Trade Policies, Health Care and Social Welfare: A General Equilibrium Analysis

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Abstract : This paper attempts to cater the impact of changes in trade policies on the volume of a non-traded health care of a developing economy. In this article we have framed a hybrid type of three sector general equilibrium trade model, where first two sectors form a Heckscher-Ohlin nugget and the third one is a non-traded health service producing sector. Overall, we find little harm from trade, and potential gains from welfare aspects.

Key words: Health sector, Trade Policy, Welfare and General equilibrium.

JELClassification: I10, I15, F11, F21, D58

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1. Introduction

In the literature on development economics we find that one of the main causes behind underdevelopment of an economy is the lack of advancement of the health sector. In recent years various policies regarding the health aspect are adopted by the policy makers of developing economies. It is a very commonly held view that poor health scenario of the country is due to the existence of poor infrastructural facilities in the economy as a whole[1]. It suggests that emphasis should be focused on infrastructural development in order to improve welfare. In the traditional literature on development economics, a developing economy is broadly classified into two sectors: an industrial sector and an export sector. But the presence of health sector along with import and export sectors, where the health commodity[2] is a non-traded final product, the

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[1] National Health Accounts (NHA) has Shown that in India public health expenditure as a share of GDP increased from 0.96 per cent in 2004-05 to just 1.01 per cent in 2008-09 as compared to 5 per cent for developed economies. The public health sector is characterized by economically inefficient along with poor physical infrastructure. The mismatch between demand and supply of healthcare services and infrastructure has triggered the emergence of private participation in the Indian health sector through FDI. Thus it is become crucial to us to examine the impact of FDI in the health sector.

[2] In a developing economy most of the health commodities are non-traded final commodities such as different types of hospital facilities as well as health facilities like availability of medicines, health check-up facilities etc.

traditional results may change. It thus creates interest among the policy makers in the context of the various polices undertaken by them for a developing economy. It is to be noted that in this study we have confined ourselves with trade related policies, for instance foreign capital inflow to health sector[3] or in general, inflow of foreign capital and changes in tariff etc.

In order to examine the impact of foreign health capital inflow in a developing economy we must start from the impact of foreign capital inflow in a developing economy. In fact health capital can also be in the form of foreign health capital. At the outset we start from the literature on the impact of foreign capital inflow[4] in a developing economy. It starts with the famous Brecher-Alejandro (1977) proposition which states that an inflow of foreign capital in a two-commodity, two factor full employment model with full repatriation of its earnings reduces social welfare if the import-competing sector is capital intensive and is protected by a tariff. However, in the absence of any tariff, the inflow of foreign capital with full repatriation of its earnings does not affect social welfare.

The main motivation behind this study generates from the fact that only a few empirical works deal with the issue of foreign health capital and welfare. In fact at the theoretical

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[3] Funds such as ICICI Ventures, IFC, Ashmore and Apax Partners invested about US$ 450 million in the first six months of 2008-2009 compared to US$ 125 million during the same period of the previous year. Feedback Ventures expects private equity funds to invest at least US$ 1 billion during 2009-2013. 12 percent of the US$ 77 million venture capital investments in July-September 2009 were in the healthcare sector. GE plans to invest over US$ 3 billion on R&D, US$ 2 billion to drive healthcare information technology and health in rural and underserved areas, US$ 1 billion in partnerships, content and services, over the next six years. International clinic chain Asklepios International plans to invest US$ 100 -200 million in the Indian healthcare market. Gulf-based group Dr Moopen is planning to invest US$ 200 million for setting up hospitals and eye-care centres across India. Fortis is planning to invest US$ 55 million to expand its pan-India operations.

[4] Foreign capital inflow also refers to Foreign Direct Investment (FDI).

level almost no work in a general equilibrium structure has been done to examine the impact of foreign health capital inflow on welfare. The present study attempts to examine the impact of foreign (health) capital inflow on welfare in terms of a three-sector general equilibrium model and hence attempts to fill up the lacuna in this line of work. Moreover most of the works in trade literature that deal with health aspect have immensely ignored the role of export sector as well as import sector (other than health sector) of a developing economy. In this study we are trying to fill up this gap also.

The present model is an extension of Beladi-Marjit(1992) as in this model a third sector, a non-traded health sector, has been introduced[5]. It attempts to examine the effects of liberalization in the form of foreign health capital inflow on the price of health commodity, returns to the various inputs and on welfare in a developing economy. Though Chaudhuri(2007) has considered the impact of foreign capital inflow in the presence of non-traded agricultural final commodity in a general equilibrium structure, our analysis is quite different because we assume health commodity as a non-traded final good and foreign health capital is specific to that sector.

The paper is organized in the following manner. Section 2 considers the basic model. The comparative static analysis is explained in section 3. Sub section 3.1 considers the impact of trade liberalization on social welfare. Finally, the concluding remarks are made in section 4.

2. The Basic Model

We consider a small open economy consisting of three sectors in a Heckscher-Ohlin-Samuelson framework. Out of the three sectors, one is an export sector(A), which

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[5] In the three-sector models on foreign capital and welfare the third sector may either be an export processing zone as in the work of Beladi-Marjit(1992) or it may be the urban informal sector as in the works of Grinols(1991), Gupta(1997) etc or it may be intermediate goods producing sector as in the works of Marjit and Beladi(1997) and Marjit, Broll and Mitra (1997).

produces its output using labour(L) and capital(K), the second sector is a import sector(M), which produces output by using labour and capital. This second sector is the import competing sector while the first sector, that is, sector A, is the export sector of the economy. Sector M is protected by tariff(t). Here K consists of domestic capital (K_D) and foreign capital(K_F) and we assume that K_D and K_F are perfect substitutes. K is perfectly mobile between sectors A and M. The third sector is the health sector. Health capital (N) has been considered as specific to the health sector(H). This sector also uses the labour input(L) to produce a non-traded final health commodity. All these three sectors[6] use labour which is perfectly mobile among them. Health capital consists of both domestic health capital(N_D) and foreign health capital(N_F), and we assume N_D and N_F are perfect substitutes.

Here sector A produces its output X_A, sectors M and H produce output X_M and X_H respectively. We assume that the export sector is more labour-intensive compared to the import sector. The export product is considered as the numeraire its price is set equal to unity. We assume that both foreign capital income and foreign health capital income are fully repatriated. Production functions of each sector exhibit constant returns to scale with diminishing marginal productivity for each factor. The following notations are used in this model.

X_i = product produced by the ith sector, i = A,M,H; P^*_A = world price of commodity A; P_A = domestic price of commodity A, we assume $P_A = P^*_A = 1$; P^*_M = world price of good M; $P_M = P^*_M(1+ t)$ = domestic price of good M; P_H = domestically determined price of good H; L = fixed number of workers in the economy; N_D = domestic health capital stock of the economy; N_F = foreign health capital stock of the economy; N = economy's aggregate health capital stock ($N = N_D + N_F$); K_F = foreign capital stock; K_D = domestic capital stock; K = economy's aggregate capital stock ($K = K_D + K_F$); a_{ji} = quantity of the

[6] All the three sectors produce final commodities in this model.

jth factor for producing one unit of output in the ith sector, j=L,K,N and i =A,M,H; θ_{ji} = distributive share of the jth input in the ith sector; λ_{ji} = proportion of the jth factor used in the production of the ith sector; t = ad-valorem rate of tariff on the import of commodity M; W = competitive wage rate; r = rate of return to capital, R = rate of return to health capital; D_i = consumption demand for the ith final commodity, i = A,M,H; E^H_{PH} =own price elasticity of demand for commodity H; E^H_Y = income elasticity of demand for commodity H; U = social utility; Y = national income at domestic price; m_M = marginal propensity to consume for commodity M; I = import demand for commodity M; σ_i = elasticity of factor substitution in sector I, i = A, M, H; ^ = proportional change

The equational structure of the model is as follows.

The competitive equilibrium conditions in the product market for the three sectors give us the following equations.

$$a_{LA}W + a_{KA}r = 1 \quad (1)$$

$$a_{LM}W + a_{KM}r = P_M^*(1+t) \quad (2)$$

$$a_{LH}W + a_{NH}R = P_H \quad (3)$$

Sector specificity of health capital is given by the following equation

$$a_{NH}X_H = N_D + N_F = N \quad (4)$$

Perfect mobility of capital between sectors A and M can be expressed as

$$a_{KA}X_A + a_{KM}X_M = K_D + K_F = K \quad (5)$$

Full employment of labour implies the following equation

$$a_{LA}X_A + a_{LM}X_M + a_{LH}X_H = L \quad (6)$$

The demand for the non-traded final commodity is given by

$D_H = D_H(P_H, P_M, Y)$ (7)

We assume that commodity H is a normal good with negative and positive own price elasticity and income elasticities of demand, respectively, that is ,$E^H{}_{PH}<0$ and $E^H{}_Y>0$. The cross price elasticity is positive, that is, $E^H{}_{PM}>0$.

The demand –supply equality condition for commodity H is

$D_H (P_H, P_M, Y) = X_H$ (8)

The demand for commodity M and the volume of import are given by the following equations respectively.

$D_M = D_M (P_H, P_M, Y)$ (9)

$I = D_M (P_H, P_M, Y) - X_M$ (10)

The national income of the economy at domestic prices is given by

$Y = X_A + P_M X_M + P_H X_H - rK_F - RN_F + tP_M^* I$

(11.1)

or

$Y = WL + RN_D + rK_D + tP_M^* I$ (11.2).

The working of the model is as follows. There are eleven endogenous variables in the system: $W, r, R, P_H, X_A, X_M, X_H, D_M, D_H$, IandY. Here we have eleven independent equations(equations (1) to(11)) to solve for eleven unknowns. We can find out the value of W and r from equations (1) and (2). From equation (3) we can express R as a function of P_H. Thus it is an indecomposable structure[7]. Hence from equation (4) a_{NH} can be expressed as a function of P_H. For given N ,X_H can be expressed as a function of P_H also. So, from equations (5) and (6) X_A and X_M are expressed in terms of P_H. From equation (11.2) we can express Y as a function of P_H. So equation (7) is expressed as a function of P_H. Thus equation (8) helps us to determine the value of P_H. Once P_H is known X_A ,X_M , Y and X_H are also known. Thus equations (7) and (9) helps us to determine the values of D_H and D_M respectively. Finally using equation (10) we get the value of I.

The demand side of the model is represented by a social utility function. Let U be the social utility function and it is shown as,

$$U = U(D_A ,D_M ,D_H) \tag{12}$$

With $U_A >0$, $U_M > 0$, $U_H >0$, $U_{AA}<0$, $U_{MM} < 0$, $U_{HH}<0$

The balance of trade equilibrium requires that

$$D_A +P_MD_M +P_HD_H = X_A +P_MX_M +P_HX_H –rK_F –RN_F +tP_M^*I \tag{13}$$

Note sector H is a non-traded final good producing sector and its price is determined endogenously from the system.

3. Comparative Statics

Here we want to examine the impact of an inflow of foreign capital as well as of foreign health capital on the level of social welfare of a developing economy. To do these at first we want to find out separately the impact of K_F and N_F on the price level of the health sector (P_H). The return to capital (r) and the wage rate (W) are not affected through a change in the price of a non-traded final good, P_H . but the factor price ,R ,is affected

[7] If the factor prices are determined independently of factor endowments we refer to the structure as a decomposable structure.

through a change P_H. Differentiating equation (3) and by using envelop theorem we get

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$$\hat{R} = (1/\theta_{NH})\ \hat{N}_F \tag{3.1}$$

Using the above result and differentiating equations (4), (5)and (6)we can get[8]

$$\hat{X}_H = \mu\, \hat{N}_F + \left(\frac{\theta_{LH}}{\theta_{NH}}\sigma_H\right)\ \hat{P}_H \tag{4.1}$$

$$\lambda_{KA}\ \hat{X}_A + \lambda_{KM}\ \hat{X}_M = \gamma\, \hat{K}_F \tag{5.1}$$

$$\lambda_{LA}\ \hat{X}_A + \lambda_{LM}\ \hat{X}_M = -(\mu\lambda_{LH})\, \hat{N}_F - \left(\frac{\lambda_{LH}}{\theta_{NH}}\sigma_H\right) \qquad \hat{P}_H \tag{6.1}$$

Solving equations (5.1) and (6.1) by Cramer's rule we obtain (see appendix for details)

$$\hat{X}_A = \frac{1}{|\lambda|}\left[A_1\ \hat{K}_F + A_2\, \hat{N}_F + A_3\, \hat{P}_H \right] \tag{15}$$

$$\hat{X}_M = \frac{1}{|\lambda|}\left[A_4\, \hat{K}_F + A_5\, \hat{N}_F + A_6\, \hat{P}_H \right] \tag{16}$$

where,

$\mu = (N_F / N)$;

$\gamma = (K_F / K)$;

$A_1 = (\gamma\lambda_{LM}) > 0$;

$A_2 = (\mu\lambda_{KM}\lambda_{LF}) > 0$;

$A_3 = [(\lambda_{LH}\lambda_{KM} / \theta_{NH})\sigma_H] > 0$;

$A_4 = (-\gamma\lambda_{LA}) < 0$;

$A_5 = (-\mu\lambda_{LF}\lambda_{KA}) < 0$;

$A_6 = [-(\lambda_{LH}\lambda_{KA} / \theta_{NH})\sigma_H] < 0$;

$A_7 = [\ (RN_D/\theta_{NH}) + tP_M^{*}P_H(\delta D_M/\delta P_H) - tP_M^{*}X_M\frac{1}{|\lambda|}\, A_6]$;

$A_8 = (-tP_M^{*}X_M\frac{1}{|\lambda|}\, A_4) < 0$;

[8] See Appendix A.1 for detailed derivation.

$A_9 = (-tP_M^{*}X_M\frac{1}{|\lambda|}A_5) < 0$;

$A_{10} = [\ \mu - E^{H}_{Y}(1/VY)A_9] > 0$;

$A_{11} = [-E^{H}_{Y}(1/VY)A_8] > 0$;

$A = [E^{H}_{PH} + E^{H}_{Y}(1/VY)A_7 - \frac{\theta_{LH}}{\theta_{NH}}\sigma_H] < 0$;

$A_{12} = \frac{1}{A}(A_{10}) < 0$;

$A_{13} = \frac{1}{A}\quad(A_{11}) < 0$;

$V = [1 - \frac{t}{1+t}m_M]$;

$m_M = [P_M(\delta D_M/\delta Y)]$ and $1 > m_M > 0$.

We now want to define $|\lambda|$. Here ,$|\lambda| = (\lambda_{KA}\lambda_{LM} - \lambda_{KM}\lambda_{LA}) < 0$, because sector A is more labour intensive relative to sector M (by assumption).

Using equations (7), (8), (9), (10) and (4.1) we get after some algebraic manipulation[9](see appendix A.2) ,

$$\widehat{P}_H = (A_{10}/A)\,\widehat{N}_F + (A_{11}/A)\,\widehat{K}_F \qquad (17)$$

$$\widehat{P}_H = A_{12}\widehat{N}_F + A_{13}\widehat{K}_F \qquad (18)$$

Using $\widehat{K}_F = 0$, in equation (18) we get

$$\frac{\widehat{P_H}}{\widehat{N_F}} = A_{12} \qquad (18.1)$$

Similarly using the fact that $\widehat{N}_F = 0$, we obtain

$$\frac{\widehat{P}_H}{\widehat{K}_F} = A_{13} \qquad (18.2)$$

[9] Stability condition of the health sector, that is, A <0 is used to derive the equation (18).

Inserting the values of A ,A_{10} into equation (3.18.1) we obtain

$$\frac{\hat{P}_H}{\hat{N}_F} = \frac{1}{A}[\mu - E^{H}_{Y} (1/VY)(tP_M^{*}X_M\frac{1}{|\lambda|}\mu\lambda_{LF}\lambda_{KA})]$$

(18.1.1)

So, from (18.1.1) it follows that $\hat{P}_H < 0$ when $\hat{N}_F > 0$. Again from (3.1) we find that $\hat{R} < 0$ when $\hat{N}_F > 0$. These are summarized in the form of the following proposition.

Proposition 1: *An inflow of foreign health capital leads to: (i) a decrease in the price of the output of non-traded health sector; (ii) a decrease in the return to health capital.*

The above proposition can be explained as follows. From equation (4.1) we find that an inflow of foreign health capital leads to an increase in the production of health sector, for given price, that is P_H. It implies that the supply curve of the health sector will shift rightward. Again for given P_H, and hence for given R and also for given a_{NH} and a_{LH} we find that an increase in N_F causes an increase in X_H. It implies an increase in $a_{LH}X_H$. Thus ($L-a_{LH}X_H$) will decline, that is from equation (6) we can say, labour available to sectors A and M will fall. It creates a *Rybczynski effect,* resulting in contraction of sector A and expansion of sector M. This is because A is more labour intensive relative to sector M. So we find an inflow of foreign health capital leads to an increase in X_M. For given P_H and for given t, an increase in X_M implies a decrease in import, since $I = D_M - X_M$, which again implies a decrease in tariff revenue. So, other things remaining same, the national income at domestic prices falls, which leads to a decrease in the demand for commodity H and, therefore, creates a downward shift of demand curve. So, for given P_H, a decrease in demand and an increase in supply create excess supply situation in health sector. It means that P_H is no longer given. This excess supply creates downward pressure on health price, that is, a decrease in P_H. From equations (3) and (3.1) it is very clear that the movement of R is only depends upon the movement of P_H. Thus, we can argue that R will fall as a result of fall in P_H.

Inserting the values of A, A_{11} into equation (18.2), we get,

$$\frac{\hat{P}_H}{\hat{K}_F} = \frac{1}{A}\,[-\, E^H{}_Y\, 1/(VY)\; tP_M{}^{*}\frac{1}{|\lambda|}\,\lambda_{LA}\,\gamma] \qquad (18.2.1)$$

From (18.2.1) it follows that $\hat{P}_H$ <0, when ,$\hat{K}_F$ >0. This leads to the following proposition.

Proposition 2 : *An inflow of foreign capital leads to: (i) a decrease in the price of the output of non-traded health sector; (ii) a decrease in the return to health capital.*

Explanation of proposition 2 is given below.

An inflow of foreign capital creates a *Rybczynski effect* leading to an expansion of import- competing sector (M) and contraction of the exportable sector(A). This is because sector M is more capital intensive than sector A. For given P_H, an increase in X_M implies a decrease in import, which again implies a decrease in tariff revenue. So, the national income at domestic prices falls, which leads to a downward shift of demand curve for non-traded health commodity. Using (4.1) we can say that, for given P_H, an inflow of foreign capital leads to no change in X_H. So, the supply curve of this sector will remain unaffected. However, P_H will remain no longer given as a reduction in demand for health, with given supply, creates an excess supply in the health sector which causes downward pressure on price of the health sector, that is, a reduction in P_H.

So far we have considered the impact of trade liberalization, in the form of foreign health capital inflow and also inflow of 'usual' foreign capital, on the rate of return on health capital and also on the price of the good of the health sector. An analysis remains incomplete if the impact of trade liberalization on the output levels of various sectors are not analyzed. We shall now focus on the impact of inflow of foreign health capital as well as impact of inflow of 'usual' foreign capital on the output levels of the three sectors that we have considered in our study.

First we consider the impact of inflow of foreign health capital on the output levels and for this we use equations (4.1), (15), (16), (18.1.1) and after simplifying we get [see appendix A.1]

$$\frac{\hat{X}_H}{\hat{N}_F} = \mu + \left(\frac{\theta_{LH}}{\theta_{NH}}\sigma_H\right)\frac{\hat{P}_H}{\hat{N}_F} \tag{4.1.1}$$

$$\frac{\hat{X}_A}{\hat{N}_F} = \frac{1}{|\lambda|}\left[A_2 + A_3\frac{\hat{P}_H}{\hat{N}_F}\right] \tag{15.1}$$

$$\frac{\hat{X}_M}{\hat{N}_F} = \frac{1}{|\lambda|}\left[A_5 + A_6\frac{\hat{P}_H}{\hat{N}_F}\right] \tag{16.1}$$

From equation (4.1.1) we can say that first term on the right hand side of that equation, that is, μ is positive and hence creates a positive impact on X_H due to an inflow of foreign health capital. We call it infrastructural development force due to inflow of foreign health capital. As $\frac{\hat{P}_H}{\hat{N}_F}$ is negative and hence creates a negative impact on X_H. We call it price force. If we assume that price force dominates over infrastructural development force due to an inflow of foreign health capital it leads to a fall in X_H. Similarly we can argue that $\frac{\hat{X}_A}{\hat{N}_F} > 0$ and $\frac{\hat{X}_M}{\hat{N}_F} < 0$, if we assume that price force dominates over infrastructural development force due to an inflow of foreign health capital.

We now consider the impact of 'usual' foreign capital on the sectoral output levels. As the algebra is similar to that of the earlier ones, we just state that $\frac{\hat{X}_i}{\hat{K}_F}$ is less than zero when i = M, H and greater than zero when i = A, if we assume that price force dominates over infrastructural development force due to an inflow of foreign capital.

Proposition 3: *An inflow of foreign health capital (or, foreign capital) leads to contraction of the output level of both health care and the import sector on one hand, and an expansion of the export sector on the other hand.*

3.1 Impact of Foreign Capital Inflow and Foreign Health Capital Inflow on Social Welfare

To analyze the welfare implication of an inflow of foreign health capital totally differentiating equations (12) and (13), we obtain [for details see appendix A.3][10]

$$(1/U_A)(dU/dN_F) = -N_F(dR/dN_F) + tP_M^*(dI/dN_F) \quad (19)$$

where,$(dR/dN_F) < 0$ and the sign of (dI/dN_F) may be either positive or negative[11].

An inflow of foreign health capital with full repatriation of its earnings produces two effects on welfare. First, an inflow of foreign health capital leads to a decrease in the rate of return to health capital, since return to health capital and price of health good has a positive relationship between them. A decrease in return to health capital implies less repatriation of foreign capital, which improves social welfare. We call it factor price effect due to repatriation. Secondly, an inflow of foreign health capital may lead to a decline or an increase in import. This is because, an increase in foreign health capital leads to a decrease in price of health commodity as there is an exogenous increase in supply of health commodity, given P_H. This increase in supply leads to a fall in price of health commodity. Fall in price of health sector implies a decrease in demand for the goods of the import sector due to positive cross price effects. Again fall in P_H leads to a fall in R and hence a decline in national income, which creates a downward pressure on

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[10] The production function for sector A is $F^A(L_A, K_A)$, for sector M is $F^M(L_M, K_M)$ and $F^H(L_H, K_H)$ is the production function for sector H. We need these production functions for derivation of equation (19) as shown in Appendix A.3.

[11] Detailed derivation of (dI/dN_F) has been shown in equation (10.1.A) in appendix A.3. Using equation (18.1) we can obtain, $dR/dN_F = (1/a_{NH})(dP_H/dN_F) < o$.

demand for import goods. Similarly, an increase in N_F leads to a decrease in X_M[12]. If fall in D_M dominates over fall in X_M, we get a decline in imports. Thus reduction in imports reduces tariff revenue and hence reduces social welfare. We call it negative tariff revenue effect. On the other hand we can get an increase in imports if fall in X_M dominates over fall in D_M and hence we get a positive tariff revenue effect. The net result of factor price effect due to repatriation and negative tariff revenue effect may be positive if former dominates over the latter otherwise it will be negative, that is, social welfare may fall due to an increase in foreign health capital. On the other hand if we consider the factor price effect and positive tariff revenue effect then the net result of these forces may creates a positive impact on social welfare. In particular, if we have a situation of full liberalization so that the tariff rate is zero then welfare definitely improves. Thus the following proposition can now be established.

Proposition 4: *An inflow of foreign health capital with full repatriation of its earnings, may improve social welfare under some reasonable conditions. However, in the absence of any tariff welfare definitely improves.*

Similarly the welfare implication of an inflow of foreign capital can be analyzed by differentiating equation (23) with respect to K_F, we get[13]

$$(1/U_A)(dU/dK_F) = - N_F(dR/dK_F) + tP_M^*(dI/dK_F)$$

(19.1)

Here, the net result of factor price effect due to repatriation and positive tariff revenue effect[14] will give us an improvement of social welfare. In fact in this we also find that

[12] Here $(dX_M/dN_F) <0$, because we assume that price force dominates over infrastructural development force. It is to be noted that in equation (18), $\hat{P}_H$ also includes $\hat{N}_F$.

[13] This has been derived in appendix A.3.

[14] Here $(dX_M/dK_F) <0$, as we assume that price force due to inflow of foreign capital dominates over infrastructural developmental force. Again we have shown that $(dR/dK_F) <0$, as $(dP_H/dK_F) <0$. Thus less

when there is full liberalization so that the tariff rate is zero we find an unambiguous increase in social welfare. This gives us the following proposition.

Proposition 5: *An inflow of foreign capital with full repatriation of its earnings, may improve social welfare under some reasonable conditions. However, in the absence of any tariff welfare definitely improves.*

4. Concluding Remarks

This paper attempts to infer the impact of infinitesimal changes of trade policies on the volume of a non-traded health care of a developing economy. In this article we have developed a hybrid type of three sector general equilibrium trade model, where first two sectors (export sector and import sector of our small open economy) form a Heckscher-Ohlin nugget and the third one is a non-traded health service producing sector. From such type of a set up we have shown that an inflow of foreign health capital (or, usual foreign Capital) leads to contraction of both import and non-traded health sectors and expansion of the export sector. Apart from output aspect in this study, we have also examined the gains from trade aspect of infinitesimal changes of trade policies and we have shown that trade liberalization in the form of foreign health capital (or, Usual foreign capital) inflow is welfare improving and social welfare of our stylized economy will definitely improve in the absence of tariff.

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repatriation of foreign capital at the initial stock of foreign capital implies a positive effect on welfare . If fall in X_M dominates over fall in D_M,we get a positive tariff revenue effect which again creates a positive effect on welfare.

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Appendix A. Mathematical expressions of the Basic Model

Appendix A.1 . Detailed derivations of different expressions

Differentiating equation (3) we get,

$a_{LH}dW + Wda_{LH} + a_{NH}dR + Rda_{NH} = dP_H$

AS, $Wda_{LH} + Rda_{NH} = O$ (by envelop theorem) and $dW = 0$,we can get,

$$\hat{R} = \frac{1}{\theta_{NH}} \hat{P}_H \quad (3.1)$$

Differentiating equation (4) we can get,

$$\hat{a}_{NH} + \hat{X}_H = \hat{N} \quad (4.A)$$

Using equation (3) we can obtain,

$$\sigma_H = (\hat{a}_{NH} - \hat{a}_{LH})/(\hat{W} - \hat{R}) \quad (A.1)$$

From envelop theorem we get

$$W da_{LH} + R da_{NH} = 0 \tag{A.2}$$

Total differentiation of equation (A.2) gives us

$$\hat{a}_{LH} = -\frac{\theta_{NH}}{\theta_{LH}}\hat{a}_{NH} \tag{A.3}$$

Using (A.3) and (A.1) in equation (4.A) we can get

$$\hat{X}_H = \mu\hat{N}_F + (\theta_{LH}\,\sigma_H/\theta_{NH})\,\hat{P}_H$$

(4.1)

Differentiation of equation (5)gives us

$$\lambda_{KA}\hat{X}_A + \lambda_{KM}\hat{X}_M = \gamma\hat{K}_F$$

(5.1)

Differentiating equation (6) we can obtain

$$\lambda_{LA}\hat{X}_A + \lambda_{LM}\hat{X}_M + \lambda_{LH}\hat{X}_H + \lambda_{LH}\hat{a}_{LH} = 0 \tag{6.A}$$

Using (3.1) ,(A.3) and (4.1) ,the above equation can be written as,

$$\lambda_{LA}\hat{X}_A + \lambda_{LM}\hat{X}_M = -(\mu\lambda_{LH})\hat{N}_F - \left(\frac{\lambda_{LH}}{\theta_{NH}}\sigma_H\right)\hat{P}_H \tag{6.1}$$

From equation (5.1) and (6.1) we can write

$$\begin{pmatrix} \lambda_{KA} & \lambda_{KM} \\ \lambda_{LA} & \lambda_{LM} \end{pmatrix} \begin{pmatrix} \hat{X}_A \\ \hat{X}_M \end{pmatrix} = \begin{pmatrix} \gamma\widehat{K_F} \\ -(\mu\lambda_{LH})\hat{N}_F - \left(\frac{\lambda_{LH}}{\theta_{NH}}\sigma_H\right)\hat{P}_H \end{pmatrix}$$

Solving by Cramer's rule and simplifying, one gets

$$\hat{X}_A = \frac{1}{|\lambda|}\left[(\gamma\lambda_{LM})\hat{K}_F + (\mu\lambda_{KM}\lambda_{LH})\hat{N}_F + (\lambda_{KM}\lambda_{LH}\sigma_H / \theta_{NH})\hat{P}_H\right.$$

$$= \frac{1}{|\lambda|}\left[A_1\hat{K}_F + A_2\hat{N}_F + A_3\hat{P}_H\right] \tag{15}$$

$$\hat{X}_M = \frac{1}{|\lambda|}\left[(-\gamma\lambda_{LA})\hat{K}_F + (-\mu\lambda_{KA}\lambda_{LH})\hat{N}_F + (-\lambda_{KA}\lambda_{LH}\sigma_H / \theta_{NH})\hat{P}_H\right]$$

$$= \frac{1}{|\lambda|}\left[A_4\hat{K}_F + A_5\hat{N}_F + A_6\hat{P}_H\right]$$

(16)

and $|\lambda| < 0$.

Appendix A.2. **Derivation of stability condition of the market for commodity H**

In our model we assume that commodity H is a non traded final commodity and its market must clear domestically through adjustments in its price, P_H.

The stability condition of the market for commodity H requires that

$[(\frac{\widehat{D}_H}{\widehat{P}_H} - \frac{\widehat{X}_H}{\widehat{P}_H})] < 0.$ (A.4)

Differentiating equation (7) we get

$$\widehat{D}_H = E^H{}_{PH}\widehat{P}_H + E^H{}_Y\widehat{Y}$$

(A.5)

Total differentiation of equation (11.2) yields

$dY = RN_D\widehat{R} + tP_M{}^*[(\delta D_M / \delta P_H)P_H\widehat{P}_H + (\delta D_M/\delta Y)dY - dX_M]$

$dY\{1- tP_M{}^*(\delta D_M/\delta Y)\} = (RN_D/\theta_{NH})\widehat{P}_H + tP_M{}^*P_H(\delta D_M/\delta P_H)\widehat{P}_H - tP_M{}^*X_M\widehat{X}_M$

$dY\{1- (tm_M/1+t)\} = (RN_D/\theta_{NH})\widehat{P}_H + tP_M{}^*P_H(\delta D_M/\delta P_H)\widehat{P}_H - tP_M{}^*X_M\widehat{X}_M$

Using equation (16) in the above equation we get

$$\widehat{Y} = (\frac{1}{VY})[\{RN_D/\theta_{NH} + tP_M{}^*P_H(\delta D_M/\delta P_H) - tP_M{}^*X_M\frac{1}{|\lambda|}A_6\}\widehat{P}_H + \{-tP_M{}^*X_M\frac{1}{|\lambda|}A_4\}\widehat{K}_F + \{-tP_M{}^*X_M\frac{1}{|\lambda|}A_5\}\widehat{N}_F]$$

$$\widehat{Y} = (\frac{1}{VY})[A_7\widehat{P}_H + A_8\widehat{K}_F + A_9\widehat{N}_F]$$

(11.2.A)

So, by using $\widehat{N}_F = \widehat{K}_F = 0$ we have

$\widehat{Y} = (\frac{1}{VY})[A_7\,\widehat{P}_H]$

$\frac{\widehat{Y}}{\widehat{P}_H} = (\frac{1}{VY})\ A_7$ (3.11.3.A)

Using (11.3.A) in equation (A.5) we get

$\frac{\widehat{D}_H}{\widehat{P}_H} = E^H{}_{PH} + E^H{}_Y(\frac{1}{VY})\ A_7$ (7.2)

From equation (4.1) we get, when $\widehat{N}_F = \widehat{K}_F = 0$

$\frac{\hat{X}_H}{\hat{P}_H} = (\theta_{LH}\ \sigma_H/\theta_{NH})$ (4.2)

Substituting the expressions for $\frac{\hat{D}_H}{\hat{P}_H}$ and $\frac{\hat{X}_H}{\hat{P}_H}$ from (7.2) and (4.2) into (A.4) one obtains

$[E^H_{PH} + E^H_Y(\frac{1}{VY})\ A_7 - (\theta_{LH}\ \sigma_H/\theta_{NH})\ ] < 0$

Or $A = [E^H_{PH} + E^H_Y(\frac{1}{VY})\ A_7 - (\theta_{LH}\ \sigma_H/\theta_{NH})\ ] < 0$ (A.4.1)

Differentiating (8), and simplifying we get

$E^H_{PH}\hat{P}_H + E^H_Y\hat{Y} = \mu\hat{N}_F + (\theta_{LH}\ \sigma_H/\theta_{NH})\ \hat{P}_H$

$E^H_{PH}\hat{P}_H + E^H_Y\ [(\frac{1}{VY})\{A_7\hat{\ } + A_8\hat{\ } + A_9\hat{\ }\}] = \mu\hat{\ }_F + (\theta_{LH}\ \sigma_H/\theta_{NH})\ \hat{\ }_H$

$[E^H_{PH} + E^H_Y(\frac{1}{\ })\ A_7 - (\theta_{LH}\ \sigma_H/\theta_{NH})\ ]\hat{\ }_H = A_{10}\hat{\ }_F + A_{11}\ \hat{K}_F$ (17.A)

Appendix A.3. The impact on welfare

Total differentiation of equations (12) and (13) gives us

$(dU/U_A) = dD_A + P_M\ dD_M + P_H\ dD_H$

(12.A)

$dD_A + P_M\ dD_M + P_H\ dD_H = dX_A + P_M dX_M + P_H dX_H - rdK_F - RdN_F - N_F dR + tP_M^* dI$

(13.A)

Differentiating equation (11.1) one can obtain

$dY = [dX_A + P_M dX_M + P_H dX_H - rdK_F - RdN_F - N_F dR] + X_H dP_H + tP_M^* dI$

(11.1.A)

By differentiating production functions (see footnote 10) and using (4), (5) and (7), we get

$[dX_A + P_M dX_M + P_H dX_H - rdK_F - RdN_F - N_F dR] + X_H dP_H$

$= [(F_L^A dL_A + F_K^A dK_A) + P_M\ (F_L^M dL_M + F_K^M dK_M) + P_H\ (F_L^H dL_H + F_N^H dN_H) - rdK_F - RdN_F - N_F dR] + X_H dP_H$

$= W(dL_A + dL_M + dL_H) + r\ (dK_A + dK_M - dK_F) + (RdN - RdN_F - N_F dR) + X_H dP_H$

$= -\ N_F dR + N\ dR$ (assuming $dK_A + dK_M = dK_F$, $dN_F = dN$ and $dL = 0$) (A.6)

$[dX_A + P_M dX_M + P_H dX_H - rdK_F - RdN_F - N_F dR] = - N_F dR$ (A.6.1)

Using (A.6) in equation (11.1.A) we get

$dY = N_D dR + tP_M^{*} dI$ (11.A)

Differentiating equation (10) and using the fact that dY contains dI (as shown by equation (11.1.A)) after simplification we get

$dI = (\delta D_M/\delta P_H)\ dP_H + (\delta D_M/\delta Y)\ dY - dX_M$

$dI = (1/V)\ [\ (\delta D_M/\delta P_H) + (m_M N_D/P_M\ a_{NH})]dP_H - (1/V)\ dX_M$ (10.1)

$(dI/dN_F) = (1/V)\ [\ (\delta D_M/\delta P_H) + (m_M N_D/P_M\ a_{NH})](dP_H\ /dN_F) - (1/V)\ (dX_M\ /\ dN_F)$ (10.1.A)

Using (A.6.1),(11.1.A) and (10.1) from (12.A) we can obtain

$(1/U_A)dU = -N_F dR + tP_M^{*} dI$ (19.A)