Service Outsourcing, International Migration, and Wage Inequality

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Abstract

This paper examines how service outsourcing differs from international migration as to their effects on the wages of skilled and unskilled workers. We develop a variant of the Ricardo-Viner model, in which differentiated business services are produced with increasing returns to scale technology and under monopolistic competition. We show that service outsourcing can benefit all workers, but emigration of skilled workers can hurt them. Service outsourcing raises wage inequality but skilled-workers immigration reduces it. We also show that movements of skilled workers create an incentive for unskilled workers to follow, generating migration cycles and "deserted islands".

Keywords: service outsourcing, international migration, Ricardo-Viner model, monopolistic competition, scale economies
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1 Introduction

The rapid growth of international trade in business services is a topical issue among the general public as well as economists. Freund and Weinhold (2002) reports that, from 1995 to 1999, the expansion of trade in business services has far outpaced the growth of overall goods and services. One of the driving forces is the recent development of communication technology. The Internet makes it possible to access low-cost skills for many types of services, such as customer services and software consulting. As a result, the skilled-labor markets that used to be disintegrated are being integrated internationally. The media focuses on the fact that high-tech companies are increasingly outsourcing their business services overseas to cut costs, and alarms that such outsourcing has adverse effect on home workers (Moran, 2003; Roberts, 2005).

On the other hand, international movement of workers is another driving force for integrating the labor markets. Migrant Watch International, based in Switzerland, estimates that 130 million people in the world live outside their countries of birth. Especially in the US, immigrants are everywhere, no matter the industry. Roberts (2005) reports that Wal-Mart is a leading business lobby in Washington D.C., for a more relaxed and tolerant approach to legal immigration, and the IT industry lobbies hard to relax visa restrictions on skilled immigrants from India.

Are the labor market effects of service trade similar to those of international migration, and if so, in what aspects? In this paper, we attempt to examine these questions. We extend the Ricardo-Viner model to allow for differentiated business services as intermediate inputs. Production of business services uses skilled workers and its technology exhibits increasing returns to scale. In our view, service outsourcing can be regarded as the arm's length trade of business services. We examine the impacts of business service outsourcing and international migration on the wages of skilled and unskilled workers.

First, we find that both the outsourcing of business services and the immigration of skilled workers promote specialization in business services, and increase the productivity of the service sector. This explains why outsourcing is becoming increasingly popular and why the IT industry lobbies for more skilled immigration. Essentially the high-technology sectors use these practices to cut costs. In this sense, outsourcing and immigration are two sides of the same coin.

Second, the media often points out that service outsourcing and skilled immigration have adverse effects on skilled workers in developed countries. However, this is not necessarily true. We show that due to the increase in productivity, outsourcing can benefit both skilled and unskilled workers in either country. In contrast, both types of workers lose from the emigration of skilled workers in the skilled-labor scarce country. However, exactly the opposite arises in the other country with skilled immigration.

Third, we investigate the effects of service outsourcing and international migration on domestic wage inequality between skilled and unskilled workers. When only final goods are tradable, the skilled-labor abundant country has a lower wage inequality. Service outsourcing reduces the international productivity gap in the service sector, and equalizes wages: the wage inequality rises in the skilled-labor abundant country, but falls in the skilled-labor scarce country. However,

skilled-worker migration widens the productivity gap so that their effects on the wage inequality are totally opposite to those of outsourcing.

Fourth, under increasing returns in services, the higher productivity of services results in higher wages for *both* skilled and unskilled workers in the skilled-labor abundant country, creating incentives for international migration. That is, the immigration of skilled workers leads to a cumulative process, which generates incentives for unskilled workers to immigrate. We show that there exist multiple migration equilibria, and migration cycles can arise in the transition to equilibrium. We find that if the degree of scale economies is sufficiently large, the skilled-labor scarce country could be "the deserted island".

The literature on the relationship between trade and wages is extensive. Several empirical studies show that growing imports of labor intensive goods from less developed countries help cause the wage gap between the more educated and less educated workers in developed countries (see Wood 1995; Feenstra and Hanson, 1996a, b), while some other studies say that this effect is not important (e.g., Lawrence and Slaughter, 1993). Different from the existing literature, we especially focus on trade in business services. Ethier (1982), Markusen (1989), and Marrewijk et al. (1997) among others also model trade in differentiated business services, but abstract from analyzing their impacts on the labor markets. Matusz (1996) merges a model of monopolistic competition in the production of intermediate goods with the Shapiro-Stiglitz model of efficiency wages to show that the introduction of international trade leads to increased employment in both countries. Our model is related to them in that business services are differentiated inputs and produced with increasing returns technology. Recently, Grossman and Helpman (2002) and Antras and Helpman (2004) also study outsourcing problems, but in different settings.

In addition, Harris (1998) and Kikuchi (2003) analyze the role of communication technology in facilitating trade in business services. Harris states that the Internet can cause "virtual mobility" of workers by reducing trade barriers in services. Our work complements theirs since we use a model of two countries with different factor endowments. However, we focus on the labor markets, so that we consider not only service outsourcing but also international migration of workers. There is voluminous theoretical literature on the impacts of international migration on host and source countries. For instance, Ethier (1985), Brecher and Choudhri (1987) model migration, trade, and foreign investment. For an analysis related to illegal immigration, see Bond and Chen (1987). However, none of these is related to service trade.

The rest of this paper is organized as follows. Section 2 develops a two-country model based on the Ricardo-Viner framework, and considers a benchmark equilibrium in which only final goods are tradable. Section 3 examines the labor market effect of business services trade. Section 4 analyzes the effects of international migration of skilled and unskilled workers on wages and the wage inequality. Finally, Section 5 summarizes our main results.

2 Benchmark equilibrium–free trade in final goods

Consider an economy that produces two homogeneous final goods: a low-technology good (x) and a high-technology good (y), and differentiated business services $Z_1, ..., Z_n$. Final goods are produced with constant returns to scale technology and under perfect competition. Business services are produced with variety-specific increasing returns to scale, and the market for business services is characterized by monopolistic competition. The low-tech good, which is the numeraire, is produced using unskilled labor L and an immobile factor T, and its production function is

$$x = f(L_x, T). \tag{1}$$

The high-tech good is produced under constant returns to scale, using unskilled labor L and a number of differentiated business services $Z_1, ..., Z_n$, and we assume its production function has the following form:

$$y = g(L_y, S), \tag{2}$$

where $g(\cdot)$ exhibits constant returns to scale, and

$$S = \left[\sum_{i=1}^{n} Z_i^{\delta}\right]^{1/\delta} \quad 0 < \delta < 1. \tag{3}$$

Each variety of business services uses only skilled labor H, and requires a fixed cost plus a constant marginal cost:

$$z_i = \frac{H_i - b}{c}, \tag{4}$$

where z_i is the production of each variety of business services, and $b, c > 0$.

On the demand side, all consumers have identical and homothetic preferences. Thus, the share of expenditure that falls on the high-tech good is $\alpha_y(p_y)$ where p_y denotes the relative price of the high-tech good in terms of the nemeraire.

Now suppose there are two countries in the world economy, Home and Foreign. They are assumed to be identical in preferences, technologies, and endowments of the immobile factor and unskilled labor, i.e., $T = T^*$ and $L = L^*$.[1] However, we assume that Home is more skilled-labor abundant than Foreign, i.e., $H > H^*$. We start with a situation in which primary factors are immobile internationally and there is free trade in final goods only.

Let us first focus on Home. We assume that the firm of each business service takes as given the output of the high-tech good x, factor prices w_L, w_H, and w_T, and prices of other firms producing business services. Since producers are symmetric, all business services are sold at the same price p_z. Profit maximization leads to

$$p_z = \frac{cw_H}{\delta}, \tag{5}$$

[1] Let a superscript * denote variables associated with Foreign.

where w_H is the wage of skilled labor (a skilled wage). Under monopolistic competition, free entry drives profits to zero. We can derive the output of each firm as

$$z = \frac{\delta b}{(1-\delta)c}. \tag{6}$$

Business services require skilled labor only. The constraint of skilled labor leads to the variety of business services:

$$n = \frac{(1-\delta)H}{b}. \tag{7}$$

And the total input of business services S is then

$$\begin{aligned} S &= (n)^{\frac{1}{\delta}} z \\ &= \Lambda H^{\frac{1}{\delta}}, \end{aligned} \tag{8}$$

where $\Lambda \equiv \left(\frac{1-\delta}{b}\right)^{\frac{1-\delta}{\delta}} \left(\frac{\delta}{c}\right)$. The producers of final goods use unskilled labor. The total demand for unskilled labor must equal its endowment:

$$L_x + L_y = L. \tag{9}$$

Similarly, we can describe the equilibrium conditions for Foreign. In the benchmark case, there is free trade in final goods only. Since countries have identical and homothetic preferences, the supply side determines comparative advantage. Without trade in business services, the total input of business services depends on the endowment of skilled labor. Since Home is more skilled labor abundant than Foreign, we have

$$S = \Lambda H^{\frac{1}{\delta}} > \Lambda (H^*)^{\frac{1}{\delta}} = S^*. \tag{10}$$

This implies that Home exports the high-tech good for the imports of the low-tech good at the benchmark equilibrium.

2.1 Wage structure

We examine wage structures within and across countries at the benchmark free trade equilibrium. For notational clarity, we call the international wage difference of the same type of workers the "wage gap", while the wage difference between skilled and unskilled workers within a country the "wage inequality." We first look into the international wage gap and then the domestic wage inequality.

International wage gaps

Figure 1 illustrates the equilibrium of unskilled-labor markets at either country. Recall that $S > S^*$ at the benchmark equilibrium, which implies that the high-tech sector's value of marginal product (VMP_y) in Home is greater than that in Foreign for any given size of unskilled workers.

Thus, the unskilled wage is higher in Home than in Foreign, $w_L > w_L^*$.

It can be shown that the price index of business service for Home is $p_s = (n)^{-\frac{1-\delta}{\delta}} p_z$. With (5), it can be rewritten as

$$p_s = (n)^{-\frac{1-\delta}{\delta}} \left(\frac{cw_H}{b}\right). \tag{11}$$

The foreign counterpart p_s^* has the same representation. We can obtain the ratio of the home skilled wage w_H to the foreign skilled wage w_H^* as

$$\frac{w_H}{w_H^*} = \left(\frac{p_s}{p_s^*}\right)\left(\frac{n}{n^*}\right)^{\frac{1-\delta}{\delta}}. \tag{12}$$

At the benchmark equilibrium, unit costs for the high-tech good are equalized between countries, which leads to $p_s < p_s^*$ due to $w_L > w_L^*$. Since Home is relatively abundant in skilled labor, the price index of business services is lower. By this effect of factor abundance, (12) then implies that the Home skilled wage can be lower than the Foreign one. At the same time, $n > n^*$ because $H > H^*$. The larger size of skilled labor leads to more specialization in business services. This effect of specialization positively affects the skilled wage.

However, in general it is ambiguous whether or not Home has the higher skilled wage. The index of scale economies in business services is $1/\delta$. This is because (5) implies that $1/\delta$ equals the ratio of average to marginal cost (see Helpman and Krugman (1985)). As δ becomes smaller, the greater is the degree of scale economies. We observe that the specialization effect is greater in (12) as δ becomes smaller. This suggests that Home could have the higher skilled wage than Foreign when the degree of scale economies is sufficiently high. We shall come back to this point in section 4.

Domestic wage inequality

Next, let us look at the domestic wage inequality. Due to the effect of factor abundance, we have $p_s/w_L < p_s^*/w_L^*$, i.e., the price index/unskilled-wage ratio in Home is lower than in Foreign. However, it is ambiguous whether or not Home has a lower wage inequality because (12) implies that $w_H/w_H^* > p_s/p_s^*$, due to the specialization effect in business services.

To simplify, suppose that the technology of the low-tech good is a Leontief type and that of the high-tech good is of a Cobb-Douglas form:

$$f(L_x, T) = \min\left\{\frac{L_x}{a_{Lx}}, \frac{T}{a_{Tx}}\right\}, \tag{13}$$

$$g(L_y, S) = L_y^{\beta} S^{1-\beta}, \tag{14}$$

where a_{ix} is the use of factor i per output of the low-tech good, and $0 < \beta < 1$. It is straightforward to show that the demand of the high-tech sector for each input reflects

$$\frac{p_s}{w_L} = \left(\frac{1-\beta}{\beta}\right)\frac{L_y}{S}. \tag{15}$$

With full employment, (9) implies that $L_y = L - a_{Lx}T/a_{Tx}$. Using this, (10), and (11), we can rewrite (15) as

$$\frac{w_H}{w_L} = \left(\frac{1-\beta}{\beta}\right)\left(\frac{a_{Tx}L - a_{Lx}T}{a_{Tx}H}\right). \tag{16}$$

Clearly, the skill premium is positive as long as

$$\left(\frac{1-\beta}{\beta}\right)\left(\frac{a_{Tx}L - a_{Lx}T}{a_{Tx}H}\right) > 1. \tag{17}$$

The skilled/unskilled wage ratio in Foreign has a representation similar to (16). It is clear from (16) and its foreign counterpart that the Home wage inequality is lower than the Foreign one because $H > H^*$. Also, (17) guarantees that the skill premium is positive in Foreign as well.

3 Outsourcing in business services

As introduced at the beginning of the paper, suppose that an improvement in technology makes individual business services tradable. This means that the high-tech sector can purchase business services abroad, i.e., international outsourcing can occur. We now examine its impact on the wages in each country. First we consider a case with "iceberg" transport costs, that is, only a fraction $\frac{1}{\tau}$ of any services sent arrives, where $\tau > 1$. Then we can examine a case with free trade in business services as an extreme case with $\tau = 1$.

In equilibrium, the high-tech sector in each country can use a number of business services produced in both countries as in Helpman and Krugman (1985). Solving the high-tech firm's profit maximization problem, it is clear that the demand of the home firm for the home business service is

$$Z = \frac{p_z^{-\frac{1-\delta}{\delta}} S}{\left[n p_z^{-\frac{\delta}{1-\delta}} + n^*(\tau p_v^*)^{-\frac{\delta}{1-\delta}}\right]^{\frac{1}{\delta}}}, \tag{18}$$

where p_z^* is the price of each business service produced at Foreign. Similarly the demand of the foreign firm for the home business service is

$$Z^* = \frac{(\tau p_z)^{-\frac{1-\delta}{\delta}} S^*}{\left[n^* p_v^{*-\frac{\delta}{1-\delta}} + n(\tau p_z)^{-\frac{\delta}{1-\delta}}\right]^{\frac{1}{\delta}}}. \tag{19}$$

Facing the overall demand $Z + Z^*$ with the constant elasticity, $1/(1-\delta)$, home firms of business services charge the same price as given in (5). Since countries have identical technologies, foreign firms of business services face the same elasticity of the total demand as home firms. This immediately leads to the price of the foreign service:

$$p_v^* = \frac{w_H^* c}{\delta}. \tag{20}$$

With the free entry condition, we can derive the output of each home firm as (6). It is easy to show that the foreign producer of business services chooses the same output as the home firm:

$$v^* = \frac{\delta b}{c(1-\delta)}. \tag{21}$$

The constraint for skilled labor leads to the number of home business services as in (7). Similarly, the number of foreign services is obtained as

$$n^* = \frac{(1-\delta)H^*}{b}. \tag{22}$$

Next, we want to determine the relative wages. As before, technologies are given by (13) and (14). Also, production factors are fully employed. It can be shown that the home price index of business services is

$$p_s = \left[n(p_z)^{-\frac{\delta}{1-\delta}} + n^*(\tau p_v^*)^{-\frac{\delta}{1-\delta}} \right]^{-\frac{1-\delta}{\delta}}. \tag{23}$$

Similarly, the foreign price index of business services is

$$p_s^* = \left[n(\tau p_z)^{-\frac{\delta}{1-\delta}} + n^*(p_v^*)^{-\frac{\delta}{1-\delta}} \right]^{-\frac{1-\delta}{\delta}}. \tag{24}$$

Using (5) and (20), we can write the relative price index as

$$\frac{p_s}{p_s^*} = \left[\frac{n\left(\frac{w_H}{w_H^*}\right)^{-\frac{\delta}{1-\delta}} + n^*\tau^{-\frac{\delta}{1-\delta}}}{n\left(\frac{\tau w_H}{w_H^*}\right)^{-\frac{\delta}{1-\delta}} + n^*} \right]^{-\frac{1-\delta}{\delta}}. \tag{25}$$

The input demand for the total business services reflects the high-tech sector's profit maximization condition, which leads to

$$\frac{p_s}{p_s^*} = \left(\frac{L_y}{L_y^*}\right)^{\beta} \left(\frac{S}{S^*}\right)^{-\beta}. \tag{26}$$

Using (26), we can write (25) as

$$\frac{S}{S^*} = \left[\frac{n\left(\frac{w_H}{w_H^*}\right)^{-\frac{\delta}{1-\delta}} + n^*\tau^{-\frac{\delta}{1-\delta}}}{n\left(\frac{\tau w_H}{w_H^*}\right)^{-\frac{\delta}{1-\delta}} + n^*} \right]^{-\frac{1-\delta}{\beta\delta}}. \tag{27}$$

This implies that S/S^* is decreasing with w_H/w_H^*, and with $S = S^*$,

$$\frac{w_H}{w_H^*} = \left(\frac{n}{n^*}\right)^{\frac{1-\delta}{\delta}} > 1.$$

Intuitions are simple. The skilled-labor abundant country has more specialization in business

services, resulting in the higher skilled wage. Also, there is a negative relation between the relative input of services S/S^* and the relative skilled wage w_H/w_H^* because of the factor abundance effect: skilled-labor abundant Home has the lower skilled wage.

With (5) and (20), the market clearing condition for the home business service can be represented as

$$\begin{aligned} z &= \frac{p_z^{-\frac{1-\delta}{\delta}} S}{\left[n p_z^{-\frac{\delta}{1-\delta}} + n^* (\tau p_v^*)^{-\frac{\delta}{1-\delta}} \right]^{\frac{1}{\delta}}} + \frac{(\tau p_z)^{-\frac{1-\delta}{\delta}} S^*}{\left[n^* p_v^{*-\frac{\delta}{1-\delta}} + n (\tau p_z)^{-\frac{\delta}{1-\delta}} \right]^{\frac{1}{\delta}}} \\ &= \frac{\left(\frac{w_H}{w_H^*} \right)^{-\frac{1-\delta}{\delta}} S}{\left[n \left(\frac{w_H}{w_H^*} \right)^{-\frac{\delta}{1-\delta}} + n^* \tau^{-\frac{\delta}{1-\delta}} \right]^{\frac{1}{\delta}}} + \frac{\left(\frac{\tau w_H}{w_H^*} \right)^{-\frac{1-\delta}{\delta}} S^*}{\left[n^* + n \left(\frac{\tau w_H}{w_H^*} \right)^{-\frac{\delta}{1-\delta}} \right]^{\frac{1}{\delta}}}. \end{aligned} \tag{28}$$

Similarly, the market for the foreign business services is cleared when

$$\begin{aligned} v^* &= \frac{p_v^{-\frac{1-\delta}{\delta}} S^*}{\left[n^* p_v^{*-\frac{\delta}{1-\delta}} + n (\tau p_z)^{-\frac{\delta}{1-\delta}} \right]^{\frac{1}{\delta}}} + \frac{(\tau p_v^*)^{-\frac{1-\delta}{\delta}} S}{\left[n p_z^{-\frac{\delta}{1-\delta}} + n^* (\tau p_v^*)^{-\frac{\delta}{1-\delta}} \right]^{\frac{1}{\delta}}} \\ &= \frac{\left(\frac{w_H}{w_H^*} \right)^{-\frac{1-\delta}{\delta}} S^*}{\left[n^* + n \left(\frac{\tau w_H}{w_H^*} \right)^{-\frac{\delta}{1-\delta}} \right]^{\frac{1}{\delta}}} + \frac{\tau^{-\frac{1-\delta}{\delta}} S}{\left[n \left(\frac{w_H}{w_H^*} \right)^{-\frac{\delta}{1-\delta}} + n^* \tau^{-\frac{\delta}{1-\delta}} \right]^{\frac{1}{\delta}}}. \end{aligned} \tag{29}$$

Using (27), we can combine (28) with (29) to obtain

$$\frac{w_H}{w_H^*} = \left[\frac{\left(\frac{S}{S^*} \right)^{\frac{1-\delta-\beta}{1-\delta}} + \tau^{-\frac{1}{1-\delta}}}{1 + \tau^{-\frac{1}{1-\delta}} \left(\frac{S}{S^*} \right)^{\frac{1-\delta-\beta}{1-\delta}}} \right]^{1-\delta}. \tag{30}$$

This implies that skilled wages are equalized, $w_H = w_H^*$ when countries have the same input of services, $S = S^*$. This is because $z = v^*$ due to the symmetry in technologies. However, under (30), there does not necessarily exist a negative relation between the relative skilled wage w_H/w_H^* and the relative input of services S/S^*. To see this, let $\delta_\beta \equiv 1 - \beta$. It is clear from (30) that the relative skilled wage w_H/w_H^* is increasing with the relative input of services S/S^* if and only if $\delta < \delta_\beta$. Recall that δ is the index of scale economies in the business service sector. As δ becomes small, the degree of scale economies rises. If the degree of scale economies is greater than the critical level given by δ_β, then the relative skilled wage is positively related to the relative input of services. This implies that skilled-labor abundant Home can have the higher skilled wage.

Solving (27) and (30) simultaneously, we can obtain the relative skilled wage w_H/w_H^* and the relative input of services S/S^* at equilibrium. Figure 2 shows the determination of w_H/w_H^*

and S/S^* when $\delta < \delta_\beta$. The schedule defined by (27) is downward sloping because it reflects the factor abundance effect. The curve represented by (30) is upward sloping because the degree of scale economies in the service sector exceeds the critical level. Equilibrium is described by point E. It is clear from this figure that the skilled-labor abundant country (Home) has the higher skilled wage and greater input of services than the skilled labor scarce country (Foreign).

The unskilled wage reflects the demand of the high-tech sector for unskilled labor. It can be shown that a relative unskilled wage is

$$\frac{w_L}{w_L^*} = \left(\frac{L_y}{L_y^*}\right)^{-\beta} \left(\frac{S}{S^*}\right)^{1-\beta}. \tag{31}$$

Figure 2 shows that $S > S^*$ and thus (31) implies that Home has the higher unskilled wage than Foreign. Using (30) and (31), we can show that a relative wage inequality is

$$\frac{\frac{w_H}{w_L}}{\frac{w_H^*}{w_L^*}} = \left[\frac{\left(\frac{S}{S^*}\right)^{-\frac{\delta}{1-\delta}} + \tau^{-\frac{1}{1-\delta}} \left(\frac{S}{S^*}\right)^{-\frac{1-\beta}{1-\delta}}}{1 + \tau^{-\frac{1}{1-\delta}} \left(\frac{S}{S^*}\right)^{\frac{1-\delta-\beta}{1-\delta}}}\right]^{1-\delta}. \tag{32}$$

When $\delta < \delta_\beta$ and $S > S^*$, (32) immediately leads to $w_H/w_L < w_H^*/w_L^*$: Home has the lower wage inequality than Foreign. We can summarize the results as follows:

Proposition 1 *Suppose that the degree of scale economies in the service sector is greater than the critical level: $\delta < \delta_\beta$. Then, in the service outsourcing equilibrium, the skilled-labor abundant country (Home) has the higher wages of both skilled and unskilled labor and the lower wage inequality than the unskilled labor abundant country (Foreign).*

Next let us examine the effect of a fall in transport costs on the structure of wages. From (27) and (30), we can see that the relative skilled wage w_H/w_H^* is independent of τ when $S/S^* = 1$. This does not hold when $S/S^* > 1$. If τ falls, in Figure 2, the downward sloping curve becomes steeper because the factor abundance effect is promoted. However, the upward sloping curve becomes flatter since the effect of scale economies is undermined. Thus, a fall in transport costs reduces the relative skilled wage w_H/w_H^*, as shown in Figure 2.

Eventually, transport costs fall to zero when $\tau = 1$. In this extreme case, the downward sloping curve is vertical at $S/S^* = 1$, and the upward sloping curve is horizontal at $w_H/w_H^* = 1$. When business services are freely tradable, both skilled wages and service inputs are equalized between countries. It is also clear from (31) and (32) that unskilled wages and skill premiums are equalized as well.

As shown in Proposition 1, the skilled labor abundant country has the higher wage inequality in the presence of transport costs. Thus, due to elimination of transport costs, wage inequality would go up in the skilled labor abundant country (Home) but it would fall down in the skilled labor scarce country (Foreign). This point can be easily verified. When services are freely

tradable, the home input of services is

$$S = \left[n \left(\frac{z}{2} \right)^{\delta} + n^* \left(\frac{v}{2} \right)^{\delta} \right]^{\frac{1}{\delta}}. \tag{33}$$

Using (15), (23), and (33), we can show that the skill premium is

$$\frac{w_H}{w_L} = \left(\frac{2}{1+\lambda} \right) \left(\frac{1-\beta}{\beta} \right) \left(\frac{a_{Tx} L - a_{Lx} T}{a_{Tx} H} \right), \tag{34}$$

where $\lambda \equiv H^*/(H+H^*) < 1$. Comparing (16) with (34), we can easily see that wage inequality rises in Home due to business service trade. Similarly, we can show that service trade reduces wage inequality in Foreign. We can establish:

Proposition 2 *Business service outsourcing tends to increase wage inequality in the skilled-labor abundant country (Home), but it tends to reduce wage inequality in the skilled-labor scarce country (Foreign).*

It is often emphasized that service outsourcing has an adverse effect on skilled workers in developed countries. However, this is not necessarily true. In fact, we can show that skilled workers at Home can benefit from service outsourcing. Let subscripts B and O denote the benchmark and outsourcing equilibrium, respectively. Then, it can be shown that

$$\begin{aligned} \frac{\left(\frac{w_H}{p_y} \right)_O}{\left(\frac{w_H}{p_y} \right)_B} &= \left(\frac{n_O + n_O^*}{n_B} \right)^{\frac{1-\delta}{\delta}} \left(\frac{S_O}{S_B} \right)^{-\beta} \\ &= \left(\frac{H+H^*}{H} \right)^{\frac{1-\delta-\beta}{\delta}} 2^{\beta}. \end{aligned}$$

Clearly, the real wage of skilled workers in Home rises due to service trade when the degree of scale economies exceeds the critical level: $\delta < \delta_\beta$. This result suggests that outsourcing benefits skilled workers in developed countries. Intuitions are as follows: international outsourcing promotes specialization in the service sector, and increasing its productivity. When the degree of scale economies is large, the productivity increase leads to a rise in the real wage of skilled workers. Similarly, it can be shown that service outsourcing benefits skilled workers in skilled-labor scarce Foreign.

On the other hand, international outsourcing can benefit unskilled workers as well. We can show that

$$\begin{aligned} \frac{\left(\frac{w_L}{p_y} \right)_O}{\left(\frac{w_L}{p_y} \right)_B} &= \left(\frac{S_O}{S_B} \right)^{1-\beta} \\ &= \left[\left(\frac{1}{2} \right) \left(\frac{H+H^*}{H} \right)^{\frac{1}{\delta}} \right]^{1-\beta}. \end{aligned}$$

Clearly, as δ becomes smaller, the real wage of unskilled workers in Home is more likely to rise due to outsourcing. Thus, if the degree of scale economies is sufficiently great, then unskilled workers can gain from service outsourcing. This is because service trade raises the productivity of the service sector, and increasing the demand of the high-tech sector for unskilled labor. Similarly, we can show that outsourcing necessarily benefits unskilled workers in skilled labor scarce Foreign. We can establish:

Proposition 3 *Service outsourcing can benefit both types of workers in both skilled-labor abundant and skilled-labor scarce countries.*

4 Labor Migration

We have just seen that if business services are not tradable, the skilled labor abundant country (Home) has more specialization in services than the skilled labor scarce country (Foreign). This means that real wages of both skilled and unskilled labor are not equalized between countries. This creates an incentive for labor movements toward a country with the larger size of skilled labor. In this section, we consider a situation in which international migration of workers is allowed, instead of trade in business services. We show that migration cycles can arise in a transition process to migration equilibrium.

4.1 Migration of skilled workers

Let M_i denote movements of labor $i = H, L$, toward skilled labor abundant Home. In section 2.1, we have seen that the relative skilled wage w_H/w_H^* is represented by (12), and the degree of scale economies is a key to the international wage gap in skilled labor. To see this, let us suppose the technologies are simplified as (13) and (14). Then, using (10) and (26), we can write (12) as

$$\frac{w_H}{w_H^*} = \left(\frac{L + M_L - L_x}{L^* - M_L - L_x^*}\right)^{\beta} \left(\frac{H + M_H}{H^* - M_H}\right)^{\frac{1-\delta-\beta}{\delta}}. \tag{35}$$

When $M_L = M_H = 0$, it can be shown that

$$\frac{w_H}{w_H^*} = \left(\frac{H}{H^*}\right)^{\frac{1-\delta-\beta}{\delta}}.$$

Recall that $\delta_\beta = 1 - \beta$, which is the critical level for the degree of scale economies. It is obvious that if the degree of scale economies is greater than the critical level, $\delta < \delta_\beta$, Home has the higher skilled wage than Foreign: $w_H > w_H^*$. The skilled labor abundant Home has more specialization in services, resulting in the higher skilled wage. However, if the degree of scale economies is smaller than the critical level, then the factor abundance effect is so large that the skilled labor abundant Home has the lower skilled wage.

We can easily see from (35) that migration of skilled workers increases the scale advantage of skilled-labor abundant Home, leading to the cumulative process of skilled-labor movements.

It is also clear from (35) that migration of unskilled workers can raise the wage gap in skilled labor, and increasing an incentive for skilled workers to migrate.

Lemma 1 *Suppose that the degree of scale economies is greater than the critical level: $\delta < \delta_\beta$. Then, skilled workers would migrate from the skilled-labor scarce country (Foreign) to the skilled-labor abundant country (Home), which leads to a cumulative process of skilled labor movements.*

4.2 Migration of unskilled workers

Next, we look into the migration of unskilled workers. Using (10), we can write (31) as

$$\frac{w_L}{w_L^*} = \left[\left(\frac{H + M_H}{H^* - M_H} \right)^{\frac{1}{\delta}} \left(\frac{L^* - M_L - L_x^*}{L + M_L - L_x} \right) \right]^{1-\beta}. \tag{36}$$

When $M_L = M_H = 0$, (36) can be simplified as

$$\frac{w_L}{w_L^*} = \left(\frac{H}{H^*} \right)^{\frac{1-\beta}{\delta}}.$$

This implies that unskilled workers have an incentive to migrate toward the skilled-labor abundant Home. From (36), we can easily see that migration of unskilled workers would reduce the difference in their wages, and eventually, the wage gap falls to zero when

$$\left(\frac{H}{H^*} \right)^{\frac{1}{\delta}} = \frac{L + M_L - L_x}{L^* - M_L - L_x^*}.$$

As usual, the movement of unskilled labor can equalize unskilled wages between countries. However, unskilled wages are not necessarily equalized when skilled labor is mobile across countries. It is clear from (36) that an increase in skilled-labor movements raises the international gap in unskilled wages, and creating an incentive for unskilled labor to follow.

Lemma 2 *Migration of skilled workers creates an incentive for unskilled workers to migrate in the same direction.*

This suggests that migration cycles can arise: migration of skilled labor drives unskilled workers to migrate toward skilled-labor abundant Home. We shall come back to this point later on.

4.3 Migration and wages

It is straightforward to show the impact of labor migration on wage inequality. Let us focus on the case with $\delta < \delta_\beta$, so that both types of workers have incentives to migrate toward skilled labor abundant Home. It is clear from (16) that movements of skilled labor reduces wage inequality in Home but increases it in Foreign. Before migration of either type of workers is allowed, wage

inequality is lower in skilled-labor abundant Home. Thus, skilled-labor movements raise the international gap in domestic wage inequality.

Proposition 4 *Skilled-workers migration reduces wage inequality in the skilled-labor abundant country (Home), but increases it in the skilled-labor scarce country (Foreign), and widening the international wage inequality gap.*

This result suggests that skilled-labor movements are totally different from service outsourcing in the effects on domestic wage inequality. As shown in Proposition 2, service outsourcing raises the wage inequality in skilled-labor abundant Home. However, skilled-workers immigration has the negative effect on it.

On the other hand, we can see from (16) that due to unskilled-workers migration, the wage inequality falls in Home but it rises in Foreign. Therefore, unskilled-workers immigration is similar to service outsourcing in terms of the effects on the skill premium in the skilled labor abundant country.

It is also easy to show the effects of migration on the real wages in terms of the high-tech good. The real wage of skilled labor can be written as

$$\frac{w_H}{p_y} = \Phi \left(L + M_L - L_x\right)^{\beta} \left(H + M_H\right)^{\frac{1-\delta-\beta}{\delta}},$$

where $\Phi \equiv (1-\beta)bc^{\beta-1}\left(\frac{1-\delta}{b}\right)^{(1-\beta)(\frac{1-\delta}{\delta})}$. This implies that migration of unskilled workers positively affects the real wage of skilled labor in Home. Also, when the degree of scale economies is greater than the critical level, skilled-workers immigration raises their real wages. We can also verify that the emigration of either type of workers reduces the real wage of skilled workers in Foreign.

The real wage of unskilled workers can be derived as

$$\frac{w_L}{p_y} = \beta\Lambda^{1-\beta} \left(L + M_L - L_x\right)^{-(1-\beta)} \left(H + M_H\right)^{\frac{1-\beta}{\delta}}.$$

This immediately tells that immigration of unskilled workers reduces their real wages, but skilled-workers immigration benefits unskilled workers in Home. We can also show that emigration of unskilled workers raises their real wages, but outflows of skilled workers hurt unskilled workers in Foreign. We can summarize as follows:

Proposition 5 *Suppose that the degree of scale economies is greater than the critical level. Then, immigration of skilled workers can benefit both types of workers in the skilled-labor abundant country, but emigration of skilled workers can hurt both types of workers in the skilled-labor scarce country.*

As shown in Proposition 3, service outsourcing reduces the productivity gap across countries, and benefits everyone in either country. However, skilled-workers migration widens the gap in the productivity. As a result, every type of workers gains in the skilled-labor abundant country only.

4.4 Migration cycles and "the deserted island"

We have shown that migration of skilled workers leads to a cumulative process and it creates an incentive for unskilled workers to migrate. This means that migration cycles can arise. To see this, consider a situation in which either type of workers can migrate across borders. As before, we focus on the case in which the degree of scale economies is greater than the critical level: $\delta < \delta_\beta$.

In migration equilibrium, wages of both types of workers must be equalized across countries: $w_H/w_H^* = 1$ and $w_L/w_L^* = 1$. Using (35), we can show that $w_H/w_H^* = 1$ holds iff

$$\left(\frac{L + M_L - L_x}{L^* - M_L - L_x^*}\right)^{-\beta} = \left(\frac{H + M_H}{H^* - M_H}\right)^{\frac{1-\delta-\beta}{\delta}}. \tag{37}$$

This implies that there is a negative relation between M_L and M_H. Similarly, with (36), we can show that $w_L/w_L^* = 1$ iff

$$\left(\frac{L + M_L - L_x}{L^* - M_L - L_x^*}\right) = \left(\frac{H + M_H}{H^* - M_H}\right)^{\frac{1}{\delta}}. \tag{38}$$

Under this condition, M_H is positively related to M_L. Solving (37) and (38) simultaneously, we can derive a migration equilibrium:

$$M_L = 0,$$
$$M_H = -\frac{H - H^*}{2}.$$

Obviously, in the equilibrium, countries have the same size of skilled labor. However, Lemma 1 suggests that this equilibrium is unstable because skilled labor must outflow from Foreign. Figure 3 shows that the migration equilibrium is described by point E. When the degree of scale economies is greater than the critical level, the curve represented by $w_H/w_H^* = 1$ is downward sloping, so that the equilibrium is unstable.

The other equilibrium is an extreme one in which all of skilled workers migrate to Home. There are two possibilities: the first is an obvious one, in which all unskilled workers are induced to migrate to Home, and Foreign is left with the sector-specific input T only, i.e., a case of "the deserted island." Then, Foreign produces neither the low-tech good nor the high-tech good.

The second case is more interesting: small but positive numbers of unskilled workers remain in Foreign. For this to arise, the unskilled wages in the two countries must be equalized as follows:

$$\frac{1}{a_{Lx}} = w_L^* = w_L = p_y \beta \left(\frac{S}{L + M_L - L_x}\right)^{1-\beta}. \tag{39}$$

To simplify, suppose that preferences are represented by a Cobb-Douglas utility function with

an expenditure share on the low-tech good, α. Then, (39) can be solved for[2],

$$M_L = \frac{a_{Lx}T}{a_{Tx}} - \left[\frac{\alpha - \beta(1-\alpha)}{\alpha + \beta(1-\alpha)}\right] L.$$

Clearly, $L^* - L_x^* < M_L$ must hold if some unskilled workers continue to outflow to Home after all skilled workers left Foreign. In addition, if $M_L < L^*$, then migration of unskilled workers halts before all unskilled workers leave Foreign. These two inequalities must hold if

$$\frac{a_{Lx}T}{a_{Tx}} < \left[\frac{2\alpha}{\alpha + \beta(1-\alpha)}\right] L < \frac{2a_{Lx}T}{a_{Tx}}. \tag{40}$$

With this condition, in Figure 3, the migration equilibrium is described by point C and a possible transition to the equilibrium can be shown by the arrows. Along this transition path, migration cycles can arise on the segment AB. As skilled workers migrate to Home, unskilled workers are induced to outflow to Home. As a result, Foreign is specialized in producing the low-tech good, and the employment of the low-tech sector is exactly equal to the size of unskilled workers who remain in Foreign.

It is also clear from (40) that an increase in β reduces the possibility that the inequality ($M_L < L^*$) holds: some unskilled workers remain in Foreign. This implies that as β becomes larger, the case with the deserted island is more likely to occur. Since δ_β is decreasing with β, the larger β also requires the greater degree of scale economies. Therefore, if the degree of scale economies is sufficiently great, Foreign would more likely to be the deserted island. We can summarize as follows:

Proposition 6 *If both types of workers are allowed to migrate simultaneously, migration cycles can arise. At equilibrium, all skilled workers migrate to Home from Foreign, but some unskilled workers remain in Foreign. However, a strong degree of increasing returns in the service sector can lead to complete migration of both types of workers to Home, and Foreign becomes "the deserted island."*

5 Concluding remarks

Using a variant of the Ricardo-Viner model, we examined the impact of business services trade on the wages of skilled and unskilled workers. Outsourcing allows each country to use all varieties of business services produced in both countries, increasing the productivity of the service sector. As a result, skilled workers benefit from outsourcing at either country. This suggests that the recent growth in service outsourcing does not necessarily hurt skilled workers in developed countries.

We also investigated the impact of international migration on wages. Before migration is allowed, due to the scale advantage, both types of wages can be higher in the skilled labor abundant country. Migration of skilled-workers leads to a cumulative process and creates an

[2]See appendix for the derivation of M_L.

	$\frac{w_H}{w_L}$	$\frac{w_H^*}{w_L^*}$	$\frac{w_H}{w_H^*}$	$\frac{w_L}{w_L^*}$
Outsourcing in business services	+	−	−	−
Migration of skilled workers	−	+	+	+
Migration of unskilled workers	+	−	+	−

Table 1: The wage effects of service outsourcing and labor migration, given the degree of scale economies is larger than the critical level.

incentive for unskilled workers to migrate. In the transition to equilibrium, migration cycles can arise. As a result, the skilled-labor scarce country turns out to be "the deserted island" when the degree of scale economies is sufficiently great.

Harris (1998) states that the Internet can cause *virtual mobility* of workers by reducing trade barriers in services. Our results suggest that this arises since business services trade can equalize wages across countries. This implies that service outsourcing erodes the basis for labor movements. However, the migration of skilled workers would induce more migration by widening the wage gaps across countries, and serving to expand trade in business services.

Services outsourcing and the immigration of skilled workers can be two sides of the same coin, because both can increase the productivity of the high-tech sector. Nonetheless, it is worth noting that they are totally different in their impacts on the international wage gap and skilled and unskilled-wage inequality within a country. These results are summarized in Table 1.

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Appendix

We shall derive M_L at equilibrium. It can be shown that (39) becomes

$$\frac{1}{a_{Lx}} = p_y \beta \left(\frac{y}{L + M_L - L_x} \right). \tag{A1}$$

Under the Cobb-Douglas utility form, we can derive

$$p_y = \left(\frac{1-\alpha}{\alpha} \right) \left(\frac{x + x^*}{y + y^*} \right). \tag{A2}$$

With (A2), $x = L_x/a_{Lx}$, $x^* = (L^* - M_L)/a_{Lx}$, and $y^* = 0$, (A1) can be written as

$$1 = \left(\frac{1-\alpha}{\alpha} \right) \beta \left(\frac{L^* - M_L + L_x}{L + M_L - L_x} \right). \tag{A3}$$

(A3) can be solved for M_L.

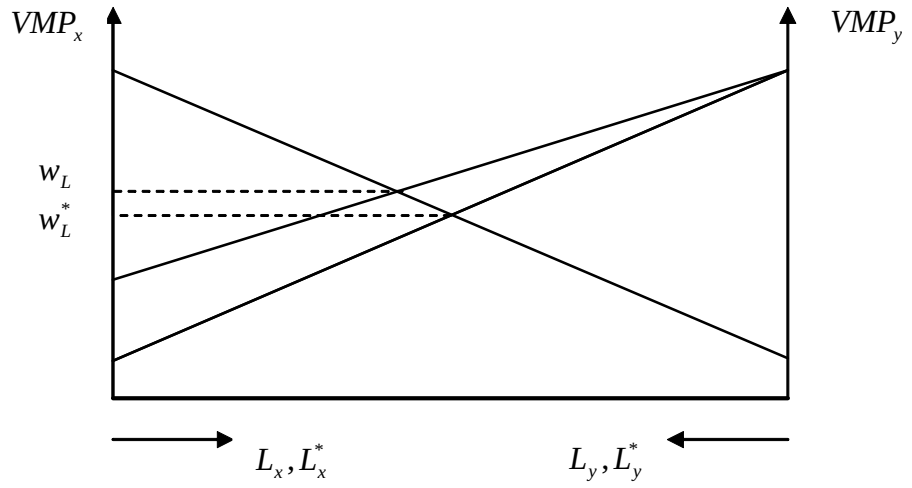

Figure 1: Unskilled-labor markets in the benchmark equilibrium

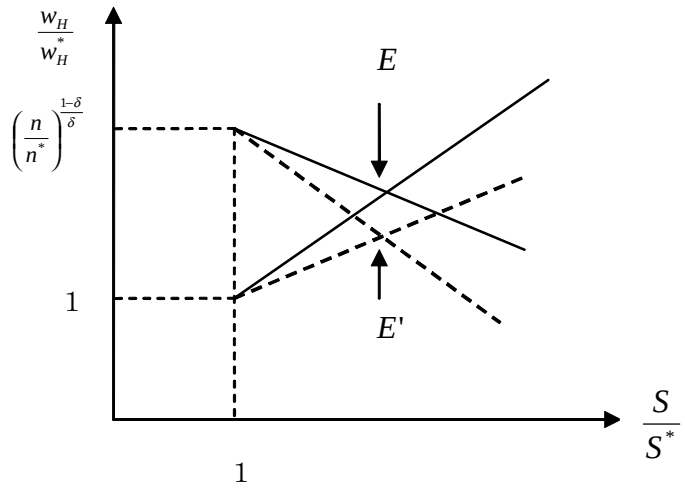

Figure 2: The outsourcing equilibrium

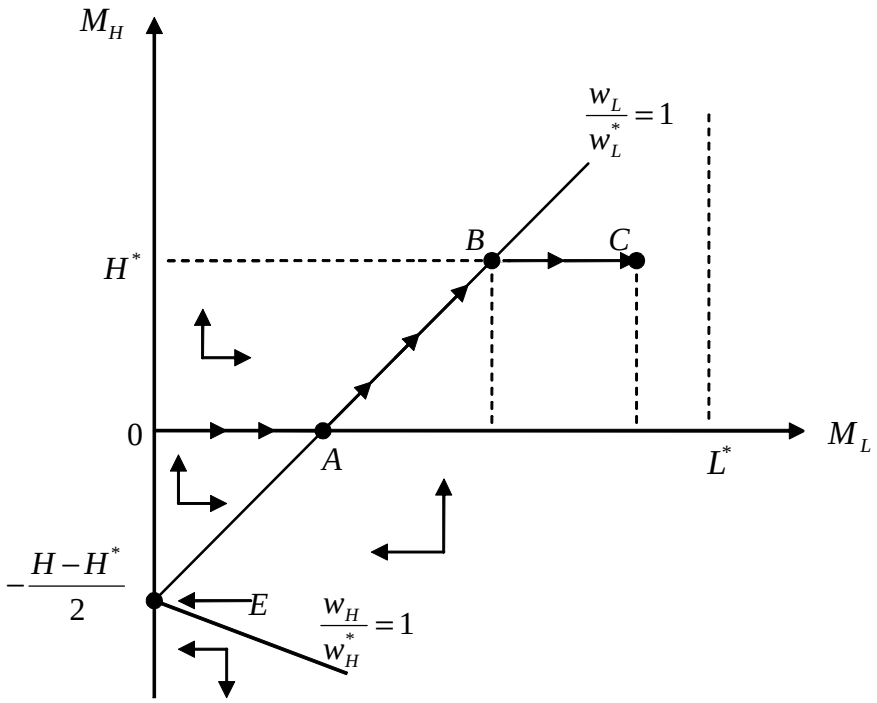

Figure 3: Migration equilibria