

Title	Rural Urban Migration, Informal Sector and Environmental Problems in a Small Open Less Developed Economy : A Theoretical Analysis
Sub Title	
Author	Gupta, Manash Ranjan
Publisher	Keio Economic Society, Keio University
Publication year	2003
Jtitle	Keio economic studies Vol.40, No.2 (2003.) ,p.37- 49
JaLC DOI	
Abstract	
Notes	
Genre	Journal Article
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=AA00260492-20030002-0037

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**RURAL URBAN MIGRATION, INFORMAL SECTOR AND
ENVIRONMENTAL PROBLEMS IN A SMALL
OPEN LESS DEVELOPED ECONOMY:
A THEORETICAL ANALYSIS**

Manash Ranjan GUPTA

Economic Research Unit, Indian Statistical Institute, Calcutta India

First version received July 2002; final version accepted November 2003

Abstract: A model of a dual economy has been developed with special emphasis on the environmental problems created by the informal sector activities and its role on the efficiency of labour. The model is used to analyze the effects of the inflow of foreign capital and of the effects of subsidization to the different sectors of the economy.

Key words: Informal Sector, Environmental Pollution, Foreign Capital, Subsidy, Welfare.

J.E.L. Classification Number: O17, R23

I. INTRODUCTION

The existence of the urban informal sector in the less developed countries is now an empirically established fact¹. Also a number of theoretical works² have analysed the problem of the urban informal sector in the three sector dual economy models which are extension of the two sector Harris–Todaro model. In the existing theoretical literature, the dichotomy between the urban formal sector and the urban informal sector is based on only one point. The labour market in the urban formal sector is protected; and the workers receive a minimum wage there. But the labour market in the informal sector is not protected; and the wage rate in that sector is perfectly flexible.

There are some other features of the informal sector which the existing theoretical models have not considered. One important feature is that the development of the urban informal sector brings along with it a number of social and environmental problems like

Acknowledgements. Helpful and constructive comments of a referee on an earlier version are gratefully acknowledged. Remaining errors of mine alone.

¹ See the works of Mazumbar (1976), Papola (1981), Romatet (1983), Weeks (1975), Sethuraman (1981), Portes, Blitzer and Curties (1986) etc.

² See the models of Quibria (1988), Chandra and Khan (1993), Grinols (1991), Gupata (1993, 1997), Khan (1992A, 1992B), Datta Chaudhuri (1989), Fields (1975, 1991), Stark (1982) etc.

squalor, congestion, pollution etc³. All of them produce health hazards in the society and this lowers the physical efficiency of the workers. The developed countries only have formal sector production units; and, in most cases, the social and environmental costs are either due to excessive technological spread or due to over development of the economy. But in the less developed countries, social and environmental costs like the problems of polluted water, poor sanitation, crowded housing, poor health system are connected with the growth of the informal sector activities⁴.

Formal sector industrial units also create environmental problems. However, there are laws to control them. On the other hand, the present pollution control policies in India and in other less developed countries do not address the small and informal sector industries, which pollute with impunity.

The expansion of the urban informal sector causes environmental pollution in various ways. The small scale and informal industries produce considerable industrial effluents and do not clean up waste water as the cleaning up is very expensive. There are over two million small scale industries in India. However, over 60% of the large and medium industries in India have installed 'Effluent Treatment Plants' (ETP) to treat water before discharge. The poorly paid workers of the informal sector stay in the urban slums where the existence of sewage treatment facilities and sanitation services are negligible. Burning of unprocessed cooking fuels made by the informal sector workers in their homes causes air pollution. The uncontrolled burning of solid waste in urban areas is another major cause of air pollution. The frequent power failure in many towns and cities have compelled the small traders to use the oil based power generators on the road sides: and this is another source of air pollution.

The negative health impact of water pollution is considerable. About 200 million people in India do not have access to safe drinking water. The death of about 1.5 million children (under 5 years) per year is caused by water related diseases. These also cause a loss of over 200 million person days of work per year. Studies show that the better water supply and sanitation facility can reduce the death due to diarrhoea by 65% and child mortality by 55%. Air pollution also produces negative health effects. Premature death due to the respiratory and cardio-vascular diseases and illness due to chronic respiratory diseases like asthma and bronchitis have increased. According to a World Bank study, in 1995, air pollution might have accounted for some 40,350 premature deaths, 19,805,000 hospital admissions and 1,201,000,000 minor illness. The study reported that, in the last three years, the number of premature death have increased by 28% and the number of sickness and hospital admissions by 30%.

In this paper, we develop a three-sector model with an urban informal sector, a rural sector and an urban formal sector. Here the growth of the informal sector defined as the increase in its level of output creates environmental pollution: and thereby lowers the efficiency of workers in the urban formal sector. The urban formal sector produces

³ See the works of Sethuraman (1981), Squire (1981), Chatterjee and Ray Chaudhuri (1994), Roy (1995) etc.

⁴ See Mahbud Ul Haq (1976), IGIDR (1999) etc.

a good which removes environmental pollution and thereby enhances the physical efficiency of the workers⁵. In the presence of the conflicting role of the formal sector and of the informal sector on the environmental pollution and thereby on the efficiency of the workers, we now want to analyze the effects of the various development policies. These policies include the various sector specific subsidy policies and the policy of financing growth through the inflow of the foreign capital.

We obtain some interesting results from this theoretical exercise. First, an inflow of foreign capital with full repatriation of its earnings lowers social welfare even under free trade. This result is inconsistent with what is known as Brecher–Alejandro (1977) proposition⁶; and this result can not be obtained in any other model on informal sector. Secondly, subsidization to the urban formal sector leads to a contraction of the labour intensive rural sector and an expansion of the capital intensive urban formal sector as well as of the urban informal sector. However this lowers the efficiency of the formal sector workers and hence the formal sector output grows at a lower rate than the rate of growth of the formal sector workers. This subsidization policy lowers the level of social welfare if the economy is largely dependent on foreign capital; and the rate of decline in this model is higher than that in any standard model which assumes exogenously given labour efficiency. Thirdly, the policy of subsidization to the rural sector restricts the expansion of the urban informal sector and thereby raises the efficiencies of the formal sector workers through reduction in the environmental pollution. This leads to a higher rate of increase of social welfare in this model than that in the other model with exogenously given labour efficiency.

The model and its workings are described in section 2 of this paper. The effects of the adoption of sector specific subsidies and of the inflow of foreign capital are analysed in section 3. Concluding remarks are made in section 4.

2. THE MODEL

We consider a small open economy consisting of three sectors—one urban formal sector, one urban informal sector and a rural sector. The formal sector produces a product which enhances the physical efficiency of the urban workers. The urban formal sector and the rural sector produce internationally traded goods whose prices are determined in the world market. However, the informal sector produces a product with a low market value. The informal sector creates environmental pollution and this leads to health hazards of the workers. The environmental pollution causes sufferings to all the formal sector workers. So the physical efficiency of the representative formal sector worker is inversely related to the level of pollution. The level of pollution generated by the informal sector varies positively with the level of output. One worker in the informal sector can produce one unit of output. Workers in this sector are self-employed and

⁵ For example, pure drinking water, housing, health and medical facilities ect.

⁶ This proposition states that an inflow of foreign capital lowers (dose not effect) the social welfare valued at world prices in the presence (absence) of a tariff provided that the import-competing sector is more capital intensive and the entire foreign capital income is repatriated.

receive wage equal to the average productivity of labour. So the wage rate in the informal sector is equal to unity. The efficiency of urban worker varies positively with the level of output of the formal sector. Capital is perfectly mobile between the rural sector and the urban formal sector. Wage rate in the urban formal sector is fixed and the rural sector's wage rate is perfectly flexible. Foreign capital and domestic capital are perfect substitutes and additive⁷ Production function in all the sectors are of fixed coefficient type. All the markets are perfectly competitive and the representative producer in the formal sector and in the rural sector maximizes profit. The rural urban migration in this model is similar to the models of Harris and Todaro (1970) and of Corden and Findlay (1975) which are well known in the literature.

Let I , R and U stand for the urban informal sector, rural sector, and the urban formal sector respectively. Here $j = I, R$ and U . X_j, L_j, Q_j , and P_j , stand for the level of output, level of employment, the rate of subsidy per unit of production, and the price of the product in the sector j respectively. \bar{w} is the fixed wage rate in the urban formal sector and W_R stands for the wage rate in the rural sector. K_D, K_F and r , stand for the stock of domestic capital, stock of foreign capital and the rate of interest on capital common to the rural sector and the urban formal sector. λ represents the ratio of urban formal sectors employment to the total urban (formal plus informal) employment; and Y stands for the national income valued at international prices. L represents the total number of workers in the economy. a_{ij} represents the input output coefficient for $i = K, L$ and $j = U, R$. X_I also represents the level of pollution because we assume that one unit informal sector's product generates one unit of pollution. β represents the efficiency of the representative formal sector worker.

The equational structure of the model is as follows: The fixed coefficient production function in the three sectors are given by the followings:

$$X_U = \text{Min} \left\{ \frac{K_U}{a_{KU}}, \frac{L_U \cdot \beta}{a_{LU}} \right\}; \quad (1)$$

$$X_R = \text{Min} \left\{ \frac{K_R}{a_{KR}}, \frac{L_R}{a_{LR}} \right\}; \quad (2)$$

and,

$$X_I = L_I. \quad (3)$$

Competitive equilibrium in the j^{th} sector for $J = U$ and R equates the marginal cost to the effective price. The assumption of fixed coefficient production function makes marginal cost to be identical to the average cost and to be independent of the level of production. Hence, we have

$$P_U = \{a_{LU} \cdot (\bar{w}/\beta) + a_{KU} \cdot r\} - Q_U; \quad (4)$$

and

⁷ This is a standard assumption borrowed from the works of Brecher and Alejandro (1977), Khan (1982), Chandra and Khan (1993), Gupta (1994, 1997) etc.

$$P_R = \{a_{LR} \cdot W_R + a_{KR} \cdot r\} - Q_R. \quad (5)$$

In the urban informal sector, wage rate is equal to average productivity of labour. Hence,

$$W_I = (X_I/L_I) = 1. \quad (6)$$

Also note that W_I represents the price of the informal sector's product because W_I is the average (marginal) cost of production in that sector and price is equal to average cost in competitive equilibrium.

The efficiency of the urban formal sector worker, β , is a positive function of the level of production of the urban formal sector, X_U , and a negative function of the level of environmental pollution. Here $X_I = L_I$ represents the level of pollution. We assume β to be homogenous of degree zero in terms of X_U and L_I . This is a restrictive assumption. However, we do it from the viewpoint of analytical simplicity. Thus we have

$$\beta = \beta(X_U/L_I) \text{ with } \beta'(\cdot) > 0. \quad (7)$$

The migration equilibrium condition is given by

$$W_R = \lambda \bar{w} + (1 - \lambda)W_I; \quad (8)$$

and

$$\lambda = (L_U/(L_U + L_I)). \quad (9)$$

Here λ and $(1 - \lambda)$ represent the probabilities of the representative rural migrant of getting the urban formal sector job and of the informal sector job respectively. So the R.H.S. of the equation (9) is the expected urban wage; and this is equal to the actual rural wage in the migration equilibrium.

Capital stock (including domestic capital and foreign capital) is fully utilized. Hence we have

$$a_{KU} \cdot X_U + a_{KR} \cdot X_R = K_D + K_F. \quad (10)$$

Also there is no open unemployment⁸ in the economy because the wage rate in the rural sector is perfectly flexible and the workers in the informal sector are self-employed with a linear production function. So the full employment of labour implies

$$(a_{LU}/\beta)X_U + L_I + a_{LR}X_R = L. \quad (11)$$

The national income of the economy is given by

$$Y = Y^* - Q_U X_U - Q_R X_R; \quad (12)$$

where

$$Y^* = W_R \cdot L + r \cdot K_D \quad (13)$$

is the domestic factor income.

⁸ See Chandra and Khan (1993), Grinols (1991), Quibria (1988) and Gupta (1977) in this context.

Social welfare, H , is assumed to vary positively with the level of national income, Y , and to vary negatively with the level of environmental pollution measured by L_I . Hence we have

$$H = H(Y, L_I) \text{ with } H_1 > 0; H_2 < 0. \quad (14)$$

Using equation (9), we have

$$L_I = ((1 - \lambda)/\lambda)L_U; \quad (9A)$$

and then putting

$$L_U = (a_{LU}/\beta)X_U$$

we can express equation (11) as follows;

$$(a_{LU}/\beta\lambda)X_U + a_{LR} \cdot X_R = L. \quad (11.1)$$

Here $P_U, P_R, \bar{w}, a_{LU}, a_{KU}, a_{LR}, a_{KR}, L, K_D$ and K_F are exogenous to the system. Q_U and Q_R are the policy parameters. $X_U, X_I, X_R, L_U, L_I, L_R, Y, Y^*, W_R, \lambda, \beta, H, W_I$ and r are the endogenous variables; and there are fourteen equations to solve for these fourteen unknowns. The working of the model is described as follows. Given P_U, P_R, Q_U, Q_R and \bar{w} , equations (4) and (5) solve for the equilibrium values of r and W_R in terms of β . Then equation (8) solves for λ in terms of β because W_I is fixed. Equation (7) then explains λ in terms of (X_U/L_I) . Again equation (9) can be expressed as follows:

$$\lambda = (1/(1 + (L_I/a_{LU}X_U))). \quad (9B)$$

Hence using (7) and (9B), we can solve for the unique equilibrium values of (X_U/L_I) and λ . The equilibrium solution in terms of (X_U/L_I) and λ is unique because equation (9B) shows a positive relationship between λ and (X_U/L_I) and the other relationship between λ and (X_U/L_I) as derived from equation (4), (5), (7) and (8) is inverse to each other.

Then the unique equilibrium value of β is obtained from equation (7) and the unique equilibrium values of W_R and r are obtained from equations (4) and (5). Then equations (10) and (11.1) solve for X_U and X_R ; and the two fixed-coefficient production functions given by equations (1) and (2) solve for L_U, K_U, L_R and K_R . Then equation (9A) solves for L_I and (3) solves for X_I .

The equation (12) and (13) solve for Y and Y^* and finally equation (14) solves for H .

Note that equilibrium values of r, W_R, λ, β and (X_U/L_I) are determined uniquely by the equations (4), (5), (7), (8) and (9). Here Q_U and Q_R enter into equations (4) and (5). So subsidization policies to the urban formal sector and/or rural sector should affect this solution. However K_F does not enter into this subset of equations. So the change in the foreign capital inflow has no effect on this equilibrium solution of r, W_R, λ, β and (X_U/L_I) . K_F enters equation (10); and looking at equations (10) and (11) we understand that equilibrium values of X_U , and X_R are dependent on K_F .

This model can be viewed as an extension of the first model of Chandra and Khan (1993) with an endogenous labour efficiency function in the urban formal sector where

labour efficiency is linked to the environmental diseconomies generated by the informal sector.

3. COMPARATIVE STATICS

3.1. Change in K_F

We have already noted that the determination of W_R , r , λ and (X_U/L_I) are independent of the change in K_F . Now the equations (10) and (11.1) are used to analyse the effect of change in K_F on X_U and X_R .

It can be easily shown that $\left(\frac{dX_U}{dK_F}\right) = \left(\frac{a_{LR}}{\Delta}\right)$;

and

$$\left(\frac{dX_R}{dK_F}\right) = \left(-\frac{a_{LU}}{\beta\lambda} \cdot \frac{1}{\Delta}\right)$$

where $\Delta = (a_{KU} \cdot a_{LR} - a_{KR} \cdot (a_{LU}/\lambda \cdot \beta))$.

Here $\Delta > 0$ because the urban region is more capital intensive than the rural region. Hence $\left(\frac{dX_U}{dK_F}\right) > 0$ and $\left(\frac{dX_R}{dK_F}\right) < 0$. The inflow of foreign capital raises the output of the capital-intensive urban formal sector and lowers that of the labour intensive rural sector. So the Rybczynski effect remains unchanged.

Since X_U/L_I is uniquely determined in equilibrium and the equilibrium value is independent of the change in K_F , we have

$$\left(\frac{dL_I}{dK_F}\right) = \frac{L_I}{X_U} \cdot \left(\frac{dX_U}{dK_F}\right) > 0.$$

So the inflow of foreign capital raises the level of employment (output) in the urban informal sector in this case. This raises environmental pollution too because it is proportional to the level of output (employment) in the urban informal sector.

In the absence of subsidization to the different sectors, i.e., with $Q_j = 0$ for $j = U$ and R and under free trade, national income is equal to the domestic factor income, i.e., $Y = Y^*$. Hence, using equation (13), it can be shown that

$$\left(\frac{dY^*}{dK_F}\right) = 0$$

because change in K_F does not affect W_R and r .

Now the welfare effect of foreign capital inflow is obtained from equation (14). We have

$$\left(\frac{dH}{dK_F}\right) = \left(\frac{dU}{dL_I}\right)\left(\frac{dL_I}{dK_F}\right) < 0$$

because $\left(\frac{dU}{dL_I}\right) < 0$ and $\left(\frac{dL_I}{dK_F}\right) > 0$.

So, the inflow of foreign capital lowers the level of social welfare under free trade. The intuition behind this is the following. The inflow of foreign capital does not affect

the factor prices. Since the labour endowment and the stock of domestic capital are given, domestic factor income remains unchanged in this case. Under freetrade domestic factor income is equal to the national income valued at world prices. However capital intensive urban formal sector expands in this case; and this leads to an expansion of the urban informal sector's employment (output) at the same rate. Since the level of pollution is proportional to the level of output (employment) of the informal sector, social welfare being a negative function of the level of pollution is reduced in this case.

The result that the foreign capital inflow lowers the social welfare even under free trade and with full repatriation of its earnings is interesting because this is contradictory to the common result of Brecher and Alejandro (1977), Khan (1982), Chandra and Khan (1993), Beladi and Marjit (1992) etc. which states that the national income remains unaffected in this case. This result of present model is even different from that in Grinols (1991) model in which the informal sector uses sector specific capital but does not produce any negative effect on the environment. In that model, the increase in foreign capital inflow raises the national income under free trade. The result of the present model is different from that in Gupta (1997) who develops a three sector model of a dual economy with the co-existence of the formal and informal credit markets. The expansion of the informal sector does not produce any negative environmental effect in that model; and hence the entry of the foreign capital into the formal capital market may raise the national income even under free trade.

3.2. Change in Q_U

We consider a situation where subsidy is given only to the sector U, i.e., $Q_U > 0$ and $Q_R = 0$. Looking at the equations (4), (5) and (8), we find that the increase in Q_U , given β , will raise r and will lower W_R . Also λ falls in this case because $\bar{w} > W_I$ (see the equation (8)). Now from equation (8) and (9) we find that (X_U/L_I) should take a lower value in the new equilibrium. This implies a decline in the labour-efficiency, β .

The comparative static effects on X_U and X_R with respect to Q_U can be obtained from the equations (10) and (11.1); and these are given by

$$\left(\frac{dX_U}{dQ_U}\right) = \left(\frac{a_{KR}A}{\Delta}\right);$$

and

$$\left(\frac{dX_R}{dQ_U}\right) = \left(\frac{a_{KU}A}{\Delta}\right)$$

where $A = \left(\frac{a_{LU} \cdot X_U}{(\lambda\beta)^2}\right) \cdot \left(\frac{d(\lambda\beta)}{dQ_U}\right)$.

So the sign of $\left(\frac{dX_U}{dQ_U}\right)$ and $\left(\frac{dX_R}{dQ_U}\right)$ will depend on the sign of $\left(\frac{d(\lambda\beta)}{dQ_U}\right)$.

We know that the increase in Q_U will lower β as well as λ . So $\lambda\beta$ is reduced and hence $\left(\frac{d(\lambda\beta)}{dQ_U}\right) < 0$. Hence X_R falls and X_U rises when Q_U is increased provided that $\Delta > 0$. So subsidization to the urban formal sector raises the level of output of the capital-intensive urban formal sector and lowers that of the labour intensive rural sector.

Here the subsidization policy lowers the effective capital intensity of the urban formal sector given by $\left(\frac{a_{KU} \cdot \lambda \beta}{a_{LU}}\right)$.

The fall in β implies a fall in (X_U/L_I) . As X_U is increased, so L_I is increased at a higher rate. Since $X_I = L_I$ also represents the level of environmental pollution, so we can say that the subsidization to the urban formal sector worsens the problem of environmental pollution.

The domestic factor income given by

$$Y^* = W_R \cdot L + r \cdot K_D$$

may move either way because r rises and W_R falls; and the same is true for the national income given by

$$Y = Y^* - Q_U \cdot X_U.$$

If Y^* is reduced, then Y also falls. So the social welfare, $H(Y, L_I)$, is reduced in this case. From equation (5), given P_U and Q_U , we find that

$$dW_R = -\left(\frac{a_{KR}}{a_{LR}}\right) \cdot dr;$$

and hence from equation (13), we have

$$\left(\frac{dY^*}{dQ_U}\right) = \left(-\left(\frac{a_{KR}}{a_{LR}}\right) \cdot L + K_D\right) \left(\frac{dr}{dQ_U}\right).$$

Since $\left(\frac{dr}{dQ_U}\right) > 0$, then the necessary and sufficient condition for the decline in Y^* due to increase in Q_U is given by the following:

$$\left(\frac{K_D}{L}\right) < \left(\frac{a_{KR}}{a_{LR}}\right). \quad (Z.1)$$

This means that the rural sector has a higher capital-intensity than the domestic capital stock normalized with respect to labour force. This is inconsistent with $K_F = 0$ because by assumption

$$\left(\frac{a_{KU} \cdot \lambda \beta}{a_{LU}}\right) > \left(\frac{a_{KR}}{a_{LR}}\right);$$

and from (10) and (11.1) this implies that

$$\left(\frac{a_{KU} \cdot \lambda \beta}{a_{LU}}\right) > \left(\frac{K_D + K_F}{L}\right) > \left(\frac{a_{KR}}{a_{LR}}\right). \quad (Z.2)$$

The conditions (Z.1) and (Z.2) are consistent with each other if K_F is very high and K_D is very low. So in an open economy largely dependent on foreign capital, the policy of subsidization to the urban formal sector lowers the domestic factor income. This leads to a fall in national income and hence a decline in social welfare. A qualitatively similar result is obtained even if we do not introduce the aspect of environmental diseconomies in the labour efficiency function and in the social welfare function. However, in the presence of environmental diseconomies, the rate of decline of social welfare is

higher because the expansion of the informal sector has a direct negative effect on social welfare which takes place through the increase in environmental pollution.

3.3. Change in Q_R

We consider the case with $Q_U = 0$ and $Q_R > 0$. Equation (5) shows that the increase in Q_R raises W_R . However, r , remains unchanged. Equation (8) shows a rise in λ in this case and equation (9) shows that $\left(\frac{X_U}{L_I}\right)$ will rise in the new equilibrium. This implies a rise in β . When we look at the equations (10) and (11.1), we find that the change in Q_R affects X_U and X_R through the effects on β and λ . These comparative static effects are given by the following:

$$\left(\frac{dX_U}{dQ_R}\right) = -\left(\frac{a_{KR} \cdot B}{\Delta}\right);$$

and

$$\left(\frac{dX_R}{dQ_R}\right) = \left(\frac{a_{KU} \cdot B}{\Delta}\right).$$

Here

$$B = \left(\frac{a_{LU} \cdot X_U}{(\lambda\beta)^2}\right) \cdot \left(\frac{d(\lambda\beta)}{dQ_R}\right).$$

The increases in Q_R raises β and λ . Hence $\left(\frac{d(\lambda\beta)}{dQ_R}\right) > 0$. Hence $\left(\frac{dX_U}{dQ_R}\right) < 0$ and $\left(\frac{dX_R}{dQ_R}\right) > 0$ because $\Delta > 0$, by assumption. So the subsidization to the rural sector raises the level of output of the capital-intensive urban formal sector. Here the effective capital intensity in the urban sector, $\left(\frac{a_{KU} \cdot \lambda\beta}{a_{LU}}\right)$ is increased.

$\left(\frac{X_U}{L_I}\right)$ is increased in this case and X_U falls. Hence $L_I = \left(\frac{L_I}{X_U}\right) \cdot X_U$ falls. So the size of the informal sector is reduced and this reduces the level of environmental pollution.

The domestic factor income given by

$$Y^* = W_R \cdot L + r \cdot K_D$$

rises in this case because W_R rises and r remains the same. The national income is given by

$$Y = Y^* - Q_R \cdot X_R.$$

Here

$$\left(\frac{dY}{dQ_R}\right) = L \cdot \left(\frac{dW_R}{dQ_R}\right) - Q_R \cdot \left(\frac{dX_R}{dQ_R}\right) - X_R$$

and the social welfare maximizing rate of subsidy is given by

$$\left(\frac{\delta U}{\delta Y}\right) \left(\frac{dY}{dQ_R}\right) + \left(\frac{\delta U}{\delta L_I}\right) \left(\frac{dL_I}{dQ_R}\right) = 0$$

or,

$$Q_R^* = \frac{\left(L \cdot \left(\frac{dW_R}{dQ_R} \right) - X_R \right) \cdot \left(\frac{\delta U}{\delta Y} \right) + \left(\frac{\delta U}{\delta L_I} \right) \cdot \left(\frac{dL_I}{dQ_R} \right)}{\left(\frac{\delta U}{\delta Y} \right) \cdot \left(\frac{dX_R}{dQ_R} \right)}. \quad (17)$$

Here $Q_R^* > 0$ if X_R is very low. So it is optimal to subsidize the rural sector if its scale of operation is small.

So the policy of subsidization to the rural sector raises the level of employment (output) in the rural sector, R , and lowers the level of employment (output) in the urban formal sector, U , and in the informal sector, I . These results are not new in the literature. However, level of environmental pollution is reduced and the efficiency of the urban workers are improved. This leads to a decline of the number of urban formal sector workers at a higher rate than the rate of fall of that sector's output. In the standard literature with fixed coefficient production function employment and output always change at the same rate.

The optimum rate of subsidy to the rural sector is positive in this model when the level of production of the rural sector is small. A similar result is obtained in a standard Harris-Todaro model—a model which does not introduce environmental diseconomies. However, given a level of output in the rural sector, the introduction of environmental diseconomies in the labour efficiency and in the social welfare must argue for a higher rate of optimal subsidy to the rural sector than that obtained in a standard Harris-Todaro model. This is so because in a standard model the positive effects of the removal of pollution and of the improvement in labour efficiency in the urban sector do not appear.

4. CONCLUSION

We have developed a static four-sector model of a small open dual economy with special emphasis on the conflicting role of the development of the urban formal sector and of the informal sector on the environmental pollution which affects the efficiency of the labour negatively. This model is used to analyze the effects of the inflow of foreign capital and of subsidization to the various sectors on the structural change of the economy and on its social welfare as measured by national income at given prices. Foreign capital inflow lowers the social welfare even under free trade when the entire foreign capital income is repatriated. Subsidization to the urban formal sector must be welfare worsening if the share of domestic capital in total capital stock is very low. These results can not be obtained from the other models available in the existing literature because they do not consider this conflicting role of the formal and of the informal sector on the environmental pollution.

However, the present work is subject to a set of limitations. A static analysis is not appropriate in this context because the relationship between labour efficiency and the intensity of environmental pollution is not instantaneous. The negative effect exists but is observed only at some future date. Even if this problem is ignored, there remains some other limitations of the static model. The assumption of perfect mobility of capital

among all the sectors may be restrictive⁹. It is an empirically established fact that the formal sector receives capital from the formal capital market and the rural sector depends on the informal capital market.

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⁹ It is borrowed from Corden and Findlay (1975) and Chandra and Khan (1993).

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