Foreign Capital Inflow, Skilled-Unskilled Wage Inequality and Unemployment of Unskilled Labour in a Fair Wage Model

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Abstract: This paper has developed a three-sector general equilibrium framework that explains unemployment of both skilled and unskilled labour. Unemployment of unskilled labour is of the Harris-Todaro (1970) type while unemployment of skilled labour is caused due to the validity of the FWH in the high-skill sector. There are two types of capital one of which is specific to the primary export sector while the other moves freely among the different sectors. Inflows of foreign capital of either type unambiguously improve the economic conditions of the unskilled working class. However, the effects on the skilled-unskilled wage inequality and the extent of unemployment of both types of labour crucially hinge on the properties implied by the efficiency function of the skilled workers.

JEL classification: F13; J41; O15

Keywords: Fair wage hypothesis; skilled labour; unskilled labour; wage inequality; foreign capital; unemployment.

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1. Introduction

The persistence of involuntary unemployment and labour market imperfection are two of the salient features of the labour market in a developing economy. Labour can be of two types: unskilled and skilled. How to explain unemployment as a general equilibrium phenomenon depends on which type of labour we are considering. Harris-Todaro (1970) (hereafter HT) type of model is one way to explain unemployment in a general equilibrium setup where the efficiency of each worker is considered to be exogenously given and equal to unity. However, in such a model unemployment is specific to the urban sector and is suitable to explain the unemployment of unskilled labour only.

The involuntary unemployment of unskilled labour can also be explained[1] by using the 'consumption efficiency hypothesis' (CEH) of Leibenstein (1957) and Bliss and Stern (1978) where the nutritional efficiency of a worker depends positively on his consumption level. The CEH is the earliest version of the efficiency wage theory and is applicable to the poor unskilled workers who are at or slightly above their subsistence consumption level.

It is important to note that in an economy the possibility of being unemployed also rises with increasing education and skills. In the case of India, NSSO surveys conducted over the years show that the unemployment rate among those educated above the secondary level was higher, in both rural and urban areas, than those with lesser educational attainments. The NSSO 61st Round report, *Employment and Unemployment Situation in India 2004-05*, attributes this to the fact that "the job seekers become gradually more and more choosers as their educational level increases." Serneels (2007) also has found that in

[1] Unemployment in the seasonal casual unskilled labour market can be explained by the 'collusive theory of unemployment' of Osmani (1991) where workers may refuse to undercut wages despite being unemployed for the fear that it would lower wages for every worker now and in the future.

Ethiopia unemployment is concentrated among relatively well-educated first time job seekers who come from the middle classes. However, the role of the demand side in determining the unemployment of skilled labour is also extremely important. For example, the global financial and economic crisis that started in 2008 has severely affected the information and technology (IT) sector across countries. Countries like India and China that are large exporters of high-skill commodities like computer software are facing serious problem due to decreased demand from developed countries resulting in lower prices for these products. For India, it is even a bigger problem because India is the land of IT outsourcing and a lot of large western companies outsource their IT services to Indian companies. So, it is obvious that the supply of works for Indian outsourcing companies is suffering seriously leaving a large number of skilled workers jobless.

For theoretically explaining the existence of unemployment of skilled labour one has to recourse to the efficiency wage theories. One version of efficiency wage theory is based upon the work of Shapiro and Stiglitz (1984) where the work-effort of a worker is positively related to both the wage rate and the unemployment rate. However, it should be kept in mind that the Shapiro and Stiglitz (1984) type of unemployment is relevant only where there exists 'hire and fire' recruitment policy of labour. A more generalized version of efficiency wage theory is the 'fair wage hypothesis' (FWH). Agell and Lundborg (1992, 1995), Feher (1991), Akerlof and Yellen (1990), etc. have explained unemployment as a general equilibrium phenomenon using the FWH. As per the Agell and Lundborg (1992, 1995) treatment of the FWH, efficiency of a worker is sensitive to the functional distribution of income. Consequently, the return on capital, wage rates of the two types of labour and the unemployment rate appear as arguments in the efficiency function.

Agell and Lundborg (1995) have demonstrated how the FWH can be accommodated in a 2×2 Hechscher-Ohlin-Samuelson (HOS) model and examined the robustness of some of the important trade theorems. However, there is no distinction between different types of labour according to their skills and hence phenomenon like the skilled-unskilled wage inequality that has worsened in the liberalized regime in complete contrast to the predictions of the HOS model cannot be analyzed using their framework.

The theoretical literature explaining the deteriorating wage inequality in the developing countries includes works of Feenstra and Hanson (1996), Marjit and Acharya (2003), Marjit and Kar (2005), Yabuuchi and Chaudhuri (2007), Marjit, Beladi and Chakrabarti (2004), and Chaudhuri and Yabuuchi (2007). They have shown how trade liberalization, international migration of labour and inflows of foreign capital might produce unfavourable effects on the wage inequality in the South given the specific structural characteristics of the less developed countries, such as features of labour markets, structures of production, existence of non-traded goods, nature of capital mobility etc.

As per the empirical literature, growth in foreign direct investment which is positively correlated with the relative demand for skilled labour has been one of the prime factors[2] responsible for the growing incidence of wage inequality in the South. The paper of Feenstra and Hanson (1996) is based on the famous Dornbusch-Fischer-Samuelson continuum-of-goods framework. According to them, inflows of foreign capital induced greater production of skilled-intensive commodities in Mexico, thereby leading to a relative decrease in the demand for unskilled labour. Marjit, Beladi and Chakrabarti (2004) have also studied the consequences of an improvement of terms of trade and inflows of foreign capital on wage inequality with or without trade fragmentation. But, all these papers have considered full-employment framework and hence have ignored the problem of unemployment which is a salient feature of these economies. However, there is a paper in the literature by Beladi, Chaudhuri and Yabuuchi (2008) that has used a 2×3 Harris-Todaro setup to examine the consequences of international mobility of different factors of production on the relative wage inequality. Nonetheless all these works do not account for the unemployment of skilled labour which is a disquieting problem in a developing economy where skilled labour is scarce.

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[2] See Harrison and Hanson (1999), Hanson and Harrison (1999), Curie and Harrison (1997), and Beyer, Rojas and Vergara (1999) in this context.

The present paper develops a three-sector specific-factor Harris-Todaro type general equilibrium model where the FWH is valid. The economy is broadly divided into two sectors: rural and urban. The urban sector is further subdivided into two subsectors so that in overall we have three sectors. The rural sector produces an agricultural commodity by means of unskilled labour and two types of capital: capital of type N and capital of type K. One of the urban sectors produces a low-skill manufacturing commodity using unskilled labour and capital of type K. Finally, the other urban sector (sector 3) produces a high-skill commodity with the help of skilled labour and capital of type K. So, the distinction between two types of labour with respect to their skills, imperfections in the market for unskilled labour[3] and its rural-urban sector division have been taken into account. There is HT type unemployment of unskilled labour in the urban sector. The skilled wage rate in the high-skill sector is set according to the FWH. In the other two sectors where unskilled labour is used competitive forces or trade union activities determine the unskilled wages. Using such a framework that explicates unemployment of both types of labour the consequences of international mobility of either type of capital have been examined on the skilled-unskilled wage inequality and the unemployment problem of unskilled labour. This theoretical analysis leads to some interesting results. For example, an inflow of foreign capital of either type always raises the average and aggregate wage incomes of the unskilled workers. Besides, the skilled-unskilled wage inequality is likely to worsen but the unemployment situations of both types of labour improve if the skilled workers are more averse to income increases of the capitalist class than to that of the unskilled workforce. However, in the opposite case, the unemployment problem may aggravate although the wage inequality unambiguously improves. Therefore, the consequences of foreign capital inflows crucially hinge on the properties implied by the efficiency function of the skilled working class although the economic

[3] The firms in the low-skill urban sector have well-organized trade unions. One of the most important roles of the labour unions is to bargain with their respective employers in respect of the betterment of the working conditions. Furthermore, through offer of negotiation, threat of strike, actual strike etc. they exert pressure on the employers (firms) in order to secure higher wages, reduced hours of work, share in profits and other benefits. Labour unions of the unskilled workers in large firms leave no stones unturned so as to reap wages higher than the rural sector wage. Therefore, it is sensible to assume that the unionized unskilled wage in sector 3 exceeds the competitive rural unskilled wage. See Bhalotra (2002) in this context.

conditions of the unskilled labourers unquestionably improve under all possible circumstances.

2. The model

We consider a small open dual economy with three sectors: one rural and two urban. There are two types of capital, capital of type N and capital of type K, and two types of labour, skilled and unskilled. The rural sector produces an agricultural commodity using both types of capital and unskilled labour. Capital of type N is interpreted as a composite input[4] that is broadly defined to include not only natural resource like land but also durable capital equipments e.g. tractors, harvesters, weed cutters, pump sets for irrigation purpose. FDI in N implies a greater use of the durable agricultural capital implements. On the other hand, capital of type K is used to purchase inputs like fertilizers, pesticides, weedicides etc. The capital (of type K)-output ratio in sector 1, a_{K1}, is assumed to be technologically given.[5] Sector 2 is an urban sector that produces a low-skill manufacturing good by means of capital of type K and unskilled labour. Finally, sector 3, another urban sector, uses capital of type K and skilled labour to produce a high-skill commodity. As sectors 2 and 3 produce non-agricultural commodities capital of type N is specific to the rural sector (sector 1).[6] Skilled labour is a specific input in sector 3. Unskilled labour is

[4] This composite input is called 'land-capital' in the works of Bardhan (1973), Chaudhuri (2007) and Chaudhuri and Yabuuchi (2008).

[5] Although this is a simplifying assumption it is not completely without any basis. Agriculture requires inputs like fertilizers, pesticides, weedicides etc. which are to be used in recommended doses. Now if capital of type K is used to purchase those inputs, the capital (K type)-output ratio, a_{K1}, becomes constant technologically. However, labour and capital of type N are substitutes and the production function displays the property of constant returns to scale in these two inputs. However, even if the capital(K type)-output ratio is not given technologically the results of the paper still hold under an additional sufficient condition incorporating the partial elasticities of substitution between capital of type K and other inputs in sector 1.

[6] An interesting question could be how the major results of the model would have been affected if either sector 2 or sector 3 used a sector-specific capital. Let us try to answer this question intuitively. Suppose sector 2 uses the sector-specific capital N while the other type of capital (K type) is used in all the three sectors of the economy. In that case equation (2) has to be modified to accommodate the unit cost of N type capital. The return to K type capital, r, is no longer

imperfectly mobile between sectors 1 and 2 while capital of type K is completely mobile among all the three sectors of the economy.

Sector 2 faces a unionized labour market where unskilled workers receive a contractual wage, W^*, while the unskilled wage rate in the rural sector, W, is market determined. The two wage rates are related by the Harris-Todaro (1970) condition of migration equilibrium where the expected urban wage equals the rural wage rate and $W^* > W$. Hence, there is urban unemployment of unskilled labour. On the other hand, we take help of the FWH to explain unemployment of skilled labour and the efficiency function is similar to that in Agell and Lundborg (1992, 1995). This function can be derived from the effort norm of the skilled workers which is sensitive to the functional distribution of income and the skilled unemployment rate. This is the optimal effort function of the utility maximizing skilled workers. Capital of either type includes both domestic capital and foreign capital. Incomes from foreign capital are completely repatriated. Sector 2 uses capital of type K more intensively with respect to unskilled labour vis-à-vis sector 1. Production functions exhibit constant returns to scale[7] with positive and diminishing marginal productivity to each factor. We do not make any assumption regarding the patterns of trade of our small open economy. This is because the results of the model are independent of the trade patterns of the country. Finally, commodity 3 is chosen as the numeraire.

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determined from equation (2). However, R falls as N increases which in turn raises r. As r rises from equation (1) it follows that the average unskilled (rural sector) wage, W falls. Sector 2 expands and draws capital from the other two sectors leading to their contraction. As the demand for skilled labour falls in sector 3, W_S falls (also see equation 3). The effect on the relative wage inequality is uncertain as both W and W_S fall. The unskilled unemployment, L_U must increase as W falls but sector 2 expands both in terms of output and employment. On the other hand, if sector 3 uses the specific capital N, equations (2) and (1) determine r and W, respectively. An inflow of N type of capital into sector 3 lowers R but r and W do not change. Sector 3 expands and W_S rises as the demand for another specific factor, skilled labour goes up. The wage inequality unambiguously worsens. On the other hand, the expanding sector 3 draws K type capital from the HOSS. Sector 2 contracts following a Rybczynski type effect that lowers the expected urban wage for a prospective rural unskilled labour. A reverse migration of unskilled labour from the urban to the rural sector takes place resulting in a fall in L_U.

[7] See footnote 3 in this context.

The following symbols will be used for formal presentation of the model.

$a_{Ki} =$ amount of capital of type K required to produce 1 unit of output in the ith sector, $i = 1,2,3$;

$a_{Ni} =$ amount of capital of type N required to produce 1 unit of output in sector 1;

$a_{Li} =$ unskilled labour-output ratio in the ith sector, $i = 1,2$;

$a_{S3} =$ skilled labour-output ratio in sector 3 (in efficiency unit);

$P_i =$ exogenously given relative price of the ith commodity, $i = 1,2$;

$X_i =$ level of output of the ith sector, $i = 1,2,3$;

$E =$ efficiency of each skilled worker;

$W_S =$ wage rate of skilled labour;

$\frac{W_S}{E} =$ wage rate per efficiency unit of skilled labour;

$W^* =$ unionized unskilled wage in sector 2;

$W =$ competitive wage rate of unskilled labour in sector 1;

$r =$ return to capital of type K (both domestic and foreign);

$R =$ return to capital of type N (both domestic and foreign)

$L =$ endowment of unskilled labour (in physical unit);

$S =$ endowment of skilled labour (in physical unit);

$v =$ unemployment rate of skilled labour;

$L_U =$ urban unemployment of unskilled labour;

$K =$ economy's aggregate capital stock of K type (domestic plus foreign);

$N =$ economy's aggregate capital stock of N type (domestic plus foreign);

$\theta_{ji} =$ distributive share of the jth input in the ith sector for $j = N, L, S, K$ and $i =$ 1, 2, 3;

$\lambda_{ji} =$ proportion of the jth input employed in the ith sector for $j = L, K$ and $i = 1,2,3$;

$'\wedge' =$ proportionate change.

Given the perfectly competitive commodity markets the three price-unit cost equality conditions relating to the three industries are as follows.

$$Wa_{L1} + ra_{K1} + Ra_{N1} = P_1 \quad (1)$$

$$W^* a_{L2} + ra_{K2} = P_2 \quad (2)$$

$$\frac{W_S}{E} a_{S3} + ra_{K3} = 1 \quad (3)$$

Following Agell and Lundborg (1992, 1995) we assume that the effort norms of the skilled labour depend positively on (i) the skilled wage relative to the average unskilled wage; (ii) the skilled wage relative to the returns on capital of both types; and, positively on (iii) the unemployment rate of skilled labour. From the 'envelope property' of the HT framework[8] it follows that the average unskilled wage in the economy is the rural sector wage. So we write

$$E = E(\frac{W_S}{W}, \frac{W_S}{r}, \frac{W_S}{R}, v) \quad (4)$$

The efficiency function satisfies the following mathematical restrictions:

$E_1, E_2, E_3, E_4 > 0$; $E_{11}, E_{22}, E_{33} < 0$; $E_{12} = E_{13} = E_{14} = E_{23} = E_{24} = E_{34} = 0$.[9]

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The unit cost of skilled labour in sector 3, denoted ϖ, is given by

$$\varpi = (\frac{W_S}{E(.)}) \quad (5)$$

[8] Unskilled workers are employed in the rural and low-skill urban sectors where they earn W and W^* wages, respectively. Some of the unskilled workers remain unemployed in the urban sector earning nothing. The average wage income of all unskilled workers in the economy is the rural sector wage. This can be easily shown from equations (10) and (11). So, the efficiency function, given by equation (4), indirectly takes into account the unionized wage and the urban unemployment of unskilled labour as determinants.

[9] Mathematical derivation of the efficiency function from the rational behavior of a representative skilled worker and explanations of the mathematical restrictions on the partial derivatives are available in Agell and Lundborg (1992, 1995).

Each firm in sector 3 minimizes its unit cost of skilled labour as given by (5). The first-order condition of minimization is

$$E = \frac{W_S}{W} E_1 + \frac{W_S}{r} E_2 + \frac{W_S}{R} E_3 \tag{6}$$

where E_i s are the partial derivatives of the efficiency function with respect to $(\frac{W_S}{W})$, $(\frac{W_S}{r})$ and $(\frac{W_S}{R})$, respectively. Equation (6) can be rewritten as follows.

$$\varepsilon_1 + \varepsilon_2 + \varepsilon_3 = 1 \tag{6.1}$$

where ε_i is the elasticity of the $E(.)$ function with respect to its i th argument. This is the modified Solow condition as obtained in Agell and Lundborg (1992, 1995).

Full utilization of N and K types of capital respectively imply

$$a_{N1} X_1 = N \tag{7}$$

$$a_{K1} X_1 + a_{K2} X_2 + a_{K3} X_3 = K \tag{8}$$

There is unemployment of skilled labour in the economy and the rate of unemployment is v. The skilled labour endowment equation is, therefore, given by

$$a_{S3} X_3 = E(1-v)S \tag{9}$$

In the migration equilibrium there exists urban unemployment of unskilled labour. The unskilled labour endowment equation is given by

$$a_{L1} X_1 + a_{L2} X_2 + L_U = L \tag{10}$$

In a Harris-Todaro framework the unskilled labour allocation mechanism is such that in the labor market equilibrium, the rural wage rate, W, equals the expected wage income in the urban sector. Since the probability of finding a job in the urban low-skill manufacturing sector is $(a_{L2} X_2 / (a_{L2} X_2 + L_U))$ the expected unskilled wage in the manufacturing sector is $(W^* a_{L2} X_2 / (a_{L2} X_2 + L_U))$. Therefore, the rural-urban migration equilibrium condition of unskilled labour is expressed as

$$(W^* a_{L2} X_2 / (a_{L2} X_2 + L_U)) = W ,$$

or equivalently,

$$(W*/W)a_{L2}X_2 + a_{L1}X_1 = L \tag{11}$$

Using (7) and (9) equations (11) and (8) can be rewritten as follows.

$$(\frac{W^*}{W})a_{L2}X_2 + \frac{a_{L1}}{a_{N1}}N = L\text{; and,} \tag{11.1}$$

$$(\frac{a_{K1}}{a_{N1}}N) + a_{K2}X_2 + (\frac{a_{K3}E(1-v)S}{a_{S3}}) = K \tag{8.1}$$

In this general equilibrium model there are ten endogenous variables; namely, W, r, R, W_S, E, v, L_U, X_1, X_2 and X_3 and the same number of independent equations; namely, (1) – (4), (6), (7), (8.1), (9), (10) and (11.1). The system does not possess the decompo sition property. r is found from (2) as $W*$ is given exogenously. W, R, W_S, v and X_2 are simultaneously solved from equations (1), (4), (6), (8.1) and (11.1). E is then found from (3). X_1 and X_3 are solved from equations (7) and (9), respectively. Finally, L_U is found from (10).

A close look at the price system reveals that given the value of R, sectors 1 and 2 can be conceived to form a Heckscher-Ohlin subsystem (HOSS) as they use two common inputs: unskilled labour and capital of type K. It is sensible to assume that sector 2 is more capital-intensive than sector 1 in value sense with respect to unskilled labour. This implies that $(a_{K2}/W*a_{L2}) > (a_{K1}/Wa_{L1})$.

3. Comparative Statics

In this section of the paper we will examine the consequences of inflows of foreign capital of either type on the skilled-unskilled wage inequality. An inflow of foreign capital into the primary export sector is captured by an increase in the endowment of N type of capital. On the other hand, the endowment of K type of capital swells up when foreign capital flows into the other two sectors. The effects of these policies on the unskilled unemployment will also be analyzed.

Differentiating equations (1), (4) (6), (11.1) and (8.1) the following expressions are respectively obtained.[10]

$$\theta_{L1}\hat{W} + \theta_{N1}\hat{R} = 0 \tag{12}$$

$$\varepsilon_1\hat{W} + \varepsilon_3\hat{R} - \varepsilon_4\hat{v} = 0 \tag{13}$$

$$B_1\hat{W} + B_2\hat{R} - B_3\hat{W}_S + \varepsilon_4\hat{v} = 0 \tag{14}$$

$$-B_5\hat{W} + B_6\hat{R} + \lambda^*_{L2}\hat{X}_2 = -\lambda_{L1}\hat{N} \tag{15}$$

$$(-\lambda_{K1}S^1_{NL})\hat{W} + (\lambda_{K1}S^1_{NL})\hat{R} + \lambda_{K2}\hat{X}_2 + \lambda_{K3}\hat{W}_S - B_4\hat{v} = \hat{K} - \lambda_{K1}\hat{N} \tag{16}$$

$$\left.\begin{array}{l}
\text{where } B_1 = \dfrac{E_{11}}{E}(\dfrac{W_S}{W})^2 < 0 \ ; B_2 = \dfrac{E_{33}}{E}(\dfrac{W_S}{R})^2 < 0 \ ; \\
B_3 = \left[(\dfrac{W_S}{W})^2 \dfrac{E_{11}}{E} + (\dfrac{W_S}{r})^2 \dfrac{E_{22}}{E} + (\dfrac{W_S}{R})^2 \dfrac{E_{33}}{E} \right] < 0 \, ; B_4 = (\dfrac{\lambda_{K3}v}{1-v}) > 0 \, ; \\
B_5 = [\lambda^*_{L2} + \lambda_{L1}(S^1_{LN} + S^1_{NL})] > 0 \, ; B_6 = [\lambda_{L1}(S^1_{LN} + S^1_{NL})] > 0 \text{ ; and,} \\
\lambda^*_{L2} = (\dfrac{W^*}{W})\lambda_{L2} > 0.
\end{array}\right\} \tag{17}$$

Here S^k_{ji} is the degree of substitution between factors in sector k. For example, $S^1_{LL} = (\frac{W}{a_{L1}})(\frac{\partial a_{L1}}{\partial W})$, $S^1_{LN} = (\frac{R}{a_{L1}})(\frac{\partial a_{L1}}{\partial R})$ etc. $S^k_{ji} > 0$ for $j \neq k$; & $S^k_{jj} < 0$.

Equations (12) – (16) can be arranged in a matrix notation as follows.

$$\begin{bmatrix} \theta_{L1} & \theta_{N1} & 0 & 0 & 0 \\ \varepsilon_1 & \varepsilon_3 & 0 & -\varepsilon_4 & 0 \\ B_1 & B_2 & -B_3 & \varepsilon_4 & 0 \\ -B_5 & B_6 & 0 & 0 & \lambda^*_{L2} \\ -\lambda_{K1}S^1_{NL} & \lambda_{K1}S^1_{NL} & \lambda_{K3} & -B_4 & \lambda_{K2} \end{bmatrix} \begin{bmatrix} \hat{W} \\ \hat{R} \\ \hat{W}_S \\ \hat{v} \\ \hat{X}_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ -\lambda_{L1}\hat{N} \\ \hat{K} - \lambda_{K1}\hat{N} \end{bmatrix} \tag{18}$$

The determinant to the coefficient matrix is

[10] Note that a_{K1} is technologically given. See footnote 3 in this context.

$$|D| = -\varepsilon_4 B_3 \Big[\theta_{L1}(\lambda_{K2}B_6 - \lambda_{K1}\lambda^*_{L2}S^1_{NL}) + \theta_{N1}(\lambda_{K2}B_5 - \lambda_{K1}\lambda^*_{L2}S^1_{NL}) \Big]$$

$$\qquad\qquad (+) \qquad\qquad\qquad\qquad (+)$$

$$+\lambda^*_{L2}[\varepsilon_4\lambda_{K3}J - B_3B_4H] \tag{19}$$

$$(-)(+)$$

where:

$$\left.\begin{aligned} J &= \{\theta_{L1}(B_2+\varepsilon_3) - \theta_{N1}(B_1+\varepsilon_1)\}\,; \\ H &= (\theta_{L1}\varepsilon_3 - \theta_{N1}\varepsilon_1)\,. \end{aligned}\right\} \tag{20}$$

As the production structure is indecomposable an increase in capital stock of type N must decrease its rate of return, R i.e. $(\hat{R}/\hat{N}) < 0$. Thus, solving (18) it can be easily proved[11] that

$$|D| > 0 \tag{21}$$

For finding out the signs of J and H we need to impose some restrictions on the relative responsiveness of the $E(.)$, E_1 and E_3 functions with respect to their two arguments: $(\frac{W_S}{W})$ and $(\frac{W_S}{R})$. The efficiency function, given by equation (4), is assumed to satisfy the following two special properties.

(A) The responsiveness of $E(.)$ with respect to $\frac{W_S}{R}$ is greater than that with respect to $\frac{W_S}{W}$ such that $(\frac{\varepsilon_3}{\theta_{N1}}) > (\frac{\varepsilon_1}{\theta_{L1}})$.

(B) The algebraic value of the elasticity of E_3 with respect to $\frac{W_S}{R}$ is not less than that of E_1 with respect to $\frac{W_S}{W}$ i.e. $(\frac{E_{33}W_S}{E_3 R}) \geq (\frac{E_{11}W_S}{E_1 W})$.

[11] This has been shown in Appendix I.

The implications of the above two properties are as follows. Although the efficiency of skilled workers depends on the relative income distribution, they are expected to have different attitudes towards the earnings of different factors of production. So changes in incomes of different factors should affect the efficiency of skilled labour in different degrees. It is reasonable to assume that the average unskilled wage is substantially lower than the skilled wage. That is why the skilled workers are expected to have a soft feeling towards their unskilled counterparts. On the contrary, they would feel to be deprived significantly if the returns on both types of capital increase relative to the skilled wage which badly affect their work morale. It is reasonable, therefore, to assume that increases in incomes of the capitalists cause a greater negative response among the skilled workers and lower their efficiency than that resulting from an increase in the average unskilled wage.

Properties (A) and (B) of the efficiency function together imply that[12]

$$\left.\begin{aligned} &(\frac{\theta_{L1}}{\theta_{N1}}) > (\frac{\varepsilon_1}{\varepsilon_3}) \geq (\frac{\varepsilon_1 + B_1}{\varepsilon_3 + B_2});\ \text{and,} \\ &J = \{\theta_{L1}(B_2 + \varepsilon_3) - \theta_{N1}(B_1 + \varepsilon_1)\} > 0; H = (\theta_{L1}\varepsilon_3 - \theta_{N1}\varepsilon_1) > 0 \end{aligned}\right\} \tag{22}$$

r is determined from equation (2). Then from (3) it follows that $(\frac{W_S}{E})$ is a constant. So differentiating equations (2) and (3) we find that

$$\hat{E} = \hat{W}_S \tag{23}$$

This leads to the following corollary.

Corollary 1: The efficiency of skilled labour, E, and the skilled wage rate, W_S, always change in the same direction and in the same proportion.

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[12] This has been proved in Appendix II.

From (12) we can write

$$\hat{W} = -(\frac{\theta_{N1}}{\theta_{L1}})\hat{R} \tag{24}$$

This establishes the following corollary.

Corollary 2: W and R are negatively correlated.

Using (24) equation (13) can be rewritten as follows.

$$\hat{v} = \frac{(\varepsilon_3\theta_{L1} - \varepsilon_1\theta_{N1})\hat{R}}{\varepsilon_4\theta_{L1}} \tag{25}$$

Using (22) from (25) the following corollary is imminent.

Corollary 3: R and v are positively correlated.[13]

Adding (13) and (14) and substituting for $\hat{W}$ from (24) we get

$$\hat{W}_S = [\frac{\theta_{L1}(\varepsilon_3 + B_2) - \theta_{N1}(\varepsilon_1 + B_1)}{\underset{(-)}{\theta_{L1}B_3}}]\hat{R} \tag{26}$$

With the help of (22) from (26) the following corollary immediately follows.

Corollary 4: R and W_S are negatively related.

Solving (18) by Cramer's rule the following proposition can be established.[14]

Proposition 1: Under assumptions A and B, an inflow of either type of capital leads to (i) an increase in the rural unskilled wage (W); (ii) a decrease in the return to capital of type N; (iii) an increase in the skilled wage (W_S); (iv) a fall in the unemployment rate of skilled labour (v); and (v) an expansion of sector 3. Besides, (vi) sector 1 expands (contracts) while sector 2 contracts (expands) owing to inflows of capital of type N (type K).

[13] As the rural sector unskilled wage and the return on capital of type N are negatively related (corollary 2) there is a negative relationship between the average unskilled (rural) wage and skilled unemployment rate.

[14] See Appendix III for mathematical derivations of the results.

An inflow of foreign capital of type N into sector 1 lowers its return, R. This raises the value of marginal product of unskilled labour and hence the rural unskilled wage, W. This becomes clear if one looks at equation (1). A fall in R lowers the skilled unemployment rate, v (corollary 3) and raises the skilled wage, W_S (corollary 4) and hence their efficiency, E (corollary 1). As employment of skilled labour rises in efficiency unit (also in physical unit) sector 3 expands and draws capital from the other two sectors. Consequently, the capital-intensive sector 2 contracts and the unskilled labour-intensive sector 1 expands following a Rybczynski type effect.

On the other hand, an inflow of foreign capital of type K cannot change its return, r, as it is determined from equation (2). It produces a Rybczynski effect in the HOSS. Sector 2 expands while sector 1 contracts as the former is more capital-intensive than the latter. As sector 1 contracts the demand for capital of type N falls. This lowers R which in turn raises both W (corollary 2) and W_S (corollary 4) and hence E (corollary 1) and lowers the skilled unemployment rate, v (corollary 3). As the employment of skilled labour rises in both efficiency and physical units sector 3 expands.

Subtracting (24) from (26) one gets

$$(\hat{W}_S - \hat{W}) = \frac{[\theta_{L1}(\varepsilon_3 + B_2) - \theta_{N1}(\varepsilon_1 + B_1 - B_3)]\hat{R}}{\theta_{L1} B_3} \tag{27}$$

$$(-)$$

As $(\frac{\hat{R}}{\hat{N}}), (\frac{\hat{R}}{\hat{K}}) < 0$, from (27) it follows that

$$(\hat{W}_S - \hat{W}) > (<) 0 \text{ iff } \theta_{L1}(\varepsilon_3 + B_2) > (<) \theta_{N1}(\varepsilon_1 + B_1 - B_3) \tag{28}$$

This leads to the following proposition.

Proposition 2: Inflows of foreign capital of either type accentuates (improves) skilled-unskilled wage inequality if and only if $\theta_{L1}(\varepsilon_3 + B_2) > (<) \theta_{N1}(\varepsilon_1 + B_1 - B_3)$.

From proposition 1 we find that both the skilled wage and the rural unskilled wage increase due to inflows of foreign capital of either type. Whether the relative wage inequality worsens or improves depends on the rates of increases of the two wages. The rate of increase in the skilled wage is greater (smaller) than that of the rural unskilled labour if and only if $\theta_{L1}(\varepsilon_3 + B_2) > (<) \theta_{N1}(\varepsilon_1 + B_1 - B_3)$. Consequently, the wage inequality deteriorates or improves.

Subtraction of equation (11) from (10) yields

$$L_U = a_{L2} X_2 \left(\frac{W^* - W}{W}\right) \tag{29}$$

Totally differentiating equation (29) one can establish the final proposition of the model.[15]

Proposition 3: An inflow of foreign capital of type N unambiguously improves the urban unemployment problem of unskilled labour. On the contrary, inflows of type K capital improve the unemployment situation of unskilled labour if $1 \geq \left(\left(\frac{(\theta_{L1} + \theta_{N1})\lambda_{L1}}{\theta_{N1}\lambda_{L2}}\right)(S^1_{LN} + S^1_{NL})\right)$.

We explain proposition 3 in the following manner. In the migration equilibrium the expected urban wage for a prospective unskilled rural migrant equals the rural unskilled wage. An inflow of foreign capital of either type affects the migration equilibrium in two ways. First, the low-skill urban manufacturing sector either expands or contracts. This leads to a change in the number of jobs available in this sector. The expected urban wage for a prospective rural migrant, $[W^* / \{1 + (L_U / a_{L2} X_2)\}]$, changes as the probability of getting a job in this sector changes for every unskilled worker. This is *the centrifugal force*. If the expected urban wage rises (falls) *the centrifugal force* is positive (negative). This paves the way for fresh migration (reverse migration) from the rural (urban) to the urban (rural) sector. On the other hand, an inflow of foreign capital of either type raise the rural unskilled wage (see proposition 1). This is *the centripetal force* that prevents rural workers from migrating into the urban sector. Thus, there are two different effects

[15] See Appendix IV for mathematical proof of this proposition.

working on determination of the size of the unemployed urban unskilled workforce. In the case of an inflow of foreign capital of type N the low-skill urban manufacturing sector contracts both in terms of output and employment. The expected urban unskilled wage falls. So the centrifugal force is negative and drives the unemployed urban workers to return to the rural sector. Thus, both the centripetal and the centrifugal forces work in the same direction and cause the urban unemployment of unskilled labour to decline unequivocally. On the contrary, in the case of an inflow of foreign capital of K type the low-skill urban sector expands and causes the expected urban unskilled wage to rise. This leads to more migration from the rural sector to the urban sector. Therefore, in this case the centrifugal and centripetal forces work in the opposite direction to each other. If the latter force outweighs the former, the level of unemployment falls. This happens under the sufficient condition as stated in proposition 3.

4. An Extension

In the analysis of the previous section the efficiency function of the skilled workers was assumed to satisfy assumptions A and B. A pertinent question is how the major results of the previous section would be affected if these two assumptions do not hold. For examining this let us suppose that instead of assumptions A and B, the following two assumptions hold.

Assumption (C): The responsiveness of $E(.)$ function with respect to $\frac{W_S}{R}$ is less than that with respect to $\frac{W_S}{W}$ such that $(\frac{\varepsilon_3}{\theta_{N1}}) < (\frac{\varepsilon_1}{\theta_{L1}})$.

Assumption (D): The algebraic value of the elasticity of E_3 with respect to $\frac{W_S}{R}$ is less than that of E_1 with respect to $\frac{W_S}{W}$ i.e. $(\frac{E_{33}W_S}{E_3 R}) < (\frac{E_{11}W_S}{E_1 W})$.

Assumptions (C) and (D) of the efficiency function, $E(.)$, together imply that

$$\left.\begin{aligned}&(\frac{\theta_{L1}}{\theta_{N1}}) < (\frac{\varepsilon_1}{\varepsilon_3}) < (\frac{\varepsilon_1 + B_1}{\varepsilon_3 + B_2});\ \text{and,}\\ &J = \{\theta_{L1}(B_2 + \varepsilon_3) - \theta_{N1}(B_1 + \varepsilon_1)\} < 0; H = (\theta_{L1}\varepsilon_3 - \theta_{N1}\varepsilon_1) < 0\end{aligned}\right\} \quad (22.1)$$

We find that corollaries (1) and (2) do not change. But using (22.1) from (25) and (26) it is easy to check that corollaries (3) and (4) are to be revised as follows.

Corollary 3.1: R and v are negatively correlated.

Corollary 4.1: R and W_S are positively related.

Solving (18) by Cramer's rule and from (27) the following two propositions follow.[16]

Proposition 1.1: Under assumptions C and D, an inflow of either type of capital leads to (i) an increase in the rural unskilled wage (W); (ii) a decrease in the return to capital of type N; (iii) a decrease in the skilled wage (W_S); (iv) an increase in the unemployment rate of skilled labour (v); and, (v) a contraction of sector 3. Besides, (vi) sector 2 expands while sector 1 contracts owing to inflows of capital of type K. However, the effects of an inflow of capital of N type on sectors 1 and 2 are uncertain.

Proposition 2.1: Under assumptions C and D inflows of foreign capital of either type unambiguously improves the skilled-unskilled wage inequality.

Propositions 1.1 and 2.1 can be explained in the following fashion. An inflow of foreign capital of type K produces a Rybczynski effect in the HOSS and leads to an expansion of the capital-intensive (K type) sector 2 and a contraction of the unskilled labour-intensive sector 1. The demand for N type of capital falls that lowers its rate of return, R. From corollaries (1), (2), (3.1) and (4.1) we then find that W_S and E fall while W and v increase. As the employment of skilled labour falls both in physical and efficiency units sector 3 contracts. The relative wage inequality unquestionably improves.

[16] See appendix V.

On the other hand, an inflow of foreign capital of N type lowers R. From the above corollaries we again find that W and v increase but W_S and E decrease. Sector 3 again contracts and the wage inequality unambiguously improves. But the effects on sectors 1 and 2 are uncertain because of the following reasons. As sector 3 contracts it releases capital of type K to the other two sectors. This produces a Rybczynski type effect in the HOSS causing the capital-intensive sector (sector 2) to expand and sector 1 to contract. On the other hand, an increase in N produces an expansionary effect on sector 1 as this type of capital is specific to this sector. This in turn raises the demand for K type capital in sector 1 that has to come from sector 2. This produces a contractionary effect on sector 2. Thus, there are two opposite effects on sectors 1 and 2, the net outcomes of which are uncertain.

Finally, differentiating equation (29) it is easy to check that if assumptions C and D hold proposition 3 should be modified as follows.

Proposition 3.1: Under assumptions C and D an inflow of foreign capital of either type produces an ambiguous effect on the unemployment problem of unskilled labour.

An inflow of foreign capital of either type unequivocally raises the rural unskilled wage. Sector 2 expands both in terms of output and employment owing to inflows of K type of foreign capital. This raises the expected urban wage for a prospective unskilled rural migrant. However, the net effect on L_U is uncertain as the centrifugal and centripetal forces work in the opposite directions to one another. On the contrary, an inflow of foreign capital of N type produces ambiguous effects on the output and employment of sector 2. Hence, both the direction and the magnitude of the centrifugal force are uncertain. Consequently, the effect on L_U would also be uncertain.

5. Concluding remarks

This paper has developed a three-sector general equilibrium framework that explains unemployment of both skilled and unskilled labour. Unemployment of unskilled labour is of the HT type while unemployment of skilled labour is caused due to the validity of the FWH in the high-skill sector. There are two types of capital: type N and type K. This theoretical analysis deserves special attention because no attempt has earlier been made to use the efficiency wage theory, especially the FWH version of the theory, in analyzing the skilled-unskilled wage inequality in a developing economy. This exercise leads to some interesting results. If the skilled workers are more averse to income increases of the unskilled workers than to increases in the earnings of the capitalists, the relative wage inequality improves unequivocally although the unemployment situations of both types of labour may worsen. If, on the contrary, an increase in the earnings of the capitalists causes a greater negative response among the skilled workers and lower their work morale than that results from an increase in the incomes of the unskilled workers, an inflow of foreign capital of either type is likely to worsen the skilled-unskilled wage inequality but improve the unemployment problem of either type of labour. Inflows of foreign capital in this case definitely make the unskilled workers better off although the economic conditions of the skilled workers improve even more.

Therefore, the consequences of foreign capital inflows crucially hinge on the properties implied by the efficiency function of the skilled workers although the average and aggregate wage incomes of the unskilled workers increase under all possible situations. Finally, how and to what extent the skilled workers would respond to changes in the earnings of different factors of production is a subject matter of the human psychology. One should recourse to empirical surveys and/or randomized experiments on the skilled workers for determining their attitudes towards the earnings of the other income classes and unfolding the exact nature of their effort function.

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Appendix I:

Solving (18) by Cramer's rule the following result is obtained.

$$\frac{\hat{R}}{\hat{N}} = \frac{|\lambda^*|}{|D|}(\theta_{L1}\varepsilon_4 B_3) \qquad \text{(A.1)}$$

$$\qquad\qquad (+)(-)$$

where:

$$|D| = -\varepsilon_4 B_3 \left[\theta_{L1}(\lambda_{K2}B_6 - \lambda_{K1}\lambda^*_{L2}S^1_{NL}) + \theta_{N1}(\lambda_{K2}B_5 - \lambda_{K1}\lambda^*_{L2}S^1_{NL})\right]$$

$$(-) \qquad\qquad (+) \qquad\qquad\qquad\qquad (+)$$

$$+\lambda^*_{L2}[\varepsilon_4\lambda_{K3}J - B_3B_4H] \qquad (19)$$

$$(+) \quad (-) \quad (+)$$

$$\left.\begin{aligned} J &= \{\theta_{L1}(B_2+\varepsilon_3) - \theta_{N1}(B_1+\varepsilon_1)\};\\ H &= (\theta_{L1}\varepsilon_3 - \theta_{N1}\varepsilon_1);\ \text{and,}\\ |\lambda^*| &= (\lambda_{L1}\lambda_{K2} - \frac{W*}{W}\lambda_{L2}\lambda_{K1}) > 0 \end{aligned}\right\} \qquad \text{(A.2)}$$

(Note that $|\lambda^*| > 0$ as sector 1 is more unskilled labour-intensive vis-à-vis sector 2 in value sense.)

In an indecomposable production structure like this it is sensible to assume that R falls (rises) if N rises (falls) i.e. $(\frac{\hat{R}}{\hat{N}}) < 0$. From (A.1) it then follows that

$$|D| > 0 \qquad (21)$$

From (19) and (A.2) it follows that two sufficient conditions for $|D| > 0$ are:

$J, H > 0$.

Appendix II:

As $E_1 = (\frac{\partial E}{\partial(\frac{W_S}{W})})$; $E_3 = (\frac{\partial E}{\partial(\frac{W_S}{R})}) > 0$ and $E_{11}, E_{33} < 0$ we must have

$[\varepsilon_1 E + E_{11}(\frac{W_S}{W})^2] > 0$; and,

$[\varepsilon_3 E + E_{33}(\frac{W_S}{R})^2] > 0$. Using (17) one can write

$$\left.\begin{array}{l}(\varepsilon_1 + B_1) > 0\text{; and,}\\ (\varepsilon_3 + B_2) > 0.\end{array}\right\} \tag{A.3}$$

From Assumption A it follows that

$$(\frac{\theta_{L1}}{\theta_{N1}}) > (\frac{\varepsilon_1}{\varepsilon_3}) \tag{A.4}$$

That $H > 0$ is a direct consequence of Assumption A. We are going to prove that $J > 0$ if Assumption B holds.

From (20) we find that

$$J > 0 \text{ iff } (\frac{\theta_{L1}}{\theta_{N1}}) > (\frac{\varepsilon_1 + B_1}{\varepsilon_3 + B_2}) \tag{A.5}$$

Now

$$[\frac{\varepsilon_1}{\varepsilon_3} - \frac{(B_1 + \varepsilon_1)}{(B_2 + \varepsilon_3)}] = [\frac{(\varepsilon_1 B_2 - \varepsilon_3 B_1)}{\varepsilon_3 (B_2 + \varepsilon_3)}] = (\frac{\varepsilon_1}{B_2 + \varepsilon_3})[\frac{B_2}{\varepsilon_3} - \frac{B_1}{\varepsilon_1}]$$

Substituting the values of B_1 and B_2 from (17) and simplifying we can obtain the following expression.

$$[\frac{\varepsilon_1}{\varepsilon_3} - \frac{(B_1 + \varepsilon_1)}{(B_2 + \varepsilon_3)}] = (\frac{\varepsilon_1}{\varepsilon_3 + B_2})[\frac{E_{33} W_S}{E_3 R} - \frac{E_{11} W_S}{E_1 W}] \tag{A.6}$$

Now if $(\frac{E_{33} W_S}{E_3 R}) \geq (\frac{E_{11} W_S}{E_1 W})$ i.e. if Assumption B holds from (A.3) and (A.6) it follows that

$$\frac{\varepsilon_1}{\varepsilon_3} \geq \frac{(B_1 + \varepsilon_1)}{(B_2 + \varepsilon_3)} \tag{A.7}$$

From (A.4) and (A.7) we can write

$$(\frac{\theta_{L1}}{\theta_{N1}}) > (\frac{\varepsilon_1 + B_1}{\varepsilon_3 + B_2}) \Rightarrow J > 0 \text{ (see (A.5)).}$$

Combining (A.4) and (A.7) and using (20) one can write

$$(\frac{\theta_{L1}}{\theta_{N1}}) > (\frac{\varepsilon_1}{\varepsilon_3}) \geq (\frac{\varepsilon_1 + B_1}{\varepsilon_3 + B_2}) \Rightarrow J, H > 0. \tag{22}$$

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Appendix III:

Solving (18) by Cramer's rule, using (17), (21) and (22) and simplifying the following results can be obtained.

$$\left.\begin{array}{l}
\dfrac{\hat{W}}{\hat{N}} = -\dfrac{\varepsilon_4\theta_{N1}B_3\left|\lambda^*\right|}{|D|} > 0\,; \quad \dfrac{\hat{W}}{\hat{K}} = -\dfrac{\varepsilon_4\theta_{N1}B_3\lambda_{L2}^*}{|D|} > 0\,; \\[2ex]
\dfrac{\hat{R}}{\hat{N}} = \dfrac{\left|\lambda^*\right|}{|D|}(\theta_{L1}\varepsilon_4 B_3) < 0\,; \qquad \dfrac{\hat{R}}{\hat{K}} = \dfrac{\lambda_{L2}^*(\theta_{L1}\varepsilon_4 B_3)}{|D|} < 0 \\[2ex]
\dfrac{\hat{W}_S}{\hat{N}} = \dfrac{\left|\lambda^*\right|}{|D|}\varepsilon_4 J > 0\,; \qquad \dfrac{\hat{W}_S}{\hat{K}} = \dfrac{\lambda_{L2}^*}{|D|}\varepsilon_4 J > 0 \\[2ex]
\dfrac{\hat{v}}{\hat{N}} = \dfrac{\left|\lambda^*\right|}{|D|}B_3 H < 0\,; \quad \dfrac{\hat{v}}{\hat{K}} = \dfrac{\lambda_{L2}^*}{|D|}B_3 H < 0 \\[2ex]
\dfrac{\hat{X}_1}{\hat{N}} = \dfrac{1}{|\mathrm{D}|}[\lambda_{L2}^*(\varepsilon_4\lambda_{K3}J - B_3B_4H) - \lambda_{K2}\varepsilon_4 B_3\{\lambda_{L1}S_{LN}^1(\theta_{N1}+\theta_{L1}) + \theta_{N1}\lambda_{L2}^*\}\ ] > 0 \\[2ex]
\dfrac{\hat{X}_1}{\hat{K}} = \dfrac{B_3 S_{NL}^1\lambda_{L2}^*\varepsilon_4}{|D|}(\theta_{L1}+\theta_{N1}) < 0\,; \dfrac{\hat{X}_2}{\hat{K}} = \dfrac{-B_3\varepsilon_4(\theta_{L1}B_6 + \theta_{N1}B_5)}{|D|} > 0 \\[2ex]
\dfrac{\hat{X}_2}{\hat{N}} = \dfrac{1}{|D|}[-\lambda_{L1}(\varepsilon_4\lambda_{K3}J - B_3B_4H) + \lambda_{K1}\varepsilon_4 B_3\{\lambda_{L1}S_{LN}^1(\theta_{N1}+\theta_{L1}) + \theta_{N1}\lambda_{L2}^*\}] < 0
\end{array}\right\} \tag{A.8}$$

Results presented in (A.8) have been verbally stated in proposition 1.

Appendix IV:

Total differentials of equation (29) yield

$$\lambda_{LU}\hat{L}_U = \lambda_{L2}[(\frac{W^* - W}{W})\hat{X}_2 - (\frac{W^*}{W})\hat{W}] \tag{A.9}$$

where $\lambda_{LU} = (\frac{L_U}{L})$

Substituting $\hat{W}$ and $\hat{X}_2$ from (A.8) into (A.9) and simplifying the following two expressions can be derived.

$$(\frac{\hat{L}_U}{\hat{N}}) = (\frac{\lambda_{L2}}{\lambda_{LU}\left|D\right|})[[(\frac{W^* - W}{W})[\lambda_{L1}(B_3 B_4 H - \lambda_{K3}\varepsilon_4 J) + \lambda_{K1}\varepsilon_4 B_3\{\lambda_{L1}S^1_{LN}(\theta_{L1}+\theta_{N1}) + \theta_{N1}\lambda^*_{L2}\}]$$

(+) (−)(+)(+) (+)(+) (+)(−) (+)

$$+(\frac{W^*}{W})(\theta_{N1}\varepsilon_4 B_3)\left|\lambda^*\right|]] < 0. \qquad (A.10)$$

(−) (+)

$$(\frac{\hat{L}_U}{\hat{K}}) = (\frac{\varepsilon_4 B_3 \lambda_{L2}}{\lambda_{LU}\left|D\right|})[(\theta_{L1}+\theta_{N1})\lambda_{L1}(S^1_{LN} + S^1_{NL}) + (\frac{W*}{W})\{\theta_{N1}\lambda_{L2}$$

$$-(\theta_{L1}+\theta_{N1})\lambda_{L1}(S^1_{LN}+S^1_{NL})\}] \qquad (A.11)$$

From (A.11) it follows that

$$(\frac{\hat{L}_U}{\hat{K}}) < 0 \text{ if } 1 \geq ((\frac{(\theta_{L1}+\theta_{N1})\lambda_{L1}}{\theta_{N1}\lambda_{L2}})(S^1_{LN}+S^1_{NL})) \qquad (A.12)$$

Appendix V:

From Assumption C it follows that

$$(\frac{\theta_{L1}}{\theta_{N1}}) < (\frac{\varepsilon_1}{\varepsilon_3}) \qquad (A.13)$$

That $H < 0$ is a direct consequence of Assumption C. We are going to prove that $J < 0$ if Assumption D holds.

From (20) we find that

$J < 0$ iff $(\frac{\theta_{L1}}{\theta_{N1}}) < (\frac{\varepsilon_1 + B_1}{\varepsilon_3 + B_2})$ (A.14)

Now if $(\frac{E_{33}W_S}{E_3 R}) < (\frac{E_{11}W_S}{E_1 W})$ i.e. if Assumption D holds from (A.3) and (A.6) it follows that

$$\frac{\varepsilon_1}{\varepsilon_3} < \frac{(B_1 + \varepsilon_1)}{(B_2 + \varepsilon_3)} \quad \text{(A.15)}$$

From (A.13) and (A.15) we can write

$$(\frac{\theta_{L1}}{\theta_{N1}}) < (\frac{\varepsilon_1 + B_1}{\varepsilon_3 + B_2}) \Rightarrow J < 0 \text{ (see (A.14)).}$$

Combining (A.13) and (A.15) and using (20) one can write

$$(\frac{\theta_{L1}}{\theta_{N1}}) < (\frac{\varepsilon_1}{\varepsilon_3}) < (\frac{\varepsilon_1 + B_1}{\varepsilon_3 + B_2}) \Rightarrow J, H < 0. \quad \text{(22.1)}$$

Besides, solving (18) by Cramer's rule, using (17), (21) and (22.1) and simplifying the results are obtained.

$$\left.\begin{array}{l}
\frac{\hat{W}}{\hat{N}} = -\frac{\varepsilon_4 \theta_{N1} B_3 |\lambda^*|}{|D|} > 0; \quad \frac{\hat{W}}{\hat{K}} = -\frac{\varepsilon_4 \theta_{N1} B_3 \lambda^*_{L2}}{|D|} > 0; \\
\frac{\hat{R}}{\hat{N}} = \frac{|\lambda^*|}{|D|}(\theta_{L1}\varepsilon_4 B_3) < 0; \quad \frac{\hat{R}}{\hat{K}} = \frac{\lambda^*_{L2}(\theta_{L1}\varepsilon_4 B_3)}{|D|} < 0 \\
\frac{\hat{W}_S}{\hat{N}} = \frac{|\lambda^*|}{|D|}\varepsilon_4 J < 0; \quad \frac{\hat{W}_S}{\hat{K}} = \frac{\lambda^*_{L2}}{|D|}\varepsilon_4 J < 0 \\
\frac{\hat{v}}{\hat{N}} = \frac{|\lambda^*|}{|D|} B_3 H > 0; \quad \frac{\hat{v}}{\hat{K}} = \frac{\lambda^*_{L2}}{|D|} B_3 H > 0 \\
\frac{\hat{X}_1}{\hat{K}} = \frac{B_3 S^1_{NL} \lambda^*_{L2} \varepsilon_4}{|D|}(\theta_{L1} + \theta_{N1}) < 0; \frac{\hat{X}_2}{\hat{K}} = \frac{-B_3 \varepsilon_4(\theta_{L1}B_6 + \theta_{N1}B_5)}{|D|} > 0 \\
\frac{\hat{X}_1}{\hat{N}} = \frac{1}{|\mathrm{D}|}[\lambda^*_{L2}(\varepsilon_4 \lambda_{K3} J - B_3 B_4 H) - \lambda_{K2}\varepsilon_4 B_3 \{\lambda_{L1} S^1_{LN}(\theta_{N1} + \theta_{L1}) + \theta_{N1}\lambda^*_{L2}\}] = ? \\
\frac{\hat{X}_2}{\hat{N}} = \frac{1}{|D|}[-\lambda_{L1}(\varepsilon_4 \lambda_{K3} J - B_3 B_4 H) + \lambda_{K1}\varepsilon_4 B_3 \{\lambda_{L1} S^1_{LN}(\theta_{N1} + \theta_{L1}) + \theta_{N1}\lambda^*_{L2}\}] = ?
\end{array}\right\} \quad \text{(A.16)}$$

Results presented in (A.16) have been verbally stated in proposition 1.1.

Finally, if assumptions C and D hold i.e. if $J, H < 0$ from (A.10) and (A.11) it is easy to check that the signs of $(\frac{\hat{L}_U}{\hat{N}})$ and $(\frac{\hat{L}_U}{\hat{K}})$ are ambiguous.