Mobility of Capital and Health Sector:A Trade Theoretic Analysis

Chatterjee, Tonmoy and Gupta, Kausik

Rabindra Bharati University, West Bengal State University

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Tonmoy Chatterjee[1],
Department of Economics, Rabindra Bharati University,
Kolkata-700050, West Bengal, INDIA
Email: tonmoychatterjee.economics@gmail.com

and

Kausik Gupta,
Vice Chancellor,
West Bengal State University,
Kolkata-700126, West Bengal, INDIA
Email: kausik2k1@rediffmail.com

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Abstract: In this paper we formulate a three-sector general equilibrium model where two sectors produce final traded goods whereas a third sector produces a non-traded final good. We refer to the third sector as a non-traded final goods producing health sector. In such a set up we have shown that a movement from a regime of international health capital immobility to a regime of international health capital mobility may lead to an expansion of the health sector. Next we have considered a variant of the basic model and we have shown that the output of the health sector must go up in case of international health capital mobility. Finally in the variant of the model we have shown that a movement from a regime of international capital immobility to a regime of international capital mobility may lead to a contraction of the health sector and one of the sectors (either Agricultural or Manufacturing) vanishes.

Key words: Health sector, International health capital mobility, Vanishing Sector and General Equilibrium.

JELClassification: I10, I15, F21

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1.Introduction

India is one of the fastest growing countries in the modern world as per as GDP is concerned as in recent years it is experiencing a GDP growth rate around 6 to 8 percent. Apart from high growth rate of GDP Indian economy is not performing well in the path of economic development and one of the reasons behind it is poor infrastructural facilities especially in the social sector. Hence instruments of social sector (education, health etc.) should gain special emphasis from the policy makers. Health sector is gaining more importance among other growing sectors like IT, education etc because of its potentiality. Recently India's total expenditure on health care as percentage of GDP is close to 5-6 percent, whereas it is 4.7% in China, 3.5% in Thailand, 4.2% in Malaysia and 3.4% in Saudi Arabia etc.

In recent past the recession in 2008 and recent economic slowdown since 2011 intensified by the Eurozone crisis and the slowdown in the US economy, have brought about a gloom in world economic growth projections. A recent report released by the United Nations (UN) shows that all developing economies will get affected by the slowdown. However, the good news is that East Asian and South Asian economies are increasingly being seen as growth drivers of the world as an outcome of which the health sector has grown exponentially. A CII- Mckinsey report states that the Indian health sector has emerged as one of the largest service sectors with estimated revenue of around $30 billion constituting 5% of GDP and offering employment to around 4 million people. By 2025, the Indian population will touch 1.4 billion with about 45% constituting urban adults[2]. To cater to this demographic change, the health sector will have to be about $100 billion in size contributing nearly 8-10% of the future GDP. It will

[2] Source: The Times of India, dated:2nd February, 2012.

provide more incentive to the foreign investors to invest in the Indian health sector. It is to be noted that such type of foreign investment through foreign direct investment (FDI hereafter) may create some positive impact along with some negative impact. For example, while the emergence of corporate hospitals or foreign funding and tie ups in the hospital segment can have many positive implications, such as helping to improve physical infrastructure, standards, quality of healthcare, technology, and processes along with spill over benefits in areas such as medical devices, pharmaceuticals, outsourcing, and research and development, it may also result in higher costs of health care and greater segmentation between the public and private health sectors.

It is to be noted that Government of India has been worried to see the trend of foreign players taking over domestic players in the health care sector (pharmaceutical firms, etc). India today allows 100 per cent FDI in the health sector, but the policy is being reviewed in the wake of fears over the takeover of these domestic companies by MNCs leading to the fact that essential medicines becoming costlier and thereby impacting public health programmes, including the universal immunisation programme. Though as many as 61 drugs worth $80 billion are likely to go off patent in the U.S. between 2011 and 2013, making it possible for Indian companies to produce cheaper generic versions. Keeping in view the need to exercise a certain degree of supervision over takeovers, the Ministry has recommended that prior approval of the Foreign Investment Promotion Board (FIPB) be made mandatory[3].

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

[3] The Hindu- 3rd September,2011.

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[4].

In this paper we have structured a theoretical model based on general equilibrium trade models with special emphasis to the health sector. From that model we are going to examine the impact of FDI in the healthcare. In a general equilibrium trade models there exists two different ways through which one can show the effect FDI on the output levels of different sectors. One is through infinitesimal change in foreign capital (change in exogenous foreign capital) and other is finite change in foreign capital (change in endogenous foreign capital). In this paper we want to show how the behaviour of health sector changes in the presence of finite change in foreign health capital (or, finite change in foreign capital). Here we want to correlate the issues related to international health capital mobility (or, international capital mobility), health sector.

The main motivation behind the present paper follows from two different facts. Firstly due to the fact that though there exists few empirical works related to FDI and health but unfortunately there exist almost no works related to health and FDI in a general equilibrium trade models. In this paper we are trying to fill up this lacuna. The second one generates from the fact that existing literature on theoretical works related to any specific problem in a developing economy attempts to examine the impact of exogenous changes (may be in the form of exogenous change in capital stock) on variables like factor prices, output levels of various sectors and national income rather than on the implications of endogenous changes in capital on the above mentioned variables. Contrary to the conventional works here we discuss the implication of regime switch from no capital mobility to full capital mobility (in the form of both usual and health capital), thus discussing the impact of finite changes in policies. This is more in line

[4] We shall refer to FDI as changes in foreign capital stock and FDI in the health sector as changes in foreign health capital stock. In other words 'usual' foreign capital in this paper is referred to as 'foreign capital' and foreign capital related to health sector is referred to as 'foreign health capital'.

with contemporary literature on trade and capital flows such as Marjit and Kar (2005), Marjit and Gupta (2008) etc.

In this paper we consider that total health capital stock consists of both domestic health capital and foreign health capital. Similarly, total capital stock of the economy consists of both domestic capital and foreign capital. We have considered two regimes here. One is the regime of international health capital immobility (or, international capital immobility) and the second one is the regime of international health capital mobility (or, international capital mobility). In the context of first regime we have considered both foreign capital and foreign health capital as exogenous implying the existence of international capital immobility and foreign health capital immobility. In the second regime we have considered endogenous foreign health capital and foreign capital implying perfect mobility of both types of capital.

The paper is organized in the following manner. Section 2 considers the basic model. It is divided into two subsections. Subsection 2.1 considers international health capital immobility and subsection 2.2 considers international health capital mobility. Section 3 considers the variant of the basic model. It is divided into four subsections. Subsection 3.1 considers international health capital immobility and subsection 3.2 considers international health capital mobility. Subsection 3.3 considers international capital immobility and subsection 3.4 considers international capital mobility. Finally, the concluding remarks are made in section 4.

2. The Basic Model

2.1 International Health Capital Immobility

We consider a small open economy where international health capital is immobile[5] and it consists of three sectors in a Heckscher-Ohlin-Samuelson framework. One of the three sectors, is the agricultural sector(A), which produces its output using labour(L) and capital(K). Another sector is the manufacturing sector (M), which produces output by using labour and capital. This is the import competing sector while sector A is a sector that produces exportable products. The third sector is the health sector (H) which uses labour as well as health capital (N) which is specific to this sector. The health sector produces a non-traded final commodity[6]. 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. All these three sectors[7] use labour which is perfectly mobile among these three sectors. Health capital is specific to sector H while K is completely mobile between sectors A and M. It is to be noted that health capital consists of both domestic health capital (N_D) and foreign health capital (N_F), and we assume that N_D and N_F are perfect substitutes.

In our model sector A produces its output X_A, sectors M and H produce output X_M and X_H respectively. Here we assume that the agricultural sector is more labour intensive compared to the manufacturing sector. The agricultural product is considered as the numeraire and its price is set equal to unity. We assume that both foreign capital income and foreign health capital income are completely repatriated. Production functions exhibit constant returns to scale with diminishing marginal productivity for each factor.

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[5] International health capital immobility is a situation where domestic rate of return on foreign health capital (R) is greater than the rate of return on foreign health capital in the international market (R^*) and there is restriction on the entry of foreign health capital to the domestic economy.

[6] 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.

[7] All the three sectors produce final commodities in this model but one of them produces non-traded final commodity.

The notations used in the model are stated as follows:

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

K_F = foreign capital stock

K_D = domestic capital stock

K = economy's aggregate capital stock

a_{ji} = quantity of the 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

Y = national income at domestic price

I = import demand for commodity M

σ_i = elasticity of factor substitution in sector i, i = A, M, H.

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

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

We assume for simplicity that a_{LH} is fixed[8].

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

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

We assume that commodity H is a normal good with negative and positive own price elasticity and income elasticities of demand, respectively, that is, $E^H_{P_H}<0$ and $E^H_Y>0$.

The cross price elasticity is positive, that is, $E^H_{P_M}>0$.

The demand –supply equality condition for commodity H is

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

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

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

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

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

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[8] In this paper we have assumed a_{LH} as fixed coefficient. It is to be noted that the relaxation of the assumption, that is fixed a_{LH}, will leave the conclusions of the model basically unchanged.

$$Y = X_A + P_M X_M + P_H X_H - rK_F - RN_F + tP_M^* I \quad (11.1)$$

or

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

The working of the model is as follows. There are eleven endogenous variables in the system: $W, r, R, P_H, X_A, X_M, X_H, D_M, D_H, I$ and Y. 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. Hence 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 (4) and (10) we get the values of R and I respectively.

2.2 International Health Capital Mobility

Here we assume that in the presence of international health capital immobility we have $R > R^*$, where R^* is the given return on foreign health capital in the international market. In such a situation we have no foreign health capital inflow. If R falls to $\tilde{R}$, where, $R > \tilde{R} > R^*$, we find that there is some amount of inflow of foreign health capital (N_F) and at last we will reach at the equilibrium level[9] of N_F where, $R = R^*$.

Here, we assume that N_D is exogenous whereas N_F is assumed to be an endogenous variable and we use $R = R^*$ in our basic model. By using equations (1) and (2) we can solve for W and r. Once W and R are known a_{NH} is also known. Using $R = R^*$ in our

[9] At $R=R^*$, we have the equilibrium level of foreign health capital inflow due to equilibrium in the international health capital market.

basic model we find that equation (3) gives us the value of P_H. Hence from equation (4) we can express X_H as a function of N_F and hence by using equations (5) and (6) we can express X_A and X_M in terms of N_F. From equation (9) D_M can be expressed as a function of Y only, since P_H and P_M are given. Thus I can be expressed in terms of Y and N_F. Using this fact in equation (11.2) we can express Y as a function of N_F. Thus from equation (7) one can express D_H in terms of N_F and hence N_F can be determined from equation (8). Once N_F is known, then X_A, X_M, X_H, D_H, D_M, I are also known. In order to examine the impact of an increase in N_F on R we need to explore the relationship between P_H and R on one hand and X_H and N_F on the other hand. To find out the relationship between P_H and R we establish the following lemma.

<u>Lemma 1</u> *A fall in R leads to a fall in P_H iff σ_H <1.*

Proof of lemma 1: Differentiating equation (3) and by using da_{LH} = dW= 0, we get,

$\theta_{NH}\,(\hat{R}+\hat{a}_{NH}) = \hat{P}_H$

By definition $\sigma_H = (\hat{a}_{NH} - \hat{a}_{LH})/(\hat{W} - \hat{R})$

Using the envelope result $Wda_{LH} + Rda_{NH} = 0$ and by inserting $\hat{a}_{LH} = \hat{W} = 0$ in the expression of σ_H one obtain

$\hat{a}_{NH} = - \hat{R}\,\sigma_H$

Using the value of $\hat{a}_{NH}$ in the expression of $\hat{P}_H$ we can write

or, $\hat{R} = [1/\,\theta_{NH}(1-\sigma_H)]\,\hat{P}_H$,

or, $\hat{P}_H = \theta_{NH}(1-\sigma_H)\,\hat{R}$

Hence $\hat{R} < 0$ implies $\hat{P}_H < 0$, iff $\sigma_H < 1$.

We thus find that the lemma holds if the production function for the health sector is non-Cobb-Douglas.

Similarly, the relationship between N_F and X_H can be established by the following lemma.

Lemma 2 *Under the assumption that* $-\frac{\mu}{\sigma_H}\hat{N}_F < \hat{R} < 0$*, where* $\mu = (N_F/N)$*; an increase in* N_F *leads to an increase in* X_H*.*

Proof of lemma 2: To prove this lemma we have to first of all show that $\hat{X}_H > 0$, when $\hat{N}_F > 0$. Differentiation of equation (4) gives us

$\hat{a}_{NH} + \hat{X}_H = \mu \hat{N}_F$

By definition $\sigma_H = (\hat{a}_{NH} - \hat{a}_{LH})/(\hat{W} - \hat{R})$

By using the envelope result $Wda_{LH} + Rda_{NH} = 0$ and by inserting $\hat{a}_{LH} = \hat{W} = 0$ in the expression of σ_H one obtain

$\hat{a}_{NH} = -\hat{R}\sigma_H$

Thus $\hat{X}_H$ can be written as $\hat{X}_H = \mu \hat{N}_F + \hat{R}\sigma_H$

Hence we can say that $\hat{X}_H > 0$, when $\hat{N}_F > 0$ iff $\hat{R} > -\frac{\mu}{\sigma_H}\hat{N}_F$.

In fact when $\hat{N}_F > 0$, we have $\hat{R} < 0$.

Thus, $\hat{X}_H > 0$, iff $-\frac{\mu}{\sigma_H}\hat{N}_F < \hat{R} < 0$.

An increase in N_F implies a fall in R. A fall in R implies an increase in a_{NH}. Given a_{LH}, from equation (3) we can say that P_H will also fall due to fall in R[10]. Again from equation (4) we can argue that there will be an increase in X_H due to an inflow of N_F[11]. An increase in X_H implies an increase in $a_{LH}X_H$ and hence a fall in $(L - a_{LH}X_H)$ as a_{LH} is fixed, that is, a reduction in the labour availability to sectors A and M. A fall in the labour endowment available to sectors A and M causes a Rybczynski effect as a result of

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[10] See lemma 1.

[11] For details see lemma 2.

which X_M increases and X_A falls, given that sector A is more labour intensive than sector M. Using equations (11.2), (10) and after some manipulation we can say that an increase in N_F leads to a fall in Y, due to the factor price effects and tariff revenue effect[12].

Proposition 1: *A shift from international health capital immobility regime to an international health capital mobility regime leads to under some reasonable conditions: (i) a decrease in the rate of return to health capital and a decrease in the price of the output of the health sector; ii) increase in the levels output of both health and manufacturing sector and a reduction in the level of output of the agricultural sector and (iii) a fall in national income.*

3. A Variant of the Basic Model

3.1 International Health Capital Immobility

The model is similar to that of the basic model but the only difference is that here we assume that the wage rate of the health sector is fixed at a higher level ($\overline{W}$) compared to the competitive wage rate (W)[13]. Thus we have $\overline{W}$ > W. In this version of the model equation (3) changes to

$$a_{LH}\overline{W} + a_{NH}R = P_H \tag{3.1}$$

Equation (11.2) can be rewritten as

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[12] An increase in N_F leads to a fall in R. Thus fall in R implies a fall in Y. We call it factor price effect. From (11.2) we can express Y as a function of P_H and I. Using this fact in equation (10) we can express I in terms of P_H and hence we can express Y in terms of P_H only. Thus D_M is expressed in terms of P_H. An increase in N_F leads to a fall in P_H and an increase in X_M. Here a fall in P_H leads to a fall in D_M. Thus increase in X_M and decrease in D_M leads to a reduction in I. Hence reduction in I leads to a fall in Y. We call it tariff revenue effect.

[13] Here we have assumed that the labour of the health sector will get a wage rate $\overline{W}$, which is higher than W because the workers of health sector deal with human health and they are involved with relatively skill-intensive works, though we have not considered in this paper any division between skilled and unskilled workers.

$Y = (\overline{W} - W)\ a_{LH}X_H + W\ L + RN_D + rK_D + tP_M^*I$

(11.3)

Equation (3.1) and (11.3) are added to our basic model[14]. The other equations and the equilibrium conditions of the other markets remain the same. Determination of the general equilibrium is possible, since we have eleven independent equations to solve for eleven unknowns[15].

3.2 International Health Capital Mobility

This version of the basic model is almost similar to that of earlier version, that is, the model is used in the section 3.1. Here we assume that R falls to $\tilde{R}$, where, $R > \tilde{R} > R^*$, and we find an inflow of N_F so that ultimately R will reach to R^*.

By assuming N_D as an exogenous variable and N_F as an endogenous variable and after using $R=R^*$ we can determine the general equilibrium[16].

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[14] Equation (11.3) is same as (11.2) if we assume $W = \overline{W}$.

[15] We can find out the value of W and r from equations (1) and (2). For given a_{LH} and for given $\overline{W}$ from equation (3.1) we can express R as a function of P_H. Thus it is an indecomposable structure. Hence 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. Again from equation (11.3) we can express Y as a function of P_H. So equation (7) is expressed as a function of P_H. Equation (8) thus 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. Once P_H and Y are known, equations (7) and (9) help us to determine the values of D_H and D_M respectively. Finally using equations (4) and (10) we get the values of R and I respectively.

[16] Using equations (1) and (2) we can solve for W and r. Here a_{NH} is given, since $\overline{W}$ and R are given.Using $R = R^*$ in our basic model we find that equation (3) gives us the value of P_H. Given a_{NH}, from equation (4)

An increase in N_F implies a fall in R. Given a_{LH}, from equation (3.1) we can say that P_H will also fall due to fall in R (see lemma 1). On the other hand from equation (4) we can argue that there will be an increase in X_H due to an inflow of N_F[17]. An increase in X_H implies an increase in $a_{LH}X_H$, as a_{LH} is fixed and hence a fall in $(L - a_{LH}X_H)$, that is, a reduction in the labour availability to sectors A and M. A fall in the labour endowment available to sectors A and M causes a Rybczynski effect as a result of which X_M increases and X_A falls, given that sector A is more labour-intensive than sector M[18]. Using equations (11.3), (10) and after some manipulation we can say that an increase in N_F leads to a fall in Y, due to the factor price effect and tariff revenue effect[19]. An increase in X_H leads to an increase in Y. This is known as labour reallocation effect[20]. Thus the effects of an inflow of N_F on Y is depends upon the net effect of factor price effect, tariff revenue effect and labour reallocation effect. If labour reallocation effect dominates over rest of the effects creates a positive effect on Y and hence on welfare. Thus the following proposition can now be established.

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we can express X_H as a function of N_F and hence by using equations (5) and (6) we can express X_A and X_M in terms of N_F. From equation (9) D_M can be expressed as a function of Y only, since P_H and P_M are given. Thus I can be expressed in terms of Y and N_F. Using this fact in equation (11.2) we can express Y as a function of N_F. Thus from equation (7) one can express D_H in terms of N_F and hence N_F can be determined from equation (8). Once N_F is known, the variables X_A, X_M, X_H, D_H, D_M, I are also known.

[17] See foot note no. 11.

[18] We shall get opposite results if we assume that sector A is more capital intensive relative to sector M.

[19] This is already explained in footnote no.12.

[20] The workers of health sector enjoy a wage rate ($\overline{W}$), which is higher compared to the competitive wage rate (W), that prevails in rest of the economy. Hence increase in employment in the health sector, (because $\overline{W} > W$) is at the cost of reduction in employment in the other sectors of the economy. Thus the wage differential ($\overline{W} - W$) leads to the labour reallocation effect.

Proposition 2: *A shift from international health capital immobility regime to an international health capital mobility regime leads to an increase in national income and hence an increase in social welfare under some reasonable conditions. The sectoral effects of such a regime change are similar to that of proposition 1.*

3.3 International Capital Immobility

The model which we use in this section is similar to that of the model of section 3.1 and hence the working of the general equilibrium[21] is similar to that of section 3.1.

3.4 International Capital Mobility

Here we use the model of the section 3.1. we assume that K_D as an exogenous and K_F as an endogenous variables. Here we also assume that r falls to $\tilde{r}$, where, r> $\tilde{r}$ > r*, and we find an inflow of K_F and ultimately r will reach to r*. By assuming K_F as an endogenous variables and after using r=r* in our variant of the basic model we will face a problem of uniqueness[22] to solve the general equilibrium. Thus determination of the general equilibrium is not possible. However, from here we can infer that an inflow of K_F leads to a fall in r. From equation (1) and (2) we can argue that a reduction r leads to an increase in W in both of these equations. If W increases more in equation (2) than in equation (1) we find that sector A vanishes. On the other hand if W increases more in equation (1) than in equation (2) we find that sector M vanishes. This leads to us the following proposition.

[21] This is explained in footnote no.15.

[22] Inserting r=r* in the variant we can get two different values of W,one from equation (1) and other from equation (2).

Proposition 3 : *A shift from international capital immobility regime to an international capital mobility leads to; (i) either only manufacturing sector survives and the agricultural sector vanishes, or (ii) only the agricultural sector survives and the manufacturing sector vanishes.*

Case 1 : Sector A is the vanishing sector

The new equational structure can be written as

The competitive equilibrium condition in the product market are given by the following equations

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

$$a_{LH}\overline{W} + a_{NH}R = P_H \quad (3.1)$$

Sector specificity of health capital is given by the following equation

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

Sector specificity of capital for sector M (when sector A vanishes) can be expressed as

$$a_{KM}X_M = K_D + K_F = K \quad (5.1)$$

Full employment of labour implies the following equation

$$a_{LM}X_M + a_{LH}X_H = L \quad (6.1)$$

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

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

The demand –supply equality condition for commodity H is

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

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

$Y = P_M X_M + P_H X_H - rK_F - RN_F + tP_M^* I$ (11.4)

or

$Y = (\overline{W} - W)\, a_{LH} X_H + WL + RN_D + rK_D + tP_M^* I$ (11.3)

Given $r = r^*$ from equation (2) we can calculate the value of W. For given a_{LH}, from equation (3.1) we can express R as a function of P_H. Thus it is an indecomposable structure. Hence 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. Similarly, from equation (5.1) we can express X_M in terms of K_F. For given a_{LH} and a_{LM}, from (6.1) we can express K_F as a function of P_H. Thus X_M can be expressed as a function of P_H. From equation (11.3) we can express Y as a function of P_H and I. From equation (10) I can be expressed as a function of P_H since X_M is a function of P_H. Hence Y can be expressed in terms of P_H only. So from equation (7) D_H can be expressed as a function of P_H. As a result of this, equation (8) helps us to determine the value of P_H. Once P_H is known K_F, X_M, Y, R and X_H are also known. Thus equations (7) and (9) help us to determine the values of D_H (since X_H is already known) and D_M respectively. Finally using equation (10) we can get the value of I. To find out the relationship between X_M and K_F we establish the following lemma.

Lemma 3 *Under the assumption that* $-\dfrac{\gamma}{\sigma_M}\hat{K}_F < \hat{r} < 0$, *where* $\gamma = (K_F/K)$; *an increase in* K_F *leads to an increase in* X_M.

Proof of lemma 3: To prove this lemma we have to first of all show that $\hat{X}_M > 0$, when $\hat{K}_F > 0$. Differentiation of equation (5.1) gives us

$$\hat{a}_{KM} + \hat{X}_M = \gamma \hat{K}_F$$

By definition $\sigma_M = (\hat{a}_{KM} - \hat{a}_{LM})/(\hat{W} - \hat{r})$ and using the envelop result $Wda_{LM} + Rda_{KM} = 0$ we can write

$$\hat{a}_{KM} = \sigma_M \theta_{LM} (\hat{W} - \hat{r})$$

From equation (2) we get $\hat{W} = -(\theta_{KM} / \theta_{LM}) \hat{r}$ and inserting it in the expression of $\hat{a}_{KM}$ we can write $\hat{a}_{KM} = -\sigma_M \hat{r}$

Thus $\hat{X}_M$ can be written as $\hat{X}_M = \gamma \hat{K}_F + \hat{r} \sigma_M$

Hence we can say that $\hat{X}_M > 0$, when $\hat{K}_F > 0$ iff $\hat{r} > -\dfrac{\gamma}{\sigma_M} \hat{K}_F$.

In fact when $\hat{K}_F > 0$, we have $\hat{r} < 0$.

Thus, $\hat{X}_M > 0$, iff $-\dfrac{\gamma}{\sigma_M} \hat{K}_F < \hat{r} < 0$.

An increase in K_F implies a fall in r. From equation (2) we can say that a fall in r implies an increase in W. From equation (5.1) we can argue that a fall in r implies an increase in a_{KM}. To maintain fullemployment condition of the capital market it follows that X_M must increase[23]. An increase in W has both positive as well as negative effects on Y. The positive effect is generated due to the wage income effect as reflected by the second term on the right hand side of equation (11.3). The negative effect is generated due to the labour reallocation effect. It is reflected by the first term on the RHS of equation (11.3). A fall in r has a negative effect on Y as reflected by the fourth term on the RHS of equation (11.3). If the sum of labour reallocation effect and domestic capital income effect dominates over the wage income effect we find that there is a fall in Y. For given P_H, a fall in Y implies a fall in D_M. Thus a fall in D_M and an increase in X_M leads to fall in

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[23] See lemma 3.

I. Again a fall in I leads to further fall in Y. From equation (7) we can say that for given P_H and for given X_H, a fall in Y leads to a downward shift of the demand curve of non-traded health commodity which implies a fall in P_H. From equation (3.1) we can say that fall in P_H implies a fall in R, because R and P_H are positively related. A fall in R implies an increase in a_{NH}, hence from equation (4) we can argue that X_H must have to fall to maintain full employment condition of the health capital market.

Proposition 4: *A shift from a regime of international capital immobility to capital mobility causes;(i) the agricultural sector to vanish and both health and manufacturing sectors to survive;(ii) a decrease in the rate of return to health capital, a decrease in price of the output of the health sector and an increase in wage rate; (iii) an increase in the level of output of the manufacturing sector and a decrease in the level of output of the health sector and finally, (iv) a fall in national income, under some reasonable conditions.*

Case 2 : Sector M is the vanishing sector

The modified equational structure can be written as

The competitive equilibrium conditions in the product market are given by the following equations

$$a_{LA}W + a_{KA}r = 1 \tag{1}$$

$$a_{LH}\overline{W} + a_{NH}R = P_H \tag{3.1}$$

Sector specificity of health capital is given by the following equation

$$a_{NH}X_H = N_D + N_F = N \tag{4}$$

Sector specificity of capital for sector A (when sector M vanishes) can be expressed as

$a_{KA}X_A = K_D + K_F = K$ (5.2)

Fullemployment of labour implies the following equation

$a_{LA}X_A + a_{LH}X_H = L$ (6.2)

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

$D_H = D_H(P_H, Y)$ (7.1)

The demand –supply equality condition for commodity H is

$D_H(P_H, Y) = X_H$ (8.1)

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

$Y = X_A + P_HX_H - rK_F - RN_F$ (11.5)

or

$Y = (\overline{W} - W)\, a_{LH}X_H + W L + RN_D + rK_D$ (11.6)

Determination of the general equilibrium is possible, since we have eight independent equations to solve for eight unknowns[24]. In order to examine the impact of inflow of K_F on X_A we have to establish the following lemma.

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[24] Given $r = r^*$ from equation (1) we can calculate the value of W. For given a_{LH}, from equation (3.1) we can express R as a function P_H. Hence 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. Similarly, from equation (5.2) we can express X_A in terms of K_F. For given a_{LH} and a_{LA}, from (6.2) we can express K_F as a function of P_H. Thus X_A can be expressed as a function of P_H. From equation (11.6) we can express Y as a function of P_H. So from equation (7.1) D_H can be expressed as a function of P_H. Thus equation (8.1) helps us to determine the value of P_H. Once P_H is known K_F , X_A , Y, R and X_H are also known. Thus equation (7.1) helps us to determine the value of D_H (since X_H is already known).

<u>***Lemma 4***</u> *Under the assumption that* $-\frac{\gamma}{\sigma_A}\hat{K}_F < \hat{r} < 0$, *where* $\gamma = (K_F/K)$; *an increase in* K_F *leads to an increase in* X_A.

Proof of lemma 4: The proof of lemma 4 is similar to that of lemma 3.

An increase in K_F implies a fall in r. From equation (1) we can say that a fall in r implies an increase in W. From equation (5.2) we can argue that a fall in r implies an increase in a_{KA}. To maintain fullemployment condition of the capital market it follows that X_A must increase[25]. From equation (11.6) we can say that a fall in r and an increase in W leads to a fall in Y under some reasonable conditions[26]. From equation (7.1) we can say that for given P_H, a fall in Y leads to a downward shift of the demand curve of non-traded health commodity which implies a fall in P_H. A fall in R implies an increase in a_{NH}, hence from equation (4) we can argue that X_H must have to fall to maintain full employment condition of the health capital market. This leads to the following proposition.

Proposition 5 : *A shift from a regime of international capital immobility to capital mobility causes;(i) the manufacturing sector to vanish and both health and agricultural sectors to survive;(ii) a decrease in the rate of return to health capital, a decrease in price of the output of the health sector and an increase in wage rate; (iii) an increase in the level of output of the agricultural sector and a decrease in the level of output of the health sector and finally, (iv) a fall in national income, under some reasonable conditions.*

4. Concluding Remarks.

[25] This is explained in lemma 4.

[26] The reason is similar to that of the earlier case (Case 1 where Sector A is the vanishing sector).

In this paper we have assumed that foreign health capital (or, foreign capital) as endogenous. By using same type of set up as we have used in the previous chapter (see section 3.2) we have shown that a change in regime from international health capital immobility to international health capital mobility, lead to expansion of both health sector and manufacturing sector and contraction of agricultural sector. We have also shown a reduction in national income under some reasonable conditions under such a regime change.

Next we have considered a variant of the basic model where wage rate of the health sector is fixed at a level higher than the competitive wage rate. This variant has two parts. In the first part we have considered a shift from a regime of international health capital immobility to health capital mobility and this shift of regime leads to an expansion of both health and manufacturing sectors and contraction of agricultural sector. The second part of the variant has considered a shift from a regime of international capital immobility to international capital mobility and such type of shift of regime leads two types of situation. The first one being the situation when the traditional manufacturing sector absorbs the entire foreign capital and leading to the extinction of the agricultural sector and contraction of the health sector. The second situation is one where the manufacturing sector vanishes, the agricultural sector survives and the health sector contracts. This result is interesting in the sense that in both the basic model and in variant of the basic model we find a regime change from international health capital immobility to international capital mobility always causes an expansion of the health sector. However, in case of the variant of the basic model a regime change from international capital immobility to international capital mobility (without any change in health capital) causes a contraction of the health sector. So, from our model we can infer that expansion of the health sector is dependent upon the form in which foreign direct investments are made by policy makers.

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