtain:

$$g + \rho = \frac{1 - \alpha}{\alpha} a_S n_S x_S . \tag{A2}$$

Substituting (A1) and (A2) into (14) gives (16).