UNIVERSAL EDUCATION AND ITS IMPACT ON CHILD AND ADULT LABOUR MARKETS : A NOTE

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ABSTRACT :

The objective of this paper is to re-examine the impact of universal education policy on the incidence of child labour and on the adult unemployment in a job-search model. The paper assumes the double role played by the universal education programme. It raises the number of school going children on the one hand and it affects the potential supply of child labour on the other hand. It has been found that govt's free education policy for the rural sector only, for the urban sector only and for the both of the two sectors lowers the incidence of child labour and accentuates the problem of adult urban unemployment. Our findings differ from that obtained in Chowdhuri and Mukhopadhaya (2003), where we find that free education policy intensifies the problem of child labour.

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1. INTRODUCTION :

At the present juncture, the incidence of child labour is alarming especially in many developing countries, like India. Not only the volume, but also the working conditions of child labour is highly inhuman. They work long and receive less. They face harassment in many times. So the child workers are exploited and socially deprived.

The traditional literature provides two arguments for the existence of child labour. First, the abject poverty of the family compels the parents to put their children to the work-force. Second, the child workers are more efficient than the adult workers because of their nimble fingers. Whatever be the cause, child labour can never be justified because it affects the human capital in future, which is detrimental to economic development.

The existing literature on the child labour includes the work of Basu and Van (1998), Eswaran (1996), Dessy (2000), Jacoby and Skoufias (1997), Ravallian and woden (2000), Rajan (2001), Baland and Robinson (2000), Jafarey and Lahiri (2002), Gupta (2000, 2002), Choudhury and Mukherjee (2003) etc.

Basu and Van (1998) have shown that unfavourable adult labour market is the main cause of the existence of child labour and they explain this by assuming substitutability between the child labour and the adult labour and child labour is a luxury commodity to the poor households. Eswaran (1996) and Dessy (2000) have suggested compulsory education can check the incidence of child labour. Rajan (2001), Jafarey and Lahiri (2002) and Baland and Robinson (2000) have shown that the imperfection of the capital market is a contributing factor to the existence of child labour. The idea is that parents send their children to school by borrowing provided the future returns to education are high. So, more children would go to school if the rate of interest is low. The credit market imperfection raises such interest rate and thus lowers the number of school going children.

Gupta (2002) has examined the efficacy of trade sanctions on exportables produced by child workers in combating the incidence of child labour and he has shown this in a general equilibrium framework where the supply of child labour varies inversely with the rate of unemployment in the adult labour market. Choudhury and Mukhopadhayay (2003) have shown that a free education policy / or inflow of foreign capital may raise the supply of child labour in the urban sector by inducing rural people to migrate to the urban sector with their children and thus intensifies the problem of adult urban unemployment.

The present model re-examines the impact of universal education policy on the incidence of child labour in a general equilibrium set up including job-

search[2]. The paper assumes a double role of the education policy : it raises the number of school goers and at the same time, it affects the potential supply of child labour. In this model, job-search efficiency is assumed to depend positively on the level of education of the job-seekers. More educated job-seekers have greater chance of getting high paid urban formal sector jobs.

Another interesting aspect of the model is that here it is assumed that child worker himself takes his decision whether to join the labour force or to join the school. Parents are passive in this case. This is observed in the era of globalisation.[3] Throughout the paper it is also assumed that child workers and adult workers are not substitutes to each other.

The model is described in this way : Section 2.1 is devoted to assumptions. Notations, equations and the working of the model are given in section 2.2, 2.3, 2.4 respectively. Section 2.5 yields some comparative static results. Conclusions are given in section 3.

2. THE MODEL

2.1. ASSUMPTIONS:

We consider a small open economy having three sectors : urban formal sector, urban informal sector and rural sector. Urban informal sector is sub-divided into two sub-sectors :Adult labour using urban informal sector and child labour using urban informal sector. The products of all the sectors are internationally traded.[4] The assumption of small open economy implies that all the product prices are exogenously given.

All the three adult labour using sectors use both labour and capital to produce their output. However, labour is the only input in the child labour using urban informal sector. The production functions of all the three capital using sectors exhibit CRS with diminishing marginal productivity to each input, while the production function of the child labour using urban informal sector is subject to the law of diminishing return to the labour. All the markets are assumed to be competitive. The competitive equilibrium for all the sectors are ensured by the price-unit cost equality.

We consider two types of capital : formal capital and informal capital. Informal capital is specific to the adult labour using urban informal sector, while formal capital is mobile between the urban formal sector and the rural sector. [5] Thus, we have a common rate of return on capital in these two sectors. The endowments of these two types of capital are fixed and fully utilised. The fixed amount of total adult labour in the economy is not fully employed, but there is full employment in the child labour market.[6]

It is assumed that each adult person is searching for high paid urban formal sector's jobs. We also assume that employers in the urban formal sector prefer educated applicants to the uneducated ones.[7] Thus, the more educated job seekers have greater chance of getting urban formal sector's jobs. Hence, the job search efficiency is assumed to depend positively on the level of education of the job-seekers. Like Fields (1989), we assume three kinds job search strategies : full

time job search, part time job search from the rural sector and part time job search from the urban informal sector. The highly educated persons devote full time for job search as they have greater chance of getting high paid urban formal sector's jobs and they do not accept low paid urban informal sector's jobs. On the other hand, the less or uneducated persons are part time job-seekers since they have very low chance of getting high paid urban formal jobs. The rural job searchers are assumed to be less educated than the urban informal sector job-seekers. So, the relative job search efficiency is greater in the urban informal sector than in the rural sector. Thus, the Government's universal education policy raises the job search efficiency for the part time job seekers. The job search efficiency for the full time job seekers is assumed to be one.

Each job-search strategy has success and failure. Success gives employment in the UFS. However, failure gives different results in different strategy. If a full time job-seeker becomes unsuccessful, he remains unemployed in the UFS with zero income. The failure of job-search from the rural sector means to remain employed in the rural sector, while such failure from the UIS means to remain in the UIS.

Each search strategy has expected income. The allocation of labour among different strategies is governed by the equalisation of expected income among the three different strategies. Like Fields (1989), the paper also considers two concepts of labour : ex-ante labour and ex-post labour.

The traditional literature on the child labour assumes that parents send their children to work. Thus, the decision to supply the child labour in the work-force is made by their guardians. This has strong empirical support. However, the situation has changed. Globalisation has changed the life-style through mass-media and networking system. The so-called child is now more conscious about their poverty. They are now more attracted to enjoy the modern life-style. This desire causes them to enter the labour-market, even without the approval of their parent (While, 1994). Thus, we may reasonably assume that children take their own decision to participate in the child-labour market.

It is assumed that a child aims at maximisation of net welfare. Net welfare is equal to the utility of their income less disutility of sacrifice of his share in the family income if he were not in the labour-market. The potential supply * of child labour is assumed to depend positively on the child wage rate and the size of the adult informal labour force and negatively on the adult informal wage rate. In equilibrium the demand for child labour is equal to the supply of child-labour and this is ensured by the perfect flexibility of the child wage rate.

The actual supply of child-labour is the difference between the potential supply of child-labour and the number of school-attending children, which in turn depends upon the Government's universal education programme.

In this paper it is assumed that the adult job-searchers do not consider their children's income in choosing different search strategies because they are passive in taking decision whether children join the labour-force or the school. It is also argued that there is no scope of child-work in the rural sector.

The urban trade-unionism and the wage legislations give the institutionally given urban formal sector wage. The wage rates of the other two adult labour using sectors are flexible [*]. Here, urban unemployment exists due to full-time job search, failure of which also means to remain unemployed with zero income [*].

It is assumed that the UFS is more capital-intensive than the RS, which is more capital intensive than the UIS.

2.2. NOTATIONS:

$j = u,r,i_a,i_c$

u = Urban formal sector

r = Rural sector

i_a = Adult labour using UIS

i_c = Child labour using UIS

X_j = Output in the j^{th} sector

f_j = Intensive production function of the j^{th} sector

F_{ic} = Production function of the UIS.

P_j = Price of the product produced in the j^{th} sector

ϖ_u = Fixed urban formal wage rate

ω_j = Wage rate in the j^{th} sector; $\forall$ j = r,i,a, ic

C_j = Unit cost of the production in the j^{th} sector

R = Common rental on formal capital

R_i = Rental on informal capital

λ = Probability of getting UFS jobs

θ_j = Job-search efficiency from the j^{th} sector; $\forall$, j= u,r, i, a

L_j = Ex-post level of employment in the j^{th} sector; $\forall$, j= u,r,ia, ic

L_t = Ex-ante amount of labour in the job-search strategy; $\forall$, t = 1,2,3

L^S_{ic} = Supply of child labour

L = Total emdowment of adult labour in the economy

K_i = Stock of informal capital in the economy

K_f = Stock of formal capital in the economy

k_j = Capital intensity of the j^{th} sector; $\forall$, j= u, r, i_a

U = Level of urban unemployment

E_j = Government's education subsidy to the j^{th} sector; $\forall$, j= r, i_a, i_c

N = The number of school-going children in the economy

β = Employment augmenting parameter in the UFS

Y = Domestic factor income of the economy

2.3. EQUATIONS:

The intensive production functions of all the three adult-labour-using sectors are given by:

$X_u = L_u f_u (k_u)$ …….. (1);

$X_r = L_r f_r (k_r)$ …….. (2); and

$X_{ia} = L_{ia} f_{ia} (k_{ia})$ …….. (3)

Where, $f_j' (\cdot) > 0$ and $f_j'' (\cdot) < 0$ $\forall j = u, r, i_a$

The production function of the child labour using UIS is:

$X_{ic} = F_{ic} (L_{ic})$ …….. (4)

where, $F'_{ic} (\cdot) > 0$ and $F''_{ic} (\cdot) < 0$

The price-unit cost equality conditions in all the sectors are given by the following set of equations:

$P_u = C_u (\varpi_u, R)$ …….. (5);

$P_r = C_r (\omega_r, R)$ …….. (6);

$P_{ia} = C_{ia} (\omega_{ia}, R_i)$ …….. (7); and

$P_{ic} = C_{ic} (\omega_{ic}, X_{ic})$ …….. (8)

The probability of getting UFS jobs for the job-seekers in the j^{th} sector is:

$\pi_j = \lambda + \theta_j (E_j)$. $\forall$ j = u, r, ia ……. (9);

where, $\theta_j = 1$ for $E_j = E^*$;

$0 < \theta_j < 1$ for $E_j < E^*$; and

$\theta'_j (\cdot) > 0$

The ratio of UFS jobs to the number of UFS job seekers is:

$\lambda = L_u / (L_1 + \theta_r L_2 + \theta_{ia} L_3)$ ……. (10)

where, $(L_1 + \theta_r L_2 + \theta_{ia} L_3)$ is the total number of job seekers in the economy.

The ex-ante allocation of job-seekers among different search strategies is made interms of expected income equalisation among different strategies. Thus, in equilibrium we get the following expression:

$\pi_u \varpi_u = \pi_r \varpi_u + (1 - \pi_r)\omega_r = \pi_{ia} \varpi_u + (1 - \pi_{ia})\omega_{ia}$ …….. (11)

Inserting equation (9) into equation (11) we get,

$\varpi_u = \theta_r (E_r) \varpi_u + \{1 - \lambda - \theta_r (E_r)\}\omega_r = \theta_{ia} (E_{ia}) \varpi_u + \{1 - \lambda - \theta_{ia}(E_{ia})\} \omega_{ia}$ ....(11.1)

The number of people searching UFS jobs from the rural sector is L_2. Out of L_2, π_r L_2 people get employment in the UFS. Thus, the ex-post number of workers in the rural sector is given by:

$$L_r = L_2(1 - \pi_r) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (12)$$

Using equations (9) & (12) we may write:

$$L_r = L_2\{1 - \lambda - \theta_r(E_r)\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (12.1)$$

Similarly, the ex-post number of workers in the UIS is:

$$L_i = L_3\{1 - \lambda - \theta_{ia}(E_{ia})\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (13)$$

The child-labour supply function[8] is

$$L^s_{ic} = L_{ic}(\omega_{ic}, \omega_{ia}, L_{ia}) - N(E_{ic}) \quad \ldots\ldots\ldots\ldots\ldots \quad (14)$$

Where, $\frac{\delta L_{ic}}{\delta W_{ic}} > 0$, $\frac{\delta L_{ic}}{\delta W_{ia}} < 0$ and $\frac{\delta L_{ic}}{\delta L_{ia}} > 0$ and $N' > 0$

In child-labour market equilibrium we get,

$$L_{ic} = L_{ic}(\omega_{ic}, \omega_{ia}, L_{ia}) - N(E_{ic}) \quad \ldots\ldots\ldots\ldots\ldots \quad (14.1)$$

The ex-ante and ex-post endowments of labour are given by the following set of equations:

$$L_1 + L_2 + L_3 = L \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (15); \text{ and}$$

$$L_u + L_{ir} + L_{ia} + U = L \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (16)$$

The full employment conditions of both informal and formal capital are as follows:

$$k_i L_i = K_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (17); \text{ and}$$

$$k_u L_u + k_r L_r = K_f \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (18)$$

The employment function of the UFS is given by: [9]

$$L_u = g(\varpi_n) + \beta \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (19)$$

These set of equations carry the entire life story of the model.

2.4. WORKING OF THE MODEL:

The model deals with eighteen endogenous variables : X_u, X_r, X_{ia}, X_{ic}, L_u, L_r, L_{ia}, L_{ic}, L_1, L_2, L_3, ω_r, ω_{ia}, ω_{ic}, R, R_i, λ , U which can be solved from equations (1) to (8), (10), (11.1), (12.1), (13), (14.1) to (19). This system is not decomposable in nature. Given ϖ_u and P_u, R can be obtained from equation (5). Substituting the value of R into equation (6), we get ω_r, giving P_r. Now, given E_r and E_{ia} and ϖ_u, the equation (11.1) determines the values of λ and ω_{ia}. Once ω_{ia} is known, R_i is found from equation (7), given P_{ia}. As optimum capital intensities depend on factor prices, we get k_u, k_r and k_{ia}, given ϖ_u, R, ω_r and ω_{ia}. L_{ic} is obtained from equation (17), given K_i. Equation (19) yields L_u, given ϖ_u and β . Then, L_r can be determined from equation (18) after substituting the values of k_u, k_r and L_u, given K_f. Then equilibrium

U is obtained from equation (16), since L_u, L_r and L_{ia} are already known and L is given. Given E_r, L_2 is obtained from equation (12.1) as λ and L_r are already known. Similarly, we get L_3 from equation (13). Then, equation (15) gives L_1, given L, L_2 and L_3.

Now, substituting equation (4) into equation (8) we get,

$P_{ic} = C_{ic} \{\omega_{ic}, F_{ic} (L_{ic})\}$ …… (8.1)

Then, the equilibrium values of ω_{ic} and L_{ic} can be determined from equations (8.1) and (14.1), given P_{ic}, ω_{ia} and L_{ia}. This is also shown graphically in Fig. 1. We use two curves AA and BB to get ω_{ic} and L_{ic}. The AA curve is obtained from equation (8.1). This curve is negatively sloped because ω_{ic} and L_{ic} have to move in opposite direction to restore product market equilibrium for the child-labour using UIS. The AA curve shifts when P_{ic} is changed. Equation (14.1) gives the BB curve which is positively sloped because ω_{ic} and L_{ic} move in the same direction to maintain equilibrium in the child-labour market. The BB curve shifts when ω_{ia} and L_{ia} are changed. The point of intersection of the two curves gives the equilibrium values of ω_{ic} and L_{ic}.

Space for Fig. 1

The set of equations (1 – 4) determine the equilibrium values of X_u, X_r, X_{ia} and X_{ic} as L_u, L_r, L_{ia}, L_{ic}, k_u, k_r and k_{ia} are already known.

Thus the entire model is determined with the given set of equations.

2.5. COMPARATIVE STATIC EFFECTS:

2.5.1. CHANGE IN E_r

In this section we examine the impact of a free education policy for the rural sector.[10] In this model, such policy has direct impact on the adult workers in the rural sector, but no effect on the child workers as by assumption, child labour does not exist in the rural sector.

If Government gives more education subsidy to the rural sector, E_r rises. The level of education of the adult rural people rises. Since the UFS

employers prefer more educated applicants to less ones, the relative job-search efficiency of the rural job seekers rises and so θ_r rises. Given ϖ_u and ω_r, equation (11.1) implies that as θ_r rises, λ also rises. Again, equation (11.1) also implies that given ϖ_u and θ_i, ω_{ia} must rise with the rise in λ. Equation (7) shows that R_i falls when ω_{ia} rises, given P_{ia}. Thus, the wage rental ratio for the UIS rises and so also the optimum capital intensity (k_{ia}) in this sector. Given L_i, as k_{ia} rises, L_{ia} falls [see equation (17)].

Now, since ω_{ia} rises and L_{ia} falls, the BB curve shifts to the left and the AA curve does not change. Thus the equilibrium level of L_{ic} falls and ω_{ic} rises. (See the appendix A.1) Equations (18) and (19) imply that L_u and L_r remain unchanged since ϖ_u, β are given and k_u, k_r do not change at all. Equation (16) implies that U must rise since L_{ia} falls and L, L_u, L_r do not change. Thus, we can make the following proposition.

PROPOSITION 1 : A rise in education subsidy to the rural sector lowers the incidence of child-labour and accentuates the problem of adult unemployment in the urban sector.

2.5.2. EDUCATION SUBSIDY TO BOTH CHILDREN AND ADULTS IN THE URBAN SECTOR:

We now examine the implication of Government's free education policy in the urban sector. This policy has direct impact on children and adult person in the UIS who are less educated or uneducated. However, in this model such policy has no effect on the full-time job searchers who have already reached the full job-search efficiency level of education. Free education policy affects the potential supply of child labour through the variation in adult labour and adult wage in the UIS and it also affects the number of school-going children and as a whole the child labour supply becomes responsive to such education policy.

A rise in education subsidy to both children and adults in the urban sector raises $N(E_{ic})$ and θ_{ia} (E_{ia}). From equation (11.1) it is obvious that given ϖ_u, θ_r and ω_r, λ does not change but ω_{ia} falls. Equation (7) implies that R_i rises if ω_{ia} falls given P_{ia}. Thus, (ω_{ia}/ R_i) falls and so also k_{ia}. Once K_{ia} falls, L_{ia} rises, given K_i.

If ω_{ia} falls and L_{ia} rises, and $N(E_{ic})$ rises, the shift of the BB curve is not so easily obvious. If the potential supply of child labour rises less than the school-going children, the BB curve shifts to the left. The AA curve does not change. So in child labour market equilibrium ω_{ic} rises and L_{ic} falls.(See the appendix A.2) Given ϖ_u, β, k_u, k_r and K_f, L_u and L_r do not change. So, U must rise. This result leads to the following proposition:

PROPOSITION 2: A rise in education subsidy to both children and adults in the urban sector lowers the incidence of child labour and accentuates the problem of urban unemployment if the potential supply of child labour rises less than the school going children.

2.5.3. EDUCATION SUBSIDY TO BOTH RS AND US:

This section examines the efficacy of free education policy to all the sectors of the economy. A rise in the education subsidy to all adults and children in the economy raises θ_r, θ_{ia} and N. Equation (11.1) shows that given ϖ_u and ω_r, a rise in θ_r leads to a rise in λ, which in turn raises ω_{ia} when θ_{ia} rises if $(d\pi_{ia}/d\theta_{ia}) > \varpi_u/\omega_{ia}$. (See the appendix B)

Equation (7) implies that if ω_{ia} rises, R_i falls given P_{ia}. Thus, k_{ia} rises and L_{ia} falls, given K_i {see equation (17)}. On the other hand, a rise in E_{ic} raises N. Thus the BB curve shifts to the left when ω_{ia}, E_{ic} rise and L_{ia} falls. The AA curve does not shift. So, in the equilibrium, L_{ic} falls and ω_{ic} rises.(See the appendix A.3)

Again, as L_{ia} falls, by the arguments similar to the previous section, U must rise. Thus we can have the following proposition:

PROPOSITION 3: A rise in education subsidy to all adults and children in the economy lowers the incidence of child-labour and raises the level of adult urban employment if $(d\pi_{ia}/d\theta_{ia}) > \varpi_u/\omega_{ia}$.

3. CONCLUSION:

This paper attempts to re-examine the implication of Government's free education policy to both adults and children for the incidence of child labour and adult urban unemployment in a job-search model. Like Fields (1989), we consider both full time job search and part time job search. Full time job searchers are assumed to be more educated and so they have greater chance to get UFS jobs. On the other hand, part time job seekers are less or uneducated and they have smaller chance of getting UFS jobs. In this paper three types of free education policy have been assumed: free education for the rural sector free education for the urban sector and free education for both of the two sectors. It has been found that if Government gives education subsidy to rural sector only, the incidence of child labour falls and the level of urban unemployment rises. It is assumed that the full time job-searchers in the urban sector have attained the education level where job-search is fully efficient. Thus, Government's education subsidy to the urban sector raises the educational level of the children and the adults in the UIS, leaving that of the UFS unchanged. It is found that free education policy for the urban sector only lowers the incidence of child labour and intensifies the problem of adult urban unemployment if the number of school going children rises more than the potential supply of child labour. Further, Government may undertake free education policy for all sectors of the economy and such universal education policy also softens the problem of child labour and intensifies the problem of adult urban unemployment if the responsiveness of probability of getting UFS jobs to the job-search efficiency in the UIS exceeds the adult wage ratio in the urban sector. Thus, it is found that Government's education subsidy may lower the incidence of child labour. However,

in Choudhury and Mukhopadhyay (2003) we find that Government's free education policy to the children may intensify the problem of child labour where child labour exists both in the RS and in the US. Thus, it is the general education policy for both child and adult that can be a panacea to the problem of child labour.

The paper assumes job-search on the one hand and the coexistence of adult and child labour on the other hand. The two concepts are not new. However, job-search is included in the paper in a more general framework where product market and capital mobility are considered. Moreover, job-search efficiency is embedded in the additive form where such efficiency depends on the educational level of the job seekers. Another difference from the traditional theory of child labour is that in this model it is assumed that child labour himself (or, herself) takes his (or, her) decision whether to join the school or to join the work and perhaps this is the outcome of international globalisation of mass-media.[11] The paper also assumes that what children can do, adults can not do. Thus, the substitutability between child labour and adult labour are assumed away. [12]

FOOT NOTES

1. This has strong empirical support especially in the matchmaking industry, brasso industry and carpet weaving industry.
2. We find job-search in the Fields (1989) model. However, our model differs from Fields (1989). In the Fields(1989) model, job-search efficiency is assumed to be constant. In this model such efficiency is positively associated with the level of education. The more educated job-searchers have greater chance of getting high-paid urban formal jobs.
3. See White (1994).
4. We find this in Grinolds (1991), Chandra and Khan (1993) and Gupta (1997).
5. We find this type of capital mobility in Grinolds (1991).
6. Full employment of child labour is ensured by the perfect flexibility of child wage rate.
7. Workers' efficiency is assumed to depend positively on their educational level. More educated workers are more efficient. Hence, employers always prefer the educated workers.
8. The child labour supply function is derived from the maximisation of net welfare of a child worker where net welfare is given by $U(\omega_{ic}) - V\{(\omega_{ia} L_{ia})/(L_{ic} + L_{ia})\}$
9. We find this type of employment function for the urban formal sector in the Fields (1989) model.
10. This policy may manifest in the adult literacy programme in the rural sector.
11. See foot note 3.
12. In many informal jobs we find that what children do adults can not do. However, in Basu and Van (1998), we find substitutability between these two types of labour.

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Appendix – A

The total differentials of equations (8.1) and (14.1) are given by :

$C_{ic2}F'_{ic}dL_{ic} + C_{ic1}dw_{ic} = 0$……..(I)

$dL_i - L_{ic1}dw_{ic} = L_{ic2}dw_{ia} + L_{ic3}dL_{ia} - N'dE_{ic}$……(II)
In matrix form we can write,

$$\begin{bmatrix} C_{ic2}F'_{ic} & C_{ic1} \\ 1 & -L_{ic1} \end{bmatrix} \begin{bmatrix} dL_{ic} \\ dW_{ic} \end{bmatrix} = \begin{bmatrix} 0 \\ L_{ic2}\,dW_{ia} + L_{ic3}\,dL_{ia} - N'dE_{ic} \end{bmatrix}$$

Here, $\Delta = -(L_{ic1}C_{ic2}F_{ic}' + C_{ic1}) < 0$

Appendix (A.1)

If Government gives education subsidy to the rural sector only, $dW_{ia} > 0$, $dL_{ia} < 0$ and $dE_{ic} = 0$ (See section 2.5.1). Then using Cramer's rule we get,

$dL_{ic} = (-C_{ic1}/\Delta)\,[\,L_{ic2}\,dW_{ia} + L_{ic3}\,dL_{ia}\,] < 0$ (since $L_{ic2}<0$, $L_{ic3}>0$, $dW_{ia}>0$, $dL_{ia}<0$)
and $dW_{ic} = (C_{ic2}/\Delta)\;F_{ic}'\,[\;L_{ic2}\,dW_{ia} + L_{ic3}\,dL_{ia}] > 0$

Appendix 2: If Government gives education subsidy to the urban sector, Section 2.5.2 shows that, in this case, $dW_{ia} < 0$ and $dL_{ia} > 0$, $dN > 0$, $dE_{ic} > 0$. Then by Cramer's rule, we get from equations I and II,

$dL_{ic} = (-C_{ic1}/\Delta)\;[\,L_{ic2}\,dW_{ia} + L_{ic3}\,dL_{ia} - N'dE_{ic}\,]$

and $dW_{ic} = (C_{ic2}F_{ic}'/\Delta)\;[\;L_{ic2}\,dW_{ia} + L_{ic3}\,dL_{ia} - N'dE_{ic}]$

The above teo expressions show that $dL_{ic} < 0$ and $dW_{ic} > 0$ if $dL_{ic} < dN$

<u>Appendix A.3</u>

In the case of education subdidy to all the sectors, W_{ia} rises and L_{ia} falls if

$(d\,\pi_{ia}/d\,\theta_{ia}) > (\overline{W}_u/W_{ia})$ (see section 2.5.3). Then we get,

$dL_{ic} = (-C_{ic1}/\Delta)\;[\,L_{ic2}\,dW_{ia} + L_{ic3}\,dL_{ia} - N'dE_{ic}\,]$

$dW_{ic} = (C_{ic2}F_{ic}'/\Delta)\;[\;L_{ic2}\,dW_{ia} + L_{ic3}\,dL_{ia} - N'dE_{ic}]$

Here, $dL_{ic} < 0$ and $dW_{ic} > 0$ Since $dW_{ia} > 0$ $dL_{ia} < 0$ $dE_{ic} > 0$, $\Delta < 0$.

Appendix – B

Section 2.5.3 shows that if education subsidy is given to both the rural sector and the urban sector, λ rises , given $\overline{W_u}$ and W_r (see equation (11.1)). Now, consider the equation (11.1) once again. We can write from equation (11.1) :

$\overline{W_u} = \theta_{ia} \overline{W_u} + (1- \pi_{ia}) W_{ia}$ .....(11.2)

When θ_{ia} rises, π_{ia} also rises (see equation (9)).

The total differential of equation (11.2) is given by

$0 = \overline{W_u}\, d\theta_{ia} + (1- \pi_{ia})\, dW_{ia} - W_{ia}\, d\pi_{ia}$

$$\text{or } (1- \pi_{ia})\, dW_{ia} = W_{ia}\, d\theta_{ia} \left(\frac{d\pi_{ia}}{d\theta_{ia}} - \frac{\overline{W_u}}{W_{ia}} \right)$$

$$\text{so, } dW_{ia} > 0 \quad \text{if} \quad \frac{d\pi_{ia}}{d\theta_{ia}} > \frac{\overline{W_u}}{W_{ia}}$$

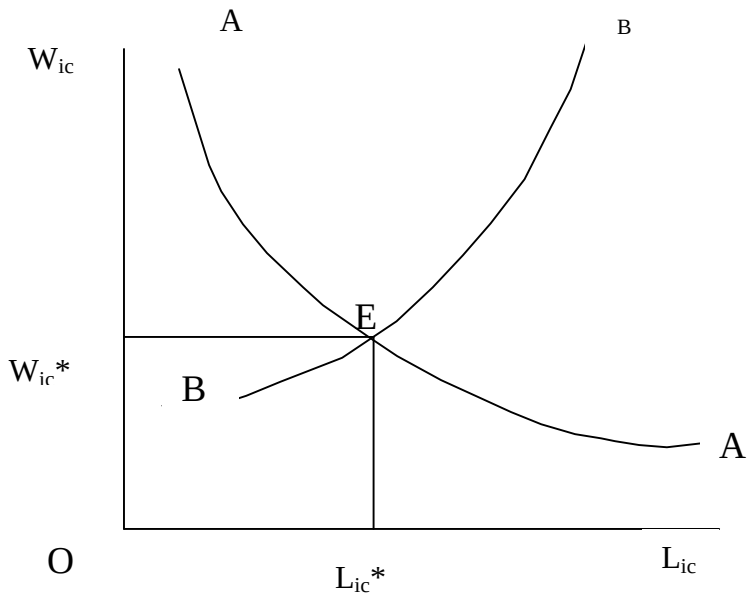

Fig. 1