

Offshoring , Trade and Services Liberalization

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Abstract

In the view of increasing importance of international trade in services, ongoing domestic reforms, and the inclusion of services issues on the agenda of multinational, regional and bilateral trade negotiations, there is an obvious need to investigate the effects of service liberalization. Our paper introduces services liberalization as an exogenous policy shock to accelerate services offshoring. However, services offshoring, considered as shadow migration, has impact on wage, price, production and trade in both countries. Orientations towards services liberalizing reform in host country will alter cost saving effect and also elevate price effect. Services liberalization and offshoring bring new kinds of services trading, FDI in services ,generate trade in final goods as a “new source of comparative advantage” and alter the trade pattern of final goods as well. The correlation between trade and FDI in services is complementary.

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1 Introduction

Globalization has experienced two great “unbundlings”.¹ The first unbundling can be traced back to the late 19th century, “rapidly falling transportation costs and tariff reduction caused the spatial separation of factories and consumers”, which is the era of trade in goods [3]. Rapidly falling coordination costs caused by the development of information technology and service liberalization, have fostered the second unbundling²—“the end of the need to perform most manufacturing stages near to each other”. The second unbundling opened up the black box of the firm, which is the package of tasks and consider the international competition at the level of tasks within firms. Hence “offshoring or trade in tasks” can be considered as the new paradigm. More recently, the new unbundling has been spread to the offshoring of service sector jobs. Much literature has documented the second unbundling, like Yi(2003)[35] Gordon, Mataloni and Matthew(2005) [18], Kumura(2005) [2]. Amiti and Wei(2005)[1] have provided evidence of the more recent services offshoring.

Developing countries, particularly in Asia, have become large providers of service tasks for developed countries. Welsum and Reif(2005) [30], Welsum and Vickory(2006) [31] summarize the four characteristics of “offshorable” jobs: high IT intensity, output that is IT transmittable, tasks that are code-fiable and task that require little face to face interaction. The range of such services is impressive. It includes back office services such as payroll, customer-facing services such as call centers and telemedicine, design services such as the design of application-specific integrated circuits, research services such as conducting clinical trials, venture capital provision from Taiwan to Silicon Valley, software services such as programming, and IT and infrastructure outsourcing such as the managing of corporate email systems and telecommunications networks.

Understanding of service offshoring may require articulation of a new paradigm. Our paper aims to set up a general equilibrium model to integrate trade in service tasks and trade in goods. We generate non-factor-price equilibrium with the assumption of differences in production technology in two countries, where one country (f country) has superior technology in both sectors, but the other country (h country) has lower wage rates. f country combines advanced technology and low wage labor tasks together, which is the offshoring’s implicit meanings in our model. h country’s adoption of services liberalizing reforms, whether they are multilateral, regional or unilateral, will certainly decrease the cost of offshoring. So what are the effects of service liberalization on offshoring, price, wage, production and trade in both countries? Services offshoring, that is accompanied by f country investing (FDI in services) in h countries, will give

¹see Baldwin (2006)[3], Blinder (2006) [6]

²The second unbundling has been called fragmentation, offshoring, vertical specialization or slicing up the value-added chain.

us a chance to explore the relationship between FDI and trade in services.

The paper is structured as follows: Section 2 gives a brief literature review; Section 3 presents the model of offshoring. Firstly, based on the GHR's model, we introduce tasks into production, give a specific offshoring cost function and order the offshoring index according to increasing offshoring cost. Then we derive the general equilibrium of two big countries, in the case that offshoring occurs in both sectors but only in one direction. Secondly, with the equilibrium condition that offshoring costs balance wage savings, we can get optimal offshoring margin, up to the level that the tasks are performed at domestic home. Then, this model is used to explore offshoring, wage, price, production and trade effects of service liberalization in both countries, through the channels of cost saving effect and price effect (terms of trade effect). Three cases without trade barriers to completed goods are discussed according to h countries' orientation towards different service job (tasks) liberalizing reform and its offshoring effects. One case with trade barriers is simply explained. The last section concludes the paper by summarizing the results.

2 Literature Review

Many economists have tried to explain the impacts of offshoring (fragmentation). Actually, "task" shares some similarities with "intermediate goods", therefore we can resort for help to the theory of trade in intermediate goods, Batra and Casas(1973) [5], Woodland(1977)[34], Dixit and Grossman (1982)[10], and Jones and Kierzkowski (1990) [26] contributed a lot in early days. Dixit and Grossman (1982), D-G for short, introduce the model of trade with a continuum of intermediate goods, ³ D-G analyzes trade in manufactured goods that are produced via a vertical production structure with a continuum of intermediate stages, at which stage a good is traded to be endogenous. Stages distinguished by factor intensities and comparative advantage determine the pattern of production and trade. Jones and Kierzkowski (1990) made great progress considering offshoring as technological progress. "The greater disparity in productivity and factor prices found between countries may encourage, via the Ricardian doctrine of comparative advantage, the use of several international locations for production block." Services links, such as activities consisting of coordination, administration, transportation, and financial services are increasingly demanded. Technology advances in the provision of services lower the cost of services links and promote the fragmentation of the production blocks.

Later on, Jones and Findlay (2000, 2001) [13],[14], Jones and Kierzkowski (1998, 2000) [27], [22], Jones and Marjit (1992) [23], and Jones, Kierzkowski

³Dornbusch, Fischer and Samuelson (1977, 1980) [21],[11] and Falvey(1981)[12] explain international trade with the model of a continuum of goods.

and Leonard (2002) [24] develop some verbal and diagrammatic analyses in the case where fragmentation occurs in only one sector and in one direction in small open economies. The factor intensity of the sector that is fragmented, the factor intensity of the process that is offshored, and relative endowment of the offshoring nation determine the offshoring effects. Francois (1990a, b, c) [15], [16],[17] formally built up a general equilibrium model to explain the mechanisms of the impacts of services liberalization on fragmentation of production blocks.

Deardorff (1998a, b)[8],[9], Venables (1999)[29], Kohler(2004a, b)[32],[33], and Markusen (2005)[25] model mathematically, the effects of offshoring on the price, wage, production and trade pattern. These papers work on the models marked by non-factor-price equilibrium and assume offshoring occurs in only one sector and only one direction. How offshoring can save costs is the key mechanisms in general equilibrium. Deardorff analyzes offshoring in H-O setting and cost-saving offshoring occurs since nation's endowments are assumed to lie in different diversification cones, which create the wage gap as fragmentation also can. The factor intensity of fragmentation and products, national endowment ratio, and the original technology affect the wage change after offshoring.

Venables's analysis is based on $2 \times 2 \times 2$ H-O model in which non-factor price equilibrium is generated by factor intensity reversal. He concludes that "production fragmentation may change factor price by changing the composition of exports as well as imports", but fragmentation does not necessarily lead to convergence of factor prices.

Kohler (2004b) uses the framework of D-G (1982) and derives a generalized factor price frontier which incorporates an endogenous adjustment of the margin of fragmentation in a 2×2 general equilibrium model. Outsourcing is a vehicle to arbitrage on factor prices differences, and outsourcing not only depends on factor prices but also determines factor prices in general equilibrium. Outsourcing effects on factor prices by two scenarios: a change in the world price of finished goods and a reduction in the cost of offshoring. No conclusions are presented on trade and production effects.

Markusen (2005) emphasizes offshoring of white-collar services. Fragmentation is assumed to occur in skill labor intensive sector and the offshored part is middle-skill intensive segment. He tries to set up a series of models by assuming both countries are in different diversification cones and captures the characteristics of this kind of offshoring, such that "knowledge and capital stocks are complementary to skilled labor and create missing inputs for countries otherwise well suited to skill intensive fragmentation". Offshoring tends to increase the relative demand for skilled labor and skill premium in both countries, but the terms of trade effect may reverse this direct effect. One interesting result is that offshoring can expand trade of goods in extensive margin. Unfortunately, Markusen's model is too comprehensive and no robust results are offered.

Baldwin(2007)[4] presents a simple framework that enables us to analyze the wage, price, production and trade effect of offshoring in both source and host countries. The model avoids the analytic complexity of multi-cone production and factor intensity reversals. Non-factor-price equilibrium is generated under free trade of final goods due to Hicks-neutral technological differences among countries in each sector. Hence the baseline model can be studied in the setting of Jones(1965) and analyze the effects of offshoring on the familiar H-O trade theory. Offshoring by the technologically advanced nation is cost saving since offshoring firms can take their superior technology with them when they fragment their production. The notable results are: 1)the factor owners of the offshoring nation are better off as a result of offshoring (controlling for terms of trade effects); 2)offshoring leads to intra-industry trade, and by itself, it is a source of comparative advantage. The greatest contributions of the Baldwin(2007) is that his model can be easily extended from a service task case (offshored tasks are all re-imported to the source country) to a goods task case (local sales are possible in the sense that offshoring production units can supply source country as well as host country),and two-way intra-industry offshoring and offshoring in a monopolistic competition model can be studied in this model setting.

Grossman and Rossi-Hansberg (2006a, b)[20], [19], GRH for short, provide a borderline model for a production framework, which present the production process in terms of sets of tasks rather than simply the combination of bundles of inputs. GRH introduce the technological specification skin to D-G model. But there are some differences between them. GRH models' completed goods are produced by continua of tasks, with each task requiring only one kind of factor, say unskilled labor, skilled labor or some other factors of production such as capital or additional categories of labor. In the D-G (1982) model, final goods' production involves a continuum of intermediate production stages, each of which requires two factors: capital and labour. The production stages are strict complements in that producing the completed goods requires each stage to be performed in fixed proportions. But in the model of GRH, each kind of task is strict complements in that producing the final goods requires each typical task to be performed in fixed proportions, but the production technology may allow a firm to change the intensity of different tasks that it performs to produce a unit good. The intensity of tasks is captured by the amount of the factor that is used to perform a typical task domestically. GRH allow for the substitution between different tasks. The GHR model concludes that offshoring unambiguously raises the wage of workers whose jobs have been offshored (controlling for terms of trade effects), because of productivity effects or we can treat offshoring as a technology progress. What is the exogenous shock of offshoring? In GHR model, cost saving effects come from improvement in transportation and communication

technology. There are no trade and production effects of offshoring discussed here.

3 The Model

In our model, it is assumed that two complete products(x and y)⁴ produced from two tasks (high-skill-labor task and low-skill-labor task) and two factors (high-skill labor and low-skill labor) in each of two countries (h and f). If h and f countries have identical relative factor endowments, identical technology, identical homothetic demand, production is characterized by constant return to scale and perfect competition, there is no trade of x and y . The model relaxes the assumption of identical technology⁵ and assume the technologies of producing x and y are superior in f country to those in h country, and those technology differences cause the wage differences between high-skill labor (H -labor) and low-skill labor (L -labor), which will encourage f country to offshore some parts of their production to h country.

3.1 Task and Production

Based on the model of GRH (2006b), we conceptualize the production process in terms of tasks, and each task requires the inputs of each single factor. Some tasks can be performed by workers who have relatively little education or training, while others must be performed by workers who have greater skills and knowledge. We refer to the former as L -tasks and the latter as H -tasks. The production of a unit of either product $g(g = x, y)$ involves a continuum of L -tasks and a continuum of H -tasks. Without loss of generality, we normalize the measurement of tasks in each industry, which employs a given factor of production to equal one. See graph 1.

If technology admits no substitution between factors or tasks, then each task must be performed at pre-determined intensity in order to provide a unit of product. That is, each of the unit measurement of H -tasks must be performed exactly once. In industry g , the representative firm needs a_{lg} units of domestic factor l to perform a typical f -task once. Since the measurement of l -tasks has been normalized to one for $g = x, y$ and $l = H, L$, a_{lg} also is the total amount of domestic factor l that would be needed to produce a unit of good g in the absence of any offshoring. We will take industry y to be relatively skill-labor intensive, which means that

$$a_{Hx}/a_{Lx} < a_{Hy}/a_{Ly}$$

⁴products x and y can be a final manufactured product or a final service product

⁵Much empirical evidence suggests that technology across countries are not identical, see Trefer (1995) [28] and Davis and Weinstein (2001)[7]

Our framework can readily accommodate substitution between L -tasks and H -tasks. When substitution between L -tasks and H -tasks is possible, a_{lg} becomes variables of choice for the firms, which select these variables to minimize cost subject to a constraint that the chosen combination of task intensities are sufficient to yield a unit of product.

Firms can undertake tasks at home or abroad. Tasks can be performed offshore either within or beyond the boundaries of the firm. In our paper, we define offshoring of service tasks as moving an activity overseas within the boundaries of the firms. With the liberalization of services trade, more service firms offshore their tasks abroad by establishing a foreign subsidiary, or we call FDI in services. (See graph 2). The cost of offshoring may reflect the process of service liberalization in h country which receives services FDI –**policy costs**; The cost of establishing subsidiaries in h country and the extra cost to manage the affiliates –**input cost**; The cost of service task trading from h country to f country –**tasks trading cost**.

We can index ($l = H, L$) tasks in all sectors by $i \in [0, 1]$. Offshoring cost may be different in different task indices, so we order i according to non-decreasing offshoring cost. Tasks with a lower index can more readily be offshored than those with a greater index. We call “ i ” as “ f task offshoring margin”. A simple way to model the offshoring costs is in terms of input requirements. A firm producing g that performs task i abroad requires $(1/\beta_l)t_l(i)a_{lg}$ units of foreign labor. Offshoring cost should be $[(1/\beta_l)t_l(i) - 1]a_{lg}$ units of foreign labor. As GRH(2006), we also assume $t_l(i)$ is continuously differentiable and that

$$(1/\beta_l)t_l(i) \geq 1$$

for all i and l , which means firms in f county have to bear offshoring cost. Our ordering of the tasks implies that

$$(1/\beta_l)t'_l(i) \geq 0$$

But in our paper we assume offshoring costs are linear: that means

$$t_H(i) = a + bi$$

$$t_L(i) = c + di$$

a, c is the fixed offshoring cost for H labor and L labor, which will not change with offshoring margin. Firms in f country which perform offshoring have to establish a subsidiary in h country first, and fixed offshoring cost accounts for this sunk cost. b, d is the marginal offshoring cost which captures that cost that will increase with offshoring margin. β_l is the measurement of policy cost. With β_l increasing, $\frac{1}{\beta_l}$ decreases. That means, liberalizing services in h country, especially for market access and national treatment, will decrease

policy cost, further decrease the cost of offshoring. With the fast development of communication and information technology, task trading cost decreases a lot. Since trading tasks occur within firms from subsidiaries in h country to headquarters in f country, we can ignore these kinds of costs in our model⁶. In sum, policy costs and input costs dominate offshoring costs.

3.1.1 f Country

We use the Cobb-Douglas production function to produce x and y in each country. x is L -labor intensive product and y is H -labor intensive product. We assume the unit production function⁷ in f country is

$$f_x = a_{Lx}^\alpha a_{Hx}^{1-\alpha} = 1 \quad (1)$$

$$f_y = a_{Ly}^{1-\alpha} a_{Hy}^\alpha = 1 \quad (2)$$

When offshoring of H -tasks and L -tasks both exist, the costs of producing a unit of x is

$$wa_{Lx}\Omega_2 + sa_{Hx}\Omega_1$$

The cost of producing a unit of y is

$$wa_{Ly}\Omega_2 + sa_{Hy}\Omega_1$$

Where w and s denote L -labor wage and H -labor wage in f country.

$$\Omega_1 = 1 - I_1 + \int_0^{I_1} t_H(i)di/t(I_1) < 1$$

$$\Omega_2 = 1 - I_2 + \int_0^{I_2} t_L(i)di/t(I_2) < 1$$

Notice that the fraction of H service task ($1 - I_1$) and the fraction of L service tasks ($(1 - I_2)$) are performed in the domestic country, while the fraction of H -tasks (I_1 ($0 \leq I_1 \leq 1$)) and the fraction of (I_2 ($0 \leq I_2 \leq 1$)) of L -tasks are offshored to h country. We only have one direction of L and H tasks trading from f country to h country because of the wage lagS. But the country which performs offshoring (f country which performs FDI) must establish subsidiaries in h country (which is the country to receive FDI) and improve the quality of the labor to the level of f country by training labor or investing some specific assets,like knowhow or specific capital. f Country has to pay the cost of extra inputs, but the total production cost is still lower than the whole production performed in one country. According to our assumption of linear offshoring cost,we get

⁶Or these kinds of costs can also be included in the input costs

⁷we assume $\alpha = 2/3$

$$\Omega_1 = 1 - I_1 + \frac{aI_1 + \frac{bI_1I_1^2}{2}}{a + bI_1} \quad (3)$$

$$\Omega_2 = 1 - I_2 + \frac{aI_2 + \frac{bI_2^2}{2}}{a + bI_2} \quad (4)$$

After solving cost minimization for firm x and y , we get factor content of unit product x and y for H -labor and L -labor.

$$a_{LX} = \frac{2^{1/3}s^{1/3}\Omega_1^{1/3}}{w^{1/3}\Omega_2^{1/3}}, a_{HX} = \frac{w^{2/3}\Omega_2^{2/3}}{2^{2/3}s^{2/3}\Omega_1^{2/3}} \quad (5)$$

$$a_{LY} = \frac{s^{2/3}\Omega_1^{2/3}}{2^{2/3}w^{2/3}\Omega_2^{2/3}}, a_{HY} = \frac{2^{1/3}w^{1/3}\Omega_2^{1/3}}{s^{1/3}\Omega_1^{1/3}} \quad (6)$$

In a competitive economy, the price of x and y are less than or equal to the unit cost of production, with equality whenever a positive quantity is produced. So we have zero profit equation:

$$1 = wa_{Lx}\Omega_2 + sa_{Hx}\Omega_1 \quad (7)$$

We take the price of x as numeraire.

$$P_f = wa_{Ly}\Omega_2 + sa_{Hy}\Omega_1 \quad (8)$$

P_f is the price of y in f country. Substitute formula (3),(4),(5)into (7),substitute (3),(4),(6)into(8), we have⁸

$$w^* = \frac{2^{2/3}}{3P_f\Omega_2} \quad (9)$$

$$s^* = \frac{2^{2/3}P_f^2}{3\Omega_1} \quad (10)$$

Next consider the domestic factor markets. Full employment condition should be

$$a_{Hx}x_f + a_{Hy}y_f = H_f/(1 - I_1) \quad (11)$$

$$a_{Lx}x_f + a_{Ly}y_f = L_f/(1 - I_2) \quad (12)$$

L_f, H_f is the labor endowment of L -labor and H -labor in f country. Offshoring of tasks leverage the domestic factor supply, as “shadow migration”. Then we can get $x_f^*(P_f, I_1, I_2)$ and $y_f^*(P_f, I_1, I_2)$.

$$x_f^* = \frac{2^{2/3}(-2(-1 + I_1)L_f + H_f(-1 + I_2)P_f^3)}{3(-1 + I_1)(-1 + I_2)P_f}$$

$$y_f^* = -\frac{2^{2/3}(L_f - I_1L_f + 2H_f(-1 + I_2)P_f^3)}{3(-1 + I_1)(-1 + I_2)P_f^2}$$

⁸*represents the optimal results

3.1.2 h Country

The technologies to produce x and y in home country are both interior to that of foreign country. So in the production function of h country, the technical efficiency parameter A ⁹ is smaller than unity. The unit production function in h country is

$$\begin{aligned} g_x &= Ab_{Lx}^\alpha b_{Hx}^{1-\alpha} \\ g_y &= Ab_{Ly}^{1-\alpha} b_{Hy}^\alpha \end{aligned}$$

we have unit cost of production

$$\begin{aligned} w_h b_{Lx} + s_h b_{Hx} \\ w_h b_{Ly} + s_h b_{Hy} \end{aligned}$$

After cost minimization, we get¹⁰

$$b_{Lx}(w_h, s_h) = \frac{2^{1/3} s_h^{1/3}}{A w_h^{1/3}}, b_{Hx}(w_h, s_h) = \frac{w_h^{2/3}}{2^{2/3} A s_h^{2/3}} \quad (13)$$

$$b_{Ly}(w_h, s_h) = \frac{s_h^{2/3}}{2^{2/3} A w_h^{2/3}}, b_{Hy}(w_h, s_h) = \frac{2^{1/3} w_h^{1/3}}{A s_h^{1/3}} \quad (14)$$

zero profit conditions are:

$$1 = w_h b_{Lx} + s_h b_{Hx} \quad (15)$$

$$p_h = w_h b_{Ly} + s_h b_{Hy} \quad (16)$$

p_h is the price of y in h country. Then we have

$$w_h^* = \frac{2^{2/3} A}{3 p_h} \quad (17)$$

$$s_h^* = \frac{1}{3} 2^{2/3} A p_h^2 \quad (18)$$

Full employment conditions are:

$$b_{Lx} x_h + b_{Ly} y_h = L_h / (1 + I_2) \quad (19)$$

$$b_{Hx} x_h + b_{Hy} y_h = H_h / (1 + I_1) \quad (20)$$

L_h, H_h is the labor endowment of low-skill labor and high-skill labor in h country. Then we can get $x_h^*(P_f, p_h, I_1, I_2)$ and $y_h^*(P_f, p_h, I_1, I_2)$.

$$x_h^* = \frac{2^{2/3} A (2(1 + I_1)L_h - H_h(1 + I_2)p_h^3)}{3(1 + I_1)(1 + I_2)p_h} \quad (21)$$

$$y_h^* = -\frac{2^{2/3} A ((1 + I_1)L_h - 2H_h(1 + I_2)p_h^3)}{3(1 + I_1)(1 + I_2)p_h^2} \quad (22)$$

⁹A is exogenous

¹⁰ b_{fg} , ($l = L, H$; $g = x, y$) is factor content of unit good for h country

3.2 Margin of Service Offshoring

If $I_1 = 0, I_2 = 0$, there is no service offshoring and no trade of completed products x and y . If $0 \leq I_1 \leq 1$, offshoring of H -task exists; $0 \leq I_2 \leq 1$, offshoring of L -task exists. f country takes advantage of low wage in h country and its advanced technology. In each industry, the task performed at home has the same index for H -tasks and L -tasks, and the marginal tasks are determined by the condition that the wage savings just balance the offshoring costs.¹¹ There are three cases we need to consider.

$$s^* = (1/\beta_1(a + bI_1))s_h^* \quad (23)$$

$$w^* = 1/\beta_2(a + bI_2)w_h^* \quad (24)$$

3.2.1 Only Offshoring of H -Tasks from h to f Country

Substituting (10), (18) into (23), and we assume no barriers to complete product trading, and the relative price of y is the same in country h and country f in general equilibrium. $P_f = p_h = P$ (We will relax this assumption in the later part).

$$I_1 = \frac{Ab - \sqrt{2aA^2b + A^2b^2 - 2Ab\beta_1}}{Ab} \quad (25)$$

Because $0 \leq I_1 \leq 1$,

$$\begin{aligned} 2aA^2b + A^2b^2 - 2Ab\beta_1 &\geq 0 \\ 0 \leq \frac{Ab - \sqrt{2aA^2b + A^2b^2 - 2Ab\beta_1}}{Ab} &\leq 1 \end{aligned}$$

So offshoring cost must satisfy the following condition:

$$aA \leq \beta_1 \leq aA + (1/2)Ab$$

From equation (25), if $\beta_1 = aA$, $I_1 = 0$. That means that when β_1 is equal to (or less than) technical efficiency parameter A multiplied by fixed offshoring cost a , the costs resulting from the services barriers are too high, so neither H -task offshoring nor trade of complete products x and y are possible. With h country liberalizing services market to f country, offshoring costs of H -tasks will decrease a lot, while β_1 will increase accordingly. Then services liberalization to H -labor will increase the offshoring margin of H -task services.¹² If $a = 1, A = 1/2$, $1/2 \leq \beta_1 \leq 1$, we can get figure 1 according to (25)

¹¹ the other way to denote the offshoring cost for each task is in term of wages, so wage saving is equal to offshoring costs $(s^* - s_h^*) = (1/\beta_1(a + bI_1) - 1)s_h^*$, $(w^* - w_h^*) = (1/\beta_2(a + bI_2) - 1)w_h^*$. $\beta_1 = \beta_H, \beta_2 = \beta_L$

¹² $\partial I_1 / \partial \beta_1 = \frac{1}{\sqrt{Ab(2aA + Ab - 2\beta_1)}} > 0$, I_1 will increase with β_1 .

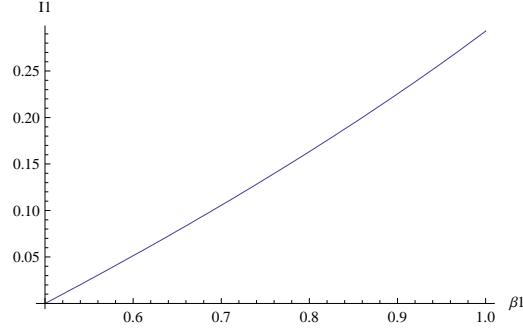


Figure 1: service liberalization and margin of offshoring H-task

3.2.2 Only Offshoring of L -Tasks from h to f Country

Substitute(9),(17)into(24),we get

$$I_2 = \frac{Ad - \sqrt{2cA^2d + A^2d^2 - 2Ad\beta_2}}{Ad} \quad (26)$$

So

$$cA \leq \beta_2 \leq cA + 1/2Ad$$

The same analysis can be applied to L -tasks for β_2 .

Offshoring cost of L -task may be different from that of H -task, if either fixed offshoring cost (c), marginal offshoring cost (d) or policy cost (β_2) is different from a, b, β_1 .¹³

3.2.3 Offshoring of Both H -Tasks and L -Tasks from h Country to f Country

substitute (9),(17)into (24),(10),(18)into(23)simultaneously,

$$I_1 = \frac{Abp_h^{*2} - \sqrt{2aA^2bp_h^{*4} + A^2b^2p_h^{*4} - 2AbP_f^{*2}p_h^{*2}\beta_1}}{Abp_h^{*2}} \quad (27)$$

$$I_2 = \frac{AdP_f^* - \sqrt{2A^2cdP_f^{*2} + A^2d^2P_f^{*2} - 2AdP_f^*p_h^*\beta_2}}{AdP_f^*} \quad (28)$$

If there are some trade barriers to completed goods x and y , then the price of y in h and f country after trade of completed goods may not be the same.

¹³ $\partial I_2 / \partial A = -\frac{\beta_2}{A\sqrt{Ad(A(2c+d)-2\beta_2)}} < 0$, so the greater technological differences between 2 countries, the more the offshoring will occur; $\partial I_2 / \partial d = \frac{Ac-\beta_2}{d\sqrt{Ad(A(2c+d)-2\beta_2)}} < 0$, so the greater the marginal cost of offshoring of the type of task, the lesser the offshoring will occur.

The price distortion in h and f country is t_h and t_f , the relative price of y is $p_h/P_f = t$.

$$I_1 = \frac{Abt^2 - \sqrt{2aA^2bt^4 + A^2b^2t^4 - 2Abt^2\beta_1}}{Abt^2} \quad (29)$$

$$I_2 = \frac{Ad - \sqrt{2A^2cd + A^2d^2 - 2Adt\beta_2}}{Ad} \quad (30)$$

$$(aAt^2)/b \leq \beta_1 \leq aAt^2 + 1/2(bt^2)$$

$$(Ac)/dt \leq \beta_2 \leq (Ac + 1/2Ad)/t$$

If we assume no barriers to completed product trading, and the relative price of y is no different in country h and country f in general equilibrium, then $t = 1$

$$I_1 = \frac{Ab - \sqrt{2aA^2b + A^2b^2 - 2Ab\beta_1}}{Ab}$$

$$I_2 = \frac{Ad - \sqrt{2A^2cd + A^2d^2 - 2Ad\beta_2}}{Ad}$$

3.3 Demand and Supply in the World

The demand is homothetic and identical in both h and f country. We use the Cobb-Douglas utility function.

$$U = x_{dj}^{1-\gamma} y_{dj}^\gamma, j = h, f$$

γ is product y 's demand share, here assuming $\gamma = 1/2$. Budget constraint for f country is

$$x_{df} + P_f y_{df} - wL_f - sH_f = 0$$

Budget constraint for h country is

$$x_{dh} + p_h y_{dh} - w_h L_h - s_h H_h = 0$$

After maximizing utility function subject to budget constraints, we can get the demand of x and y in h and f country.

$$x_{df}^* = \frac{L_f \Omega_1 + H_f P_f^* \Omega_2}{32^{1/3} P_f^* \Omega_1 \Omega_2}$$

$$y_{df}^* = \frac{L_f \Omega_1 + H_f P_f^* \Omega_2}{32^{1/3} P_f^{*2} \Omega_1 \Omega_2}$$

$$x_{dh}^* = \frac{A(L_h + H_h p_h^{*3})}{32^{1/3} p_h^*}$$

$$y_{dh}^* = \frac{A(L_h + H_h p_h^*)}{32^{1/3} p_h^{*2}}$$

If home and foreign country are both big countries, the price of y must be determined by the world market demand and supply, and P is the world price for y .

$$D = S$$

$$D = (y_{df} + y_{dh}) / (x_{df} + x_{dh})$$

$$D^* = \frac{1}{P}$$

$$S = (y_f + y_h) / (x_f + x_h)$$

$$S^* = \frac{-(-1 + I_1^2)(L_f + I_2 L_f + A L_h - A I_2 L_h) + 2(H_f + A H_h + H_f I_1 - A H_h I_1)(-1 + I_2^2) P^3}{2(-1 + I_1^2)(L_f + I_2 L_f + A L_h - A I_2 L_h) P - (H_f + A H_h + H_f I_1 - A H_h I_1)(-1 + I_2^2) P^4}$$

D^* is the world relative demand for y , and S^* is the world relative supply for y . If there is barrier difference $t(t \neq 1)$ between h and f , we can add trade balance condition and t can be endogenously determined.

$$(y_{df} - y_{dh}) / (x_{df} - x_{dh}) = (y_f - y_h) / (x_f - x_h)$$

3.4 No Trade Barriers to Completed Goods

With services liberalization and trading of H -tasks and L -tasks from h country to f country, the cost of production will shrink in f country which has advantages in technology. Tasks offshoring is like “shadow migration”¹⁴ and will effect the equilibrium price determined by world relative supply and world relative demand.

3.4.1 Case 1: $I_1 = I_2$

Price and Liberalization

Proposition 1 *The relative price of y will not change with offshoring of both H -tasks and L -tasks, when offshoring margins are the same and shadow migrations of L -labor and H -labor are the same as well.*

If the cost of H -task and L -task offshoring is the same, that means: $a = c, b = d, \beta_1 = \beta_2$. Then according to (31) and (32), we can get $I_1 = I_2$. Shadow immigration of H -labor should be $H_f I_1$. Shadow immigration of L -labor should be $L_f I_2$. So the production of x and y in f country will increase in the same proportion, while the production of x and y in h country will decrease in the same proportion. The relative supply of y in the world, as $(y_f + y_h) / (x_f + x_h)$

¹⁴which is defined in Baldwin (2007) [4]

will not change at all. For the relative demand side, there is no change for the world ¹⁵Therefore the relative world price of y (price of x is numeraire) will not change after services liberalization. For the technology leads in f country, the absolute supply (x and y) of the whole world will increase in greater proportion than no task trading.

Wage, Cost Saving and Liberalization

Proposition 2 *when offshoring of both L-tasks and H-tasks exists and offshoring margins are the same, both real wages and nominal wages for L and H labor in f country will increase because of cost saving effect; real wages and nominal wages in h country will not change.*

Proof According to (9) and (10), we can get

$$w^* = (2 * 2^{2/3}(c + dI_2)) / (3(2c - d(-2 + I_2)I_2)P^{*2})$$

$$s^* = (22^{2/3}(a + bI_1)P^{*2}) / (6a - 3b(-2 + I_1)I_1)$$

After total derivative,

$$dw^* = \frac{2 * 2^{2/3} (-2c^2 dP^* + d^2 I_2^2 (dP^* (-2 + I_2) + diP^*) + cdI_2 (dP^* (-4 + I_2) + 2diP^*))}{3(-2c + d(-2 + I_2)I_2)^2 P^{*2}} \quad (31)$$

$$ds^* = \frac{2 * 2^{2/3} P^* (4a^2 dP^* + 2abI_1 (-dP^* (-4 + I_1) + diP^*) + b^2 I_1^2 (-2dP^* (-2 + I_1) + diP^*))}{3(-2a + b(-2 + I_1)I_1)^2} \quad (32)$$

$$w_h^* = (2^{2/3} A) / (3P^*), \quad dw_h^* = -((2^{2/3} A) / (3P^{*2})) dP^* \quad (33)$$

$$s_h^* = 1/32^{2/3} AP^{*2}, \quad ds_h^* = 2/32^{2/3} AP^* dP^* \quad (34)$$

If $dP = 0, dI_1 > 0, dI_2 > 0$

$$dw^* = \frac{2di2^{2/3}dI_2(2c + dI_2)}{3(-2c + d(-2 + I_2)I_2)^2 P^*} > 0$$

$$ds^* = \frac{2di2^{2/3}bI_1(2a + bI_1)P^{*2}}{3(-2a + b(-2 + I_1)I_1)^2} > 0$$

$$dw_h^* = 0$$

$$ds_h^* = 0$$

¹⁵We assume the consumption share of x and y is both half unit and will not change.

According to (5), (6), (13), (14), we can get cost saving of offshoring in f country, but no cost saving effect in h country.

$$a_{Lx}^* \Omega_2^* = \frac{(2c - d(-2 + I_2)I_2)P^*}{2^{2/3}(c + dI_2)}$$

$$d(a_{Lx}^* \Omega_2^*) = \frac{2c^2 dP^* - d^2 I_2^2 (dP^* (-2 + I_2) + diP^*) - cdI_2 (dP^* (-4 + I_2) + 2diP^*)}{2^{2/3}(c + dI_2)^2} \quad (35)$$

$$a_{Hx}^* \Omega_1^* = \frac{(2c - d(-2 + I_2)I_2)P^*}{2^{2/3}(c + dI_2)}$$

$$d(a_{Hx}^* \Omega_1^*) = \frac{2c^2 dP^* - d^2 I_2^2 (dP^* (-2 + I_2) + diP^*) - cdI_2 (dP^* (-4 + I_2) + 2diP^*)}{2^{2/3}(c + dI_2)^2} \quad (36)$$

$$a_{Ly}^* \Omega_2^* = \frac{(2c - d(-2 + I_2)I_2)P^2}{2^{2/3}(c + dI_2)}$$

$$d(a_{Ly}^* \Omega_2^*) = -\frac{P^* (-4c^2 dP^* + 2cdI_2 (dP^* (-4 + I_2) + diP^*) + d^2 I_2^2 (2dP^* (-2 + I_2) + diP^*))}{2^{2/3}(c + dI_2)^2} \quad (37)$$

$$a_{Hy}^* \Omega_1^* = \frac{2a - b(-2 + I_1)I_1}{2^{2/3}(a + bI_1)P^*}$$

$$d(a_{Hy}^* \Omega_1^*) = \frac{-2a^2 dP^* + abI_1 (dP^* (-4 + I_1) - 2diP^*) + b^2 I_1^2 (dP^* (-2 + I_1) - diP^*)}{2^{2/3}(a + bI_1)^2 P^{*2}} \quad (38)$$

$$b_{Lx}^* = \frac{2^{1/3} P^*}{A}, db_{Lx}^* = \frac{2^{1/3}}{A} dP^* \quad (39)$$

$$b_{Hx}^* = \frac{1}{2^{2/3} A P^{*2}}, db_{Hx}^* = -\frac{2^{1/3}}{A P^{*3}} dP^* \quad (40)$$

$$b_{Ly}^* = \frac{P^{*2}}{2^{2/3} A}, db_{Ly}^* = \frac{2^{1/3} P^*}{A} dP^* \quad (41)$$

$$b_{Hy}^* = \frac{2^{1/3}}{A P^*}, db_{Hy}^* = -\frac{2^{1/3}}{A P^{*2}} dP^* \quad (42)$$

if $dP = 0, di > 0$, then

$$d(a_{Lx}^* \Omega_2^*) = \frac{-2cddiI_2 P^* - d^2 diI_2^2 P^*}{2^{2/3}(c + dI_2)^2} < 0$$

$$d(a_{Hx}^* \Omega_1^*) = -\frac{2abdiI_1 P^* + b^2 diI_1^2 P^*}{2^{2/3}(a + bI_1)^2 P^{*3}} < 0$$

$$d(a_{Ly}^* \Omega_2^*) = -\frac{P^* (2cddiI_2 P^* + d^2 diI_2^2 P^*)}{2^{2/3}(c + dI_2)^2} < 0$$

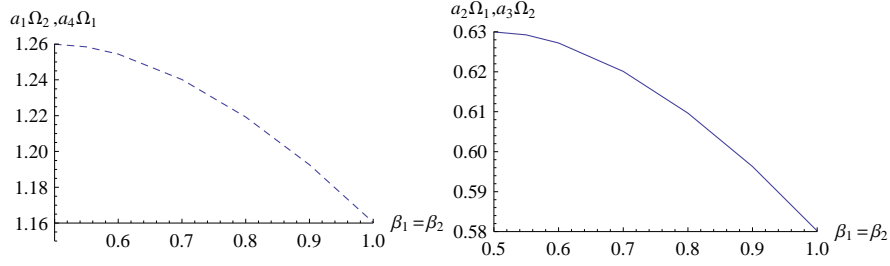


Figure 2: services liberalization and cost savings in f country, $I_1 = I_2$

$$d(a_{Hy}^* \Omega_1^*) = \frac{-2abdiI_1P^* - b^2diI_1^2P^*}{2^{2/3}(a + bI_1)^2P^{*2}} < 0$$

$$db_{Lx}^* = 0, db_{Hx}^* = 0, db_{Ly}^* = 0, db_{Hy}^* = 0$$

□

If $I_1 = I_2$, the relative price of y will not change with services liberalization. As the policy cost of offshoring reduces with services liberalization, the cost of performing the set of H -tasks or L -tasks may decrease in both x and y industry in f country. (see figure 3, 4)¹⁶ This kind of cost saving which comes from the use of f country's superior technology with h country's cheap labor, is much the same as would result from an economy-wide increase in the productivity of L and H labor and proportional to their premiums to L and H labor in f country. So they are like the effect of "productivity effect"¹⁷. The relative price of y will not change, so there is no price effect. Since factor prices are insensitive to factor supplies in an economy that produces as many complete tradable goods (x and y) as there are factors (L and H labor).¹⁸ Hence shadow migration of L and H labor has no effect on factor prices in h country and wages have nothing to do with offshoring margin. See figure 4, 5. Therefore, we notice that offshoring can widen the international wage disparity for each type of labor. Offshoring has created the opportunities to continue further. That means if h country with low labor wage proceeds to services reform and f country with superior technology starts service offshoring, offshoring itself has the ability to develop further.

¹⁶we simulate the results, assuming $L_f = 100, H_f = 100, L_h = 100, H_h = 100, a = 1, b = 4, c = 1, d = 4, A = 1/2, 0.5 \leq \beta_1 \leq 1, 0.5 \leq \beta_2 \leq 1$. All the figures are based on these assumptions unless we notice. figure 2, 3 show cost saving effect in f and h country.

¹⁷Grossman(2008) "identified three channels through which changes in the opportunities for offshoring affect the wages of low skill and high skill labor: productivity effect, relative price effect and labor supply effect"

¹⁸see Feestra (2003)[?]

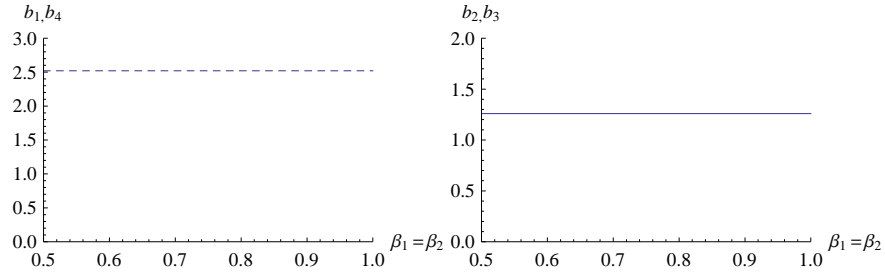


Figure 3: services liberalization and cost savings in h country, $I_1 = I_2$

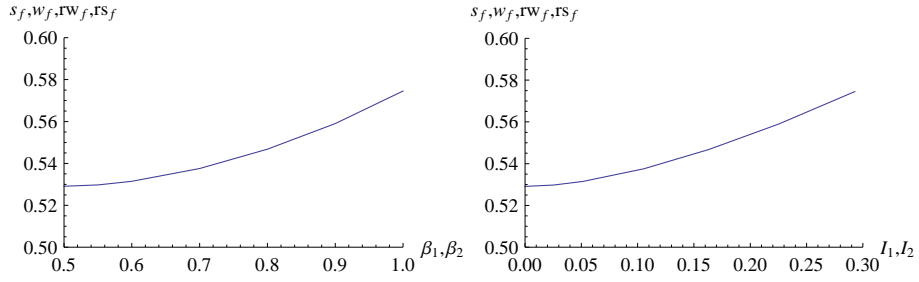


Figure 4: services liberalization, offshoring margin and wage rate in f country, $I_1 = I_2$

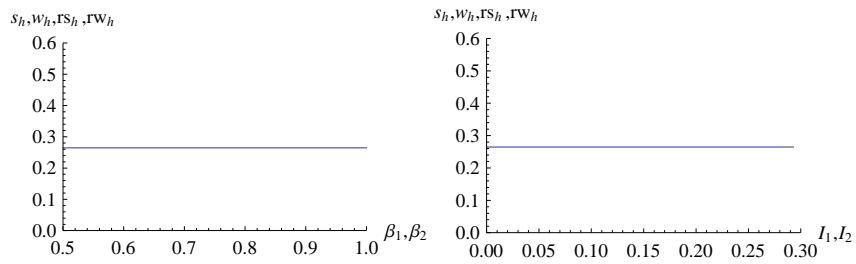


Figure 5: services liberalization, offshoring margin and wage rate in h country, $I_1 = I_2$

Trade and FDI in h Country Based on the assumptions of our model, there is no trade of final products (x and y) without offshoring of services. With services liberalization expanding offshoring, it is possible for firms in f country to combine the advanced technology and cheap labor in home country.

Proposition 3 *Services liberalization and offshoring bring new kind of service task trading, FDI in services and arise trade in complete products as a "new source of comparative advantage".*

Proof The fruit of offshoring L-tasks and H-task can be denoted as TT_L and TT_H ,

$$\begin{aligned} TT_L &= w_h(a_{Lx}x_f + a_{Ly}y_f)I_2 \\ TT_L^* &= (2^{2/3}AI_2L_f)/(3P^* - 3I_2P^*) \\ \partial TT_L/\partial I_2 &= (2^{2/3}AL_f)/(3(-1 + I_2)^2P^*) > 0 \end{aligned} \quad (43)$$

$$\begin{aligned} TT_H &= s_h(a_{Hx}x_f + a_{Hy}y_f)I_1 \\ TT_H^* &= (2^{2/3}AH_fI_1P^{*2})/(3 - 3I_1) \\ \partial TT_H^*/\partial I_1 &= (2^{2/3}AH_fP^{*2})/(3(-1 + I_1)^2) > 0 \end{aligned} \quad (44)$$

□

Proof

$$\begin{aligned} FDI_L &= w_h(a_{Lx}x_f + a_{Ly}y_f) \int_0^{I_2} 1/\beta(c + di)di \\ FDI_L^* &= -\frac{AI_2(2c + dI_2)L_f}{32^{1/3}(-1 + I_2)P^*} \\ \partial FDI_L^*/\partial I_2 &= \frac{A(2c - d(-2 + I_2)I_2)L_f}{32^{1/3}(-1 + I_2)^2P^*} > 0 \end{aligned} \quad (45)$$

$$\begin{aligned} FDI_H &= s_h(a_{Hx}x_f + a_{Hy}y_f) \int_0^{I_1} 1/\beta(a + bi)di \\ FDI_H^* &= -\frac{AH_fI_1(2a + bI_1)P^{*2}}{32^{1/3}(-1 + I_1)} \\ \partial FDI_H^*/\partial I_1 &= \frac{AH_f(2a - b(-2 + I_1)I_1)P^{*2}}{32^{1/3}(-1 + I_1)^2} > 0 \end{aligned} \quad (46)$$

□

Proof

$$T_{yh}^*{}^{19} = \frac{A((1+I_1)(3+I_2)L_h + H_h(-3+I_1)(1+I_2)P^{*3})}{32^{1/3}(1+I_1)(1+I_2)P^{*2}} \quad (47)$$

$$\partial(-T_{yh}^*)/\partial I_1 = \frac{2(2^{2/3})AH_hP^*}{3(1+I_1)^2} > 0$$

$$\partial T_{yh}^*/\partial I_2 = \frac{2^{2/3}AL_h}{3(1+I_2)^2P^{*2}} > 0$$

$$d(T_{yh}) = \frac{2(2^{2/3})AH_hP^*}{(1+I_1)^2} di > 0$$

$$T_{xh}^*{}^{20} = \frac{A((1+I_1)(-3+I_2)L_h + H_h(3+I_1)(1+I_2)P^{*3})}{32^{1/3}(1+I_1)(1+I_2)P^*} \quad (48)$$

$$\partial T_{xh}^*/\partial I_1 = \frac{2^{2/3}AH_hP^{*2}}{3(1+I_1)^2} > 0$$

$$\partial(-T_{xh}^*)/\partial I_2 = \frac{2(2^{2/3})AL_h}{3(1+I_2)^2P^*} > 0$$

$$d(T_{xh}) = \frac{2^{2/3}AH_hP^{*2}}{(1+I_1)^2} di > 0$$

□

First of all, offshoring of services itself generates service task trading of L -labor and H -labor. f country establishes subsidiaries in h country and service tasks trading occurs as an inter-firm trade between the headquarters in f country and subsidiaries in h country. We can treat the sum of costs of offshoring and inputs of wage paid to h country's labor as h country's inflow of FDI in services. FDI_L is FDI in low-skill labor intensive service sector, FDI_H is FDI in high-skill labor intensive service sector. With services liberalization, β_1 and β_2 increase, offshoring margins I_1 and I_2 increase, while offshoring and FDI in services will increase simultaneously. see figure 6, in the left figure, the dashed line is trade of L-tasks (H-tasks), the solid line is total task trade of services.

Secondly, offshoring will also bring "shadow migration" to change the labor supply in both countries and impact on supply of completed goods. Offshoring also alters the factor content of either industry through cost savings and factor substitution, and factor prices change in either country accordingly. Hence offshoring can be treated as "a new source of comparative advantage" and arises trade of final product x and y .²¹

¹⁹ T_{yh}^* is the excess demand of y in h country, $dI_1 = dI_2 = di$, $H_h = L_h$, $P = 1$

²⁰ T_{xh}^* is the excess demand of x in h country

²¹Baldwin (2007) analyze the results and channels in much detail.

If $I_1 = I_2$ ²², volumes of L -task and H -task offshoring are the same and FDI in L -labor intensive services and H -labor intensive services are also the same. Global absolute supply of x and y increase proportionally. However, absolute supply of y in f country increases in greater proportion than the reduction of supply of y in h country. The change of supply of x is the same as y . There is no change of demand side in h country, and that means income and the price has no change. Therefore, h country starts importing completed product x and y to satisfy the unchanged demand. With service offshoring costs decreasing, offshoring margins increase, and import of x and y will increase. h country exports the fruit of L -task and H -task and receives FDI in services, but imports of x and y from f country. According to equation (47) and (48), services liberalization in L -labor service task will increase the exports of L -labor intensive product x and imports of H -labor intensive product y ; services liberalization in H -labor service task will increase the exports of H -labor intensive product y and imports of L -labor intensive product x . In case of $I_1 = I_2$, the net import of both product will increase with offshoring.

Proposition 4 *With the services liberalization, a new kind of task trading and FDI in services will increase simultaneously. Our conclusion is that trade in services and FDI in services are complements, but not substitutes. If completed goods are service products, our conclusion of a complementary relationship between FDI and trade in services would be enforced.*

Offshoring and service liberalization will bring FDI in services, export of new kinds of services and import of complete product in h country. If we assume that all completed goods in our model are final service products or that most of them are service-intensive products, the complementary relationship between trade and FDI in services is obvious, Offshoring and FDI in services also boost exports.(see figure 7,8)

In figure 7, the solid line is FDI in services, the upper dashed line is total task trade in services (positive sign represent export) and the lower dashed line in the total trade of completed products. In figure 8, solid line is FDI in services and dashed line is net trade in f country.

3.4.2 Case 2: $I_1 > I_2$

Price and Liberalization Offshoring margin differences should be owed to the differences of offshoring costs, such as $a \neq c, b \neq d, \beta_1 \neq \beta_2$. In reality, services reform in h country may be inclined to different sectors or different tasks. Here, we emphasize policy cost proxy, $\beta_1 > \beta_2$, and assume $a = c, b = d$.

²²offshoring cost is the same, $a = c, b = d, \beta_1 = \beta_2$

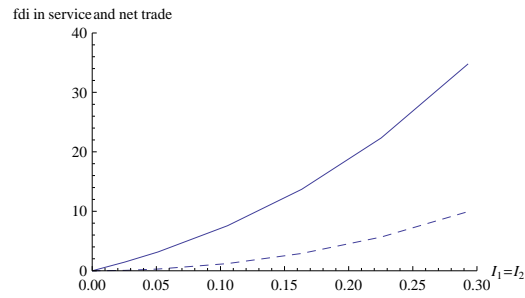


Figure 6: services liberalization and trade of complete products in h country, $I_1 = I_2$

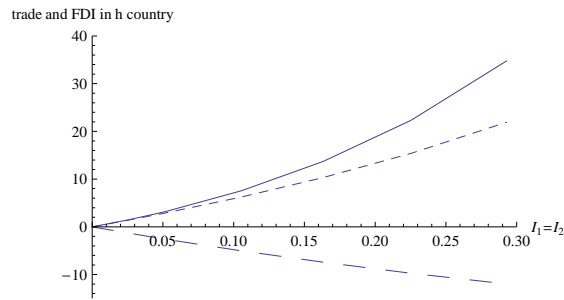


Figure 7: FDI in services, total trade of completed goods and services task trade in h country, $I_1 = I_2$

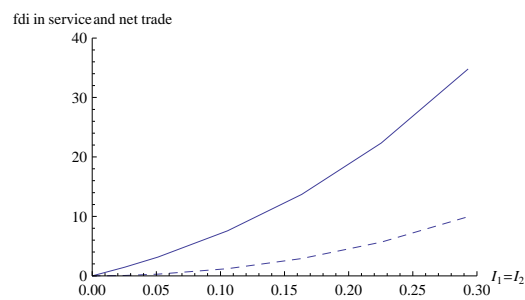


Figure 8: services liberalization, net export and FDI in services in h country, $I_1 = I_2$

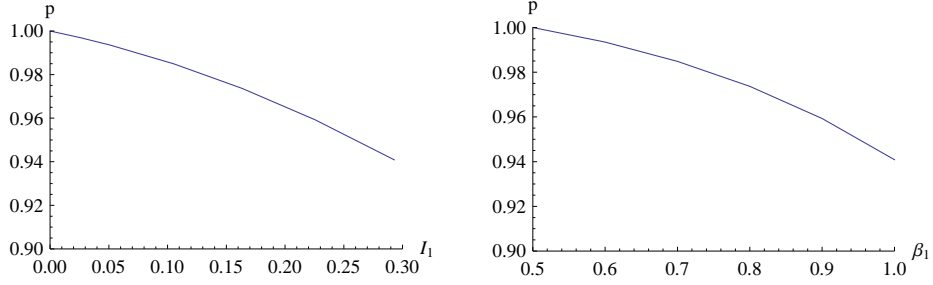


Figure 9: services liberalization, offshoring margin and price, $I_1 > I_2$

h country open more towards high-skill labor intensive service tasks. According to (31) and (32), $I_1 > I_2$.²³ The relative supply of y in the world will increase and relative price of y will decrease accordingly (See figure 9).

Wage and Liberalization

Proposition 5 *The wage change will depend on cost saving effect and price effect. If the offshoring margin of H -tasks is greater than L -tasks, the real return to low-skill labor in h and f country increases, but the real wage to high-skill labor in f country is undefined, the real return for high-skill labor in h country decreases.*

Proof

$$w_f^*/P^* = (2^{5/3}(c + dI_2))/(3(2c - d(-2 + I_2)I_2)P^{*2})$$

$$d(w_f^*/P^*) = (2^{5/3}(-4c^2dP^* + 2cdI_2(dP^*(-4 + I_2) + diP^*) + d^2I_2^2(2dP^*(-2 + I_2) + diP^*)))/(3(-2c + d(-2 + I_2)I_2)^2P^{*3}) \quad (49)$$

$$s_f^*/P^* = (2^{5/3}(a + bI_1)P^*)/(6a - 3b(-2 + I_1)I_1)$$

$$d(s_f^*/P^*) = (2^{5/3}/(3(-2a + b(-2 + I_1)I_1)^2))((2a^2 + 4abI_1 - abI_1^2 + 2b^2I_1^2 - b^2I_1^3)dP^* + bI_1(2a + bI_1)P^*)di \quad (50)$$

$$w_h^*/P^* = (2^{2/3}A)/(3P^{*2})$$

$$d(w_h^*/P^*) = -((2^{5/3}A)/(3P^{*3}))dP^* \quad (51)$$

²³In our simulation, we only consider an extreme case that is $I_1 > 0$, $\beta_1 > Aa$, $I_2 = 0$, $\beta_2 = 0.5$

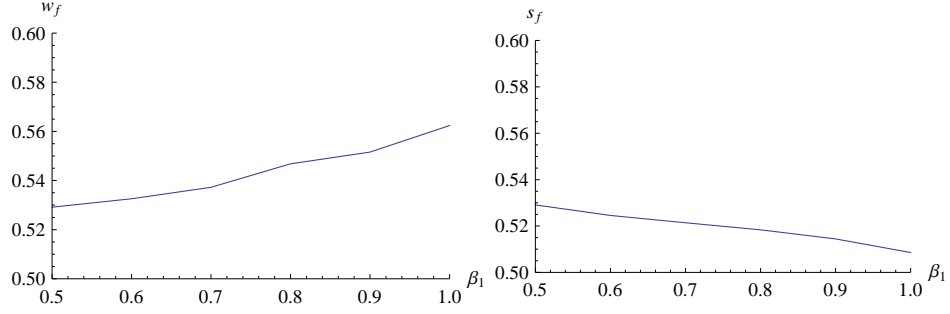


Figure 10: services liberalization and wage in f country, $I_1 > I_2$

$$\begin{aligned}
s_h^*/P^* &= (2^{2/3}A)/(3P^{*2}) \\
d(s_h^*/P^*) &= 1/32^{2/3}AdP^* \tag{52}
\end{aligned}$$

If $I_1 > I_2$, $dP < 0$, $d(w_f^*/P^*) > 0$, $d(s_f^*/P^*)$ is undefined ²⁴, $d(w_h^*/P^*) > 0$, $d(s_h^*/P^*) < 0$ \square

If H -task offshoring margin is greater than L -task offshoring margin, this will lead to a great deal of cost saving in H -tasks intensive industry, and increase the nominal wage of H labor. However, the price effect (as the relative price of y reduces) will decrease the return to H -labor in both country. Hence H -labor wage will be determined by the tradeoff of positive effect caused by cost savings of offshoring and negative effect of price decrease. Because the substitution between L and H labor exists, the price effect will increase the return to L -labor in h and f countries. H -task offshoring will inevitably increase the nominal and real wage of L -labor. But the effect on the nominal and real wage of H -labor is different. Offshoring of H -tasks will decrease nominal and real return of H labor in h country, but the negative effect on wage of H -labor in f country will be melt by the positive cost saving effect. we can see it in figure 10, 11, 12, 13. ²⁵

FDI and Trade in h Country

Proposition 6 *If $I_1 > I_2$, the elasticity of offshoring margin on price is less than $(1/(2 - 2I_1))$, H -task service offshoring and FDI in h country will increase with offshoring. h country starts to import H labor intensive good y and export*

²⁴if $(-4c^2 + 2cd(-4 + I_2)I_2 + 2d^2(-2 + I_2)I_2^2) dP^* + diP^* (2cdI_2 + d^2I_2^2P) > 0$, $d(s_f^*/P^*) > 0$

²⁵in our simulation, the offshoring cost: $a = 1, b = 4$, with I_1 increasing, cost saving effect dominates, so only offshoring of H -tasks will increase the real wage of H -labor in f country.

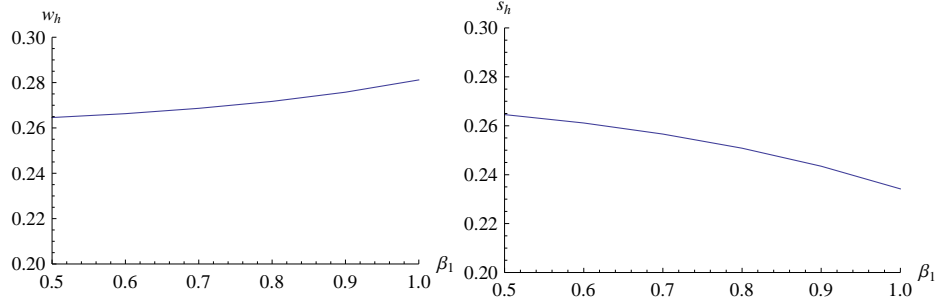


Figure 11: services liberalization and wage in h country, $I_1 > I_2$

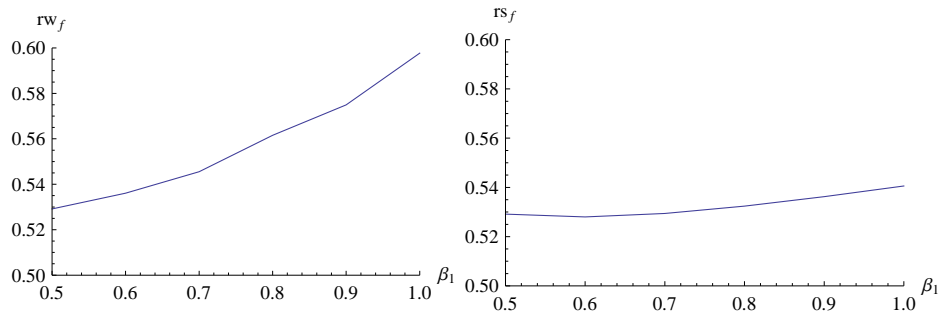


Figure 12: services liberalization and real wage rate in f country, $I_1 > I_2$

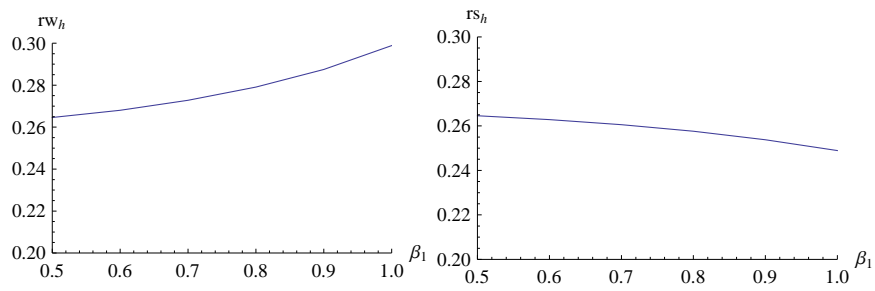


Figure 13: services liberalization and real wage rate in h country, $I_1 > I_2$

L labor-intensive goods x. FDI in services, trade of services and trade of completed goods are complementary and all increase with service liberalization and offshoring.

Proof

$$d(TT_H) = (2^{2/3}AH_fP^*(-2dP^*(-1 + I_1)I_1 + diP^*))/((3(-1 + I_1)^2)) \quad (53)$$

$$d(FDI_H) = (AH_fP^*)/(3(2^{1/3})(-1 + I_1)^2) * (-2dP^*(-1 + I_1)I_1(2a + bI_1) + di(2a - b(-2 + I_1)I_1)P^*) \quad (54)$$

If

$$-(dP^*/P^*)/(di/I_1) < 1/(2 - 2I_1), d(TT) > 0$$

If

$$-(dP^*/P^*)/(di/I_1) < (2a - b(-2 + I_1)I_1)/2(1 - I_1)(2a + bI_1), d(FDI) > 0$$

□

Trade and FDI in services in h country will increase with offshoring and service liberalization, but decrease with price reduction. The elasticity of offshoring margin on price is less than $1/(2 - 2I_1)$, then task trading and FDI will increase with offshoring. Actually, the condition is not hard to be satisfied.

Proof

$$d(T_{xh}) = \frac{A(-2diH_hP^{*4} + dP^*(1 + I_1)(3(1 + I_1)L_h + 2H_h(3 + I_1)P^{*3}))}{32^{1/3}(1 + I_1)^2P^{*2}} < 0$$

$$d(T_{yh}) = \frac{A(4diH_hP^{*4} + dP^*(1 + I_1)(-6(1 + I_1)L_h + H_h(-3 + I_1)P^{*3}))}{32^{1/3}(1 + I_1)^2P^{*3}} > 0$$

□

As for trade of completed products x and y in h country, they will increase with shadow migration. But the pattern of trade will be different from $I_1 = I_2$. When $I_1 > I_2 = 0$, country h starts to import y and export x , and with offshoring of H -tasks, trade of completed goods will increase. No doubt that the relationship between FDI in services, trade in service task and trade of final products will be complementary. Services liberalization will also boost export of services and complete products. See figure 14, 15, 16, 17. In figure 16, the solid line is FDI in services; the upper dashed line is total trade of completed goods in h country and the lower dashed line is H -task trade. In figure 17, the solid line is the total trade, and the dashed line is net exports in h country.

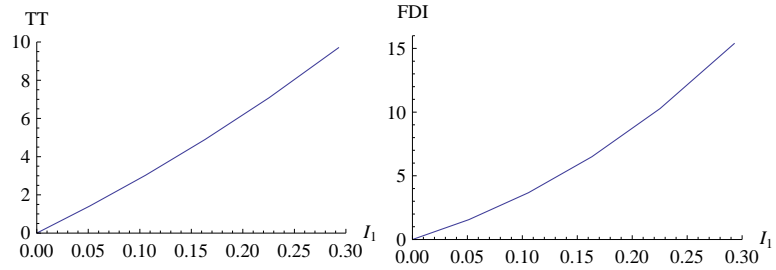


Figure 14: Services liberalization, offshoring of services and FDI in services in h country, $I_1 > I_2$

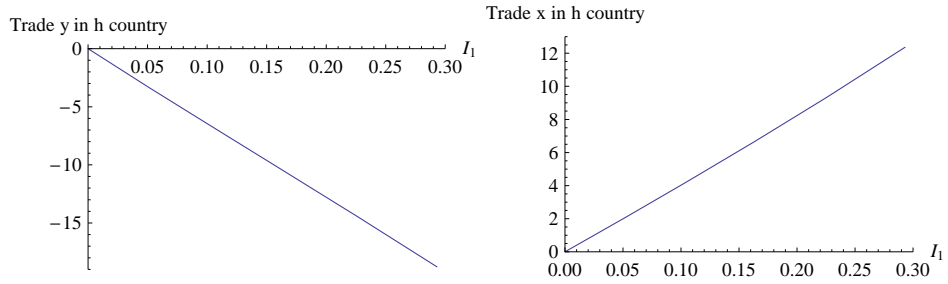


Figure 15: Services liberalization and trade of complete product in h country, $I_1 > I_2$

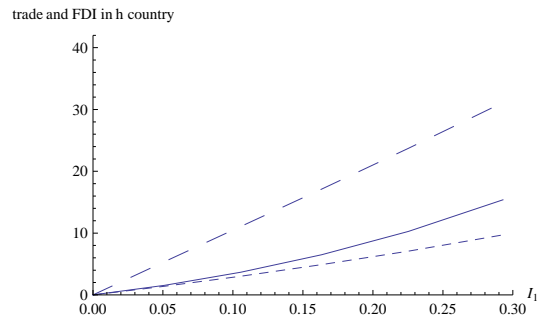


Figure 16: FDI and task trade in services and total trade of completed goods in h country, $I_1 > I_2$

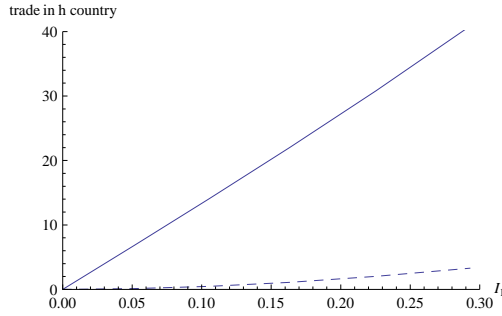


Figure 17: total trade and net export in h country, $I_1 > I_2$

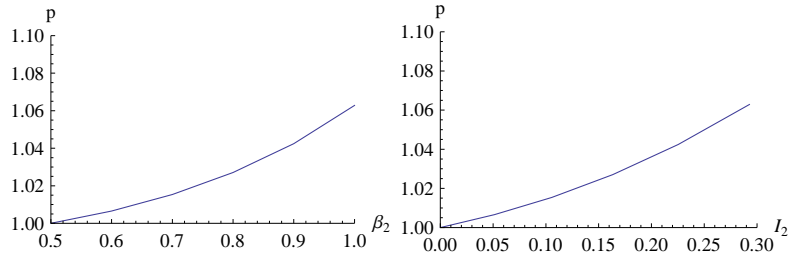


Figure 18: services liberalization ,offshoring margin and price , $I_2 > I_1 = 0$

3.4.3 Case 3: $I_2 > I_1$

If $\beta_2 > \beta_1$, $I_2 > I_1$, Services liberalization in h country is inclined to L -labor intensive service tasks.

Price and Liberalization The relative supply of y : $(y_f + y_h)/(x_f + x_h)$ in the world decreases, so the world relative price of y increase with offshoring of L -tasks. See figure 18.

Wage and Liberalization

Proposition 7 *The wage change will depend on the cost saving effect and price effect. If offshoring margin of L -tasks is greater than H -task, the real return to high skilled labor in h and f country increases; but the real wage to low-skill labor in f country is undefined, the real return to L -labor in h country decreases.*

If $I_2 > I_1$, $dP > 0$, according to formula (33), (34), (35), (36), dw^* is undefined, $ds^* > 0$, $dw_h^* < 0$, $ds_h^* > 0$. According to formula (49),(50),(51),(52), we can get $d(w^*/P^*)$ which is undefined, $d(s^*/P^*) > 0$, $d(w_h^*/P^*) < 0$, $d(s_h^*/P^*) > 0$.

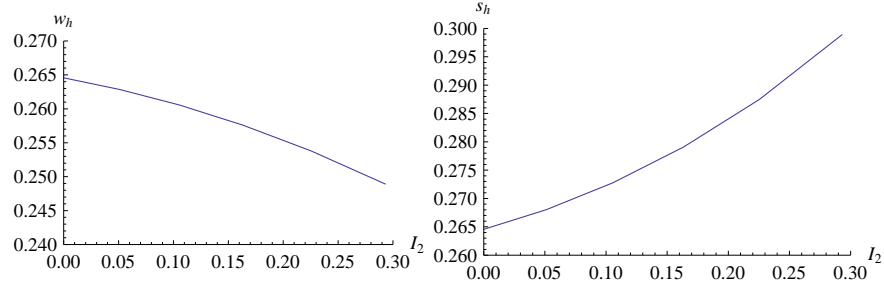


Figure 19: offshoring and nominal wage in h country , $I_2 > I_1$

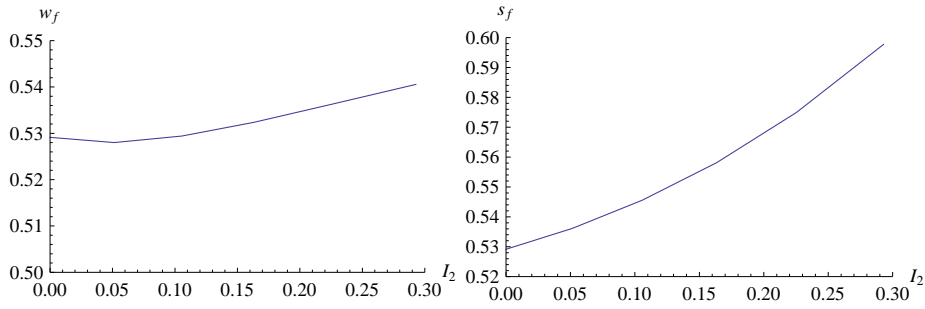


Figure 20: offshoring and nominal wage in f country , $I_2 > I_1$

The nominal and real wage rate of L -labor in f country will depend on the tradeoff of cost saving effect and price effect. See figure19, 20, 21, 22. Based on our assumptions, real wage of L -labor decreases but nominal wage of L -labor in h country increases with services liberalization.

FDI and Trade in h Country

Proposition 8 *If $I_2 > I_1$, the elasticity of offshoring margin on price is less than $1/(1-I_2)$, L -task service offshoring and FDI in h country will increase with offshoring. h country starts to import L -labor-intensive product x and export H -labor-intensive product y . FDI in services, trade of services tasks and trade of completed goods are complements and all increase with service liberalization and offshoring.*

Proof

$$d(TT_L) = (2^{2/3}AL_f(dP^*(-1 + I_2)I_2 + diP^*))/((3(-1 + I_2)^2P^{*2})$$

If $(dP^*/P^*)/(di/I_2) < 1/(1 - I_2)$, $d(TT) > 0$, $d(TT) > 0$

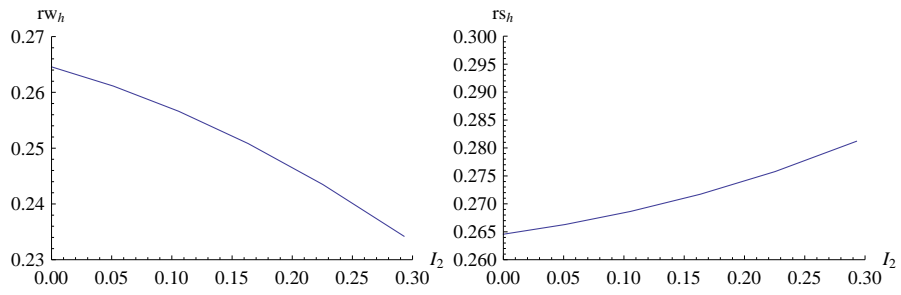


Figure 21: offshoring and real wage in h country, $I_2 > I_1$

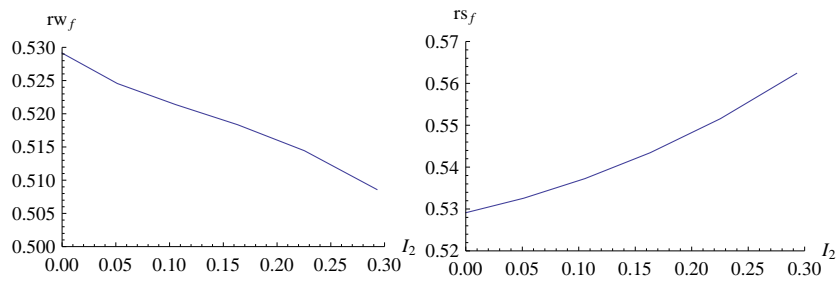


Figure 22: offshoring and real wage in f country, $I_2 > I_1$

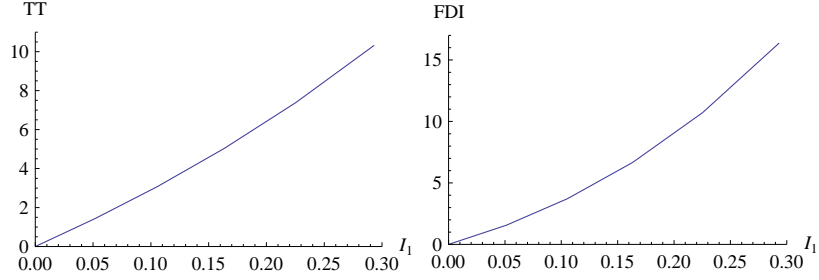


Figure 23: Services liberalization, offshoring of services and FDI in services in h country, $I_2 > I_1 = 0$

$$d(FDI_L) = AL_f / (2^{1/3}(-3+3I_2)^2 P^{*2}) * (dP^*(-1+I_2)I_2(2c+dI_2) + di(2c-d(-2+I_2)I_2)P^*)$$

$$\text{if } (dP^*/P^*) / (di/I_2) < (2c - (I_2 - 2)d) / ((1 - I_2)(2c + dI_2)), d(FDI) > 0. \quad \square$$

Proof The fruits of task trading and FDI in services increase with expanding offshoring margin. With respect to trade of complete product x and y , according to equation(49),(50),we get

$$d(T_{xh}) = \frac{A(4diL_hP^* - dP^*(1+I_2)((-3+I_2)L_h - 6H_h(1+I_2)P^{*3}))}{32^{1/3}(1+I_2)^2P^{*2}} > 0$$

$$d(T_{yh}) = -\frac{A(2diL_hP^* + dP^*(1+I_2)(2(3+I_2)L_h + 3H_h(1+I_2)P^{*3}))}{32^{1/3}(1+I_2)^2P^{*3}} < 0$$

□

So country h starts to import completed product x and export y , and trade of x and y will increase with service liberalization. (see figure 23, 24, 25, 26) In figure 25, the solid line is FDI in services; the upper dashed line is total trade of completed goods and the lower dashed line is L -tasks trade in h country. In figure 26, the solid line is the total trade, and the dashed line is net exports in h country.

3.5 Trade Barriers Exist for Completed Goods

If countries collect tariffs on import or subsidize exports of the completed goods, this will distort the price of final goods. So $P_h = t_h P$, $P_f = t_f P$, and then $p_h = tP_f$, $t = t_h/t_f$. We can add trade balance condition and t can be endogenously determined.

$$(y_{df} - y_{dh}) / (x_{df} - x_{dh}) = (y_f - y_h) / (x_f - x_h)$$

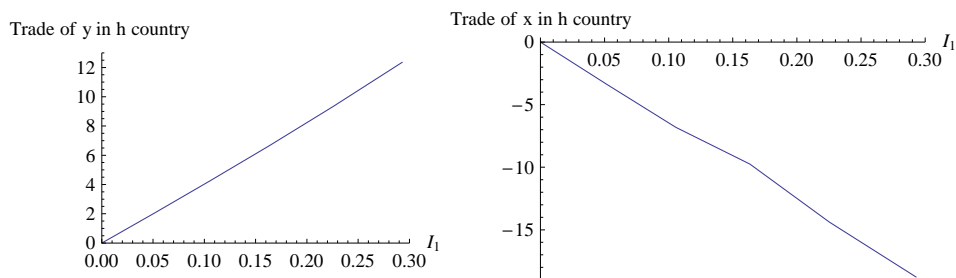


Figure 24: Services liberalization and trade of complete product in h country, $I_2 > I_1 = 0$

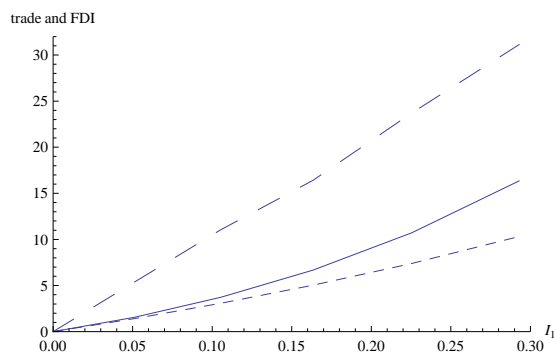


Figure 25: FDI and L -task trade in services and total trade of completed goods in h country, $I_2 > I_1 = 0$

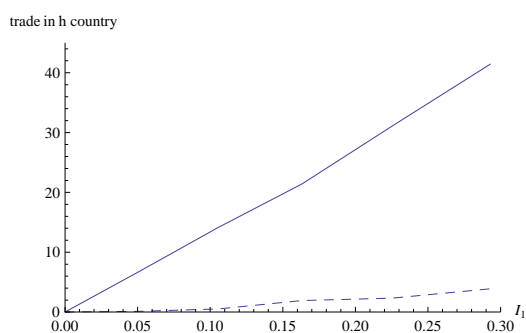


Figure 26: total trade and net export in h country, $I_2 > I_1 = 0$

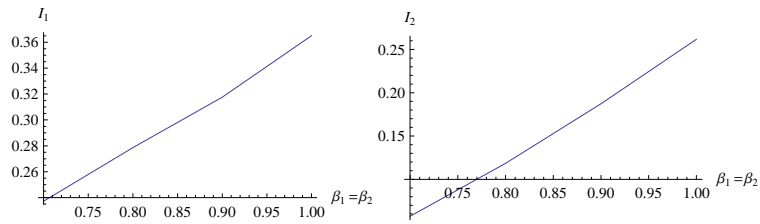


Figure 27: services liberalization and offshoring with trade barriers in complete goods

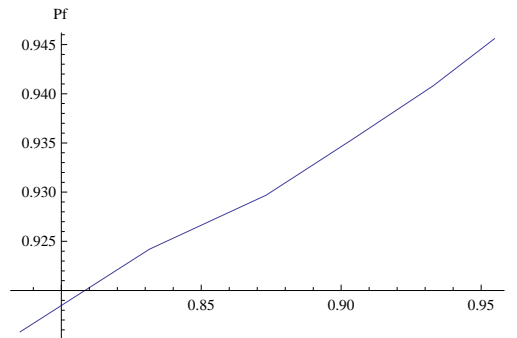


Figure 28: price distortion and price of y in f country

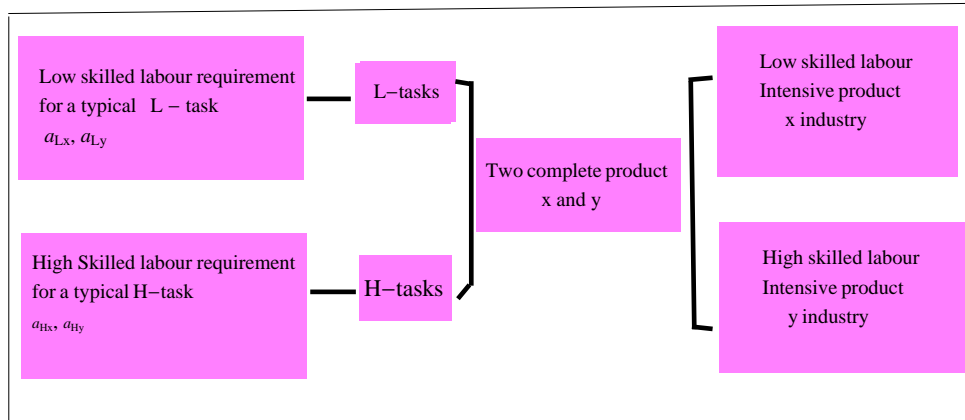
When h country carries on synchronous services reform on L -task services and H -task services, $\beta_1 = \beta_2$, the effect will be different from the case that no trade barriers exist. According to formula (27), (28) and the simulation results, we can get figure 27, 28. Offshoring margin of L -task and H -task services will be different, and $I_1 > I_2$. The optimal t^* and the price of y in h and f country will all increase with service liberalization. Trade and FDI in services and completed goods will depend on cost saving effect of offshoring and price effect determined by price distortion and world demand and supply .

4 Conclusions

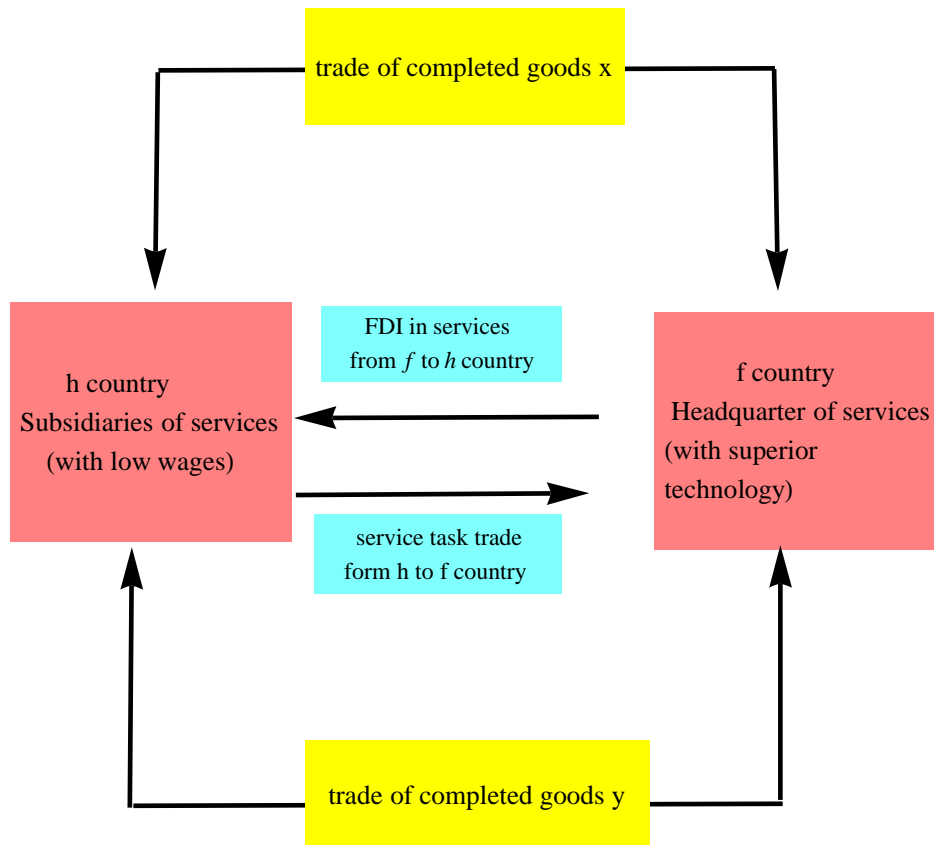
Due to drastic technological improvement and cost reduction in the transportation and communication sector, a variety of tasks clustered geographically within production process can be offshored to different locations around the world, in order to capture the cost saving aroused by the cheaper premiums. Therefore, international competition is not only the price war between final goods, but also expands to the gap of factor prices. In our paper, we try to incorporate both in a uniform general equilibrium model. However, people pay much attention

to transportation cost of trading in goods and services , but they always ignore a key push-factor of cost reduction in service offshoring, that is the policy related cost which decreases a lot with the efforts of multinational liberalization (GATS), regional negotiation (ASEAN, NAFTA), and domestic services sector reforms.

Our paper's major contribution is to introduce services liberalization as an exogenous policy shock to accelerate services offshoring. Furthermore, service offshoring, as shadow migration will impact on wage, price, production and trade in both countries. Our main conclusions are as followings: Liberalizing services reforms in host country (h country) will promote offshoring from that country; Offshoring is a determinant of, as well as a reaction to, wages in both countries. Wages of offhored labor (which is used to perform the tasks) in source country (f country) of offshoring will increase due to cost saving effect, and wages of h country are unaffected (controlling for price effect). However, orientations towards services liberalization reform in host country will alter cost saving effect and also elevate price effect which mitigates (reinforces) cost effect. Services liberalization and offshoring brings new kinds of services trading ,FDI in services and generates trade in final goods as a "new source of comparative advantage" and alters the trade pattern of final goods; And last but not least, Trade and FDI in services has a complementary relationship.



Graph1: tasks and production



Graph2: offshoring and trade of complete goods

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