A Model of Liberalization of Nurse and Trade

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Abstract:
Aging developed countries are now accepting foreign nurse and liberalizing trade. This paper proposes a model of an aging developed economy with nurse inflow and trade and analyzes the welfare effects of liberalization of nurse and trade. We show that the welfare effects of liberalization of nurse depend on the cost-saving and tariff revenue effect and that the liberalization is not always welfare enhancing. We derive a sufficient condition for the liberalization of nurse and trade to be welfare enhancing. Moreover, we derive the optimal gap of the rate of returns to foreign nurse and the optimum tariff.

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1. Introduction

As a result of EPAs (Economic Partnership Agreements), Japan is going to accept nurse from foreign countries. Japan has already accepted 208 nurses from Indonesia in August 2008 and 283 nurses from Philippines in May 2009.[1] This year we will accept 105 nurses from Indonesia. In addition, in June 2011, the Japanese government decided to accept nurse from Vietnam. Is the acceptance of foreign nurse welfare enhancing for Japan? If welfare enhancing, under what conditions? In spite of many papers on international labor movements, previous literatures have paid little attentions to the economic analysis of medical migration. To the best of our knowledge, Rutten (2009) is the only one exception. By the use of a three sectors (one health and two tradables) two factors (skilled and unskilled labor) model, it considers the impacts of expansion of health sector by an increase in two types of labor, where some labors are recruited from immigrant.

Today, many developed countries are facing aging society and are obliged to expand the medical care sector by an increase in domestic and foreign nurse. They are also liberalizing trade through EPAs. Thus, the economic analysis of the liberalization of nurse and trade has become an important issue. To deal with this issue, we propose a model of an aging developed economy with nurse inflow and trade and analyze the welfare effects of liberalization. We show that the welfare effects of liberalization of nurse depend on the cost-saving and tariff revenue effect. Rutten (2009) analyzes how the output of health sector changes as a result of an increase in two types of labors by the use of the Rybczynski theorem. In contrast, we consider how welfare changes as a result of the liberalization of nurse and trade by the use of a duality approach. Hence, this paper is a complement to Rutten (2009). We show that the liberalization of nurse is not always welfare enhancing under a tariff. We also derive the optimal gap of the rate

of returns to foreign nurse and the optimum tariff.

This paper is organized as follows. In section 2, we first provide brief comments on the features of Japanese nurse market and then develop a model with nurse inflow and trade. We also consider a relationship between aging and the demand for nurses and explain the demand for nurses endogenously. Section 3 analyzes the welfare effects of liberalization of nurse and trade and shows that nurse inflow is not always welfare enhancing under a tariff. Section 4 concludes the paper. We show that the desirability of liberalizations and the optimum tariff depend on the structural parameters of the model.

2. The Model

2.1 Features of Nurse Markets

Before setting up our model, we offer brief comments on the features of the Japanese nurse market and suggest that we must consider three kinds of the rate of returns to nurse.

On the Japanese nurse market, we could confirm at least following two features. First, the Japanese nurse market is divided into two distinct markets: the market for Japanese nurse and that for foreign nurse. The market for Japanese nurse is organized by only Japanese. It is very difficult for foreign nurse to enter into the market for Japanese nurse even if the quality is the same. The rate of returns to Japanese nurse is higher than that to foreign nurse. Second, as the inflow of foreign nurse is restricted by non-tariff barriers and as the medical service sector in Japan uses more capital and better infrastructure than in foreign country, the rate of returns to foreign nurse in Japan is higher than that in foreign country. Also there is a nurse market in foreign country with low rate of returns. These facts suggest that we must consider three kinds

of the rate of returns to nurse: the returns to Japanese nurse, that to foreign nurse in Japan and that to foreign nurse in foreign country.[2]

On the labor inflow, Japan is restrictive to foreign labor inflow and accepts only skilled labors.[3] In the case of nurse inflow, Japan accepts it as a skilled labor and through some agreements such as EPAs.

It is necessary to define nurse. We define it as a skilled labor used specifically in the medical care sector. We should also note that the medical care is non-traded good. Thus, unlike mobile labor, nurse is a specific factor used in non-traded medical care sector. Hence, to analyze the welfare effects of nurse inflow, it is necessary to use a specific factor model with non-traded goods. Specific factor model has been popular since Jones (1971). In this paper, we will propose a simple model that reflects above features with two types of nurse in non-traded sector.[4]

2.2 Set up of the model

Assume a small open aging economy with three sectors and four factors. Three sectors are export, import and non-traded and four factors are capital (K), labor (L), domestic nurse (N_h) and foreign nurse (N_f). Let this country be home country and the set up of a model is for home country. The production functions are:

$$X = X(K_x, L_x),$$
$$Y = Y(K_y, L_y),$$
$$Z = Z(K_z, N_h, N_f).$$

They are export, import and non-traded medical care sectors respectively. Capital is a general factor used in all three sectors and labor is also a general factor used in both

traded sectors. On the other hand, both domestic and foreign nurse are skilled labor specific to non-traded sector. Note that the medical care is produced by the use of capital and two types of nurse. Both nurses are different in quality and necessary and are imperfect substitutes in producing medical service.[5] It is assumed that the production functions satisfy all standard neoclassical assumptions. Perfect competition and full employment are assumed.

Home country not only accepts foreign nurse but also imports a good under a tariff. Choosing the export good as the numeraire, we denote the domestic relative price of imports by p. Also let q denotes the relative price of non-traded good determined endogenously in home market. Under perfect competition, we have:

$$1 = c^x(r, w), \tag{1}$$

$$p = c^y(r, w), \tag{2}$$

$$q = c^z(r, n_h, n_f). \tag{3}$$

Under a tariff, we have:

$$p = p^* + t, \tag{4}$$

where, r is the rental rate of capital, w the wage rate of labor, n_h the rate of returns to domestic nurse, n_f the rate of returns to foreign nurse, p^* foreign price of imports and t the specific tariff rate. The right hand side of equations (1), (2) and (3) are the unit cost function of each sector. Under full employment, we have:

$$c_r^x(r, w)X + c_r^y(r, w)Y + c_r^z(r, n_h, n_f)Z = K, \tag{5}$$

$$c_w^x(r, w)X + c_w^y(r, w)Y = L, \tag{6}$$

$$c_{n_h}^z(r, n_h, n_f)Z = N_h, \tag{7}$$

$$c_{n_f}^z(r, n_h, n_f)Z = N_f, \tag{8}$$

where, by the Shephard's lemma, $c_r^x (= \partial c^x / \partial r)$ is, for example, the unit demand for capital in sector X. While K, L and N_h are supplied domestically, N_f is from foreign country. Equations (1) through (8) provide the supply side of the model. There are eight equations with the same number of variables; $p, r, w, n_h\ n_f, X, Y, Z$ with given p^*, t, q, K, L, N_h, N_f.

The supply side of the model is captured by the revenue function. It is defined as; $R(1, p, q, N_h, N_f) = \max \left[X(K_x, L_x) + pY(K_y, L_y) + qZ(K_z, N_h, N_f) \right]$ with respect to X, Y and Z subject to full employment. It is assumed that $R(1, p, q, N_h, N_f)$ is twice continuously differentiable, homogeneous of degree one and convex in prices and concave in factor supply.[6] Using a subscript to $R(1, p, q, N_h, N_f)$ to denote the partial derivatives, by the envelop theorem, we have; $R_p = Y$, $R_q = Z$, $R_{N_h} = n_h$, $R_{N_f} = n_f$. It is reasonable to assume; $R_{pp} > 0$, $R_{qq} > 0$, $R_{N_h N_h} < 0$, $R_{N_f N_f} < 0$, $R_{N_h N_f} > 0$, $R_{N_f N_h} > 0$. We assume $R_{pK} > 0$, $R_{qK} > 0$ due to the factor intensity. It is assumed that the cross partial derivatives are continuous and $R_{pq} = R_{qp} < 0$.

The demand side is captured by the expenditure function. It is defined as; $E(1, p, q, u) = \min \left[C_x + pC_y + qC_z \right]$ with respect to C_j subject to $U(C_x, C_y, C_z) = u$, where C_j is the consumption of jth commodity, $(j = x, y, z)$. $U(\cdot)$ is the utility function and u the level of utility of domestic people. It is assumed that $E(1, p, q, u)$ is twice continuously differentiable, homogeneous of degree one and concave in prices and increasing in utility. From the expenditure function, by the envelop theorem, we obtain; $E_p = C_y$ and $E_q = C_z$ and they are the compensated demand for two commodities with $E_{pp} < 0$, $E_{qq} < 0$. It is assumed that the cross partial derivatives are continuous and $E_{pq} = E_{qp} > 0$.

By the use of the revenue and expenditure functions, we obtain additional equations:

$$E(1, p, q, u) = R(1, p, q, N_h, N_f) - n^* N_f + tM \ , \tag{9}$$

$$M = E_p(1, p, q, u) - R_p(1, p, q, N_h, N_f) , \tag{10}$$

$$E_q(1, p, q, u) = R_q(1, p, q, N_h, N_f) , \tag{11}$$

where, n^* is the rate of returns to nurse in foreign country and we assume that home country remits $n^* N_f$ to foreign country.[7] It is assumed that n^* is fixed.[8] M is the quantity of imports, so that tM is the tariff revenue. Equation (9) is the budget constraint implying that the expenditure is equal to the sum of net income and tariff revenue. Equation (10) shows that the quantity of imports is the excess demand for that product. Equation (11) gives the equilibrium condition in non-traded good sector. Three equations from (9) to (11) are added with the same number of variables; u, M, q.

Equations from (1) to (11) constitute our model. The model consists of eleven equations with the same numbers of variables. Given the exogenous variables; p^*, n^*, t, N_h, N_f and domestic supplies of capital and labor, we can determine eleven variables; p, r, w, n_h, n_f, X, Y, Z, u, M and q. As noted before, a feature of our model is that it has three kinds of the rate of returns to nurse; n_h, n_f and n^*. They are the returns to domestic nurse, the returns to foreign nurse in home country and the returns to foreign nurse in foreign country respectively. Note also that while n^* is assumed to be fixed, n_h and n_f are determined in home country endogenously.

2.3 Aging and Demand for Nurses

In this section, we consider a relationship between population aging and the demand for nurses and consider how a small increase in aging affects the demand for nurses. Even

if the analysis in next section treats two nurses as exogenous, we provide a way to explain them by an increase in aging.

As people become aged he needs medical care more. This is the same with a country. It is possible to measure the degree of aging in various ways. The most standard one is the ratio of people aged 65 years and over to total population. Let the number of total population be P and that of aged 65 years and over be Q. Then the degree of aging is Q/P and is denoted by α, where $\alpha \in (0,1)$.[9]

Let the rate of foreign nurse requirement of Q via the demand for the medical care be β_f, then the demand for foreign nurse is $N_f^d = \beta_f Q$, where $\beta_f \in (0,1)$ Assume that two nurse markets in home country clear initially. Then $N_f^d = N_f$, so that we obtain:

$$N_f = \beta_f Q. \qquad (12f)$$

On the other hand, let the supply of labor force be S_L and assume that it is given by γ times total population:

$$S_L = \gamma P, \qquad (12)'$$

where, $\gamma \in (0,1)$ and is fixed. Equation (12)' implies that the supply of labor force is equal to total population times γ. From (12f), (12)' and the definition of α, we obtain:

$$\alpha = \delta_f (N_f / S_L), \qquad (12)''$$

where, $\delta_f = \gamma / \beta_f > 0$. Equation (12)" connects the demand for foreign nurse with the degree of aging. It is a definitional equation. From (12)", if δ_f and S_L are fixed, we obtain:

$$dN_f = (S_L / \delta_f) d\alpha. \qquad (13f)$$

Equation (13f) shows how an increase in aging affects the demand for foreign nurse. We see that the value of S_L and δ_f affect the effects of aging on demand for foreign nurse. Specifically, δ_f plays a key role and an increase in δ_f reduces the effects of aging on

the demand for foreign nurse.

As domestic and foreign nurse are different in quality, the demand for domestic nurse must be formulated separately. However the formulation is the same. In the case of domestic nurse, we have:

$$N_h = \beta_h Q, \tag{12h}$$

where, β_h is the rate of domestic nurse requirement of Q via the demand for the medical care and $\beta_h \in (0,1)$. Similarly, instead of (13f), we have:

$$dN_h = (S_L / \delta_h) d\alpha, \tag{13h}$$

where, $\delta_h = \gamma / \beta_h > 0$. From (13f) and (13h), we obtain:

$$dN_f + dN_h = S_L \left(\frac{1}{\delta_f} + \frac{1}{\delta_h} \right) d\alpha = S_L \left(\frac{\delta_h + \delta_f}{\delta_f \delta_h} \right) d\alpha . \tag{13)'}$$

From (13f) and (13h), we obtain followings. First, the demand for nurses is positively related to an increase in aging. Second, if $\beta_h > \beta_f$, so that $\delta_h < \delta_f$, then we have: $dN_h > dN_f$. In such a case, an increase in aging increases the demand for domestic nurse more than that of foreign nurse. Thus the effects of aging on the demand for nurses depend on the rates of nurse requirement. On the other hand, equation (13)' gives the total increase in demand for nurse by aging. Thus we have to consider what factors determine the values of β_h and β_f. They would be n_h, n_f as well as the preference of people of aged 65 years and over for two nurses in the medical care service.

Now we consider the welfare effects of an increase in N_h and N_f and a reduction in t. It will be shown that the welfare effects of liberalization of nurse depend on the cost-saving and tariff revenue effects, which are in turn determined by the structural parameters of the model.

3. Analysis

Differentiating (9), we obtain:

$$E_u du = n_h dN_h + (n_f - n^*) dN_f + t dM \,, \qquad (14)$$

where, equation (10) and (11) as well as $dp = dt$ are used. Since $E_u > 0$, equation (14) shows that if the coefficient of dN_h is positive, an increase in domestic nurse increases welfare. Also if the coefficients of dN_f and dM are positive, an increase in nurse inflow and imports increases welfare.[10] It is reasonable to assume $(n_f - n^*) > 0$, if home country restricts nurse inflow by non-tariff barriers and more capital and better infrastructure are used in home country than in foreign country. Also since we consider the effects of tariff reduction, we assume $t > 0$ initially. From (10), we obtain:

$$dM = E_{pu} du + A dt + B dq - R_{pN_h} dN_h - R_{pN_f} dN_f \,, \qquad (15)$$

where, $A = (E_{pp} - R_{pp}) < 0$ and $B = (E_{pq} - R_{pq}) > 0$. Equation (15) shows that changes in imports are determined by changes in u, t, q, N_h and N_f with $E_{pu} > 0$, $R_{pq} < 0$, $R_{pN_h} < 0$, $R_{pN_f} < 0$. Thus, an increase in welfare, trade liberalization, and an increase in the price of non-traded good increases imports. Also an increase in domestic and foreign nurse increases imports. Differentiating (11), we obtain:

$$dq = \frac{R_{qN_h} dN_h + R_{qN_f} dN_f - E_{qu} du - B dt}{D} \,, \qquad (16)$$

where, $D = (E_{qq} - R_{qq}) < 0$ if the non-traded good market is stable. We assume that it is stable. It is reasonable to assume that $R_{qN_h} > 0$ and $R_{qN_f} > 0$. We will see that the values of R_{pN_h}, R_{pN_f}, R_{qN_h} and R_{qN_f} as well as the values of B and D play important roles on the welfare effects of liberalization of nurse. If all goods are normal, $E_{qu} > 0$. From (16), we see that an increase in domestic nurse will reduce the price of non-traded good. Also the liberalization of nurse and trade will reduce the price of non-traded good. Further, an increase in u will increase the price of non-traded good. Substituting (16) into (15), we obtain:

$$dM = \left(E_{pu} - \frac{BE_{qu}}{D} \right) du + \left(\frac{BR_{qN_h}}{D} - R_{pN_h} \right) dN_h + \left(\frac{BR_{qN_f}}{D} - R_{pN_f} \right) dN_f + \left(A - \frac{B^2}{D} \right) dt \text{ . (17)}$$

Equation (17) shows that an increase in welfare increases imports. However, the effects of an increase in domestic nurse as well as the liberalization of nurse and trade on imports are not determinate. Finally substituting (17) into (14), we obtain:

$$du = \frac{\left\{ n_h + t\left(\frac{BR_{qN_h} - DR_{pN_h}}{D} \right) \right\} dN_h + \left\{ (n_f - n^*) + t\left(\frac{BR_{qN_f} - DR_{pN_f}}{D} \right) \right\} dN_f + t\left(\frac{AD - B^2}{D} \right) dt}{\left\{ (E_u - tE_{pu}) + \frac{tBE_{qu}}{D} \right\}}$$

(18)

Equation (18) consists of three terms. The first term is the effect of an increase in domestic nurse, the second term the effect of liberalization of nurse and the third term the effect of trade liberalization. From (18), we obtain:

$$\frac{\partial u}{\partial N_h} = \frac{n_h + t\left(\frac{BR_{qN_h} - DR_{pN_h}}{D} \right)}{(E_u - tE_{pu}) + \frac{tBE_{qu}}{D}}, \quad (19)$$

$$\frac{\partial u}{\partial N_f} = \frac{\left(n_f - n^*\right) + t\left(\frac{BR_{qN_f} - DR_{pN_f}}{D} \right)}{\left(E_u - tE_{pu}\right) + \frac{tBE_{qu}}{D}}, \quad (20)$$

$$\frac{\partial u}{\partial t} = \frac{t\left(\frac{AD - B^2}{D} \right)}{\left(E_u - tE_{pu}\right) + \frac{tBE_{qu}}{D}}. \quad (21)$$

Equation (19), (20) and (21) show how welfare changes as a result of an increase in domestic nurse, liberalization of nurse and liberalization of trade respectively.

To consider the effects, we must determine the signs of the denominator of these equations. Since $E(1, p, q, u)$ is homogenous of degree one in prices, it could be written as: $E(1, p, q, u) = e(1, p, q)u$. Thus $E_u(1, p, q, u) = e(1, p, q)$, which is homogeneous degree one in prices. Thus we obtain: $E_u = pE_{up} + qE_{uq} = (p^* + t)E_{up} + qE_{uq} > tE_{up}$, so that $\left(E_u - tE_{pu}\right) > 0$. Hence the first term is positive. However the second term is negative, so that in general it can take either signs. We assume:

Assumption 1. The absolute value of D is greater than that of B.

Assumption 2. Based on Assumption 1, the absolute value of the first term of the denominator is greater than that of the second term.

The intuition of Assumption 1 is based on the fact that while D is the direct effect B is the indirect effect. This assumption will be used to analyze the tariff revenue effect. Assumption 2 is sufficient to make the denominator positive.

We are interested in deriving sufficient conditions for following policies to be welfare enhancing: an increase in domestic nurse, an increase in foreign nurse and the reduction of tariff. While first two are related to population aging, the third is related to trade liberalization. It will be shown that the tariff revenue effect plays an important role in all three cases.

3.1 Increase in domestic nurse

This section considers the welfare effects when home country increases the quantity of

domestic nurse. An analysis of this aspect is important because in order to cope with population aging the Japanese government is encouraging potential and retired nurse to work.

Equation (19) consists of two terms. The first term is the marginal value product effect of domestic nurse. If this is positive, any policies that increase the supply of domestic nurse are welfare enhancing. Also any policies that increase n_h would be welfare enhancing. For example, if N_f increases n_h will increase. Thus, an increase in foreign nurse is beneficial to domestic nurse and is welfare enhancing. This is in contrast to the conventional wisdom that domestic nurse suffers from the acceptance of foreign nurse.

The second term is the tariff revenue effect produced by an increase in domestic nurse. We will see that it can take either sign. It is interesting to see that the welfare effects depend on tariff rate. From (19), we obtain:

Proposition 1. If $n_h > 0$, then free trade is a sufficient condition for an increase in domestic nurse to be welfare enhancing. Also if $n_h > 0$ and $t > 0$, then $(BR_{qN_h} - DR_{pN_h})/D > 0$ is a sufficient condition for an increase in domestic nurse to be welfare enhancing.

To determine the sign of tariff revenue effect, we must consider the values of B, D, R_{qN_h} and R_{pN_h}. These are the structural parameters of the model. We assumed already Assumption 1. In addition, we assume:

Assumption 3. The absolute value of R_{qN_h} is greater than that of R_{pN_h}

The intuition of Assumption 3 is that the direct effect is greater than the indirect effect. Under Assumption 1.and 3, the tariff revenue effect can take either sign. Thus an increase in domestic nurse is not always welfare enhancing under a tariff.

Setting (19) equal to zero, we obtain the optimum tariff as:

$$\tilde{t} = \frac{n_h}{\left(\frac{DR_{pN_h} - BR_{qN_h}}{D} \right)}. \tag{22}$$

It is interesting to see that the optimum tariff depend on the value of n_h and if $n_h = 0$, the optimum tariff is zero.

3.2 Liberalization of foreign nurse

This section considers the welfare effects when home country increases the quantity of foreign nurse. Equation (20) consists of two terms; the first term is the cost-saving effect and the second term the tariff revenue effect.[11]

If the first term is positive, home country can exploit foreign nurse by this amount and can increase its welfare. If the second term is positive (negative), the tariff revenue effect is positive (negative), so that it works to increase (reduce) domestic welfare. We obtain:

Proposition 2. If $(n_f - n^*) > 0$, then free trade is a sufficient condition for an increase in foreign nurse to be welfare enhancing. Also if $(n_f - n^*) > 0$ and $t > 0$, then $(BR_{qN_f} - DR_{pN_f})/D > 0$ is a sufficient condition for an increase in foreign nurse to be welfare enhancing.

We assume:

Assumption 4. The absolute value of R_{qN_f} is greater than that of R_{pN_f}.

The intuition of Assumption 4 is that the direct effect is greater than the indirect effect. Under Assumption 1 and 4, the tariff revenue effect can take either sign. Thus an increase in foreign nurse is not always welfare enhancing under a tariff. Note the similarity and difference of the tariff revenue effects in two types of nurse increase.

We will add following remarks.

Remark 1. First, if $n_f - n^* = 0$, i.e., if the nurse mobility is perfect, then the cost-saving effect is zero. Second, if $t = 0$ or $(BR_{qN_f} - DR_{pN_f})/D = 0$, then the tariff revenue effect is zero. Third, even if the cost-saving effect is zero, the tariff revenue effect could be welfare enhancing if $t > 0$ and $(BR_{qN_f} - DR_{pN_f})/D > 0$. Fourth, if $(BR_{qN_f} - DR_{pN_f})/D < 0$, then an import subsidy rather than import tariff would be welfare enhancing.

Remark 2. Define n_f as the maximum rate of remittance and n^* the minimum rate of remittance. Also let n_a be an agreed rate of remittance such that $n_f \geq n_a \geq n^*$. At given n_f and n^*, if $n_a = n^*$, the minimum remittance will be made and if $n_a = n_f$, the maximum remittance will be made. As n_a approaches to n^*, gain from the cost-saving increases and if it approaches to n_f, it will decline. If $n_f > n_a > n^*$, we have a partial remittance. In the partial remittance, both countries obtain net gain from nurse migration. The determination of n_a will be a topic in EPAs negotiations.

Remark 3. Any policies that increase n_f are welfare enhancing. Followings policies could be considered. First, an increase in N_h increases n_f. This implies that any policy that increases the use of domestic nurse is welfare enhancing. Second, an increase in capital allocation to medical care sector increases n_f. Third, any policy that restricts foreign nurse inflow increases n_f. This provides the idea of optimal gap of the rate of returns to foreign nurse. Fourth, since $R_{N_f q} > 0$, an increase in q will increase n_f. Fifth, since $R_{N_f p} < 0$, a reduction of p will increase n_f.

From (20), we obtain the optimal gap of the rate of returns to foreign nurse and the optimum tariff. Setting (20) equal to zero, we obtain:

$$(n_f - n^*)_{opt} = t\left(\frac{DR_{pN_f} - BR_{qN_f}}{D}\right). \tag{23}$$

It is interesting to see that the optimal gap depends on the tariff rate. This implies that if t is zero, the optimal gap is zero. This means that free trade is a substitute to perfect nurse mobility. Also if $(DR_{pN_f} - BR_{qN_f}) = 0$, the optimal gap is zero.

Now, let τ be the tax rate on the rate of return to foreign nurse that makes the gap equal to $n_f \tau$, i.e., $n_f - n^* = n_f \tau$. Then the optimal tax is:

$$\tau_{opt} = n_f^{-1} t\left(\frac{DR_{pN_f} - BR_{qN_f}}{D}\right). \tag{23'}$$

On the other hand, from (20), we obtain the optimum tariff $\hat{t}$ as:

$$\hat{t} = \frac{(n_f - n^*)}{\left(\frac{DR_{pN_f} - BR_{qN_f}}{D}\right)}. \tag{24}$$

Note the similarity between (22) and (24). We see that the optimum tariff depends on $(n_f - n^*)$. Specifically, if $(n_f - n^*) = 0$, then the optimum tariff is zero. From (23) and

(24), we obtain:

Proposition 3. If the tariff rate is zero, then the optimal gap of the rate of returns must be zero. Also if the gap of the rate of returns is zero, then the optimum tariff must be zero.

3.3 Liberalization of trade

This section considers the welfare effects of tariff reduction. Here only the tariff revenue effect exists. We obtain followings. First, if tariff rate is zero, there is no tariff revenue gain. Second, if $t > 0$, the tariff revenue effect depends on the signs of $(AD - B^2) / D$. We obtain:

Proposition 4. If $t > 0$, then $(AD - B^2)/D < 0$ is a sufficient condition for the liberalization of trade to be welfare enhancing.

The condition $(AD - B^2)/D < 0$ implies that a reduction of tariff increases quantity of imports, tariff revenue and thus welfare.[12]

This condition is the same as $(AD - B^2) > 0$, which is rewritten as

$$(E_{pp} - R_{pp})(E_{qq} - R_{qq}) - (E_{pq} - R_{pq})^2 > 0. \qquad (25)$$

The first term of the left hand side is the product of two direct effects of price change while the second term is the square of indirect effects. Thus if the product of two direct effect is greater than that of the indirect effect, the liberalization of trade is welfare enhancing. As it is reasonable to assume that the direct effect is greater than that of the

indirect effect, trade liberalization is welfare enhancing. Further, we obtain following remark:

Remark 5. If $t < 0$ and home country is paying an import subsidy initially. Then the trade liberalization will be welfare reducing if $(AD - B^2)/D < 0$.

3.4 Liberalization of nurse and trade

In this section, we consider a more realistic case where the quantity of domestic nurse is fixed and home country liberalizes nurse and trade simultaneously. In such case, we first consider a relationship between liberalization of nurse and trade that makes the level of welfare constant and then derives a sufficient condition for both liberalizations to be welfare enhancing. From (18), we obtain:

$$\left.\frac{dN_f}{dt}\right|_{u=const} = -\frac{t\left(\dfrac{AD - B^2}{D}\right)}{(n_f - n^*) + t\left(\dfrac{BR_{qN_f} - DR_{pN_f}}{D}\right)}. \tag{26}$$

We assume:

Assumption 5. $(n_f - n^*) > 0$, $(AD - B^2) > 0$ and $t > 0$.

Under assumption 5, we obtain:

Proposition 5. If $(BR_{qN_f} - DR_{pN_f})/D > 0$, then we obtain $dN_f/dt > 0$, so that trade liberalization must be accompanied by the restriction of nurse inflow.

Proposition 5 implies that trade liberalization must be accompanied by the restriction of nurse inflow in order to maintain the level of utility constant. This implies that the welfare gain by liberalization of trade must be compensated by the loss of welfare by the restriction on nurse inflow.

On the other hand, if $(BR_{qN_f} - DR_{pN_f})/D < 0$ and the absolute value of the second term of the denominator of (26) is greater than that of $(n_f - n^*) > 0$, then we obtain $dN_f / dt < 0$. In such a case, the liberalization of trade must be accompanied by the liberalization of nurse. Thus the combination of policies to maintain the level of welfare constant depend on the signs of $(BR_{qN_f} - DR_{pN_f})/D$.

Finally, we consider a condition under which both liberalizations is to be welfare enhancing under $t > 0$. We obtain:

Proposition 6. A sufficient condition for both liberalizations to be welfare enhancing is $(n_f - n^*) > 0$, $(BR_{qN_f} - DR_{pN_f})/D > 0$ and $(AD - B^2)/D < 0$.

Comparing with Proposition 2 and 4, a sufficient condition for both liberalizations to be welfare enhancing is more stringent than that of either nurse or trade liberalization.

4 Conclusions

Proposing a simple model of an aging developed economy with nurse inflow and trade, we analyzed the welfare effects of liberalization of nurse and trade by the use of a duality approach.

We derived following novel results. First, the liberalization of foreign nurse is not always welfare enhancing under a tariff. The welfare effect depends on the cost-saving

and tariff revenue effect. Second, we derived sufficient conditions under which the liberalizations are welfare enhancing. Third, we derived the optimal gap of the rate of returns to foreign nurse as well as the optimum tariff. Fourth, we showed that in all three cases the tariff revenue effect plays a key role. Fifth, a conventional wisdom that domestic nurse suffers from an inflow of foreign nurse does not hold in our model. Instead, domestic nurse could gain by an increase in foreign nurse. Six, we connected the demand for nurses with an increase in aging and provided a way to make the demand for nurses endogenous. Last, we demonstrated that the desirability of liberalization as well as the optimum tariff depends on the values of the parameters of the model.

Following extensions are important directions for future research. First, we showed a way in which an increase in demand for foreign nurses is explained by the increase in the degree of aging. However it may be explained as the result of a game between two governments that reflect the welfare of each country. Second, for simplicity we assumed that home country is small and the terms of trade is given. But it is desirable to consider a case of large country, specifically in the case of Japan. Third, it is assumed that the rate of returns to nurse in foreign country is fixed. However, an increase in inflow of foreign nurse may increase it. Fourth, we focused on the short-run welfare effect of liberalization of nurse and trade and did not consider any dynamic aspects where domestic labor becomes nurse. It is necessary to consider such a dynamic aspect. Fifth, even if our model reflects some important aspects of existing Japanese nurse market and nurse inflow, this paper has no empirical analysis. Our model and results should be examined and tested empirically. Extensions to these aspects are the topics for further research.

Nonetheless, this paper is the first to analyze the welfare effects of liberalization of

nurse. We added new ideas and insights to the existing literatures on medical migration and considered economic implications for the acceptance of foreign nurse. We hope that this will stimulate the analysis of international medical migration which has been neglected in existing literatures.

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Notes

1. These foreign nurses are now working at the medical care facilities and preparing for the qualifying examination. Following difficulties have already been pointed out

about the examination: i) they must pass the examination in Japanese, ii) they must pass within three years and if not they must return to home countries. In March 2010, nurses from Indonesia took the first round examination. The result was pessimistic as expected. Just 3 nurses passed and the rate of passing was only 1.2%. The second round examination was in Feb. 2011. This time, nurses from Philippines also took the examination and totally 16 nurses passed. The passing rate was 4%. Thus totally 19 nurses passed the examination. Faced with aging society, we should consider this program more seriously. To cope with this problem, it is necessary to make hearings at the medical care facilities where these nurses are working. It is also necessary to reconsider the education system of Japanese and provide the chance to challenge the qualifying examination again. In Jan.2011, the Japanese government decided to extend the time limit of stay for one more year in order to provide another chance for the examination. However, only extension of stay will not settle the problems. At June 2011, nurses from Indonesia are totally 793 and that from Philippines are 483. On the other hand, Japanese nurse is about 1,380,000 in 2010.

2. At 2010, the wage rate of Japanese nurse is about 320,000 yen per month. On the other hand, the wage rate of Indonesian nurse in Japan is about 150,000 yen and that in Indonesia is 30,000 yen per month. These figures would represent following facts. First, the Japanese nurse market is divided into two markets; the markt for Japanese and foreign. Second, the difference in returns between Japanese and Indonesian nurse in Japan will reflect the quality and productivity difference. Third, while the difference in returns between Japanese nurse and Indonesian nurse in Japan is about two times, the difference in returns between Indonesian nurse in Japan and in Indonesia is five times. This five times difference could be explained by

the difference in technology and infrastructure in medical care sector between two countries.

3. In order to accept foreign skilled labor and level up the competitiveness of Japanese economy, the Japanese government decided, in March 2011, to relax the restrictions on the conditions for permanent stay of foreign skilled labors in science and technology sectors.

4. Our model is set up in order to reflect the features of nurse, so that it is different from the labor market model of Harris-Todaro (1970) that considers the mobility of identical labor between two sectors. However our model is standard in the sense that full employment is assumed and the rate of returns to nurses in home country is determined endogenously.

5. It is said that the quality of nurse from Indonesia and Philippines is lower than that of Japanese nurse and foreign nurse is considered as an assistant to Japanese nurse. The difference in quality can be represented by the difference in productivity and it corresponds to the difference in returns. The quality difference is mainly due to the weakness in communication ability and understanding medical technical terms in Japanese. Also the differences in culture and custom between domestic and foreign will reduce the quality of foreign nurse.

6. The supplies of capital and labor in the revenue function are suppressed because they are fixed.

7. This budget equation shows that home country repatriates the minimum rate of return to foreign nurse. The justification is as follows. First, the minimum rate provides a criterion to evaluate the gains from nurse inflow. Second, this paper intends to show that even if the rate of returns to foreign nurse is the minimum, the liberalization of nurse is not always welfare enhancing for home country. Third,

foreign nurse has an incentive to immigrate if she can not only repatriate what she could earn in foreign country but also learn higher medical care knowledge in home country. If the rate of returns of remittance becomes higher than the minimum rate, the cost-saving gain to home country will decline.

8. We assume that the return to nurse in foreign country is fixed. A justification of this fixity is that foreign country could supply nurse indefinitely.

9. We have following data on the values of the parameters in this section. First, the degree of aging of Japan in this measure was 22.7% in October 2009. Second, the rate of nurse requirement of people aged 65 years and over is on average 15.5% in 2010. Third, the ratio of supply of labor force (the sum of employed and unemployed labor aged 15 years and over) to total population is 51.7% in 2010.

10. Unlike to the case of capital inflow, foreign nurse lives in home country so that she spends in home country. Thus the second term of the right hand side of equation (14) could be interpreted as the additional income that foreign nurse can spend in home country. This additional income in home country is produced as the result of nurse inflow.

11. We define the first term as the cost-saving effect because home country repatriates less than the value of the marginal product of foreign nurse so that the cost of foreign nurse is saved. Thus this term can also be considered as the exploitation effect because home country exploits foreign nurse.

12. This implies that the rate of increase in quantity of imports must be more than that of the reduction of tariff.

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