Service Trade, Offshore Production, and Wage Inequality

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Abstract

A simple North-South model is presented to analyze the relation of offshore production and service trade. It shows that the South attracts more offshore activities from the North when it is more open for service trade; however, wage inequality between skilled and unskilled labor rises not only in the manufacturing sector but also in the business service sectors in both country. This model also implies that trade balance in the manufacturing sector in the North(South) worsens(improves) while that of the business service sector improves(worsens) with offshore production.

Keywords: Offshore Production, Service Trade, Wage Inequality

JEL Classification: F15, J31

1.Introduction

Since the late 1980s, the rising inequality between skilled and unskilled workers in terms of wages and employment has become a common phenomenon in many developed and developing countries. Economists generally agree that skill-biased technological progress is the main cause behind such a phenomenon, while a new wave of theoretical and empirical studies suggests that offshore production (or global outsourcing) also plays a pivotal role in the widening inequality in labor markets.[1] The rising inequality in labor market since the late 1980s has been linked to offshore production in the manufacturing sector (Feenstra and Hanson, 1996). In particular, Feenstra and Hanson (1996) assumed that capital rent is lower in the North (developed countries) than in the South (developing countries) and argued that an open policy in the South induces capital outflow from the North to the South and thereby results in increased offshore production, which in turn leads to a widening wage inequality not only in the North but also in the South.

Would the increase in wage inequality also occur in the service sector? At the same time, it is coincident that the employment in the service sector relative to the manufacturing sector in many countries has increased steadily but accelerated since the late 1980s, especially in developed countries as shown in Figure 1. Does the phenomenon of a disproportionate also rise in the service sector compared to the manufacturing sector since the late 1980s linked to widespread offshore production? In order to address these issues and explore how offshore production is driven and how it affects the labor markets in both the manufacturing and service sectors, I develop a new theoretical model that incorporates business services into Feenstra and Hanson's (1996) structure, in which the manufacturing sector is in perfect competition but the business service sector is in monopolistic competition.

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[1] See Feenstra and Hanson (1996), Antràs et al. (2006), and Ethier (2005) for theoretical analysis, and Epifani and Gancia (2008), Attanasio et al. (2004), Beyer et al. (1999), and Feenstra and Hanson (1997) for empirical analysis.

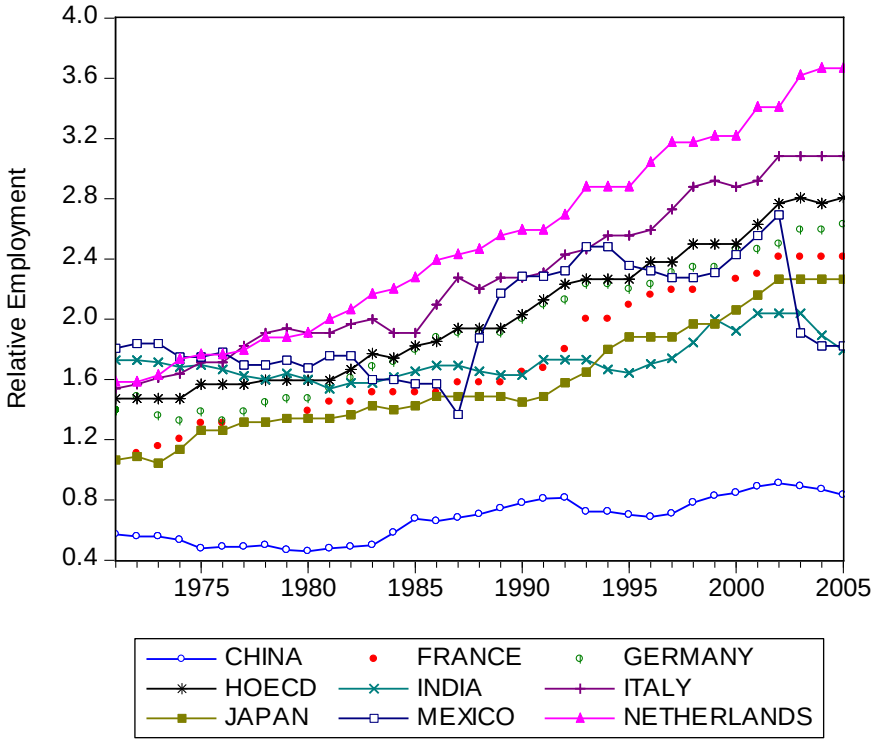

Figure 1: Employment in the service sector relative to the manufacturing sector[2]

About 70% of jobs in the OECD economy are within service industries, and many are, in fact, provided by standalone firms that offer specialized business services, consisting of financial services (e.g., banks), legal services (e.g., law firms), consulting services (e.g., Mckinsey & Company), transportation services (e.g., airline companies), marketing services (e.g., Era Ogilvy and Broadcasting Stations), telecommunication services (e.g., AT&T), distribution services (e.g., post offices and UPS), and even public services (e.g., water and electricity supply). These specialized business services are in a horizontal fashion. Thus, in contrast to Feenstra and Hanson's (1996) model, I suppose that each intermediate input requires a bundle of specialized business services, in addition to skilled/unskilled workers.

Reasonably, the matured North is capable of providing a greater number of specialized business services while a lower number of services are provided by the less mature South. This gives the North a price advantage in business services due to gains from specialization. An increase in intra-industry trade in business services due to an open policy in services trade (e.g., deregulation) or technology development (e.g., Internet and fiber communication) increases the number of business services available to both the North and South. I argue that the price of aggregate business services decreases diminishingly with the increase in the available number of business services. With the diminishing characteristics, the South benefits more from an increase in intra-industry trade of business services because it provides less variety of business services in the origin compared to the North. This disproportionate impact reduces price of the aggregate business services in the South more than that in the North. As a result, the general production costs in the South may become lower in some manufacturing activities that were originally located in the North, leading to more offshore activities from the North to the South.

In this model, I also allow unskilled labor to be mobile between the manufacturing and business service sectors in each country. An increase in intra-industry trade in business services leads to more offshore production from the North to the South, which results in relatively less demand for unskilled labor, thus worsening the wage inequality in the manufacturing sector.

[2] HOECD denotes OECD countries with a higher income.

On the other hand, I argue that the increase in intra-industry trade in business services gives a rise not only to the relative demand for skilled labor but also to the absolute demand for skilled/unskilled labor in the business service sector due to increasing economies of scale.[3] While unskilled labor is mobile across sectors, some of the relatively "oversupplied" unskilled labor in the manufacturing sector moves to the business service sector, which is demanding more skilled/unskilled labor until the two sectors reach the same wage inequality. As a result, the relative employment in the business services sector compared to the manufacturing sector increases with an increase in offshore production. The remainder of this paper is organized as follows. In Section 2, I analyze the relation of offshore production and service trade in the model set forth by Feenstra and Hanson (1996) where their capital factor is replaced with business services. The equilibrium is demonstrated in Section 3, and Section 4 concludes.

2. The Model

In a world of North and South, there are manufacturing and business services sectors. The manufacturing outputs, including final-goods and intermediate inputs are freely traded. Let the total supply of skilled and unskilled labor be H_M and L_M in the manufacturing sector, respectively, and H_S and L_S in the business service sector. Hence, the total labor supply of skilled and unskilled labor in the North is given by $H = H_M + H_S$ and $L = L_M + L_S$, respectively. The skilled labor is immobile across sectors because each sector requires specific skills and specialties. However, unskilled labor is mobile across the manufacturing and business service sectors because no specialty is required from them. Assume full employment and let the wage inequality between skilled and unskilled labor be the same between the manufacturing and business service sectors in the initial equilibrium.

2.1 Manufacturing Sector

Suppose that there is a single tradable manufactured final-good in the North, which is assembled by a continuum of intermediate inputs, indexed by $z \in [0,1]$. As in Feenstra and Hanson's model (1996), each unit of input z exogenously uses $a_L(z)$ of unskilled labor and $a_H(z)$ of skilled labor, and the labor required ratio $a_H(z)/a_L(z)$ is increasing in z. I use the model set forth by Feenstra and Hanson's model (1996) to develop in the production function of intermediate inputs, in which I replace their capital factor with business services:

$$x(z) = [\min\left\{\frac{AL(z)}{a_L(z)}, \frac{A^* H(z)}{a_H(z)}\right\}]^{\theta} [S(z)]^{1-\theta}. \qquad (1)$$

Variables associated with the South are denoted with an asterisk. In (1), A denotes labor productivity of the North, with $A > A^*$ meaning the North is more productive than the South. The term $S(z)$ in (1) represents the aggregate business services that bundle a horizontal array of specialized business services. It requires $S(z)$ units of aggregate business services to facilitate the production of intermediate input $x(z)$.

Let the manufacturing final-good be costlessly assembled:

$$\ln X = \int_0^1 \rho(z) \ln x(z) dz \text{, with } \int_0^1 \rho(z) dz = 1. \qquad (2)$$

With (1) and (2), the minimum costs of producing one unit of $x(z)$ in the North can be easily calculated following a standard methodology:

$$c(w, q, P_S; z) = B[wa_L(z) + qa_H(z)]^{\theta} P_S^{1-\theta}, \qquad (3)$$

where $B = \theta^{-\theta}(1-\theta)^{-(1-\theta)} A^{-\theta}$. Here, w and q are the wage rates of unskilled/skilled labor in the North, respectively. In (3), P_S is the price of the aggregate business services in the North, which are discussed in greater detail later. Similarly, the minimum costs of producing one unit of $x(z)$ in the South are given by

[3] In monopolistic competition, I assume that each variety of specialized business service requires a fixed amount of skilled labor to set up the operation and variable amount of skilled/unskilled labor for operation. An increase in the economies of scale leads to increased demand for the both skilled and unskilled labor. This will be discussed in detail in the following section.

$$c(w^*, q^*, P_S^*; z) = B^*[w^* a_L(z) + q^* a_H(z)]^\theta P_S^{*1-\theta}, \qquad (4)$$

where $B^* = \theta^{-\theta}(1-\theta)^{-(1-\theta)} A^{*-\theta}$. Here, w^* and q^* are the wage rates of unskilled/skilled labor in the South, respectively.

Comparing (3) to (4), the relative unit cost of producing an intermediate input between the North and South is given by $\frac{c(w,q,P_S,z)}{c(w^*,q^*,P_S^*,z)} = (\frac{\frac{w}{A}}{\frac{w^*}{A^*}})^\theta (\frac{P_S}{P_S^*})^{1-\theta} (\frac{1+\frac{q}{w}\frac{a_H(z)}{a_L(z)}}{1+\frac{q^*}{w^*}\frac{a_H(z)}{a_L(z)}})^\theta$. Feenstra and Hanson (1996) assume that the North is more abundant in the relatively supply of skilled labor than in the South, such that the wage inequality in the North is smaller than in the South as $\frac{q}{w} < \frac{q^*}{w^*}$.[4] Let's take Feenstra and Hanson's (1996) essential assumption as given here, which implies $(\frac{1+\frac{q}{w}\frac{a_H(z)}{a_L(z)}}{1+\frac{q^*}{w^*}\frac{a_H(z)}{a_L(z)}}) < 1$. That is, the relative unit cost $\frac{c(w,q,P_S,z)}{c(w^*,q^*,P_S^*,z)}$ increases in z as $\frac{a_H(z)}{a_L(z)}$ increases in z.

Remind that it is the political barriers hinge the international outsourcing activities in this paper. If an open policy is undertaken, the northern firms would like to relocate the labor-intensive production to the South in order to take advantage of the relatively lower unskilled-labor costs there, implying $\frac{w}{A} \geq \frac{w^*}{A^*}$; otherwise, there is no motivation for international outsourcing. With $(\frac{1+\frac{q}{w}\frac{a_H(z)}{a_L(z)}}{1+\frac{q^*}{w^*}\frac{a_H(z)}{a_L(z)}}) > 1$ and $\frac{w}{A} \geq \frac{w^*}{A^*}$, we can suppose that there exists a dividing point z^* to equal the relative unit cost as $\frac{c(w,q,P_S,z^*)}{c(w^*,q^*,P_S^*,z^*)} = 1$.[5] The South has a price competitive in the intermediate inputs with a smaller z.

[4] In order to make the relative unit cost be downward sloping with respect to z, Feenstra and Hanson (1996) directly assume $\frac{q}{w} < \frac{q^*}{w^*}$ and also assume that the skill intensity $a_H(z)/a_L(z)$ is increasing in z.

[5] We can assume that, in an extreme case, the intermediate input $z = 0$ is highly unskilled-labor intensive such that $\frac{a_H(0)}{a_L(0)} \to 0$, then the unskilled-labor cost dominates (i.e., $\frac{w}{A} \geq \frac{w^*}{A^*}$), leading to $\frac{c(w,q,P_S,0)}{c(w^*,q^*,P_S^*,0)} > 1$. On the other hand, in another extreme case, the intermediate input $z = 1$ is highly skilled-labor intensive such that $\frac{a_H(1)}{a_L(1)} \to \infty$, then the unskilled-labor cost dominates (i.e., $(\frac{1+\frac{q}{w}\frac{a_H(z)}{a_L(z)}}{1+\frac{q^*}{w^*}\frac{a_H(z)}{a_L(z)}}) > 1$), leading to $\frac{c(w,q,P_S,1)}{c(w^*,q^*,P_S^*,1)} < 1$.

Obviously, the relative price of the business service determines the producing location of intermediate input z. The more prices competitive the North has in business service provision, the less outsourcing activities are undertaken.

In (3) and (4), the locus of minimum costs for intermediate inputs production in the North and South can be illustrated by the thin lines in Figure 2, respectively (see Appendix 1 for further discussion). As in Feenstra and Hanson's model, the North has a cost advantage in the range of $[z^*,1]$ and the South has a cost advantage in the remaining range $[0,z^*]$. As a result, the inputs in the ranges of $[z^*,1]$ are produced in the North and the remaining are produced in the South.

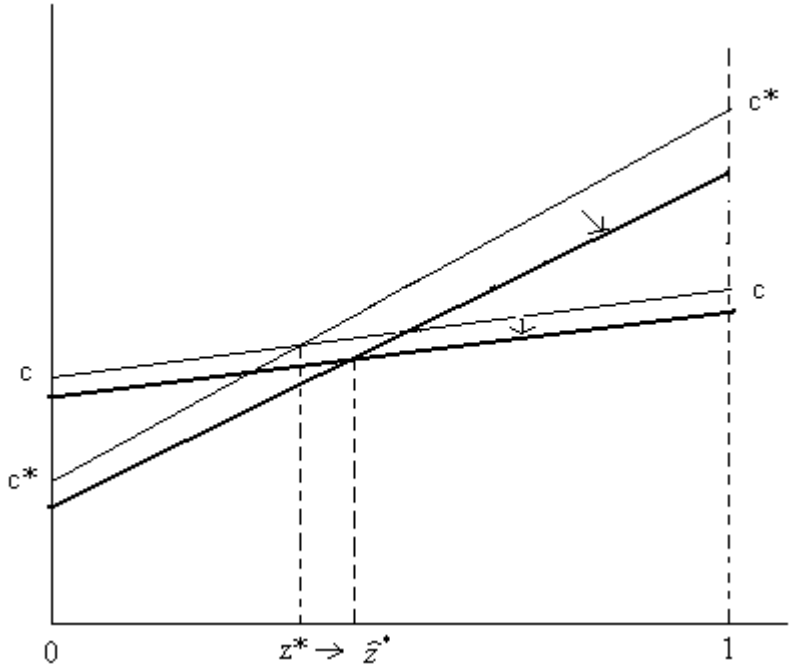

Figure 2: Market equilibrium of intermediate input.

2.2 Business Services

The manufacturing sector can be relocated for offshore activities. However, the offshoring of service jobs and production is rather limited not only in scale but also in the path of speed currently (McCarthy et al., 2004; Bhagwati, et al., 2004). Therefore, in the current model, I assume the presence of no offshore activities in the business service sector for simplicity. Furthermore, in contrast to the manufacturing inputs, specialized business services do not occur in vertical stages but are bundled together in a horizontal fashion.

Inspired by Jones and Kierzkowski (1990), Van Long et al. (2004) applied a standard CES framework to formalize aggregate business services in order to reflect gains from specialization. Similar to Van Long et al. (2004), I assume that the aggregate business services are a bundle of various specialized business services as

$$S(z) = [\sum_{j=1}^{N} s_j^{\alpha}(z)]^{1/\alpha}, \qquad (5)$$

where $0 < \alpha < 1$. However, I extend the structure of Van Long et al. (2004) from one labor framework to skilled/unskilled labor framework, so that I can discuss the impact of offshore production on the inequality between the skilled and unskilled labor in terms of wages and employment. Then, my model also differs from Van Long et al. (2004) with regard to the treatment of the production cost of specialized business services. Further, Van Long et al. (2004) introduced an iceberg transport cost in the trade of services while the transport cost in my model is either infinity or virtually nothing.

Supposed in initial equilibrium, the total number of business service variety is given by $N = n + n^*$ in (5), where n denotes the number of business services that are provided by the North and n^* presents those provided by the South. The business service sector is skilled labor intensive. While the North is relatively abundant in the supply of skilled workers than the South, it is feasible to assume that the former is capable of providing more varieties of business services than the latter, as $n > n^*$.

Intra-Industry Trade of Business Services

In order to provide a kind of specialized business input $s_j(z)$, fixed f units of *effective* skilled workers for setting up the operation is required in each country, in addition to variable costs for all j. However, with $\frac{q}{A} < \frac{q^*}{A^*}$, we have $\frac{qf}{A} < \frac{q^* f}{A^*}$ to indicate that the North is more competitive in the business service sector.[6] This assumption is based on the common observation that the skilled workers in the North are more productive (be more educated and more trained) in comparison to the skilled workers in the South.

In contrast to Van Long et al. (2004), the variable operation costs require not only v units of *effective* unskilled workers to run a routine set of instructions but also μ units of *effective* skilled workers with more training to deal with complex and tacit tasks. This assumption is applicable to both the North and the South. As a result, the provision of $s_j(z)$ units of specialized business service demands skilled workers of $\frac{f}{A} + \frac{\mu}{A} s_j(z)$ and $\frac{f}{A^*} + \frac{\mu}{A^*} s_j(z)$ for the North and South, respectively. It also demands unskilled workers of $\frac{v}{A} s_j(z)$ and $\frac{v}{A^*} s_j(z)$ for the North and the South, respectively. In the North, the aggregate employment of skilled workers is $H_S = \sum_{j=1}^{n} \int_0^1 \frac{f + \mu s_j(z)}{A} dz = \frac{n(f + \mu \int_0^1 s_j(z) dz)}{A}$ and that of unskilled workers is given by $L_S = \sum_{j=1}^{n} \frac{v}{A} \int_0^1 s_j(z) dz = \frac{nv}{A} \int_0^1 s_j(z) dz$. Similarly, the aggregate employment of skilled/unskilled labor in the South is given by $H_S^* = \frac{n^*(f + \mu \int_0^1 s_j(z) dz)}{A^*}$ and $L_S^* = \frac{n^* v}{A^*} \int_0^1 s_j(z) dz$, respectively.

In monopolistic competition, each business input provider equates marginal revenue with marginal cost. By assuming equilibrium for the specialized service providers, we obtain the price of each specialized business input as:

$$p_j = \frac{q\mu + wv}{\alpha A} = p \text{ for } j \in n, \text{ and}$$

$$p_j^* = \frac{q^* \mu + w^* v}{\alpha A^*} = p^* \text{ for } j \in n^*. \qquad (6)$$

[6] In the spectrum of the business services, the low-value services are usually provided by the South, which consist of back-office operations, phone centers, data entry, and so on. However, the high-value services, consisting of financial, legal services and so on, generally remain in the North in order to be closer to the place where new products tend to be developed (Bhagwati et al., 2004).

In (6), we obtain $\frac{p}{p^*} = \frac{1+\frac{q}{w}\frac{\mu}{\nu}}{1+\frac{q^*}{w^*}\frac{\mu}{\nu}} \frac{(w/A)}{(w^*/A^*)}$. With $w/A > w^*/A^*$ and $\frac{q}{w} < \frac{q^*}{w^*}$, it is feasible to assume that $\frac{p}{p^*}$ is not far larger than one, especially when $\frac{\mu}{\nu}$ is large. Note that the business service sector is relatively skilled-labor intensive, implying that $\frac{\mu}{\nu}$ is not small.

In autarky, the price of the aggregate business services in the North and the South is given by $\overline{P}_S = (\sum_{j=1}^{n} p_j^{\alpha/(\alpha-1)})^{(\alpha-1)/\alpha} = p(n)^{(\alpha-1)/\alpha}$ and $\overline{P}_S^* = p^*(n^*)^{(\alpha-1)/\alpha}$, respectively. We obtain the relative price of the aggregate business services as $\frac{\overline{P}_S}{\overline{P}_S^*} = (\frac{n}{n^*})^{\frac{\alpha-1}{\alpha}} \frac{p}{p^*}$, which shows that the price of aggregate business service is decreasing diminishingly with the number of specialized business services.

Warzynski (2001) estimated the average mark-up in the U.S. manufacturing industry, averaged across 450 industries and over the period 1958–1994, which was found to range from 20% to 40%. His estimation suggests that the elasticity of substitution ranges from 3 to 5. Let's use the mid-point estimation and assume the elasticity of substitution is 4 for simplicity, implying $\alpha = \frac{3}{4}$. Plug the $\alpha = \frac{3}{4}$ into the relative price of the aggregate business services, we obtain $\frac{\overline{P}_S}{\overline{P}_S^*} = (\frac{n}{n^*})^{-3} \frac{p}{p^*}$. As argued above that $\frac{p}{p^*}$ is not far larger than one, we should then observe $\frac{\overline{P}_S}{\overline{P}_S^*} < 1$ when n is sufficiently larger than n^*.[7] That is, I presume in this model that the North is more competitive in business service sector, leading to $\overline{P}_S < \overline{P}_S^*$ even through we have $p > p^*$. With this key assumption in this model, I will show in the following that the price difference in the aggregate business services (e.g., $\overline{P}_S < \overline{P}_S^*$) is analogous to the assumption of a capital rent difference (e.g., $r < r^*$) between the North and South as assumed in Feenstra and Hanson's (1996) model.

After opening trade, the price of aggregate business services in the North and South is

$$\hat{P}_S = [\sum_{j=1}^{n+n^*} p_j^{\alpha/(\alpha-1)}]^{(\alpha-1)/\alpha} = (np^{\alpha/(\alpha-1)} + n^* p^{*\alpha/(\alpha-1)})^{(\alpha-1)/\alpha} = \hat{P}_S^*, \qquad (7)$$

where the prices of the aggregate business services equal in the two countries after free trade. In (6) and (7), it is easy to observe the inequality as $\overline{P}_S - \hat{P}_S < \overline{P}_S^* - \hat{P}_S^*$, which implies that the open trade in business services reduces the prices of aggregate business services to a larger extent in the South. Due to the disproportionate impact, the general production cost in the South may become lower in some intermediate inputs that were originally located in the North, encouraging more offshore activities from the North to the South. The argument that trade liberalization in trade services can stimulate the fragmentation of the production of goods is also in line with Deardorff (2001).

[7] For example, if $\frac{n}{n^*} = 2$ and $\frac{p}{p^*} = 7$, we obtain $\frac{\overline{P}_S}{\overline{P}_S^*} = \frac{7}{8} < 1$. In real practice, for example, comparing the U.S. and China, it is very likely that $\frac{n}{n^*} > 2$ but very unlikely that $\frac{p}{p^*} > 7$.

However, Deardorff argued that the international provision of trade services is aimed to facilitate *trade* in goods. Instead, specialized business services in the current model are production factors that facilitate the *production* of goods.

Proximity in Service Trade

In this model, manufacturing inputs are freely traded without physical transportation costs involved, as are the business services. However, many services, which are intangible and requiring proximity to the users, render service provision to distant location infeasible. Even with a free trade agreement, some of the business services, such as telecommunications and broadcasting, are heavily regulated because of their economic importance and political sensitivity, to the extent that the access of service providers from abroad has still been largely hurdled (Garner, 2004). Thus, I argue that, with the proximity limitation, there is a g share of business services in each country that cannot cross national borders, where $0 < g < 1$. It is reasonable to believe that favorable deregulation policies (or technology development) in service trade should be reciprocal, so I assume $g^* = g$ for simplicity.[8] The remaining $1-g$ share of business services is able to freely trade. In comparison to the ideal free trade condition (i.e., $g = 0$) represented in (7), the role of proximity in service trade leads to a new price of aggregate business in the North, indicated as the following:

$$P_S = [\sum_{j=1}^{n+(1-g)n^*} p_j^{\alpha/(\alpha-1)}]^{(\alpha-1)/\alpha} = [np^{\alpha/(\alpha-1)} + (1-g)n^* p^{*\alpha/(\alpha-1)}]^{(\alpha-1)/\alpha}, \qquad (8)$$

which implies that the South can only export $(1-g)n^*$ number of specialized business services to the North.

Similarly, the price of aggregate business services in the South is:

$$P_S^* = [\sum_{j=1}^{(1-g)n+n^*} p_j^{\alpha/(\alpha-1)}]^{(\alpha-1)/\alpha} = [(1-g)np^{\alpha/(\alpha-1)} + n^* p^{*\alpha/(\alpha-1)}]^{(\alpha-1)/\alpha}, \qquad (9)$$

which shows that the North can only export $(1-g)n$ number of specialized business services to the South.

Comparing (8) and (9), we have $P_S < P_S^*$ if $\frac{n}{n^*} > (\frac{p}{p^*})^{\frac{\alpha}{1-\alpha}}$. Again, if n is sufficiently larger than n^*, the North is more competitive in the business service sector.

Freund and Weinhold (2002) argued that new technology, such as the Internet, provides a medium of exchange that overcomes such trading hurdles for many services, effectively reducing transport costs from infinity to virtually nothing. Therefore, I allow g, which is exogenously determined, to reduce with an open policy of service trade, like deregulation, or with technology development in proximity improving technology, such as the Internet. Taking the derivate of (8) and (9) with g, we get $\frac{\partial P_S}{\partial g} = (\frac{1-\alpha}{\alpha})(n^* p^{*\alpha/(\alpha-1)}) P_S^{\frac{1}{1-\alpha}}$ and $\frac{\partial P_S^*}{\partial g} = (\frac{1-\alpha}{\alpha})(np^{\alpha/(\alpha-1)}) P_S^{*\frac{1}{1-\alpha}}$ for the North and South, respectively. With $P_S^* > P_S$, as n is sufficiently larger than n^*, the South reflects more than the North with the technology development or with open trade policy in the service sector as

$$\frac{\partial p_S^*}{\partial g} > \frac{\partial p_S}{\partial g} > 0.^{9} \qquad (10)$$

[8] While aggregate business services decrease diminishingly with the number of varieties, our results will not be altered if we assume g is a certain amount rather than a share of business services. For simplicity, I also assume that the impact of g on the n and n^* is negligible.

[9] We can rewrite the inequality $\overline{P}_S = pn^{(\alpha-1)/\alpha} < \overline{P}_S = p^* n^{*(\alpha-1)/\alpha}$ to $(p^{\alpha/(\alpha-1)}n)^{(\alpha-1)/\alpha} < (p^{*\alpha/(\alpha-1)}n^*)^{(\alpha-1)/\alpha}$, which implies

The inequality in (10) implies that the price of the South's aggregate business services reduce with technology development/open trade policy to a greater extent, making the tailoring of business-specific packages in favor of the South. The North may relocate more intermediate inputs to the South to pursue a lower general production cost there, as illustrated by the bold lines in Figure 2. That is, while n is sufficiently larger than n^*, an increase in intra-industry trade in business services, due to either technology development or an open policy in the business service sector, leads to more offshore activities in the manufacturing sector. While Feenstra and Hanson's (1996) model focus the open trade policy on the manufacturing sector, I argue that the South can adopt open policy in the business service sector to attract more offshore activities from the North. Form the above argument, we obtain the following proposition.

Proposition 1: Regarding business service trade, South country adopting a more open policy not only help reduce more on the domestic aggregate service cost, but also becomes more attractive for offshore activities from the North.

2.3 Balance of Trade

The North exports $(1-g)n$ varieties of business services to serve the intermediate input producers along $[0, z^*]$ that are located in the South, and imports $(1-g)n^*$ varieties of business services from the South for its intermediate input producers along $[z^*, 1]$. With equilibrium, the North's net export of value-added from the business service sector is determined by

$$(1-g)[np\int_0^{z^*} s(z)dz - n^* p^* \int_{z^*}^1 s(z)dz], \qquad (11)$$

which increases with an increase in z^*. That is, an increase in offshore production in the manufacturing sector (i.e., a greater value for z^*) improves the North's trade balance in the business service sector.

A good example of the "virtual" manufacturers is made by Apple Inc., which designed the majority of the system architectures of the iPod in-house, but *simultaneously* outsourced more than 99% of iPod's components to the low-waged Asia-Pacific region (Linden et al., 2007). A similar pattern of offshore production also occurs to the personal computer (PC) industry, in which more than 99% of PC components are produced in the Asia-Pacific region. Another well-known example of offshore production is the IC (Integrated circuit chips) industry, which are used in almost all electronic products in the information technology industry today and have revolutionized the world of electronics. About one-half of the integrated circuits produced in the world are manufactured by dedicated semiconductor foundries located in the Asia-Pacific region (e.g., Taiwan; Hodges and Leachman, 2004). With $p > p^*$, the sign in (11) should be positive when n is sufficiently larger than n^* unless z^* approaches to zero. However, given observations above that offshore activities are, in fact, prevailing in the manufacturing sector currently, it is feasible to assume that z^* is far from be in a trifling amount. As a result, (11) implies that the North runs a trade surplus in the business service sector when the offshore activities in the manufacturing sector are not in a trifling amount.

All intermediate inputs are in perfect competition and in a free traded environment. Thus, being the least skilled labor intensive activity, the assembly of the final good must be accomplished in the South. The North exports its skilled labor intensive components to the South in order to be assembled with the relatively unskilled labor intensive components produced by the South into the final goods. The South then exports the majority of the final goods to the North and consumes the remaining final goods itself. This pattern of trade is in line with real practice. The division of the total output of the final goods is determined by the relative size of each economy, implying $\frac{n}{n+n^*}$ share of the total output of the final goods is attributed to the North and the remaining is attributed to the South.[10]

$(p^{\alpha/(\alpha-1)}n) > (p^{*\alpha/(\alpha-1)}n^*)$ while $0 < \alpha < 1$.

[10] Note that we have already allowed n and n^* to denote countries' stage of development, which also represents the relative size of each economy. Alternatively, if we relax this assumption by assuming that the division of output is positively related,

Then, the North's net export of value-added of labor inputs from the manufacturing sector is determined by

$$\int_{z^*}^{1}(wa_L(z)+qa_H(z))dz-\frac{n}{n+n^*}[\int_{z^*}^{1}(wa_L(z)+qa_H(z))dz+\int_{0}^{z^*}(w^*a_L(z)+q^*a_H(z))dz]. \quad (12)$$

The (12) suggests that the North exports intermediate inputs along $[z^*,1]$ to the South and imports the $\frac{n}{n+n^*}$ share of the total output of the final goods from the South in exchange. With some algebra, equation (12) can be rewritten as

$$\frac{1}{n+n^*}[n^*\int_{z^*}^{1}(wa_L(z)+qa_H(z))dz-n\int_{0}^{z^*}(w^*a_L(z)+q^*a_H(z))dz], \quad (13)$$

which implies that an increase in offshore production in the manufacturing sector (i.e., a greater value for z^*) worsens the North's trade balance in the manufacturing sector.

Net trade is balanced when the trade deficit/surplus in the manufacturing sector equals the trade surplus/deficit in the business service sector, such that we should obtain zero by adding (11) and (13) together. As argued in (11) above, the North runs a trade surplus in the trade of business services. In order to balance trade in the aggregate, (13) must be negative especially when n is sufficiently larger than n^* and the offshore activities in the manufacturing sector are not in a trifling amount, suggesting that the North runs a trade deficit in the manufacturing sector.

Proposition 2: An increase in offshore production worsens (improves) the trade balance in the manufacturing (business service) sector in the North. When trade is balanced, the North runs a trade surplus (deficit) in the business service (manufacturing) sector in response to a sufficiently large n. The reverse occurs in the South.

3. Equilibrium

The relative demand for skilled labor to unskilled labor is $\frac{H_S}{L_S}=\frac{f_N}{v\int_0^1 s_j(z)dz}+\frac{\mu}{v}$ and $\frac{H_S^*}{L_S^*}=\frac{f_S}{v\int_0^1 s_j(z)dz}+\frac{\mu}{v}$ for the North and South, respectively. As Krugman's (1979) monopolistic model suggests, a reduction in g leads to a greater number of specialized business services available to each country, but results in lower demand for each variety $s_j(z)$, implying a larger $\frac{f_i}{v\int_0^1 s_j(z)dz}+\frac{\mu}{v}$, where $i=N,S$. That is, the relative demand for skilled labor in the business service sector increases with an increase in the intra-industry trade in business services in both economies. The illustration in Figure 3(b) shows that the relative skilled labor demand curve in the business service sector is shifting upward with a reduction in g. On the other hand, the reduction in g leads to a disproportionate impact on general production costs, in favor of the South, results in more offshore activities in the manufacturing sector as implied in (10). It then causes the relative skilled labor demand curve in the manufacturing sector to shift upward, as illustrated in Figure 3(a).[11]

Mobile unskilled workers

The elasticity of relative skilled labor supply is likely to be determined by a nation's educational resources. Reasonably, a country that is endowed with more educational resources can more easily transform unskilled labor to skilled labor, implying a flatter skilled labor supply curve. However, the discussion of the role of education on the endogenous supply of skilled labor is not in the scope of this paper.

rather than equal, to the countries' stage of development, our results will not be altered.

[11] The proof is very similar to the calculation in Feenstra and Hanson (1996, p. 92-97), except that the capital rent in their model is replaced by the price of aggregate business service in my model. To save space in this paper, I simplify the proof in the appendix 2.

Thus, I directly follow Feenstra and Hanson (1996) in assuming that the relative supply of skilled labor is increasing in wage inequality as $\frac{H_M}{L_M}'(\frac{q}{w}) > 0$ and $\frac{H_S}{L_S}'(\frac{q}{w}) > 0$. We can then illustrate an upward-sloping curve as shown in Figure 3(a) and 3(b) for the manufacturing and the business service sectors, respectively. Reasonably, the two relative supply curves share similar elasticity of supply.

To maintain the full employment condition, Feenstra and Hanson (1996) assumed that employment at both the highest-skilled and lowest-skilled activities increase, with less employment in the middle range of activities after open trade. However, the relative skilled labor supply curves do not shift if labor is immobile across the manufacturing and business service sectors. To the contrary, I allow unskilled workers to be mobile across sectors in this model, such that some unskilled workers reshuffle within industry but the remaining shift across the manufacturing and business service sectors.

In the business service sector, not only the relative demand for skilled labor increases with a reduction in g, but also the absolute demand for unskilled/skilled workers increases consequently with a larger scale of economies. Then, an increase in absolute demand for unskilled workers in the business service sector coincides with an oversupply of unskilled workers in the manufacturing sector, resulting in a labor flow of unskilled workers from the manufacturing to the business service sector until wage inequality equals in each sector. The labor flow increases the relative supply of skilled labor in the manufacturing sector, shifting the relative skilled labor supply curve to the right, as shown in Figure 3(a).

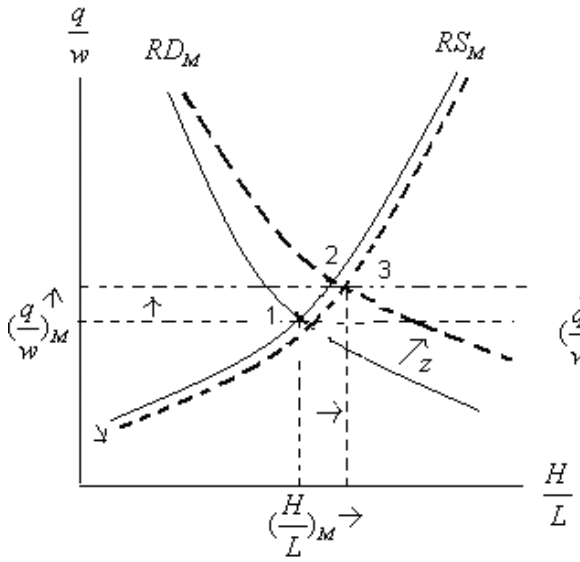

Figure 3 (a) Manufacturing Sector

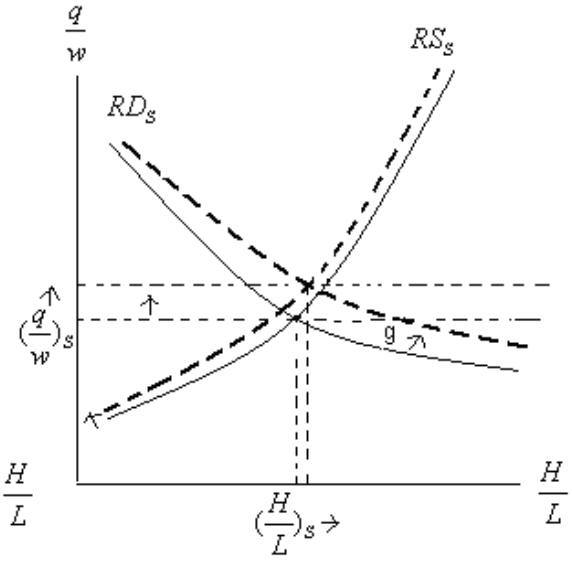

Figure 3 (b) Service Sector

On the other hand, with the inflow of unskilled labor from the manufacturing sector, the relative supply of skilled labor in the business service sector is reduced, shifting the relative skilled labor supply curve to the left, as illustrated in Figure 3(b). Only a part of unskilled workers shift across sectors while the remaining unskilled workers reshuffle within industry, leading to only a minor shift in the relative skilled labor supply curve. On net, I argue that the new equilibrium still shows greater inequality between skilled and unskilled labor in terms of employment in each sector, as illustrated in Figures 3(a) and 3(b). **As a result, both the manufacturing and business service sectors become more skilled labor intensive.**

Proposition 3: An increase in offshore production due to increased intra-industry trade in business services leads to widening inequality between skilled and unskilled labor in terms of wages and employment not only in the manufacturing but also the business service sectors in both the North and South.

Proof : See Appendix for the proof.

Due to the mobility of unskilled labor, employment in the business service sector increases while that of the manufacturing sector reduces with the offshore production in the North.

The scenario that occurs in the North also occurs in a similar way in the South. In the South, the increase in intra-industry trade of business services leads to a greater demand for skilled labor relative to unskilled labor, leading to a rising wage inequality in the business service sector. On the other hand, the consequent increase in offshore production generates a bias toward skilled labor and gives a rise to wage inequality in its manufacturing sector. While cost functions of the business services are similar to that in the North, open trade leads to more demand for skilled/unskilled workers in the business service sector, making the relative employment in the business service sector compared to the manufacturing sector in the South increasing with the offshore production as well. While the derivation of this argument is similar to that in Section 3.2, I omit the derivation to save space in this paper.

Proposition 4: An increase in offshore production leads to an increase in the relative employment of the business service sector compared to the manufacturing sector in both the North and the South.

The argument in Proposition 4 matches the data. Mann (2003) confirmed that, due to international outsourcing, disproportionate and continuing employment losses in manufacturing in the U.S., but increased employment in the service sector, throughout the period of 1999-2003. The service sectors in the South also grow faster than their respective manufacturing sectors with the increase in offshore production. Taking China as example, the service share (% of GDP) of China increased from 24% in 1970 to 40% in 2007, while the industry share (% of GDP) increased from 40% to 49% throughout the same period, indicating a rising share of the service sector relative to the manufacturing sector. Similar trends also occur in India, Mexico, Thailand, Malaysia, Pakistan, and so on.

4. Conclusions

I have presented a simple North-South model to argue that the South can attract more offshore activities in the manufacturing sector from the North by adopting a more open policy for business service imports. An increase in the intra-industry trade of business services, either due to an open policy (e.g., deregulation) in service trade or technological development in improving proximity (e.g., Internet), leads to more varieties of business services available to each country and then brings up gains from specialization in business services. The gains from specialization reduce the cost of business services in the aggregate, but lead to a disproportionate price reduction in favor of the South. As a result, the general production costs in the South may reduce more in some intermediate inputs that were originally located in the North, thereby encouraging more offshore activities. This model suggests a policy implication: the more a country is open for business service imports, the more the country is able to attract offshore activities from advanced nations. In line with Feenstra and Hanson (1996), this model shows that offshore production leads to a widening inequality between skilled and unskilled labor in the countries involved. Additionally, I argue that the widening inequality in labor markets occurs not only in the manufacturing sector but also in the business service sector, making both sectors more skilled labor intensive.

Most important, Feenstra and Hanson (1996) argue that trade liberalization has to lead to a worsening wage inequality between skilled and unskilled labor. Instead, this current paper argues that the deterioration in the wage inequality is softened if the economy is more prosperous in business service provisions or more open to business service trade. The model specifies circumstances where offshore manufacturing and worsening wage inequality may be reduced. In this model, the general production cost is reduced with an increase in the number of varieties of business services provided, such that a country that is able to provide a greater variety of business services tends to gain price competitiveness in the manufacturing industry, restraining the manufacturing industry's hollowing-out. Therefore, a government should create an environment favorable to the expansion of business services in order to reduce wage inequality.

Finally, this paper, which focuses only on business services in the analyses, argues that relative employment in the business service sector compared to the manufacturing sector increases with offshore production in both the North and the South.

The service sector, in fact, consists of not only business services but also personal services, education and health services (Askenazy, 2005). Ideally, to study the implications of services in regards to the impact of offshore activities, this model should take into account all of these sub-sectors, in which the choice of skill upgrading is endogenized. The extension will better clarify the complex interactions between wages, skill upgrading, services trade, and offshore activities. I hope to address these issues in future research.

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Appendix 1

In (4), the unit cost function in the North is given by

$$c = \theta^{-\theta}(1-\theta)^{-(1-\theta)} a_L(z) \frac{w}{A^{\theta}} [1 + \frac{q}{w} \frac{a_H(z)}{a_L(z)}]^{\theta} P_S^{1-\theta}.$$

The unit cost function in the South is given by

$$c^* = \theta^{-\theta}(1-\theta)^{-(1-\theta)} a_L(z) \frac{w^*}{A^{*\theta}} [1 + \frac{q^*}{w^*} \frac{a_H(z)}{a_L(z)}]^{\theta} P_S^{*1-\theta}.$$

We can plot the two unit cost functions with respect to z in the Figure 2. Note that we already have two essential presumptions: $\frac{q}{w} < \frac{q^*}{w^*}$ and $\frac{a_H(z)}{a_L(z)}$ increases in z. It implies that both the unit costs in the North and South increase with z, but the locus of the unit cost in the South is steeper than that in the North because of $\frac{q}{w} < \frac{q^*}{w^*}$.

Remind that the South has comparative advantage in the unskilled labor cost as $\frac{w}{A} > \frac{w^*}{A^*}$, such that the northern firms like to relocate the unskilled-labor intensive production the South. It implies that $\frac{w}{A^\theta}$ is even larger than $\frac{w^*}{A^{*\theta}}$ when $0 < \theta < 1$. As for the initial point of $z = 0$, the impact of difference $\frac{q}{w} < \frac{q^*}{w^*}$ is minimized when $\frac{a_H(0)}{a_L(0)} < \frac{a_H(z)}{a_L(z)}$ for $1 > z > 0$. Therefore, Feenstra and Hanson (1996) presumed that, in the initial point, the advantage of the South in the unskilled-labor cost $\frac{w}{A} > \frac{w^*}{A^*}$ dominates the advantage of the North's relative abundant in skilled-labor supply $\frac{q}{w} < \frac{q^*}{w^*}$, leading to $c(z=0) > c^*(z=0)$. In the comparison, they take that the interesting rate difference between the North and South play a minor role, so do the business service price difference in this current model. Without loss of generality, we than can illustrate the locus of the unit cost function as linear for simplicity.

Appendix 2

As in Feenstra and Hanson's (1996) model, the supply of skilled and unskilled labor in the manufacturing industry respond to their relative wage, as $H'(\frac{q}{w}) > 0$ and $L'(\frac{q}{w}) < 0$ in the North and $H^{*\prime}(\frac{q}{w}) > 0$ and $L^{*\prime}(\frac{q}{w}) < 0$ in the South, respectively. That is, the relative supply of skilled to unskilled labor increases with their relative wage. In this current model, these supply response reflect excess supply from the rest of the economy.

As for the relative demand for skilled to unskilled labor, the derivation is also similar to that in Feenstra and Hanson's (1996) model as following. To produce one unit of $x(z)$ in the North, it requires the unskilled labor at the amount:

$$\frac{\partial c(q, w, P_S; z)}{\partial w} = B\theta a_L [w a_L(z) + q a_H(z)]^{\theta-1} P_S^{1-\theta} \quad . \qquad \text{(A1)}$$

With the cost function $c(w, q, P_S; z) = B[w a_L(z) + q a_H(z)]^\theta P_B^{1-\theta}$ from the text, the total demand for the unskilled labor in the manufacturing industry is then given by

$$L(\frac{q}{w}) = \int_{z^*}^1 B\theta [\frac{P_S}{w a_L(z) + q a_H(z)}]^{1-\theta} a_L(z) x(z) dz \, . \qquad \text{(A2-1)}$$

Similarly, we have the total demand for skilled labor in the manufacturing industry as

$$H(\frac{q}{w}) = \int_{z^*}^1 B\theta [\frac{P_S}{w a_L(z) + q a_H(z)}]^{1-\theta} a_H(z) x(z) dz \, . \qquad \text{(A2-2)}$$

In the Cobb-Douglas production function, the business share of output is $1-\theta$, so we have

$$P_S \int_{z^*}^1 S(z) dz = (wL + qH) \frac{1-\theta}{\theta} \, . \qquad \text{(A3)}$$

Let E denote world expenditure. Implied in (2), the intermediate input $x(z)$ receives $\alpha(z)$ share of expenditure on the final good. Then, the demand for an intermediate input in the North is given by

$$x(z) = \frac{\alpha(z) E}{c(w, q, P_S; z)} \, . \qquad \text{(A4)}$$

Plug (A4) into (A2-1), we rewrite the total demand for the unskilled labor as

$$L(\frac{q}{w}) = \int_{z^*}^1 \theta [\frac{\alpha(z) a_L(z) E}{w a_L(z) + q a_H(z)}] dz \, . \qquad \text{(A5)}$$

Similarly, rewrite (A2-2) by incorporating (A4), we obtain

$$H(\frac{q}{w}) = \int_{z^*}^{1} \theta[\frac{\alpha(z)a_H(z)E}{wa_L(z) + qa_H(z)}]dz . \qquad \text{(A6)}$$

Define the relative demand for skilled to unskilled labor in the North as

$$D(\frac{q}{w}, z^*) \equiv \frac{H}{L} = \frac{\int_{z^*}^{1} [\frac{\alpha(z)a_H(z)E}{wa_L(z) + qa_H(z)}]dz}{\int_{z^*}^{1} [\frac{\alpha(z)a_L(z)E}{wa_L(z) + qa_H(z)}]dz} . \qquad \text{(A7)}$$

When a free trade policy leads to a larger z^*, we can calculate the relative demand for the skilled labor in the North consequently by taking (A7) with respect to z^* as

$$\frac{\partial \ln D}{\partial z^*} = (\frac{L}{H})(\frac{H}{L} - \frac{a_H(z^*)}{a_L(z^*)})(\frac{\alpha(z^*)E}{wa_L(z^*) + qa_H(z^*)}) > 0 , \qquad \text{(A8)}$$

where $\frac{H}{L} > \frac{a_H(z^*)}{a_L(z^*)}$ because the North is more skilled-labor abundant comparing the marginal sector z^*. The labor demand for unskilled and skilled workers in the South are similar to (A5) and (A6), respectively. We then can also show that the relative demand for the skilled labor in the South with respect to an increase in z^* as

$$\frac{\partial \ln D^*}{\partial z^*} = (\frac{L^*}{H^*})(\frac{a_H^*(z^*)}{a_L^*(z^*)} - \frac{H^*}{L^*})(\frac{\alpha(z^*)E}{w^* a_L^*(z^*) + q^* a_H^*(z^*)}) > 0 , \qquad \text{(A9)}$$

where $\frac{a_H^*(z^*)}{a_L^*(z^*)} > \frac{H^*}{L^*}$ because the South is more unskilled-labor abundant comparing the marginal sector z^*.

Figure A illustrates the relative demand and supply of skilled to unskilled labor in the manufacturing industry in the North. It shows that an increase in offshore production (i.e., an increase in z^*), the equilibrium moves from A to B, implying a rising wage inequality in the North. This analysis is similar in the South.

As for the business sector, while labor is mobile within a nation, the widening wage inequality in the manufacturing sector will transit into the business service sector. Note that, in this current model, the "redundant" manufacturing labors due to an increase in international outsourcing activity is more unskilled-labor intensive comparing to the business service sector. Therefore, the redeployment infuses into the business service sector relatively more unskilled labor, worsening the wage inequality in the business service sector as well.

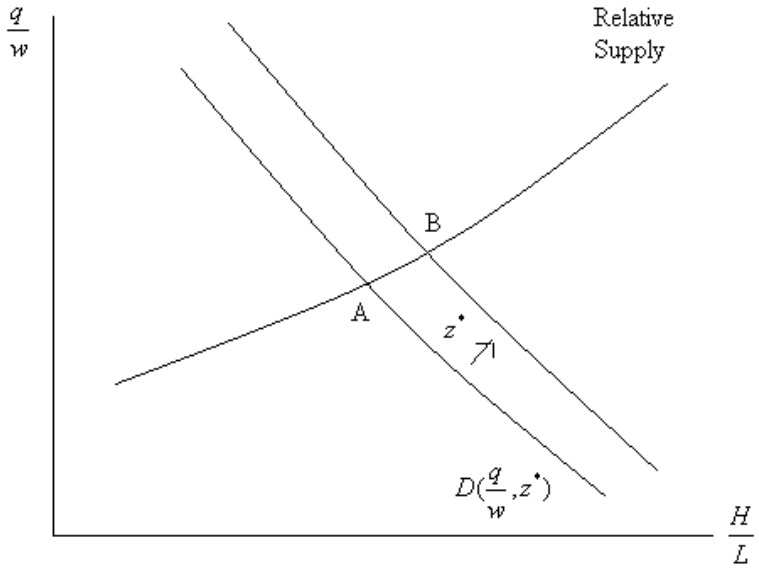

Figure A: Labor market equilibrium in the manufacturing industry