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Economies of Scale and the Incidence of the Minimun Wage in the less Developed Countries

by

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ABSTRACT

The purpose of this paper is to extend the original Harris-Todaro model by allowing for increasing returns to scale, and to examine the effects of a change in the minimum wage in the urban sector on income distribution, and sectoral factor allocation. We consider first the case of a small open economy, and show that the effects of a change in the minimum wage on income distribution and factor allocation depend critically on the elasticity of demand for labour in the urban sector. With commodity prices being endogenously variable, we show that the above effects depend also on the price-elasticity of output supply in the urban sector, and the elasticity of substitution between commodities in consumption.

1. INTRODUCTION

In their celebrated paper, Harris and Todaro (1970) presented a simple general equilibrium model of a dual economy, in which the long-run equilibrium is characterized by unemployment in the urban sector. Since its publication, the model has been extended in several ways in the areas of development economics and international trade, and the relevant literature is already very large.[1]

One aspect of the model, however, to which economists have paid only scant attention, is the incidence of the minimum wage, which is set institutionally in the urban sector. In other words, although many aspects of the model have been analytically examined, the effects of setting or changing the minimum wage on factor incomes and factor allocations have been rather neglected. One noted exception to this literature is the work of Imam and Whalley (1985), who examined the incidence of the minimum wage in the Harris-Todaro (henceforth H-T) model and related their analysis to Harberger's analysis of tax incidence.[2] One basic feature of the Imam and Whalley analysis is that all factors of production are intersectorally mobile, in contrast to the original H-T model, where the only mobile factor is labour. A similar approach is taken by Panagariya and Succar (1986) with the additional assumption that there are economies of scale in manufacturing, and in addition to the incidence of the minimum wage, they examine the effects of changes in the terms of trade, and factor endowments. If we take into account the fact that not all factors of production are easily shiftable from one sector to the other, and that in some cases it may take a long time for a factor to move from one sector to the other, it seems reasonable to examine the case in which some factors of production are specific to some activities.[3] Moreover, we shall attempt to integrate into our analysis economies of scale in production, since as Panagariya and Succar (1986) have noted this aspect is particularly important for developing countries.

The purpose of this paper is to examine the effects of the minimum wage on income distribution, labour allocation and unemployment in the original H-T model with economies of scale in the manufacturing sector. More specifically, in the second section we present the basic features of our model and derive the basic relations for our analysis. In the third

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[1]. See for example, Bhagwati and Srinivasan (1974, 1975), Calvo (1975), Stiglitz (1974), Corden and Findlay (1975), Fields (1975), Neary (1981), etc.

[2].Neary (1981) also refers to some of the effects of the minimum wage in a factor-specific model by using mainly a diagrammatic analysis.

[3]. For the importance of factor specificity in economic theory, see Neary (1978).

section, we analyse the effects of a change in the minimum wage on income distribution, sectoral employment, and urban unemployment in the framework both, of a small open economy and with endogenous commodity-price changes. Finally, we summarise our main findings and draw some potential policy implications.

2. ECONOMIES OF SCALE AND THE HARRIS-TODARO MODEL

Following the two sector general equilibrium analysis, as proposed by Jones (1971), we shall consider an economy consisting of two sectors, the urban and the rural. The urban sector produces a manufacturing good X_M by utilising a specific factor, capital (K), and a mobile factor, labour (L_M). Moreover, in the production of this good there are economies of scale, which are external to the firms but internal to the industry, and the production function of a typical firm, k, in manufacturing can be written as follows:

$$X^k_M = g(X_M)F_M(K^k, L^k_M) \tag{1}$$

where X^k_M, K^k, and L^k_M denote the quantities of output, capital and labour, respectively, associated with firm k in the manufactures industry. The total industry output is denoted by X_M. Function F_M is assumed to be linearly homogeneous, with the standard properties of a neoclassical production function. Function g is assumed to be increasing with industry output, and captures the economies of scale. Finally, we define $\varepsilon = (g/X_M)(dX_M/dg)$, and assume that ε is positive, which implies that that there is a positive externality. We also assume that $0 < \varepsilon < 1$, which ensures that more inputs are required to produce more output.

The output of the manufacturing sector as a whole, can be derived by summing over all firms, so that:

$$X_M = g(X_M)F_M(K, L_M) \tag{2}$$

where K and L_M, denote the total quantity of capital and labour, respectively, employed in manufacturing.

In the rural sector, an agricultural output (X_A) is produced by using land (T) which is specific to agriculture, and labour (L_A), which is mobile between the urban and the rural sector.[1] Assuming constant returns to scale, we can write:

$$X_A = F_A(T, L_A) \tag{3}$$

With regard to labour markets, we assume that the total amount of labour is in fixed supply, and that the wage in the manufacturing industry (w_M) is set exogenously, while the

[1]. In this paper, we use the terms urban and manufacturing, and rural and agriculture interchangeably.

wage in agriculture is determined by market forces. Labour moves between the urban and the rural sector in such a way as to ensure that the **expected** wage in the former equals the wage in the latter. Following Harris and Todaro, we assume that the expected urban wage is equal to the exogenously set wage times the probability of finding employment in the urban sector. More formally, equilibrium in the labour market requires that:

$$w_M = w_A[L_M/(L_M + L_U)] \tag{4}$$

where L_U denotes unemployment in the urban sector, and the term $L_M/(L_M + L_U)$ is the probability of finding employment in the urban sector.

As regards the other factor markets, capital and land are specific to each industry, and their returns, r_M and r_A respectively, are set by the markets endogenously. Finally, with the total endowments of factors of production, K, T, and L, being in fixed supply, we have:

$$K = K \tag{5}$$

$$T = T \tag{6}$$

$$L_M + L_A + L_U = L \tag{7}$$

Assuming that perfect competition prevails in all markets, we have the following zero profit conditions:

$$a_{LM}w_M + a_{KM}r_M = p_M \tag{8}$$

$$a_{LA}w_A + a_{TA}r_A = p_A \tag{9}$$

where a_{ij} is the ratio of input i to the output of sector j, (i = K,T,L; j = M,A), and p_j is the price of the output of the jth sector.

Finally, we also have that:

$$a_{ij} = a_{ij}(w_j, r_j) \tag{10}$$

The above equations specify the production structure of our economy. On the demand side, we assume that all individuals have identical and homothetic preferences, and taking p_A, as the numeraire we have:

$$X_M/X_A = f(p_M/p_A) = f(p_M) \tag{11}$$

Equations (2)-(11) completely specify our model, and we can proceed to its presentation in terms of rates of change, so that we can proceed to our comparative statics analysis.

2.1. The Model in Terms of Rates of Change

In order to examine some comparative statics properties of the model, its presentation in terms of change makes the analysis easily tractable. Denoting the rate of change by an asterisk over the relevant variable (i.e. $x^* = dx/x$), we get from total differentiation of equations (2) and (3) the following:

$$(1-\varepsilon)X_M^* = \Theta_{LM}L_M^* + \Theta_{KM}K^* \tag{12}$$

$$X_A^* = \Theta_{LA}L_A^* + \Theta_{TA}T^* \tag{13}$$

where Θ_{ij} $(i=K,T,L;\ j=M,A)$ denotes the share of the ith factor in the value of the jth indusrty's output, and $\Theta_{LM}+\Theta_{KM}=\Theta_{LA}+\Theta_{TA}=1$.

Differentiating totally equations (4)-(11), and taking into account the fact that, due to the nature of the returns to scale, firms follow average cost pricing in manufactures, we obtain:

$$(1-\lambda_{LA})w_A^* = (1-\lambda_{LA})w_M^* + \lambda_{LU}(L_M^*-L_U^*) \tag{14}$$

$$\lambda_{LM}L_M^* + \lambda_{LA}L_A^* + \lambda_{LU}L_U^* = L^* = 0 \tag{15}$$

$$K^* = K^* = 0 \tag{16}$$

$$T^* = T^* = 0 \tag{17}$$

$$\Theta_{LM}w_M^* + \Theta_{KM}r_M^* = p_M^* + \varepsilon X_M^* \tag{18}$$

$$\Theta_{LA}w_A^* + \Theta_{TA}w_A^* = p_A^* = 0 \tag{19}$$

$$L_M^* - K^* = -\sigma_M(w_M^* - r_M^*) \tag{20}$$

$$L_A^* - T^* = -\sigma_A (w_A^* - r_A^*) \tag{21}$$

$$X_M^* - X_A^* = -\sigma_D (p_M^* - p_A^*) = -\sigma_D p_M^* \tag{22}$$

where λ_{ij} denotes the allocative share of factor i in sector j, e.g. $\lambda_{LA} = L_A/L$, σ_j is the elasticity of substitution between labour and the specific factor in industry j, and σ_D is the elasticity of substitution between commodities in consumption.

Before we proceed to our comparative statics exercises, it will be useful, for the rest of our analysis, to obtain the supply function of manufactures. Making use of equations (12) and (16)-(19), and with some appropriate substitutions and manipulations, we obtain:[1]

$$X_M^* = s_M (p_M^* - w_M^*) \tag{23}$$

where $s_M = [\Theta_{LM}\sigma_M / [(1-\varepsilon)\Theta_{KM} - \varepsilon\Theta_{LM}\sigma_M)]$. It is clear that s_M is the price elasticity of output supply, and it is plausible to assume that it is positive, which means that $(1-\varepsilon)\Theta_{KM} - \varepsilon\Theta_{LM}\sigma_M > 0$.[2] It can be also assumed that the urban sector is relatively capital intensive, although in the case of perfect factor mobility Neary (1981) has shown that stability requires that the urban sector should be capital abundant.

From the above relations it is clear that with fixed factor supplies, and p_A as numeraire which imply $L^* = K^* = T^* = p_A^* = 0$, we have nine equations [(12-15), and (18-22)] with nine unknown variables (X_M^*, X_A^*, L_M^*, L_A^*, L_U^*, w_A^*, r_M^*, r_A^*, p_M^*), and five exogenous variables (K, T, L, p_A, and w_M).

We can now proceed to the analysis of the effects of a change in the minimum wage on income distribution, sectoral employment, output, and urban unemployment.

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[1]. Making use of equations (16) and (20) we get $r_M^* = [(1-\varepsilon)X_M^* / \Theta_{LM}\sigma_M] + w_M^*$. Substituting the latter into equation (18) yields equation (23) of the text.

[2]. This is a condition which is also required for long-run stability in the case of intersectoral mobility of all factors of production, as Panagariya and Succar (1986) have shown. We assume that this also holds in our model which can be considered as the short-run version of the Panagariya-Succar model.

3. THE INCIDENCE OF THE MINIMUM WAGE

One of the most common assumptions in the theory of international trade is to assume that we deal with a small open economy, where commodity prices are exogenous. This assumption has been also followed in the analysis of the H-T model. In the following analysis, we shall consider first the case of a small open economy, and next the case with variable commodity prices.

3.1. Incidence in a Small Open Eonomy

The assumption of the small open economy implies that commodity prices chane exogenously, and therefore p_M^* is zero. From equations (12), (16), (18), and (20), we obtain that:

$$r_M^* = -Aw_M^* \tag{24}$$

where $A = [(1-\varepsilon)\Theta_{LM} + \varepsilon\Theta_{LM}\sigma_M]/[(1-\varepsilon)\Theta_{KM} - \varepsilon\Theta_{LM}\sigma_M]$, which is positive. It is clear from (24) that the return to capital in the manufacturing sector will fall as a result of the increase in the minimum wage. As regards the effect of the increase in the minimum wage on labour demand in manufactures, we can obtain from equations (20) and (24) that:

$$L_M^* = -e_M w_M^* \tag{25}$$

where $e_M = (1-\varepsilon)/[(1-\varepsilon)\Theta_{KM} - \varepsilon\Theta_{LM}\sigma_M]$ is the elasticity of demand for labour, and is positive. So the demand for labour in manufactures will fall, as is natural. The fall in demand for labour, however, releases workers who would normally move to the rural sector. But the increase in the minimum wage raises, ceteris paribus, the expected urban wage (see equation 14), and therefore, it is not clear that there will be out-migration to the rural sector.

Making use of equations (14), (15), (18)-(21), (24) and (25) we can find the change in the employment in the rural sector:[1]

$$L_A^* = (-1/B)(1-\lambda_{LA})e_A(1-e_M)w_M^* \tag{26}$$

[1]. For further details see Appendix.

where $e_A = \sigma_A/\Theta_{KA}$, is the elasticity of demand for labour in the rural sector, and $B = (1-\lambda_{LA}) + \lambda_{LA}e_A$. It is clear that the demand for labour in the rural sector may rise or fall depending on whether the elasticity of demand for labour in the urban sector is larger or less than one. But even if the demand for labour in the rural sector rises, i.e. $e_M > 1$, it does not imply that urban unemployment will fall, since the increase of demand for labour in agriculture may be less than the released labour from the urban sector. It is straightforward to show that:

$$\lambda_{LU}L_U^* = (1/B)[(1-\lambda_{LA})(\lambda_{LM}e_M + \lambda_{LA}e_A)-(\lambda_{LU}\lambda_{LA}e_Ae_M)]w_M^* \tag{27}$$

As equation (27) reveals, the change in urban unemployment does not depend only the elasticities of demand for labour in the urban and the rural sector but also on the initial level of urban unemployment. An intuitive explanation for these results may be the following: If e_M is greater than one the increase in the minimum wage will reduce employment in the urban sector by a larger proportion. This released labour could move to the rural sector, and employment there would rise. At the same time, however, the expected urban wage may rise, as a result of the increase in the minimum wage, and despite the decrease in the probability to find employment in the urban sector. Consequently there will be an extra incentive for rural workers to move to the urban sector and those fired by manufacturing to stay in the urban sector to look for a job there. Thus, urban unemployment rises. If, however, the level of urban unemployment is already high, the increase in the minimum wage may not by sufficient to compensate for the reduced probability to find employment in the urban sector, and the expected urban wage will fall. As a result there will be out-migration from the urban to the rural sector, and if this out-migration exceeds the reduced employment in manufactures, urban unemployment will fall.

With respect to the effects of the minimum wage on other factor prices we have:

$$w_A^* = (1/B)(1-\lambda_{LA})(1-e_M)w_M^* \tag{28}$$

$$r_A^* = (-1/B)(\Theta_{LA}/\Theta_{KA})(1-\lambda_{LA})(1-e_M)w_M^* \tag{29}$$

As expected, the wage rate in the rural sector will rise if e_M is less than one, which means that the employment in that sector falls, and given the fixed supply of land the marginal productivity of labour there will rise. At the same time, however, the marginal productivity of land, and its return, will fall. If, on the other hand, e_M is greater than one the above results will be reversed. In other words, the increase in the minimum wage may lead to an increase in the wage rate in the rural sector as well, and it is possible that the latter rises by more than the former. More formally

$$w_M^{\bullet}-w_A^{\bullet}=(1/B)\{-(1-\lambda_{LA})(1-e_M)+\lambda_{LU}[1-\lambda_{LA}(1-e_A)]\}w_M^{\bullet} \tag{30}$$

It is obvious that if $e_M<1$, e_A is very small, and λ_{LU} is also small, then the rural wage may rise by more than the urban wage. In other words, the exogenous increase in the urban wage might finally benefit by more those who remain working in agriculture. A similar relationship can be derived for $r_M^{\bullet}-r_A^{\bullet}$ and $X_M^{\bullet}-X_A^{\bullet}$.

Before ending this section it is worth noting that some of these results have been derived by Neary (1981) in a framework with constant returns to scale in manufacturing. Neary's approach, however, has been mostly diagrammatic and his main interest was the long-run stability properties of the H-T model. Our analysis has allowed for a more general and rigorous analysis of the incidence aspects of the minimum wage, and moreover our results differ quantitatively from those derived by Neary. In particular, the elasticity of demand for labour is assumed by Harris and Todaro to be less than one. In our model, the presence of returns to scale may change significantly the value of the elasticity of demand for labour in the urban sector. Under constant returns to scale this elasticity is equal to σ_M/Θ_{KM}, while in our model $e_M=(1-\varepsilon)\sigma_M/[(1-\varepsilon)\Theta_{KM}-\varepsilon\Theta_{LM}\sigma_M]$, which is greater than σ_M/Θ_{KM}. In order to see this more clearly, consider the following example. Suppose that $\sigma_M=.5$, $\Theta_{KM}=.6$, and $\varepsilon=.4$. Under constant returns to scale the elasticity of demand for labour in the urban sector will be equal to $.83<1$, while under increasing returns to scale this elasticity becomes $1.07>1$.

3.2. Variable Prices and the Incidence of the Minimum Wage

In the following analysis we shall relax the assumption of a small open economy and assume instead that commodity prices change endogenously under the influence of demand and supply conditions. Taking the price of the agricultural good as numeraire, the only price that changes is p_M. Solving simultaneously equations (12)-(22), we can obtain the relationships for commodity and factor price changes, urban and rural employment, and urban unemployment.

Let us consider first the effects of the change in the minimum wage on sectoral employment and urban unemployment, on the basis of following equations:

$$L_M^{\bullet}=(\sigma_M/\Delta)\{(1-\lambda_{LA}+\lambda_{LA}\sigma_A)E\sigma_D+(1-\lambda_{LA})\Theta_{LA}\sigma_A[\sigma_M+E(1-\sigma_M)]\}w_M^{\bullet} \tag{31}$$

$$L_A^* = (1/\Delta)(1-\lambda_{LA})\sigma_A[\sigma_D(1-e_M) + s_M]w_M^* \tag{32}$$

$$\lambda_{LU}L_U^* = (-1/\Delta)\{\lambda_{LM}\sigma_M[1-\lambda_{LA} + \lambda_{LA}\sigma_A]E\sigma_D + (1-\lambda_{LA})\sigma_A[\lambda_{LM}\sigma_M\Theta_{LA}(E-A\sigma_M) + \lambda_{LA}\sigma_D(1-e_M) + \lambda_{LA}s_M]\}w_M^* \tag{33}$$

where $\Delta = -\{[(1-\lambda_{LA}) + \lambda_{LA}\sigma_A](\sigma_D + s_M) + (1-\lambda_{LA})\Theta_{LA}\sigma_A\sigma_M\} < 0$, and $E = (1-\varepsilon)/[\Theta_{KM}(1-\varepsilon)-\varepsilon\Theta_{LM}\sigma_M] > 1$.

If $e_M < 1$, which implies that $\sigma_M < 1$, then we have from equations (31)-(33) that employment in the urban and rural sectors will fall and urban unemployment will rise. An intuitive explanation for this change may be the following: As the minimum wage rises the demand for labour, and therefore employment, in the urban sector will fall. The released labour will either move to the rural sector or stay in the urban sector as unemployed looking for employment there. The increase in the minimum wage, however, affects the expected urban wage in two ways: First it raises the urban wage, and secondly it reduces the probability of finding employment in the urban sector. With $e_M < 1$ the increase in the minimum wage outweights the decrease in the probability of employment in the urban sector, and, therefore, the expected urban wage rises.[1] As a result there is also migration from the rural to the urban sector, and rural employment falls (see also equation 32). The reduced employment in the urban and rural sector leads to an increase in the urban unemployment, as equation (33) also reveals. With the same reasoning we can analyse the case where $e_M > 1$, and the above results may be reversed. It is interesting to note that in this case,and under certain conditions concerning the value of s_M and σ_D, it is possible that even urban employment may rise and urban unemployment may fall, although this does not seem very likely.

As regards the change in factor and commodity prices we have the following relationships:

$$r_M^* = (1/\Delta)\{[(1-\lambda_{LA}) + \lambda_{LA}\sigma_A][\Theta_{LM}E + s_M(\varepsilon\sigma_D-1)] + E(1-\lambda_{LA})\Theta_{LA}\sigma_A(1-\sigma_M)\}w_M^* \tag{34}$$

$$r_A^* = (1/\Delta)(1-\lambda_{LA})\Theta_{LA}[\sigma_D(1-e_M) + s_M]w_M^* \tag{35}$$

$$w_A^* = -(1/\Delta)\Theta_{KA}(1-\lambda_{LA})[\sigma_D(1-e_M) + s_M]w_M^* \tag{36}$$

$$p_M^* = -(1/\Delta)[(1-\lambda_{LA} + \lambda_{LA}\sigma_A)s_M + (1-\lambda_{LA})\Theta_{LA}\sigma_A(1-e_M)]w_M^* \tag{37}$$

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[1]. More formally this can be seen by combining equations (14), (31)-(33), and the equations for change in the rural wage below.

It is clear that if $e_M < 1$, the wage rate in the rural sector will rise, since, as we explained earlier, employment in that sector will fall. Similarly the marginal productivity of land will fall, and consequently its return. With $e_M < 1$, the return to capital will fall, and the price of the manufactured good will rise. If on the other hand, $e_M > 1$, the preceding results may be reversed, depending also on the elasticity od substitution between commodities in consumption, the price-elasticity of supply of the manufactures, and the elasticity of substitution between labour and land.

Finally, it may be worth examining whether the increase in the minimum wage may benefit the rural workers by more than the urban workers as in the case of a small open economy. From (36) we can obtain that:

$$w_A^{\bullet} - w_M^{\bullet} = (1/\Delta)\{(1-\lambda_{LA})[(\Theta_{LA} + \Theta_{KA}e_M)\sigma_D + \Theta_{LA}\sigma_A\sigma_M] + \lambda_{LA}\sigma_A(\sigma_D + s_M)\}w_M^{\bullet} \qquad (38)$$

We can see from the above relationship that the wage rate in the urban sector will unambiguously rise in relation to the rural wage, while in the case of the small open economy the opposite result could not be excluded.

Comparing our results with those of Panagariya and Succar (1986), whose model can be considered as the long-run version of ours, we observe that they are quite different as expected. While in the Panagariya and Succar approach the relative factor intensities play a very important role in determining the effects of a change in the minimum wage, in our analysis the elasticities of factor substitution play a much more important role. Moreover, we have allowed for endogenous price variability, while Panagariya and Succar take commodity prices as exogenous. Our results, could also be compared with those derived by Imam and Whalley (1985), if we were to relax the assumption of increasing returns to scale. In that case, we also observe that our results differ significantly from theirs, something that is quite natural since the Imam-Whalley model assumes perfect mobility of all factors of production,like the Panagariya and Succar model, while our model is much closer to the original Harris-Todaro model.

4. CONCLUDING REMARKS

The Harris-Todaro model has been a valuable instrument in the hands of economists in order to analyse the effects of various trade and development policies on national welfare, income distriburion and factor allocation. One aspect of the model that has been little exploited, with very few notable exceptions, is that associated with the effects of the change in the minimum wage in the urban sector.

In the preceding analysis we attempted to examine the incidence and the factor allocation effects of a change in the minimum urban wage in the original Harris-Todaro model. By original we mean that the only factor that is freely mobile between activities is labour, while all other factors of production, capital in manufacturing, and land in agriculture, are not shiftable. Our model can be considered, therefore, as a short-run version of the Panagariya and Succar (1986) model, if we assume that in the longer run all factors of production could move from one activity to the other. Our analysis has shown that this approach can be very fruitful since the derived results are quite different, not only from those of Panagariya and Succar, but also from the analyses of Neary (1981) and Imam and Whalley (1985).

The main conclusions of our analysis could be summarised as follows. Under the assumption that the elasticity of demand for labour in the urban sector is less than one, we have that: First, the increase in the urban minimum wage will most likely increase urban unemployment. Secondly, employment in the urban sector (manufacturing) will most likely fall, and with capital been specific to that activity, manufacturing output will also fall. This is also accompanied by a fall in the employment in the agricultural sector. Third, in the case of a small open ecomomy, the return to capital will fall, the return to land will fall, and the rural wage will rise. In other words, the increase in the minimum wage benefits labour and harms landowners and capitalists. Fourth, with variable commodity prices, the above factor-price changes may be reversed depending also on the price-elasticity of supply of the manufactures, and the elasticity of substitution between commodities in consumption. Finally, it is worth noting that if the elasticity of demand for labour in the manufacturing sector is greater than one, all the above results may be reversed.

We hope that the preceding analysis has confirmed the view expressed by Neary (1981b), namely that "...the sector-specific model exhibits properties which are at least as interesting as those of the much better explored Heckscher-Ohlin model with intersectoral capital mobility.". Our approach is certainly an attempt in the direction suggested by Neary.

APPENDIX

In this appendix, we shall attempt to show how some of the basic relationships of our model are derived.

Differentiating totally equations (8) and (9) we obtain:

$$\Theta_{LM}w_M^* + \Theta_{KM}r_M^* = p_M^* - (\Theta_{LM}a_{LM}^* + \Theta_{KM}a_{KM}^*) \quad \text{(A1)}$$

$$\Theta_{LA}w_A^* + \Theta_{TA}r_A^* = p_A^* - (\Theta_{LA}a_{LA}^* + \Theta_{TA}a_{TA}^*) \quad \text{(A2)}$$

From equations (12) and (13), but also the assumption of cost minimization, we have:

$$\varepsilon X_M^* = -(\Theta_{LM}a_{LM}^* + \Theta_{KM}a_{KM}^*) \quad \text{(A3)}$$

$$0 = -(\Theta_{LA}a_{LA}^* + \Theta_{TA}a_{TA}^*) \quad \text{(A4)}$$

since $a_{LM}^* = L_M^* - X_M^*$, etc. From (A1)-(A4) , we obtain equations (18) and (19) of the text.

By substituting into (15) equations (21) and (25), we get:

$$-\lambda_{LM}e_M w_M^* - \lambda_{LA}\sigma_A(w_A^* - r_A^*) + \lambda_U L_U^* \quad \text{(A5)}$$

From (19) we have that

$$r_A^* = -(\Theta_{LA}/\Theta_{KA})w_A^* \quad \text{(A6)}$$

Combining (A5) and (A6) yields

$$\lambda_{LU}L_U^* - \lambda_{LA}e_A w_A^* = \lambda_{LM}e_M w_M^* \quad \text{(A7)}$$

where $e_A = \sigma_A/\Theta_{KA}$. Similarly from equations (14) and (15) we obtain:

$$\lambda_{LU}L_U^* + (1-\lambda_{LA})w_A^* = (1-\lambda_{LA}-\lambda_{LU}e_M)w_M^* \quad \text{(A8)}$$

Solving simultaneously (A7) and (A8), and making use of (A6), we obtain equations (27)-(29) of the text.

Subtracting (13) from (12), and making use of (22) and (A6) we obtain:

$$\Gamma r_M^* + \sigma_D p_M^* - \sigma_A r_A^* = \Gamma w_M^* \tag{A9}$$

where $\Gamma = \Theta_{LM}\sigma_M/(1-\varepsilon)$

From (14), (15) and (A6), we can get:

$$-(1-\lambda_{LA}+\lambda_{LA}\sigma_A)r_A^* - (1-\lambda_{LA})\Theta_{LA}\sigma_M r_M^* = (1-\lambda_{LA})\Theta_{LA}(1-\sigma_M)w_M^* \tag{A10}$$

Finally, substituting (16), (17), (20) and (12) into (18), we obtain after some manipulations:

$$r_M^* - Ep_M^* = -Aw_M^* \tag{A11}$$

Solving simultaneously equations (A9)-(A10), and taking into account (A6), we get equations (34)-(37) of the text. By substituting these values into equations (20), (21), and (15), we can obtain the relationships (31)-(33), which give the change in the allocation of labour between the rural and urban sectors, and the change in urban unemployment.

REFERENCES

Bhagwati, J.N. and Srinivasan, T.N. (1974), "On reanalysing the Harris-Todaro model", American Economic Review, 64, 502-508.

----------- (1975), "Alternative policy rankings in a large open economy with sector specific minimum wages", Journal of Economic Theory, 11, 365-371.

Calvo, G.A. (1978), "Urban unemployment and wages determination in LDCs: Trade unions in a Harris-Todaro model", International Economic Review, 19, 55-81.

Corden, W.M. and Findlay, R. (1975), "Urban unemployment, intersectoral capital mobility and development policy", Economica, 43, 59-78.

Fields, G.S. (1975), "Rural-urban migration, urban unemployment and underemployment and job search activity in LDC's", Journal of Development Economics, 2, 165-187.

Harris, J.R. and Todaro M. (1970), "Migration, unemployment and development: A two-sector analysis", American Economic Review, 60, 126-142.

Imam, H.M. and Whalley, J. (1985), "Incidence analysis of a sector-specific minimum wage in a two-sector Harris-Todaro model", Quarterly Journal of Economics, 100, 207-224.

Jones, R.W. (1971), "A three factor model in theory, trade and history", in Bhagwati et al. (eds), Trade, Balance of Payments and Growth: Essays in Honor of C.P.Kindleberger, Amsterdam, North-Holland.

Neary, J.P. (1978), "Short-run capital specificity and the pure theory of international trade", Economic Journal, 88, 488-510.

----------- (1981a), "On the Harris-Todaro model with inter-sectoral capital mobility", Economica, 48, 1-24.

------------ (1981b), "On the short-run effects of technological progress", Oxford Economic Papers, 33, 224-233.

Panagariya, A. and Succar, P. (1986), "The Harris-Todaro model and economies of scale", Southern Economic Journal, 52, 984-998.

Stiglitz, J.E. (1974), "Alternative theories of wage determination and unemployment in LDCs: The labor turnover model", Quarterly Journal of Economics, 88, 194-227.

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