Migration, Unemployment and Development: A Two-Sector Analysis

By JOHN R. HARRIS AND MICHAEL P. TODARO*

Throughout many less developed economies of the world, especially those of tropical Africa, a curious economic phenomenon is presently taking place. Despite the existence of positive marginal products in agriculture and significant levels of urban unemployment, rural-urban labor migration not only continues to exist, but indeed, appears to be accelerating. Conventional economic models with their singular dependence on the achievement of a full employment equilibrium through appropriate wage and price adjustments are hard put to provide rational behavioral explanations for these sizable and growing levels of urban unemployment in the absence of absolute labor redundancy in the economy as a whole. Moreover, this lack of an adequate analytical model to account for the unemployment phenomenon often leads to rather amorphous explanations such as the "bright lights" of the city acting as a magnet to lure peasants into urban areas.

In this paper we shall diverge from the usual full employment, flexible wage-price models of economic analysis by formulating a two-sector model of rural-urban migration which, among other things, recognizes the existence of a politically determined minimum urban wage at levels substantially higher than agricultural earnings.[1] We shall then consider the effect of this parametric urban wage on the rural individual's economic behavior when the assumption of no agricultural labor surplus is made, i.e., that the agricultural marginal product is always positive and inversely related to the size of the rural labor force.[2] The distinguishing feature of this model is that migration proceeds in response to urban-rural differences in *expected earnings* (defined below) with the urban employment rate acting as an equilibrating force on such migration.[3] We shall then use the overall model for the following purposes:

1) to demonstrate that given this po-

* The authors are assistant professor of economics, Massachusetts Institute of Technology and research fellow, Institute for Development Studies, University College, Nairobi, respectively. They would like to thank the Rockefeller Foundation for making possible their research on economic problems of East Africa. Peter Diamond, Richard Eckaus, Joseph Stiglitz, two anonymous referees, and the managing editor made valuable comments on a previous draft. The authors, of course, are responsible for remaining errors.

[1] For some empirical evidence on the magnitude of these real earnings differentials in less developed economies, see Reynolds, Berg, Henderson, and Ghai.

[2] We do not make the special assumption of an agricultural labor surplus for the following reasons: Most available empirical evidence to date tends to cast doubt on the labor surplus argument in the context of those economies of Southeast Asia and Latin America where such a surplus would be most likely to exist (see Kao, Anschel, and Eicher). Moreover, few if any economists would seriously argue that general labor surplus exists in tropical Africa, the area to which this paper is most directly related.

[3] For a dynamic model of labor migration in which urban unemployment rates and expected incomes play a pivotal role in the migration process, see Todaro. However, unlike the present model which attempts to view the migration process in context of aggregate and intersectoral welfare considerations, Todaro's model was strictly concerned with the formulation of a positive theory of urban unemployment in developing nations. As such, it did not specifically consider the welfare of the rural sector, nor was it concerned with the broader issues of economic policy considered in the present paper.

litically determined high minimum wage, the continued existence of rural-urban migration in spite of substantial overt urban unemployment represents an economically rational choice on the part of the individual migrant;

2) to show that economists' standard policy prescription of generating urban employment opportunities through the use of "shadow prices" implemented by means of wage subsidies or direct government hiring will *not* necessarily lead to a welfare improvement and may, in fact, exacerbate the problem of urban unemployment;

3) to evaluate the welfare implications of alternative policies associated with various back-to-the-land programs when it is recognized that the standard remedy suggested by economic theory—namely, full wage flexibility—is for all practical purposes politically infeasible. Special attention will be given here to the impact of migration cum unemployment on the welfare of the rural sector as a whole which gives rise to intersectoral compensation requirements; and, finally,

4) to argue that in the absence of wage flexibility, an optimal policy is, in fact, a "policy package" including *both* partial wage subsidies (or direct government employment) and measures to restrict free migration.

I. *The Basic Model*

The basic model which we shall employ can be described as a two-sector internal trade model with unemployment. The two sectors are the permanent urban and the rural. For analytical purposes we shall distinguish between sectors from the point of view of production and income. The urban sector specializes in the production of a manufactured good, part of which is exported to the rural sector in exchange for agricultural goods. The rural sector has a choice of either using all available labor to produce a single agricultural good, some of which is exported to the urban sector, *or* using only part of its labor to produce this good while *exporting* the remaining labor to the urban sector in return for wages paid in the form of the manufactured good. We are thus assuming that the typical migrant retains his ties to the rural sector and, therefore, the income that he earns as an urban worker will be considered, from the standpoint of sectoral welfare, as accruing to the rural sector.[4] However, this assumption is not at all necessary for our demonstration of the rationality of migration in the face of significant urban unemployment.

The crucial assumption to be made in our model is that rural-urban migration will continue so long as the *expected* urban real income at the margin exceeds real agricultural product—i.e., prospective rural migrants behave as maximizers of *expected* utility. For analytical purposes, we shall assume that the total urban labor force consists of a permanent urban proletariat without ties to the rural sector plus the available supply of rural migrants. From this combined pool or urban labor, we assume that a periodic *random job selection process* exists whenever the number of available jobs is exceeded by the number of job seekers.[5] Consequently, the expected

[4] In tropical Africa especially, this notion that migrants retain their ties to the rural sector is quite common and manifested by the phenomenon of the extended family system and the flow of remittances to rural relatives of large proportions of urban earnings. However, the reverse flow, i.e., rural-urban monetary transfers is also quite common in cases where the migrant is temporarily unemployed and, therefore, must be supported by rural relatives. For an excellent discussion of this phenomenon from a sociological point of view, see Gugler (pp. 475–78).

[5] The qualitative conclusions of the model do not depend on the precise nature of the selection process. We have assumed random selection not merely for analytic convenience but also because it directly corresponds to an appropriate dynamic construct developed in Todaro's 1969 article. There it is shown that over time expected and actual earnings will converge to a positive number even though the rate of job creation is less than the rate of migration so that unemployment is increasing.

urban wage will be defined as equal to the fixed minimum wage (expressed in terms of manufactured goods) times the proportion of the urban labor force actually employed (see equation (6)). Finally, we assume perfectly competitive behavior on the part of producers in both sectors with the further simplifying assumption that the price of the agricultural good (defined in terms of manufactured goods) is determined directly by the relative quantities of the two goods produced.

Consider now the following formulation of the model.

Agricultural Production Function:

$$(1)\quad X_A = q(N_A, \bar{L}, \bar{K}_A), \qquad q' > 0, \quad q'' < 0$$

where,

X_A is output of the agricultural good,
N_A is the rural labor used to produce this output,
$\bar{L}$ is the fixed availability of land,
$\bar{K}_A$ is the fixed capital stock,
q' is the derivative of q with respect of N_A, its only variable factor.

Manufacturing Production Function:

$$(2)\quad X_M = f(N_M, \bar{K}_M), \qquad f' > 0, \quad f'' < 0$$

where

X_M is the output of the manufactured good,
N_M is the total labor (urban and rural migrant) required to produce this output.
$\bar{K}_M$ is fixed capital stock, and
f' is the derivative of f with respect to N_M, its only variable factor.

Price Determination:

$$(3)\quad P = \rho\left(\frac{X_M}{X_A}\right), \qquad \rho' > 0$$

where

P, the price of the agricultural good in terms of the manufactured good, (i.e., the terms of trade) is a function of the relative outputs of agricultural and manufactured good when the latter serves as numeraire.[6]

Agricultural Real Wage Determination:

$$(4)\quad W_A = P \cdot q'$$

where

W_A, the agricultural real wage, is equal to the value of labor's marginal product in agriculture expressed in terms of the manufactured good.

Manufacturing Real Wage:

$$(5)\quad W_M = f' \geqq \bar{W}_M.$$

The real wage in manufacturing, expressed in terms of manufactured goods, is equated with the marginal product of labor in manufacturing because of profit maximization on the part of perfectly competitive producers. However, this wage is constrained to be greater than or equal to the fixed minimum urban wage. In our analysis, we shall be dealing only with cases in which $f' = \bar{W}_M$ (i.e., there is never an excess demand for labor at the minimum wage).

Urban Expected Wage:

$$(6)\quad W_u^e = \frac{\bar{W}_M N_M}{N_u}, \qquad \frac{N_M}{N_u} \leq 1,$$

It is interesting to note in this context that sociologist Gugler who has spent considerable time studying labor migration in Africa has recently concluded that rural-urban migration is essentially an economic phenomenon that can be portrayed as a "game of lottery" in which rural migrants come to the city fully aware that their chances of finding a job are low. However, the great disparity between urban and rural wages makes the successful location of an urban salaried job so attractive that unskilled migrants are willing to take a chance (pp. 472–73). See also Hutton.

[6] A sufficient, but not necessary, condition for this assumption is that all individuals in the economy have the same homothetic preference map. Again, the assumption is made for analytical convenience. The qualitative conclusions of our analysis will remain unaffected under several plausible assumptions about distribution of income and tastes.

where the *expected* real wage in the urban sector, W_u^e, is equal to the real minimum wage $\overline{W}_M$ adjusted for the proportion of the total urban labor force (permanent urban plus migrants, denoted as N_u) actually employed, N_M/N_u.[7] Only in the case of full employment in the urban sector ($N_M=N_u$) is the expected wage equal to the minimum wage (i.e., $W_u^e=\overline{W}_M$).

Labor Endowment:

$$(7) \qquad N_A + N_u = \overline{N}_R + \overline{N}_u = \overline{N}$$

There is a *labor constraint* which states that the sum of workers actually employed in the agricultural sector (N_A) plus the total urban labor force (N_u) must equal the sum of initial endowments of rural ($\overline{N}_R$) and permanent urban ($\overline{N}_u$) labor which in turn equals the total labor endowment ($\overline{N}$).

Equilibrium Condition:

$$(8) \qquad W_A = W_u^e$$

Equation (8), an equilibrium condition, is derived from the hypothesis that migration to the urban area is a positive function of the urban-rural *expected* wage differential. This can be written formally as

$$(9) \qquad \dot{N}_u = \psi\left(\frac{\overline{W}_M N_M}{N_u} - P\cdot q'\right), \qquad \psi' > 0, \quad \psi(0) = 0$$

where $\dot{N}_u$ is a time derivative. Clearly then, migration will cease only when the expected income differential is zero, the condition posited in (8).[8] It is important to note that this assumes that a migrant gives up only his marginal product.[9]

We thus have 8 equations in 8 unknowns X_A, X_M, N_A, N_M, W_A, W_u^e, N_u and P. Given the production functions and fixed minimum wage $\overline{W}_M$, it is possible to solve for sectoral employment, the equilibrium unemployment rate and, consequently, the equilibrium expected wage, relative output levels and terms of trade. Let us analyze how such an unemployment equilibrium can come about.

The essence of our argument is that in many developing nations the existence of an institutionally determined urban minimum wage at levels substantially higher than that which the free market would allow can, and usually does, lead to an equilibrium with considerable urban unemployment. In our model migration is a disequilibrium phenomenon. In equilibrium $\overline{W}_M N_M/N_u=Pq'$ and migration ceases. (See Appendix I for proof that this equilibrium is stable.) Now we know from equation (5) that in the competitive urban manufacturing sector, $\overline{W}_M=f'$. We also know from equation (7) that $\overline{N}-N_A=N_u$ and from equation (3) that $P=\rho(X_M/$

[7] This assumes a very particular form of wage expectation, namely that the expected wage is equal to the average urban wage. Although this is a convenient expression to work with, we could be more general and make the expected wage some function of the average urban wage. Indeed, the only restrictions on such a function that are necessary for our results are that, *ceteris paribus*, the expected wage varies directly with the minimum wage and inversely with the unemployment rate.

[8] $\psi(0)=0$ is purely arbitrary. If, instead, we assume $\psi(\alpha)=0$ where α can take on any value, migration will cease when the urban-rural expected wage differential is equal to α. None of the subsequent analysis is affected qualitatively by specifying $\alpha=0$. Equation (8) would merely be written as $W_A+\alpha=W_u^e$.

[9] Other assumptions could be made. Much of the literature has stressed that in peasant economies producers receive their average product which is higher than their marginal product. Indeed, this is at the heart of the well-known Lewis and Fei-Ranis models. However, these models ignore the migration decision and seem to assume that migrants continue to receive their share of peasant production yet migrate only if jobs are actually available. In much of Africa it appears that migrants continue to receive income from land after migration and commonly hire labor to work on their farms in their absence. There is also a considerable group of landless individuals who work on farms for wages. Thus it would appear that our assumption is not unreasonable. The analysis could easily be modified to make earnings foregone equal to average product, however.

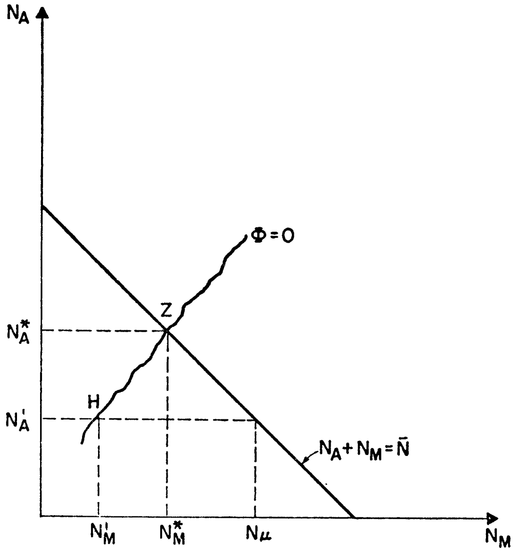

FIG 1.

X_A). Therefore, we can rewrite our equilibrium condition (8) as

$$(8') \quad \Phi = \rho(X_M/X_A)q' - \frac{f'N_M}{\bar{N} - N_A} = 0.$$

Since X_M and X_A are functions of N_M and N_A respectively, Φ is an implicit function in N_A and N_M which, for any stated minimum wage, can be solved for the equilibrium combination of agricultural and manufacturing employment. From this solution the levels of urban unemployment and commodity outputs can also be determined. There will be a unique equilibrium associated with each possible value of the minimum wage, and the locus of these equilibria is plotted in Figure 1 as the line $\Phi=0$ in N_A, N_M space.[10] The line $N_A + N_M = \bar{N}$ in Figure 1 is the locus of full-employment points.

Point Z is the only equilibrium full-employment point in Figure 1 at which N_M^* workers would be employed in manufacturing and N_A^* in agriculture. Points on the locus $\Phi=0$ east of Z are infeasible and will not be considered further, while points to the west of Z are associated with min-

[10] In Figure 1 we have assumed that

$$\frac{dN_A}{dN_M} = -\left[\Phi_{N_M}/\Phi_{N_A}\right] > 0$$

although this need not necessarily hold true. Differentiating (8′) partially with respect to N_A we find that

$$\Phi_{N_A} = \frac{-\rho' f q'^2}{q^2} + \rho q'' - \frac{\rho q'}{\bar{N} - N_A}$$

which is unambiguously negative since $q''<0$ and $\rho'>0$. Differentiating (8′) partially with respect to N_M we find that

$$\Phi_{N_M} = \frac{1}{\eta_{LW}} - \eta_P \frac{f'N_M}{X_M} + 1$$

which is less than, equal to, or greater than zero as

$$-\frac{1}{\eta_{LW}} + \eta_P \frac{f'N_M}{X_M} \gtreqless 1,$$

where

$$\eta_{LW} = -\frac{dN_M}{d\bar{W}_u} \cdot \frac{\bar{W}_u}{N_M}$$

is the wage elasticity of demand for labor and

$$\eta_P = \frac{dP}{d\left(\dfrac{X_M}{X_A}\right)} \cdot \frac{X_M/X_A}{P}$$

is the elasticity of the terms of trade with respect to a change in relative outputs. It follows, therefore that the slope of the locus of equilibria, dN_A/dN_M depends on the respective employment and price elasticities.

A sufficient condition for Φ_{N_M} to be negative (making dN_A/dN_M positive) is for the wage elasticity of employment to be less than one, a situation which recent empirical studies suggest is likely to exist (see Erickson, Harris and Todaro (1969), and Katz). However, even if η_{LW} exceeds unity, dN_A/dN_M can still be positive providing price elasticity is sufficiently high. The logic of these conditions is clear. If η_{LW} is less than one, a decline in the minimum wage will lower the urban wage bill even though employment and output increase. This causes the expected urban wage to decline thereby reducing the expected rural-urban earnings differential which gives rise to reverse migration and increased rural employment and output. If η_{LW} exceeds unity, a fall in the minimum wage is accompanied by an increased urban wage bill and, hence, a higher expected urban wage. However, the expected rural-urban earnings differential can either increase or decrease in this case depending on the movement in terms of trade which raises the value of the marginal product in agriculture. For example, if η_{LW} were 1.5 and the wage share of manufacturing output ($f'N_M/X_M$) were .50, then an agricultural price elasticity greater than 0.67 would be sufficient to make dN_A/dN_M positive.

imum wages higher than the full-employment wage. There is a monotonic mapping such that higher minimum wages are associated with points on $\Phi=0$ lying farther to the west. Thus we can demonstrate that the setting of a minimum wage above the market-clearing level causes an economy to settle at a point such as H in Figure 1. At H, N'_A workers are employed in agriculture, N'_M in manufacturing, and $N_u - N'_M$ workers are unemployed. It is evident that the minimum wage causes a loss of employment and hence output in both sectors.[11]

It is important to note that even though an equilibrium at point H represents a suboptimum situation for the economy as a whole, it does represent a rational, utility maximizing choice for individual rural migrants given the level of the minimum wage.

One final point might be raised at this juncture. So far we have assumed that the urban minimum wage is fixed in terms of the manufactured good. What if, instead, the minimum wage were fixed in terms of the agricultural good? We would then substitute for equation (5):

$$W_M = \frac{f'}{P} \geqq \overline{W}_M. \tag{5'}$$

Substituting (4), (5′), and (6) into (8) we get the equilibrium relationship

$$Pq' = \frac{\left(\dfrac{f'}{P}\right) \cdot N_M}{N_u}. \tag{11}$$

[11] If $dN_A/dN_M < 0$, which we believe to be empirically unlikely, this statement would have to be modified. In such a case, increasing the minimum wage will decrease manufacturing employment but will increase agricultural employment and output. Unemployment will result from the imposition of a minimum wage but we can no longer assert that the level of unemployment will increase concomitantly with the level of the minimum wage.

We can then imagine an economy starting initially at the point on the production possibilities frontier at which X_M is that for which equation (5′) is satisfied and assume that

$$Pq' < \frac{\left(\dfrac{\bar{f}'}{P}\right) \cdot N_M}{N_u}$$

at that point. The equilibrium point will again be reached through a simultaneous raising of Pq' and lowering of W_u^e in response to migration. As relative agricultural output falls, P will rise. This in turn will cause output of the manufactured good to fall as well, since producers will produce up to the point that $f' = \overline{W}_M P$ which rises in terms of the manufactured good. Note that f' can be raised only through output restriction (since $f'' < 0$). Therefore, in general, we would find that imposition of a minimum wage gives rise to an equilibrium characterized by unemployment and loss of potential output of both goods. A new locus $\Phi' = 0$ will be defined in Figure 1 such that the point on Φ' corresponding to any given minimum wage will be west of the corresponding point on Φ.

Although our initial assumption is a bit easier to handle, the principal conclusion remains unaffected if we make the minimum wage fixed in terms of the agricultural good. Equilibrium is only achievable with unemployment. Actual minimum wage setting is usually done with reference to some general cost of living index, and food is the largest single item in the budget of most urban workers. (See Massell and Heyer, and the Nigeria report.) Hence, the second case may be somewhat more realistic. Note that in the first case the "true" real wage was reduced somewhat by the rising agricultural price, while in the latter case it is increased by the falling relative price of the manufactured good.

III. *Implications for Development Policy*

A. *Planning in Terms of Shadow Prices*

The standard solution to the problem of an institutionally determined wage that is higher than the equilibrium level is to employ labor in the public sector according to a shadow wage and/or to grant a payroll subsidy to private employers that equates private costs with this shadow wage.[12] Two main problems arise with this prescription: first, how can one determine the appropriate shadow wage? and, secondly, what are the implications of executing such a scheme when the institutional wage will continue to be paid to the employed? Our model can shed light on both of these issues.

In a static framework the appropriate shadow wage is the opportunity cost of labor hired by the industrial sector. Hence, if labor is hired to the point that its marginal product in industry is equated with the shadow wage which in turn is equated with the marginal product in agriculture, marginal productivity of labor will be equal in both sectors, a necessary condition for an optimal allocation of resources. Naturally, this assumes a positive marginal product in agriculture and sufficient factor mobility to ensure full employment of labor. The existence of urban unemployment, however, suggests that there may be a pool of labor that can be tapped without sacrificing output. Consequently, it might be suggested that even though agricultural labor is fully employed at peak seasons, the appropriate shadow wage for urban labor is likely to be one that is lower than the marginal product in agriculture. This would be correct if the two labor forces, urban and rural, were separate noncompeting groups. In linear programming terms, there are two labor constraints and each may well have a different associated shadow wage.

Now, the essence of our model is that the two sectors *are* intimately connected through labor migration. If one additional job is created in the industrial sector at the minimum wage, the expected wage will rise and rural-urban migration will be induced. In Appendix II it is shown that more than one agricultural worker will likely migrate in response to the creation of one additional industrial job. Hence, the opportunity cost of an industrial worker will exceed the marginal product of an agricultural worker. On the other hand, an increase in agricultural income will induce reverse migration with no diminution of industrial output. Thus, the opportunity cost of labor is lower to the agricultural than to the industrial sector!

The literature has been strangely silent for the most part about the full implications of using shadow-wage criteria. In a static context, Stolper has pointed out that financing subsidies or losses of public enterprises gives rise to fiscal problems, but unfortunately this issue has not yet been pursued in sufficient detail.[13] If the problem is considered at all, the analyst usually assumes that a system of nondistorting lump-sum taxes is available. Little, Lefeber, and

[12] Hagen (p. 498) states, "a subsidy per unit of labor equal to the wage differential [between agriculture and industry] will increase real income further [than a tariff] and if combined with free trade will permit attaining an *optimum optimorum*." Bardhan (p. 379) similarly adds. "The best remedy for the misallocation caused by a wage differential is . . . an appropriate subsidy to the use of labor in the manufacturing industry." It is important to recall that this argument is dependent on variable proportions production functions. If production coefficients are fixed, a wage subsidy will have no effect in the short run. The classic statement of this case is by Eckaus. Bardhan explores its implications for subsidy in a dynamic context. Both of these papers, however, posit surplus labor in agriculture, an assumption we do not wish to make in an African context.

[13] Lefeber assumes that a wage subsidy can be financed by a profits tax, while other writers, e.g. Hagen, Bardhan, and Chakravarty never even consider the problem. Even Little and Mirrlees who present an excellent discussion of how to calculate a shadow wage never mention the fiscal problems of implementation.

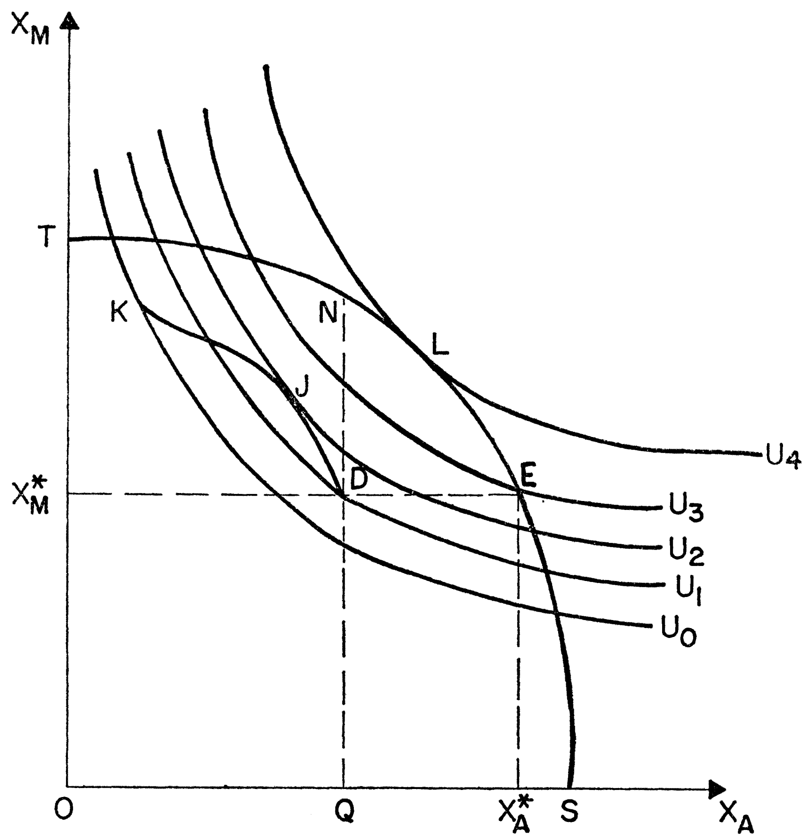

FIGURE 2

Little and Mirrlees have pointed out that in a dynamic setting, the extra consumption arising from payment of the institutional wage diverts resources from investment to consumption; thus some of the foregone future consumption should be considered in calculating the shadow wage. In our model, payment of the minimum wage to additional industrial workers will induce more rural-urban migration. Therefore, implementation of a shadow-wage employment criterion will have important effects on the level of agricultural output and on urban unemployment. The argument can be clarified with reference to Figure 2.

The initial equilibrium, given the minimum wage, is at point D with output of the manufactured good restricted to OX_M^*. If individuals did not migrate in response to expected wage differentials, the economy could product at point E, but migration reduces agricultural output to the level OQ. The theory of shadow pricing suggests that with an appropriate wage subsidy (or public-sector-hiring rule) the economy could move to point L on the production possibilities frontier which, with the posited social indifference map, is the optimum position. Welfare would be increased from a level U_1 to a higher level U_4.

In the context of our model, such a point is unattainable. The effect of implementing a shadow wage will be to increase production of the manufactured good. But creation of an additional job at the minimum wage will induce some additional migration (see Appendix II) from the rural sector and therefore agricultural output will fall. Hence, movement from D can only be in a northwest direction. The line DK in Figure 2 is the locus of all such attainable points and it is evident that there is only one point, K, at which there can be full employment of the economy's labor resources. At that point the expected wage will be equal to the minimum wage since there is no urban unemployment. Therefore, the marginal product in agriculture will have to be equal to the minimum wage. But, with the subsidy, the marginal product of labor in manufacturing will be lower than in agriculture, hence K lies inside the production possibilities frontier. (In the extreme case in which marginal productivity in agriculture can never be as high as the minimum wage, K will coincide with T, the point of complete specialization in manufactures.) This situation will certainly not meet the conditions for a general optimum which can be met only at L. Thus, implementing a shadow wage criterion to the point that urban unemployment is eliminated will not generally be a desirable policy.[14]

However, some level of wage subsidy will usually lead to an improvement. In Figure 2 it is clear that point J, with a welfare level U_2, will be preferable to D. The criterion for welfare maximization, derived in Appendix III, is the following:

$$f' = Pq'\left(\frac{dN_u}{dN_M}\right). \tag{12}$$

Note what this means. Creating one additional job in the industrial sector increases output by f' but, since increased employment will raise the expected urban wage, migration will be induced in an amount dN_u/dN_M. The right-hand side of equation (12) states the amount of agricultural output sacrificed because of migration. Thus the shadow wage will be equal to this opportunity cost of an urban job and the amount of subsidy will be $\overline{W}_M - f'$. So long as $f' > Pq'\ (dN_u/dN_M)$, aggregate welfare can be increased by expanding industrial employment through subsidy or public sector hiring. Clearly the more responsive is migration to industrial employment, the higher is the social cost of industrialization and the smaller is the optimal amount of subsidy. In many African economies it is likely that dN_u/dN_M exceeds unity. If so, it will be optimal for the marginal product of labor in industry to be higher than in agriculture and urban unemployment will be a persistent phenomenon so long as minimum wages are set above a market-clearing level.

The discussion so far has ignored two other adverse effects of using a shadow wage. As mentioned earlier, several writers have noted that payment of a subsidized minimum wage to additional workers will increase total consumption, thereby reducing the level of resources available for investment. If foregone future consumption is positively valued, the opportunity cost of industrial labor will be higher than indicated in equation (12) and the shadow wage will be raised correspondingly. Furtermore, wage subsidies or public enterprise losses must be financed and if revenue cannot be raised through costless lump-sum taxes, the opportunity cost of raising taxes must be considered. Both of these effects will reduce the desirable amount of subsidized job creation in the industrial sector.

It is interesting to note that this model implies different opportunity costs of labor to the two sectors. While the creation of an additional job in the urban area reduces

[14] As shown in Appendix III, DK is not uniformly convex. Therefore, K may be the best attainable point in some cases and the first-order conditions may not ensure optimality. As drawn in Figure 2, moving from D to K represents a worsening of welfare, but this clearly is not a necessary conclusion.

agricultural output through induced migration, additional employment can be generated in the agricultural sector without reducing manufacturing output. If this phenomenon is not taken into account, standard application of investment criteria is likely to be biassed in favor of urban projects.

B. *Migration Restriction*

An alternative approach to the problem of urban unemployment is to physically control migration from the rural areas. Such controls have recently been introduced in Tanzania and have been used for some time in South Africa.[15] Other countries, such as Kenya, are giving serious consideration to instituting such a policy. Although we personally have grave reservations about the ethical issues involved in such a restriction of individual choice and the complexity and arbitrariness of administration, it seems desirable to investigate the economic implications of such a policy.

Looking at Figure 2 it is obvious that with the minimum wage such that industrial output is OX_M^*, prohibition of migration in excess of the labor required to produce that output will allow the economy to produce at point E. The movement from D to E arising from restriction of migration leads to an unambiguous aggregate welfare improvement providing appropriate lump-sum redistribution is effected. Since such compensation is notoriously difficult to carry out in practice, it will be useful to examine the welfare implications of such a move on each of the two sectors in the absence of compensation.

Recall that the two sectors were defined to be a permanent urban group and a rural sector that produces both agricultural goods and exports labor to the urban area in exchange for wages in the form of manufactured goods.[16] In Figure 3 the line $T'S'$ represents production possibilities for the agricultural sector when labor export is allowed. If its entire labor endowment is devoted to agricultural production, it can produce a quantity OS'. However, by exporting its labor, the agricultural sector can "produce" the manufactured good (wages are paid in the form of this good). Hence this production possibilities frontier depends on market forces (wage levels and unemployment) as well as on purely technological factors. The amount of agricultural output foregone if a unit of labor is to be "exported" is its marginal product; the amount of manufactured goods obtained by the exported labor unit depends on the wage, the amount of employment obtained by the exported unit, and its effect on employment of previously exported units.

In addition to these production possibilities, the rural sector also has the opportunity to trade some of its agricultural output with the permanent urban sector in exchange for manufactured goods. Corresponding to each point on the production possibilities frontier $T'S'$, there is a determinate price of the agricultural good. The manner in which alternative constellations of production and trade affect the

[15] See Harris and Todaro (1969) for an analysis of the Tanzanian program.

[16] In considering the welfare of the rural sector as a whole we are making the tacit assumption that there is redistribution of goods between individuals in this sector. This is a very strong assumption. Yet there is considerable evidence from tropical Africa that employed urban migrants repatriate substantial portions of their earnings to their kinsmen remaining in the rural areas and conversely that income both in cash and kind is received by unemployed migrants from kinsmen remaining on the farm. To the extent that the extended family system does redistribute goods between members, this assumption may be tenable as a first approximation. As Gugler (p. 480) has pointed out, it is appropriate to view the extended family as maximizing its income by allocating its members between agriculture and urban wage employment. Although there is some evidence that growing numbers of urban workers are settling permanently and gradually eliminating rural ties, it will be many years before such ties are completely severed.

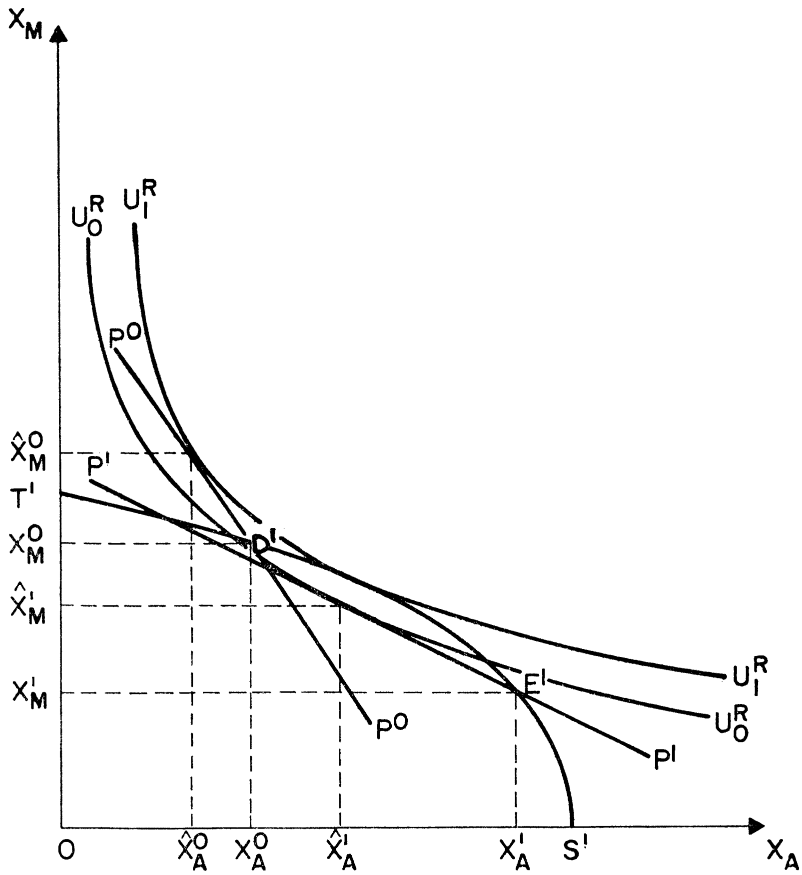

FIGURE 3

sector's welfare can be illustrated by Figure 3.

D' corresponds to the initial unemployment equilibrium D (Figure 2). At that point the rural sector as a whole "produces" $X_A{}^0$ and $X_M{}^0$ of the two goods. It also has the opportunity to trade at the price P^0. By trading some of its agricultural output to the permanent urban sector for additional manufactured goods, it consumes $\hat{X}_A{}^0$, $\hat{X}_M{}^0$ and achieves a welfare level of U_1^R. Restriction of migration results in the sector's producing $X_A' \; X_M'$. If it could still trade at price P^0, the agricultural sector would clearly be better off. But this is impossible. At E' (which corresponds to E in Figure 2), the price of agricultural good will fall to P' and with trade the best consumption bundle attainable by the sector is $\hat{X}_A$, $\hat{X}_M$ which corresponds to a lower level of welfare U_0^R. (Note that if P' did not cut $T'S'$ there could be no incentive to migrate at E'.)

It can be shown that $Pq'(1-1/\eta)$ (where η is the price elasticity of demand for the agricultural good) is the amount of the manufactured good sacrificed by the rural sector as a result of removing one worker from producing the agricultural good which could have been exchanged for the manufactured good at the market price $1/P$. This quantity is less than the value of labor's marginal product in agriculture (Pq') since the reduction in output has a favorable terms-of-trade effect. If the demand for the agriculture good is inelastic ($\eta<1$) we reach the startling conclusion that the sacrifice becomes negative! This is, of course, the familiar proposition that aggregate farm income may be increased by reducing output. The *direct* gain in manufactured goods achieved by the rural sector through exporting an additional unit of labor is $\overline{W}_M N_M/N_u$, the expected urban wage. But additional migration, by increasing unemployment, reduces the earnings of *all* migrants already in the urban labor force by a factor $(1-R)$, where R is the fraction of the total urban labor force supplied by the rural sector.[17]

As long as $Pq'\ (1-\eta)<\overline{W}_M N_M/N_u\,(1-R)$ the welfare of the rural sector will be increased by allowing migration even though unemployment ensues and the economy as a whole sacrifices output. Since Pq' and $\overline{W}_M N_M/N_u$ are always positive and $R\leq 1$, additional migration will always benefit the rural sector when $\eta<1$. In general, the lower is Pq', η, or R and the higher is $\overline{W}_M N_M/N_u$, the more will the rural sector benefit from the opportunity to migrate.

From the foregoing, one can conclude that although migration restriction will improve aggregate welfare of the economy, given plausible values of η and R, substantial compensation to the rural sector will be required if it is not to be made worse off by removing the opportunity for free migration. The permanent urban labor force clearly will be made better off by becoming fully employed at the high minimum wage while also being able to buy food at a lower price. Each unit of labor exported by the rural sector will similarly earn more but this gain will be offset by reduced total labor exports and lower agricultural prices. Whether or not this will be true depends, of course, on the values of the specific parameters of the economy. If η is sufficiently high, the rural sector could be made better off by restricting migration in the absence of compensation, but this seems very unlikely.

C. *A Combination of Policies*

It has been shown that either a limited wage-subsidy or a migration-restriction policy will lead to a welfare improvement. Which of the two policies will lead to the better position cannot be determined without knowing all the relevant parameters for a particular economy. It is clear, however, that neither policy alone is capable of moving the economy to the optimum that could be achieved with competitive wage determination (point L in Figure 2).

At first sight it may seem strange that with a single market failure, the wage level, a single policy instrument is unable to fully correct the situation.[18] The reason is that the wage performs two functions in this model. It determines *both* the level of employment in the industrial sector *and* the allocation of labor between rural and urban areas. While a subsidy changes the effective wage for determination of industrial employment, so long as the wage actually received by workers exceeds agricultural earnings there will be migration and urban unemployment. Restriction of migration prevents the minimum wage having its effect on unemployment but does nothing to increase the level of industrial employment. Therefore, if the optimum position is to be achieved, a combination of both instruments will have to

[17] If the urban unemployment were experienced only by migrants, this term would equal zero since the total amount of earnings through labor export would be constant. It can be positive only because the permanent urban labor force shares in unemployment, thereby reducing its share of the constant wage bill in the manufactured good industry. An interesting extension of the model would be to incorporate different employment probabilities for the permanent urban and migrant rural labor forces and then to check the sensitivity of results with our more simplified assumption of equal probabilities.

[18] We wish to thank a referee of this *Review* for drawing this to our attention.

be used. In order to reach point L a wage subsidy must be instituted such that industrial employment will increase to the extent that with full employment the marginal product of labor will be equal in manufacturing and agriculture. The subsidy will be positive and equal to the difference between the minimum wage and marginal productivity. At that point $W_u^e = \overline{W}_M$ and $\overline{W}_M > Pq'$. Therefore, individuals would still find it in their interest to migrate and the point will not be attainable unless migration is restricted.

The agricultural sector has to be better off at L than at E since each additional unit of labor exported earns the full minimum wage, marginal productivity in agriculture is less than the minimum wage, and the price of the agricultural good rises. Whether the agricultural sector is better off at L than at D, however, depends again on the parametric values of the model.[19] It can be stated with certainty that the amount of compensation needed to make the rural sector *no worse off* than at D will be less at L than at E, and, furthermore it should be easier to finance since total income is greater.

Even so the fiscal requirements of subsidy (or public enterprise losses) and compensation cannot be taken lightly.[20] A government may find it difficult to find nondistorting taxes capable of raising sufficient revenue. Perhaps a head-tax on all urban residents would be feasible although this too raises the question of how minimum wages are set (unions in tropical Africa have, in some cases, successfully fought to maintain the real after-tax wage). A tax on rural land is ruled out if there must be *net* compensation to the rural sector which, in the absence of pure profits in manufacturing, leaves an urban land tax as the remaining potential ideal tax.

All of the above suggests that altering the minimum wage may avoid the problems of taxation, administration, and interference with individual mobility attendant to the policy package just discussed. Income and wages policies designed to narrow the rural-urban wage gap have been suggested by D. P. Ghai, and Tanzania has formally adopted such a policy along with migration restriction. In the final analysis, however, the basic issue at stake is really one of political feasibility and it is not at all clear that an incomes policy is any more feasible than the alternatives.

Appendix I

Proof of Stability of Unemployment Equilibrium

In order to prove that our urban unemployment equilibrium is stable, we can differentiate ψ (equation (9)) with respect to N_u remembering that $dN_u = -dN_A$ according to (7). We therefore obtain

$$\frac{d\dot{N}_u}{dN_u} = \psi'(\cdot)\left[-\frac{\overline{W}_M N_M}{(N_u)^2} + Pq'' + \frac{\partial P}{\partial X_A}(q')^2\right]. \tag{1.1}$$

Stability requires $d\dot{N}_u/dN_u < 0$ which is satisfied if

$$\frac{\partial P}{\partial X_A} < \frac{\dfrac{\overline{W}_M N_M}{(N_u)^2} - Pq''}{(q')^2}.$$

[19] As drawn in Figure 2, L must represent a higher welfare level than D for the rural sector since P rises and the sector produces more of both goods. In fact if L lies along TS north of the ray going through D there will be an unambiguous sectoral welfare improvement. However, if L lies south of the ray on TS, the rural sector could be worse off than at D since P falls.

[20] This argument coincides with the statement by Stolper (p. 195), "It should be noted, however, that even at best the application of shadow prices leads to the substitution of one problem, the budget, for another one, an imperfect market."

We would not go as far as Stolper in rejecting out of hand any use of shadow pricing because of the fiscal implications. The general point is valid that one cannot disregard the consequences of implementation of shadow-price criteria if actual prices or wages continue to diverge from the shadow prices or wages.

The right side of this inequality is unambiguously positive since $q''<0$. Hence our assumption that $\partial P/\partial X_A<0$ will ensure stability and, indeed, is stronger than necessary. The adjustment mechanism may be made clear by the following phase diagram in which the function ψ is plotted. Its positive slope reflects the hypothesis that migration flows will increase with the magnitude of the urban-rural expected wage differential. In Figure 4, ψ is plotted under the assumption that $\psi(0)=0$, hence the horizontal intercept is at the origin (in general the intercept would be α). Furthermore, we have arbitrarily assumed that ψ is a linear function. The arrows show the direction of adjustment in accordance with (1.1). If $\overline{W}_M N_M/N_u - Pq'>0$, then $\dot{N}_u>0$ but we know that if $\dot{N}_u>0$, the expected wage differential will decrease since $d\dot{N}_u/dN_u<0$. Additional migration by increasing N_u without affecting N_M will reduce the expected urban real wage through increased unemployment. Concomitantly, the transfer of labor out of agriculture raises q' and reduced agricultural output also causes P to rise. Thus migration reduces the expected wage differential to zero and equilibrium is achieved when there is no further incentive for migration. See Todaro for a more detailed analysis of this process in a dynamic setting.

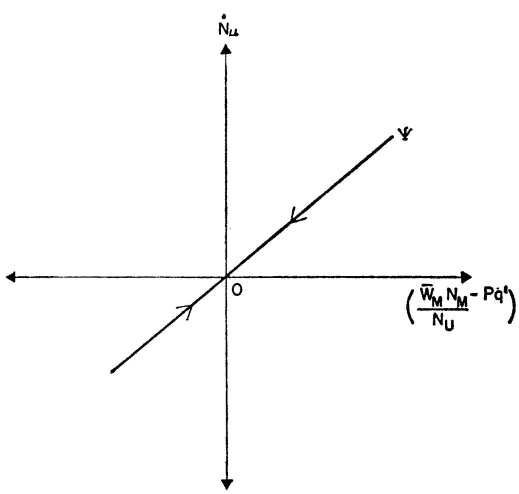

FIGURE 4.

APPENDIX II

Differentiating the equilibrium condition (8) with respect to N_M, recalling that $dN_u = -dN_A$, we obtain the expression

$$\text{(II.1)} \quad \frac{dN_u}{dN_M} = \frac{\dfrac{\overline{W}_M}{N_u} - q'\rho'\dfrac{f'}{X_A}}{\dfrac{\overline{W}_M N_M}{N_u^2} - \rho q'' + q'\rho'\dfrac{q' X_M}{X_A^2}}.$$

Defining the elasticity of demand for the agricultural good as

$$\text{(II.2)} \quad \eta_A = -\frac{\partial X_A}{\partial P}\cdot\frac{P}{X_A} = \frac{\rho X_A}{\rho' X_M},$$

(II.1) can be rewritten as

$$\text{(II.3)} \quad \frac{dN_u}{dN_M} = \frac{\dfrac{\overline{W}_M}{N_u} - \dfrac{\rho q' f'}{\eta_A X_M}}{\dfrac{\overline{W}_M N_M}{N_u^2} - \rho q'' + \dfrac{\rho (q')^2}{\eta_A X_A}}.$$

Differentiating the expression partially with respect to its various arguments it can be shown that dN_u/dN_M will vary directly with $\overline{W}_M$, N_M, η_A and inversely with ρ, q', f', N_u, and q''. In general, the greater is the urban-rural wage differential, and the less sensitive are prices and marginal products in agriculture, the greater will be the migration induced by creation of an additional job. If the minimum wage exceeds agricultural earnings, (II.3) will generally be positive and, with parameter values relevant for many African economies, will exceed unity.

When $dN_u/dN_M>1$, creation of an additional job at the minimum wage will increase the absolute level of unemployment although the *rate* of urban unemployment will have to fall. This can be seen by converting (II.3) to an elasticity measure.

$$\text{(II.4)} \quad \frac{dN_u}{dN_M}\cdot\frac{N_M}{N_u} =$$

$$\frac{\dfrac{\overline{W}_M N_M}{N_u^2} - \dfrac{N_M \rho q' f'}{N_u \eta_A X_M}}{\dfrac{\overline{W}_M N_M}{N_u^2} - \rho q'' + \dfrac{\rho (q')^2}{\eta_A X_A}} < 1$$

since $q'' < 0$.[21] To give an example of what this means, suppose that an economy initially has an urban unemployment rate of 25 percent. If in response to the creation of 100 additional industrial jobs, 125 additional individuals migrate to the urban area, the absolute number unemployed increases by 25 although the unemployment rate will drop, since the marginal unemployment rate is only 20 percent.

Appendix III

If minimum wages are maintained and migration takes place in accordance with equation (8), aggregate welfare will be maximized if the following Lagrangean expression is maximized:

$$\begin{aligned} \Omega = {} & U(X_A, X_M) \\ & + \lambda_1[q(\overline{N} - N_u) - X_A] \\ & + \lambda_2[f(N_M) - X_M] \\ & + \lambda_3 \left\{\rho\left(\frac{f(N_M)}{q(\overline{N} - N_u)}\right) \right. \\ & \left. \cdot q'(N - N_u) - \frac{\overline{W}_M N_M}{N_u}\right\} \end{aligned} \tag{III.1}$$

where U is the social welfare function and the succeeding terms are the constraints imposed by equations (1), (2), and (8) (recall that $N_A = \overline{N} - N_u$ from equation (7)).

Maximizing (III.1) we get the following first-order conditions:

$$\frac{\partial \Omega}{\partial X_A} = \frac{\partial U}{\partial X_A} - \lambda_1 = 0 \tag{III.2}$$

$$\frac{\partial \Omega}{\partial X_M} = \frac{\partial U}{\partial X_M} - \lambda_2 = 0 \tag{III.3}$$

[21] We are grateful to Peter Diamond for deriving this expression.

$$\frac{\partial \Omega}{\partial N_u} = -\lambda_1 q' + \lambda_3\left[\rho' \frac{f q'}{q^2} - \rho q'' + \frac{\overline{W}_M N_M}{N_u^2}\right] = 0 \tag{III.4}$$

$$\frac{\partial \Omega}{\partial N_M} = \lambda_2 f' + \lambda_3\left[\rho' \frac{f' q'}{q} - \frac{\overline{W}_M}{N_u}\right] = 0 \tag{III.5}$$

and the $\partial\Omega/\partial\lambda_i = 0$ ($i = 1, 2, 3$) which ensures that the constraints hold.

Substituting (III.2) and (III.3) into (III.4) and (III.5) we get

$$\frac{\dfrac{\partial U}{\partial X_M} f'}{\dfrac{\partial U}{\partial X_A} q'} = \frac{\dfrac{\overline{W}_M}{N_u} - q'\rho' \dfrac{f'}{q}}{\dfrac{\overline{W}_M N_M}{N_u^2} - \rho q'' + q'\rho' \dfrac{f q'}{q^2}}. \tag{III.6}$$

We know that in equilibrium $(\partial U/\partial X_M)/(\partial U/\partial X_A) = 1/P$ and it has been shown in Appendix II that the right-hand side of (III.6) is equal to dN_u/dN_M. Therefore (III.6) can be rewritten as

$$f' = Pq' \frac{dN_u}{dN_M}, \tag{III.7}$$

which is the condition used in the text to determine the optimal wage subsidy.

Condition (III.7) can also be written as

$$-P = \frac{-f'}{q' \dfrac{dN_u}{dN_M}} = \frac{dX_M}{dX_A}. \tag{III.8}$$

We know that $-P$ is equal to the marginal rate of substitution between the two commodities and dX_M/dX_A is the marginal rate of transformation. Hence (III.8) states the familiar condition for optimality: equate marginal rates of substitution and transformation. dX_M/dX_A is the slope of the line DK in Figure 2 and it clearly will be negative. However, its derivative with respect to N_M,

$$\text{(III.9)}\quad \frac{d\left(\dfrac{dX_M}{dX_A}\right)}{dN_M} = \frac{-q'\dfrac{dN_u}{dN_M}f'' - f'\left(\dfrac{dN_u}{dN_M}\right)^2 q'' + f'q'\dfrac{d^2N_u}{dN_M^2}}{\left(q'\dfrac{dN_u}{dN_M}\right)^2}$$

is of indeterminate sign since f'', $q''<0$ and d^2N_u/dN_M^2 will generally be negative as well. (III.9) must be positive if the effective production possibilities frontier (*DK*) is to be convex, a condition that is likely to hold but the possibility of concavity as full employment is approached must be considered. The slope of *DK* in Figure 2 seems plausible on a priori grounds.

REFERENCES

P. K. Bardham, "Factor Market Disequilibrium and the Theory of Protection," *Oxford Econ. Pap.* (New Series), Oct. 1964, *16*, 375–88.

E. J. Berg, "Wage Structure in Less Developed Countries," in A. D. Smith, ed., *Wage Policy Issues in Economic Development*, London 1969.

A. Callaway, "From Traditional Crafts to Modern Industries," *ODU: University of Ife Journal of African Studies*, July 1965, *2*.

S. Chakravarty, "The Use of Shadow Prices in Programme Evaluation," in Rosenstein-Rodan, ed., *Capital Formation and Economic Development*, London 1964.

Y. S. Cho, *Disguised Unemployment in Developing Areas, with Special Reference to South Korean Agriculture*, Berkeley 1960.

R. S. Eckaus, "The Factor-Proportions Problem in Underdeveloped Areas," *Amer Econ. Rev.*, Sept. 1955, *45*, 539–65.

J. Erickson, "Wage Employment Relationships in Latin American Industry: A Pilot Study of Argentina, Brazil, and Mexico," International Labour Office, 1969, typescript.

J. Fei and G. Ranis, *Development of the Labor Surplus Economy*, Illinois 1964.

D. P. Ghai, "Incomes Policy in Kenya: Need, Criteria and Machinery," *East Afr. Econ. Rev.*, June 1968, *4*, 19–35.

J. Gugler, "The Impact of Labour Migration on Society and Economy in Sub-Saharan Africa. Empirical Findings and Theoretical Considerations," *African Social Research*, Dec. 1968, *6*, 463–86.

E. E. Hagen, "An Economic Justification of Protectionism," *Quart. J. Econ.*, Nov. 1958, *72*, 496–514.

J. R. Harris and M. P. Todaro, "Urban Unemployment in East Africa: An Economic Analysis of Policy Alternatives," *East Afr. Econ. Rev.*, Dec. 1968, *4*, 17–36.

——— and ———, "Wages, Industrial Employment, and Labour Productivity: The Kenyan Experience," *East Afr. Econ. Rev.* (New Series), June 1969, *1*, 29–46.

J. P. Henderson, "Wage Policy in Africa," Paper prepared for delivery at the African Conference on Economics, Temple University, mimeo, April 1968.

C. R. Hutton, "The Causes of Labour Migration," in Gugler, ed., *Urbanization in Sub-Saharan Africa*, Kampala 1969.

C. H. C. Kao, K. R. Anschel, and C. K. Eicher, "Disguised Unemployment in Agriculture: A Survey," in C. K. Eicher and L. W. Witt, eds., *Agriculture in Economic Development*, New York 1964, 129–44.

J. M. Katz, "Verdoorn Effects; Returns to Scale, and the Elasticity of Factor Substitution," *Oxford Econ. Pap.*, Nov. 1968, *20*, 342–52.

L. Lefeber, "Planning in a Surplus Labor Economy," *Amer. Econ. Rev.*, June 1968, *58*, 343–73.

W. A. Lewis, "Economic Development with Unlimited Supplies of Labour," *Manchester Sch. Econ. Soc. Stud.*, May 1954, *22*, 139–91.

I. M. D. Little, "The Real Cost of Labour, and the Choice Between Consumption and

Investment," in P. N. Rosenstein-Rodan, ed., *Pricing and Fiscal Policies: A Study in Method,* Cambridge 1964, 77–91.

——— and J. A. Mirrlees, *Manual of Industrial Project Analysis,* Vol. II, "Social Cost Benefit Analysis," Paris 1969.

B. F. Massell and J. Heyer, "Household Expenditure in Nairobi: A Statistical Analysis of Consumer Behaviour," *Econ. Develop. Cult. Change,* Jan. 1969, *17,* 212–34.

L. G. Reynolds, "Wages and Employment in a Labor-Surplus Economy," *Amer. Econ. Rev.*, Mar. 1965, *55,* 19–39.

W. F. Stolper, *Planning Without Facts: Lesson's in Resource Allocation from Nigeria's Development.* Cambridge 1966.

M. P. Todaro, "A Model of Labor Migration and Urban Unemployment in Less Developed Countries," *Amer. Econ. Rev.,* Mar. 1969, *59,* 138–48.

Nigeria, *Report of the Commission on the Review of Wages, Salary and Conditions of Service of the Junior Employees of the Governments of the Federation and in Private Establishments 1963–64.*