The Developing Economies, XXV-3 (September 1987)

WELFARE ASPECTS OF A HARRIS-TODARO ECONOMY WITH UNDEREMPLOYMENT AND VARIABLE PRICES

IRA N. GANG
SHUBHASHIS GANGOPADHYAY

I. INTRODUCTION

OVER the last two decades development scholars have focused their attention on measures of development other than growth [10]. Output growth remained a major consideration, but it was recognized that the gains from growth are not usually distributed equitably [4]. Part of the change in focus is reflected by the switch from aggregate growth models to dual and surplus labor models [8, pp. 1–12]. These models emphasize the labor allocation effects of policies and are convenient for analyzing changes in workers' earnings.

The model developed by Harris and Todaro [11] is a major tool for these purposes. The Harris-Todaro (HT) model is characterized by an urban minimum wage fixed above the market clearing level, and by workers who are risk neutral and maximize expected income. Equilibrium in the economy is attained when expected income in the urban sector is equated to competitively determined income in agriculture. Under such a situation, the economy can end up with open unemployment in the urban sector.

Although the HT model captures many essential features of less developed countries (LDCs), it does not possess an element central to the analysis of many LDC problems, namely surplus labor or underemployment in the rural sector [21]. Existence of underemployment in a sector implies that the output of that sector does not fall when some *laborers* move out of it. One can incorporate underemployment within the HT framework. Such a model has been developed by Bhatia [3] using a concept of surplus labor first discussed by Sen [20].

In this paper we propose an alternative method of incorporating underemployment into the HT framework. This method allows us to derive the welfare aspects of a policy in the presence of a HT labor market both with, and without, underemployment. Within this framework and allowing for endogenous price determination we study the welfare aspects of wage policies. In their 1970 paper [11] Harris and Todaro considered policies aimed at decreasing open unemployment. The implicit assumption there was that social welfare is inversely related to open unemployment. However, if individual labor welfare is determined by

This work was completed while Ira Gang was visiting the Indian Statistical Institute, Delhi Centre. He acknowledges the support of the Claremont Center for Economic Policy Studies at Clarement Graduate School. The paper has benefited from referee's comments.

decisions arrived at by maximizing expected income, it may not always be true, as will be shown, that more unemployment is bad in the individual welfare sense.

Section II lays out the general model. The discussion of the implications of the models is then broken up into two parts. Section III deals with the situation of no underemployment; Section IV handles the situation with underemployment. In Section V we conclude our paper.

II. THE MODEL

Our model falls in the tradition of the two-sector dual economy models developed by Lewis [15], Ranis and Fei [18], and Harris and Todaro [11]. Like many of these models, we assume homogeneous labor (but see [7]), a wage differential between the two sectors and the absence of a capital market. The latter allows us to focus on the labor market and is equivalent to an assumption of sector specific capital. We incorporate two elements into the usual HT framework—price endogeneity via an agricultural demand relationship and a form of income sharing in agriculture which we specify below.

Homogeneous labor is the only variable factor of production. There are two production sectors, agriculture and manufacturing, both of which use labor. Formally,

$$M=M(L^M),\quad M_1\equiv\frac{\partial M}{\partial L^M}>0,\quad M_{11}\equiv\frac{\partial^2 M}{\partial (L^M)^2}<0, \tag{1}$$

and

$$A=A(L^E),\quad A_1\equiv\frac{\partial A}{\partial L^E}>0,\quad A_{11}\equiv\frac{\partial^2 A}{\partial (L^E)^2}<0, \tag{2}$$

where M is the manufacturing sector output, A is agricultural sector output, L^M is the amount of labor employed in manufacturing, and L^E is the amount of labor *actually* employed in agriculture. We will distinguish between the amount of labor *employed* in agriculture and the amount of labor *present* in that sector.

Employment levels in both sectors are determined by profit maximizing employers who equate the marginal productivity of labor to the wage rate. Thus,

$$pM_1=w^M, \tag{3}$$

and

$$A_1=w^A, \tag{4}$$

where p is the price of the manufacturing sector output in terms of the agricultural produce whose price is unity, w^i is the wage rate in the ith sector, $i=M, A$. We further assume that L^M and L^E can be solved as follows:

$$L^M=L^M(p, w^M), \tag{5}$$

and

$$L^E = L^E(w^A). \tag{6}$$

In keeping with the dual economy literature, we assume that

$$w^M \geq \bar{w}, \tag{7}$$

where $\bar{w}$ is exogenously given. This $\bar{w}$ is typically above the market clearing level. In the usual HT models w^A is less than $\bar{w}$ and this gives rise to open unemployment around the manufacturing sector as people migrate out from agriculture expecting larger incomes in the manufacturing sector. In these models w^A is endogenously determined.

However, in some LDCs, e.g., India, there is a minimum wage fixation for the agricultural sector also. Unlike in the manufacturing sector, this gives rise to *under* or *disguised* unemployment rather than open unemployment [19]. Such a situation is characterized by income and work sharing [14]. Thus father and son may share the work (and income) though the agricultural employer pays out wages to the father alone. Here L^E is the *effective* labor employed or, the number of hours worked, while L^A is the number of laborers in the labor force. We assume income is shared equally, and the average income in the agricultural sector, y, is given by

$$Y = \frac{w^A L^E}{L^A}. \tag{8}$$

See [14]. Note, if w^A is also endogenously determined, then L^E equals L^A, Y equals w^A, and we are in the usual HT framework. Thus, it is the fixity of w^A that allows us to capture the phenomenon of underemployment in agriculture.

For the labor market to be in equilibrium the average income in agriculture must equal the expected income in manufacturing, i.e.,

$$Y = \bar{w} \frac{L^M}{L - L^A}. \tag{9}$$

If there is open unemployment, one can show that equation (7) holds with equality so that we can put $w^M = \bar{w}$ [1]. Here L is the total labor force endowment and $L - L^A$ is the number of people seeking manufacturing jobs. Note that at full employment, $L^M = L - L^A$. $L^M/(L - L^A)$ is therefore the probability of obtaining a job in manufacturing at wage $\bar{w}$ [11].

To complete the model we need an equation in price. Harris and Todaro in their original article considered an economy under autarky and determined the terms of trade between agricultural and manufactured goods as a function of their relative outputs. Most work following theirs (for example, [2] [5] [1]), with the significant exception of Zylberberg [22], simplified the analysis by assuming either a small open economy or that the manufactured and agricultural goods were perfect substitutes in consumption, i.e., they fixed the relative prices of the goods. We reintroduce the autarky assumption to bring out the role of relative prices and of consumers preferences, i.e., the role of demand. The small country assumption eliminates the need for thinking about the demand side. To capture the demand side, we propose an aggregate demand relationship. Workers and non-workers (e.g., the owners of the specific factors) both demand agricultural *and* manufacturing goods but, for simplicity, we assume that preferences are homothetic. In other words, the *fraction* of income spent on any one good depends on its *relative price* and not on the *absolute* level of income. Total income in the economy is given by $pM+A$ out of which labor's share is given by $I^L=w^M L^M+w^A L^E$ and $pM+A-I^L$ goes to non-labor. Equilibrium in agricultural sector's output implies demand for its output must equal its supply. Thus,

$$I^L b^L(p)+(pM+A-I^L)b^N(p)=A, \tag{10}$$

where $b^j(p)$ is the fraction of jth group's income spent on agricultural produce (j=labor, non-labor). Hence, clearly, $b_1{}^j(p)\equiv\frac{\partial b^j}{\partial p}>0$, i.e., as the relative price of manufacturing output increases, a larger fraction of income is spent on agricultural output [9].

Thanks to Walras law, we do not need a separate relationship for equating demand and supply in the manufacturing sector. In equations (5) to (10) we have a system of equations in the variables p, L^E, L^M, L^A, Y, and w^M. One can reduce the above system to one with two equations in the variables L^A and p as follows:

$$I^L b^L(p)+(pM+A-I^L)\ b^N(p)=A[L^E(w^A)], \tag{11}$$

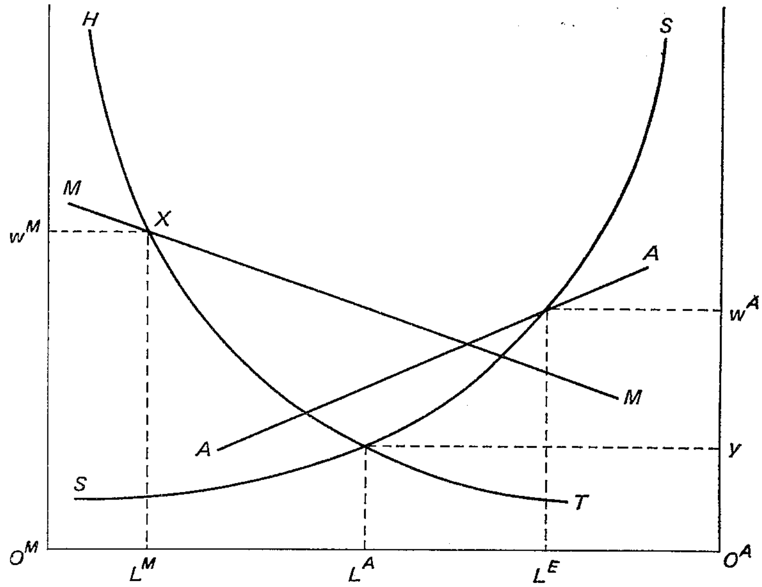
and

$$\frac{w^A L^E(w^A)}{L^A}-\frac{\bar{w}L^M(p,\bar{w})}{L-L^A}=0. \tag{12}$$

Workers maximize their expected earnings. Thus any situation that increases their expected earnings is "better" for them. One can discuss the effects of various policies on workers' earnings. Since there are two commodities and workers consume both of them, to be able to get an unambiguous increase in workers' welfare, one has to look at both Y and Y/p. It is possible for Y to be higher in a situation where open unemployment is also higher. This means, while at any moment of time more people are unemployed, since workers get a higher wage when employed their expected incomes are higher. In other words, in a situation where workers maximize *expected* earnings, concentrating on unemployment as a measure of workers' welfare may be misleading. This is especially true when, as in the HT framework, there is perfect information, full turnover, and an objective equilibrium measure of probability. However, unemployment has often been equated with a worker's welfare loss [11].

We shall now develop a diagrammatic framework that will help us illustrate our model. Figure 1, adopted from [5], depicts the labor market equilibrium condition. MM and AA are the marginal product of labor curves in the urban and rural sectors, respectively, with O^M and O^A as origins. Given the manufac-

Fig. 1.



turing wage $\bar{w}$, employment within that sector is given at O^ML^M. Similarly, given w^A, effectively employed labor in agriculture is O^AL^E. Two rectangular hyperbolas, *HT* and *SS*, appear in the diagram. *HT* relates the expected urban wage to the manufacturing labor force (those employed plus those openly unemployed) for given $\bar{w}$ and O^ML^M of employed labor. Similarly *SS* relates the average agricultural income, *Y*, to L^A given w^A and O^AL^E. Equilibrium is attained where these two intersect—equation (9). Thus *Y* and L^A can be read off directly from the diagram, L^ML^A gives the amount of open unemployment and L^AL^E the amount of underemployment. If w^A is flexible, *SS* becomes irrelevant and equilibrium is attained where *HT* and *AA* intersect—the usual Harris and Todaro equilibrium [5].

It is evident in Figure 1 that the *MM* and *AA* curves as drawn, have elasticity greater than one. This is because, *HT* and *SS* are both of unitary elasticity given that they are rectangular hyperbolas. If the *MM* curve is inelastic then it would intersect the *HT* curve at *X* from above. The formal analysis is found in the Appendix.

In the next section a version of the HT model without underemployment and endogenous prices is handled. Section IV deals with underemployment.

III. NO UNDEREMPLOYMENT

This is the standard HT case, only here we introduce endogenous prices via a domestic market for goods. As indicated earlier, we need a perfectly flexible agricultural wage w^A, to have no underemployment. This also means $L^E = L^A$ so that w^A and L^E (or L^A) are variables in the model. A possible policy parameter of the government is $\bar{w}$. Neary [17] has neatly summarized the implications of a change in $\bar{w}$. He showed that with fixed prices, if the MM curve, or the labor demand in manufacturing, is inelastic, a rise in $\bar{w}$ increases unemployment and the expected earnings of the workers. Thus both agricultural sector output and manufacturing sector output register declines. On the other hand, if the MM curve is elastic, a rise in $\bar{w}$ encourages people to move back to agriculture, increasing the output there and reducing wages in that sector. Form equation (9), where now $Y = w^A$, this means that expected earnings in the urban sector fall. Moreover, unemployment would fall if it was very high to begin with, but such a situation is unlikely. For the flexible price world we shall consider two cases: (i) equal propensities to consume of workers and non-workers or $b^L(p) = b^N(p)$; and (ii) where these two propensities are not equal or $b^L(p) \neq b^N(p)$, separately.

A. *Case 1.* $b^L(p) = b^N(p) = b(p)$

To analyze what happens in the variable price case, we use equation (10). With $b^L(p) = b^N(p) = b(p)$, equation (10) reduces to

$$b(p)\ pM = [1 - b(p)]\ A(L^E). \tag{13}$$

If prices are unchanged, an increase in $\bar{w}$ implies that the left hand side of (13) decreases. If the MM curve is elastic, as Neary correctly pointed out, total agricultural employment would go up and hence agricultural output. In other words, there would be an excess supply of agricultural produce and equilibrium can be attained only if p increases, for $b_1(p) > 0$. But as p goes up, the MM curve shifts to the right, since $L_1^M \equiv \dfrac{\partial L^M}{\partial p} > 0$. This tends to increase the employment in the urban sector and expected earnings in manufacturing rises compared to the fixed price case. Indeed, if the effect through prices is large enough, *even with elastic demand for labor in manufacturing,* agricultural employment always goes up if the MM curve is elastic [17, p. 222]. In the fixed price case elastic demand for labor in manufacturing is necessary and sufficient for agricultural employment to go up; in the flexible price case it is necessary but not sufficient.

Since the agricultural labor demand curve is downward sloping, $A_{11} < 0$, lower agricultural employment implies a higher agricultural wage and consequently, through equation (9), a higher expected earnings in manufacturing. If a rise in $\bar{w}$ decreases L^A, or $\dfrac{dL^A}{d\bar{w}} \leq 0$, then w^A rises. In equilibrium $w^A = (\bar{w}L^M)/(L - L^A)$, thus an increase in w^A implies an increase in expected urban wages. Since workers are expected income maximizers a reduction in L^A increases the welfare of workers, i.e., they earn higher (expected) incomes. Here we are measuring incomes in terms of the agricultural commodity. However, workers consume both commodities, so to get an unambiguous increase in workers welfare, their incomes in terms of both commodities must increase. So far we have been concentrating on w^A; we also need to look at (w^A/p).

Fig. 2.

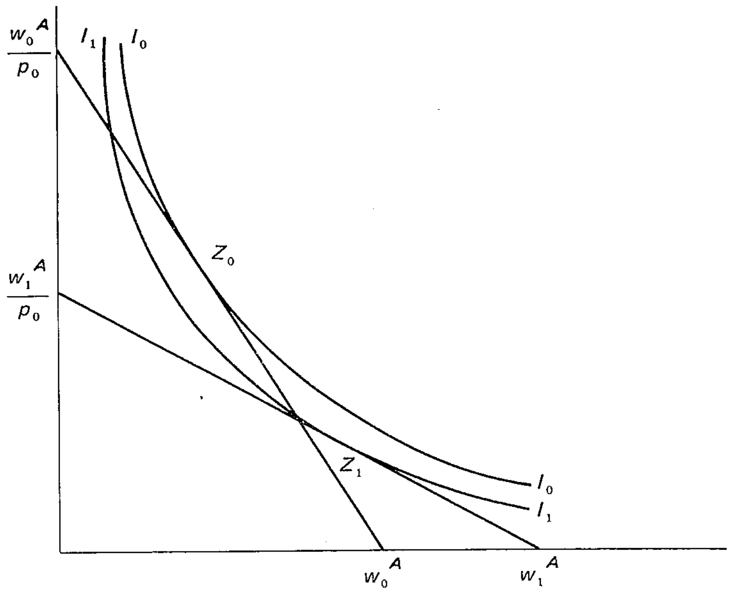


Figure 2 illustrates the problem. Let the worker's utility function defined on commodities M and A be given by the indifference maps represented by I_0I_0 and I_1I_1. Let Z_0 be the equilibrium when $\bar{w}=\bar{w}_0$. Now consider $\bar{w}_1>\bar{w}_0$ and let the new equilibrium be Z_1. Thus w_1^A is greater than w_0^A but since p_1 is greater than p_0 and $\frac{w_1^A}{p_1}$ is less than $\frac{w_0^A}{p_0}$, Z_1 gives lesser welfare than Z_0. In this situation prices are taken to be given by the workers (even though *equilibrium* prices are different) and given risk neutrality (implicitly assumed in the HT labor market) they maximize income. In welfare terms, Z_1 would be unambiguously better than Z_0 if the budget line corresponding to $\bar{w}_1$ always lies above $\bar{w}_0$.

It is clear from equation (10) that whenever an increase in $\bar{w}$ leads to an excess supply of agricultural goods at unchanged prices, prices must increase for commodity market equilibrium. As argued above, an elastic demand for manufacturing labor leads to an increase in prices if $\bar{w}$ is increased. Indeed, anything that results in an increase in L^E and a reduction in L^M increases p_0. But if income and agricultural output responses are such that excess demand in agriculture results from an increase in $\bar{w}$ then prices will have to go down to bring about commodity market equilibrium. This will clearly depend on the employment responses of both manufacturing and agricultural sectors, changes in incomes and the relative output shares. Formally, p will fall if and only if

$$|e_{\bar{w}}{}^{L^M}|\leq(1-b)/\left(1-\frac{L-L^A}{L^A}e_{w_A}{}^{L^E}\right), \qquad (14)$$

where $e_{\bar{w}}^{L^M}$ is the elasticity of labor demand in manufacturing and $e_{w^A}^{L^E}$ is the elasticity of labor demand in agriculture. Condition (14) is a sufficient condition for an unambiguous welfare gain to the workers. Note that condition (14) implies that for p to fall the MM curve must be very inelastic, for $(1-b)$ is less than unity and, since $e_{w^A}^{L^E}$ is negative, the denominator on the right hand side of condition (14) is greater than unity. To illustrate the condition it may be worthwhile to use a few numerical values. The minimum value of the denominator is 1 and if $b=0.6$, this implies that $e_{\bar{w}}^{L^M}$ must be less than 0.4.

One can also derive a sufficient condition for an unambiguous *decline* in workers welfare. Both w^A and w^A/p will fall if

$$|e_{\bar{w}}^{L^M}|\geq 1+(\bar{w}L_1^M/M)/\left(1+\frac{e_p^bY}{p^M}\right), \tag{15}$$

where e_p^b is the elasticity of the propensity to consume agricultural goods with respect to prices. Note if prices are fixed, there is no effect on L^M through p and condition (15) reduces to the Neary [17].

B. *Case 2.* $b^N(p)\neq b^L(p)$; $b^L(p)>b^N(p)$ *for all* p

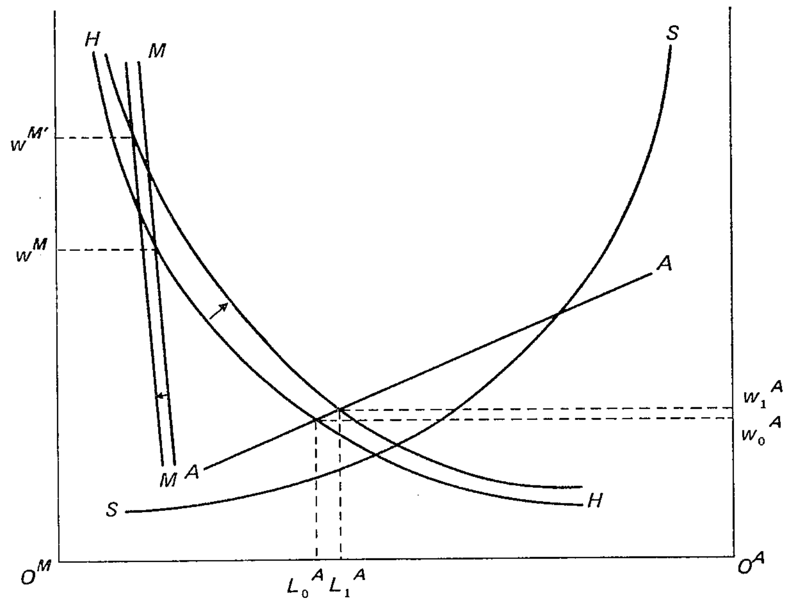
Here we assume that the propensities to consume from labor and non-labor are different. Furthermore, in keeping with the empirically observed phenomenon, we assume that labor's propensity to consume agricultural produce from income is higher than non-labor's; i.e., $b^L(p)>b^N(p)$ for all $p>0$. Once again, anything that increases the worker's expected income in the manufacturing sector increases the worker's welfare. However, as in the previous case, because of the price effect, this can happen even when the labor demand in manufacturing is elastic. In other words, the range of possible parametric values (as regards elasticity of the MM curve) for which expected income rises is now larger than in the fixed price case. This result is similar to the one derived in the previous subsection.

Workers consume both commodities, so to get an unambiguous increase in worker's welfare, one has to consider w^A/p as well as w^A. It is possible for w^A to go up, but prices may increase to such an extent that w^A/p falls. The following conditions are sufficient for w^A/p to fall,

$$|e_{w^A}^{L^E}|\leq 1 \text{ and } |e_{\bar{w}}^{L^M}|\leq\frac{b^L-b^N}{b^L}. \tag{16}$$

Let us see why this is so. Note, by assumption $b^L>b^N>0$, so that condition (16) implies $|e_{\bar{w}}^{L^M}|$ is less than unity. Thus as $\bar{w}$ increases, if p is unchanged $\bar{w}L^M$ goes up. But L^M goes down implying total value of manufacturing output and thus non-labor manufacturing income goes down. Furthermore, an increase in $\bar{w}L^M$ leads to an increased expected urban wage, and for labor market equilibrium people will migrate out of agriculture. Again, given condition (16) and a downward sloping demand curve for labor, w^A will go up leading to a fall in agricultural output. Also, w^AL^A will go up. As in the manufacturing sector, labor's income will go up and non-labor's will go down. Thus in the whole economy, labor's

Fig. 3.



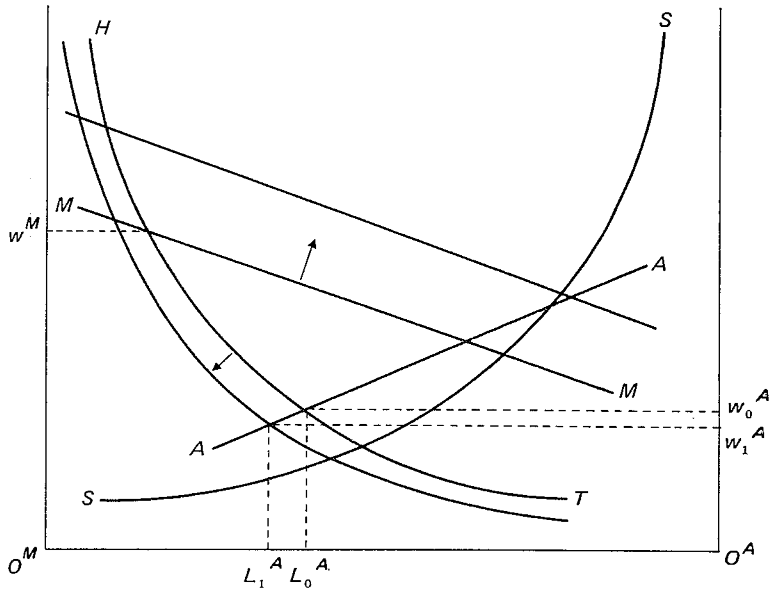
income share is higher both in the *absolute* and *relative* sense. With a higher propensity to consume agricultural produce by labor, this will lead to an excess demand in the agricultural market. Given $b_1^j(p)>0$ (for $j=L, N$), p must fall to maintain equilibrium [see equation (10)].

Condition (16) is sufficient but not necessary for an unambiguous increase in worker's welfare. It is evident from the previous paragraph that anything that increases labor's income share tends to create additional demand for agricultural produce and thus a downward pressure on the relative price of manufactured goods.

To summarize, one can make the following observations. In the variable price case, compared to the fixed price, the range of the parametric values of the elasticity of labor demand in manufacturing, for which worker's welfare is higher with higher $\bar{w}$, is increased. In the fixed price case any fall in L^A leads to a welfare rise and L^A falls if and only if MM is inelastic. With variable prices, however, welfare may increase even when MM is elastic. Since workers consume both commodities, looking at incomes valued in agricultural commodities alone may not be sufficient. For an unambiguous increase in welfare one also needs conditions on the elasticity of labor demand in agriculture. In the fixed price case, the latter played no role in such calculations.

We can capture the spirit of the results of this subsection in Figures 3 and 4 —the more or less inelastic and elastic cases, respectively. Here we ignore the SS curve of Figure 1 and the distinction between the two cases: $b^L=b^N$ and $b^L\neq b^N$, as we are simply after a general diagrammatic framework. With $\bar{w}$

Fig. 4.



increasing and a very inelastic *MM* curve, p falls and the *HT* curve shifts to the right. Thus the new equilibrium has a smaller L^A, higher unemployment and higher w^A and w^A/p. On the other hand, if the *MM* curve were not so inelastic the results would be different, as the increase in p may outweigh the effects of an inelastic *MM*. The case with *MM* elastic is illustrated in Figure 4. Here p increases but the *HT* curve shifts to the left, increasing L^A, lowering w^A and also w^A/p. However, if the increase in p is large enough, the *HT* curve (reflecting expected wages) would actually shift to the right, L^A falling, w^A rising and the effect of w^A/p ambiguous. We started the paragraph claiming that the illustration would capture the "spirit" of the results. This is, of course, because the actual changes depend on the degree of the shifts, i.e., on the conditions we outlined above.

IV. UNDEREMPLOYMENT

Here the labor market equilibrium is given by

$$Y=\frac{w^A L^E}{L^A}=\frac{\bar{w}L^M}{L-L^A} \tag{17}$$

with w^A exogeneously given. Unlike the no underemployment case, here Y may go up because of a change in $\bar{w}$ or a change in w^A. An increase in $\bar{w}$ gives rise to higher Y if $\bar{w}L^M$ goes up or if the labor demand in manufacturing is inelastic.

A. *Case 1.* $b^L(p)=b^N(p)=b(p)$

The results of a change in $\bar{w}$ are similar to the no underemployment case (see III.A). The major difference is that in this situation an increased $\bar{w}$ always leads to an increased p. This is because, from equation (13), an increase in $\bar{w}$ decreases the demand for agricultural produce at fixed prices, while the supply of agricultural output is unchanged because w^A and hence L^E are fixed. This results in an excess supply in the agricultural market and a price rise. Similarly, in the no underemployment case, if the labor demand in manufacturing was elastic, people moved back to agriculture when $\bar{w}$ was increased and this increased the agricultural output. A very inelastic *MM* curve, on the other hand guaranteed a fall in agricultural output more than the fall in demand leading to an excess demand in agriculture and prices had to come down to restore equilibrium [see equation (14)].

A parametric increase in w^A, on the other hand, always leads to a *fall* in the prices for much the same reason. Increased w^A means a lower L^E and a lower agricultural output implying an excess demand which can be reduced only through lower prices.

In the underemployment situation, Y and Y/p are the relevant welfare measures. An increase in $\bar{w}$ increases Y if $|e_{\bar{w}}{}^{L^M}|<1$ and this reduces L^A. Thus Y increases along with lesser underemployment but more open unemployment. Also p goes up, as argued above, and Y/p goes up if the price increase is not as great as the increase in Y. In other words, if the labor demand in manufacturing is sufficiently inelastic, and/or the response of b to price changes very high, then an increase in $\bar{w}$ will give rise to an unambiguous welfare gain for workers.

For increases in $\bar{w}$, if L^A goes down then worker's income in terms of agricultural produce goes up. For increases in w^A, however, if L^A goes up, worker's income levels tend to go up. This can be seen from the following relation:

$$Y=\frac{w^A L^E}{L^A}=\frac{\bar{w}L^M}{L-L^A}. \tag{9'}$$

Since w^A above is changing, $\bar{w}$ and L^M are fixed with unchanging prices. An increase in L^A, therefore increases Y. L^A will increase if $w^A L^E$ increases, i.e., $|e_{w_A}{}^{L^E}|\leq 1$. An adverse effect may occur, however, through price changes. p may fall so much that L^M may fall to an even larger extent than L^A is rising, causing $(\bar{w}L^M)/(L-L^A)$ to fall. This gives rise to large underemployment, low manufacturing employment and a possible loss in worker's welfare. Nevertheless, since p is always falling when w^A is increasing, a rise in Y is sufficient for an unambiguous increase in worker's welfare, for Y/p always rises when Y is rising. More formally,

$$\frac{dY}{dw^A}=\frac{\bar{w}L^M}{(L-L^A)^2}\,\frac{dL^A}{dw^A}+\frac{\bar{w}L_1{}^M}{(1-L^A)}\,\frac{dp}{dw^A},$$

and this is greater than or equal to zero if and only if

$$\frac{1}{L-L^A}\frac{dL^A}{dw^A}+\frac{L_1^M}{L^M}\frac{dp}{dw^A}\geq 0$$

i.e.,

$$\frac{dL^A}{dw^A}\geq -\left(\frac{1}{p}\frac{dp}{dw^A}\right)e_p^{L^M}(L-L^A), \tag{18}$$

where $e_p^{L^M}$ is the elasticity of the labor demand in manufacturing with respect to the manufacturing price. It is clear from condition (18) that if dL^A/dw^A is less than zero, Y must always go down. Intuitively it can be explained as follows. Since p is always going down, L^A decreasing implies the expected wage in manufacturing is higher than in agriculture. But a fall in p implies $\bar{w}L^M$ falling since L_1^M is greater than zero, L^A decreasing implies the denominator of $(\bar{w}L^M)/(L-L^A)$ rising along with the numerator falling. Thus Y is going down.

Whereas in the no underemployment case, with $b^L(p)=b^N(p)$, prices can go up or down depending on the elasticities of labor demand in agriculture and manufacturing, in the underemployment case, an increase in $\bar{w}$ always leads to an increase in p while an increase in w^A leads to a fall. As in the subsection III.A, whenever an increase in $\bar{w}$ leads to a fall in L^A, Y goes up. This is because

$$\frac{dY}{d\bar{w}}=-\frac{w^A L^E}{(L^A)^2}\frac{dL^A}{d\bar{w}}. \tag{19}$$

Here increased open unemployment is always associated with decreasing underemployment. Furthermore, a positive $dL^A/d\bar{w}$ implies an unambiguous dcrease in worker's welfare because, from equation (19), $dY/d\bar{w}$ is negative and we know p is always rising. In the no underemployment case it is possible for Y to fall and Y/p to rise if the fall in p is large enough.

B. *Case 2.* $b^L(p)\neq b^N(p)$; $b^L(p)>b^N(p)$

In this case, as in the previous sections, when $\bar{w}$ is increased the labor force in agriculture falls if $|e_{\bar{w}}^{L^M}|\leq 1$. However, again because of flexible prices, unlike the fixed price case, the above condition is sufficient but not necessary for L^A to go down. Prices, unlike in IV.A, now depend on how inelastic the labor demand in manufacturing is. Here, price will go down if and only if

$$|e_{\bar{w}}^{L^M}|\leq\frac{b^L-b^N}{b^L}<1. \tag{20}$$

Note this condition also appears in condition (16). However, in the no underemployment case any change in L^A affected labor income and hence demand for agriculture. Thus for a fall in prices an extent of the response in demand for labor in agriculture was needed. In the presence of underemployment, since agricultural output and employment is unaffected, this extra elasticity condition on agricultural labor demand is not necessary. The rest of the intuition is the same as for condition (16). Since condition (20) implies $|e_{\bar{w}}^{L^M}|<1$, the condition implies an unambiguous increase in worker's welfare.

If agricultural wages are increased, and the demand for labor in agriculture is inelastic, $w^A L^E$ would go up and there would be a tendency for people to move back into agriculture and, thus, $(\bar{w}L^M)/(L-L^A)$, or Y, would tend to rise. Coupled with this, for reasons already discussed in the previous subsection, p always falls if $b^L(p)$ is greater than $b^N(p)$. In other words, $|e_{w^A}^{L^E}|\leq 1$ is a sufficient condition for an unambiguous welfare increase of workers if the price changes are not too large to bring about a drastic fall in p and, therefore, L^M.

The flavor of the underemployment case can be obtained by reintroducing the SS curve of Figure 1 into Figures 3 and 4. The sensitivity of the results of the conditions above can be illustrated by manipulating the curves and allowing greater or lesser shifts. We are now able to see what happens to underemployment and to Y and Y/p when $\bar{w}$ and/or w^A are increased.

V. CONCLUSION

In this paper we discuss the welfare effects of wage policies in a Harris-Todaro economy with variable prices. We distinguish a case without underemployment from a case with underemployment. In the no underemployment case a very inelastic demand for manufacturing labor is sufficient to guarantee an unambiguous welfare gain when welfare is measured by agricultural wages in terms of both commodities. This is the proper measure of welfare when we are concerned with worker's welfare and workers are expected income maximizers. In contrast to the fixed price case welfare gain is still possible even with an elastic demand for manufacturing labor.

It is important to note that we have not in this paper analyzed the situation of underemployment in the urban sector. The phenomenon of the informal or murky sector in urban areas is different from that of underemployment in rural-agricultural areas, and has recently received well-deserved attention [16] [13] [12]. However, introducing an urban informal sector into the Harris-Todaro model, while quantitatively important, has generally not been found to affect the qualitative results [7] [6]. In our model above we can think of the urban informal sector as where all those whom we have been calling unemployed are located. This recognizes that in LDCs only the very rich can afford to be truly openly unemployed. The analysis procedes as above (where we were assuming for simplicity that the unemployed received a wage equal to zero), only now the unemployed receive some positive "informal sector wage" which is, however less than that in manufacturing or in agriculture. Our analysis above will now carry through, only the mathematics will be a bit more complicated.

Underemployment is defined to exist if the number of laborers in the agricultural labor force exceeds the effective labor employment by profit maximizing employers. It arises because of the downward rigidity of the agricultural wage—possibly due to a minimum wage—and work sharing by labor. Two policy parameters are open to the government: the wage in manufacturing and the wage in agriculture.

An increase in the manufacturing wage increases p and for inelastic labor demand raises Y and lowers underemployment. The change in Y/p is ambiguous. If labor demand is not so inelastic the degree of change in the price level must be taken account of. For increases in $\bar{w}$, if L^A decreases, workers income in terms of agricultural goods goes up. On the other hand, for increases in w^A, if L^L increases workers income tends to go up. Moreover, p always falls. While more underemployment occurs, the agricultural labor force tends to enjoy a higher income in terms of both commodities. The higher agricultural income implies higher expected income and higher welfare.

REFERENCES

1. Basu, K. C. "Optimal Policies in Dual Economies," *Quarterly Journal of Economics,* Vol. 95, No. 1 (August 1980).
2. Bhagwati, J. N., and Srinivasan, T. N. "On Reanalyzing the Harris Todaro Model: Rankings in the Case of Sector-Specific Sticky Wages," *American Economic Review,* Vol. 64, No. 3 (June 1974).
3. Bhatia, K. B. "Rural-Urban Migration and Surplus Labour," *Oxford Economic Papers,* Vol. 31, No. 3 (November 1979).
4. Chenery, H. B., et al. *Redistribution with Growth* (London: Oxford University Press, 1974).
5. Corden, W. M., and Findlay, R. "Urban Unemployment, Intersectoral Capital Mobility and Development Policy," *Economica,* Vol. 42, No. 165 (February 1975).
6. Das-Gupta, A., and Gang, I. N. "A Framework for Analyzing Economies with Wage Differentials," *Rivista Internazionale di Scienze Economiche e Commerciale,* forthcoming.
7. Field, G. S. "Rural-Urban Migration, Urban Unemployment, and Job-Search Activities in LDCs," *Journal of Development Economics,* Vol. 2, No. 2 (June 1975).
8. ————. *Poverty, Inequality and Development* (London: Oxford University Press, 1980).
9. Gang, I. N., and Gangopadhyay, S. "A Note on Optimal Policies in Dual Economies," *Quarterly Journal of Economics,* Vol. 100, Supplement (1985).
10. Gillis, M.; Perkins, D. H.; Roemer, M.; and Snodgrass, D. R. *Economics of Development* (New York: W. W. Norton, 1983).
11. Harris, J. R., and Todaro, M. P. "Migration, Unemployment and Development: A Two-Sector Analysis," *American Economic Review,* Vol. 60, No. 1 (March 1970).
12. Heady, C. J. "Shadow Wages and Induced Migration," *Oxford Economic Papers,* Vol. 33, No. 1 (March 1981).
13. International Labour Office. *Employment, Incomes and Equality: A Strategy for Increasing Productive Employment in Kenya* (Geneva: International Labour Office, 1972).
14. Lele, U., and Mellor, J. W. "Technological Change, Distributive Bias and Labour Transfer in a Two Sector Economy," *Oxford Economic Papers,* Vol. 33, No. 3 (November 1981).
15. Lewis, W. A. "Economic Development with Unlimited Supplies of Labour," *Manchester School of Economics and Social Studies,* Vol. 22, No. 2 (May 1954).
16. Mazumdar, D. *Paradigms in the Study of Urban Labour Markets in LDCs,* World Bank Staff Working Paper N. 366 (Washington, D.C.: International Bank for Reconstruction and Development, 1979).
17. Neary, J. P. "On the Harris-Todaro Model with Intersectoral Capital Mobility," *Economica,* Vol. 48, No. 191 (August 1981).
18. Ranis, G., and Fei, J. C. H. "A Theory of Economic Development," *American Economic Review,* Vol. 51, No. 4 (September 1961).
19. Robinson, J. *Essays in the Theory of Employment* (Oxford: B. Blackwell, 1947).

20. SEN, A. K. "Peasants and Dualism with or without Surplus Labour," *Journal of Political Economy,* Vol. 74, No. 5 (October 1966).
21. ————. *Employment, Technology and Development* (Delhi: Oxford University Press, 1975).
22. ZYLBERBERG, A. "Migration Equilibrium with Price Rigidity: The Harris and Todaro Model Revisited," *Journal of Economic Theory,* Vol. 37, No. 2 (December 1985).

APPENDIX A

NO UNDEREMPLOYMENT

Here we are assuming that wages in the agricultural sector are perfectly flexible. As a result, the effective employment in the agricultural sector is equal to the actual amount of labor present in that sector or, in other words, $L^E = L^A$. The reduced form system that describes our model in this case is given by (A.1) and (A.2):

$$w^A(L^A) - \frac{\bar{w}L^M}{(L-L^A)} = 0, \tag{A.1}$$

$$I^L b^L(p) + (pM + A - I^L)\, b^N(p) = A(L^A). \tag{A.2}$$

We will consider changes in $\bar{w}$ and for that we totally differentiate equations (A.1) and (A.2) and write out in matrix form as follows:

$$\begin{bmatrix} w_1{}^A - \dfrac{\bar{w}L^M}{(L-L^A)^2} & -\dfrac{\bar{w}L_1{}^M}{L-L^A} \\ (w_1{}^A L + w^A)(b^L - b^N) & \bar{w}L_1{}^M b^L + b^N M \\ +(b^N-1)w^A & +I^L b_1{}^L + I^N b_1{}^N \end{bmatrix} \begin{bmatrix} dL^L \\ \\ dp \end{bmatrix} = \begin{bmatrix} \dfrac{L^M + \bar{w}L_2{}^M}{L-L^A} \\ (b^N - b^L)L^M \\ -\bar{w}L_2{}^M b^L \end{bmatrix} d\bar{w}. \tag{A.3}$$

Note that $I^L = \bar{w}L^M + w^A L^A$, $I^N = pM + A - I^L$ and $pM_1 = \bar{w}$. Throughont out paper we have assumed that $b^L(p) \geq b^N(p)$ for all p, i.e., laborers use up a larger fraction of their income in buying agricultural products than do non-laborers. This assumption, which makes $Lb^L - b^N L^A \geq 0$, guarantees that the matrix on the left hand side of (A.3) has determinant value negative. We shall denote this matrix by D.

By Kramer's rule, one can solve for $\dfrac{dL^A}{d\bar{w}}$ and $\dfrac{dp}{d\bar{w}}$. Formally,

$$\frac{dL^A}{d\bar{w}} = \frac{1}{|D|}[(L^M + \bar{w}L_2{}^M)(I^L b_1{}^L + I^N b_1{}^N + b^N M) + b^N L^M \bar{w} L_1{}^M] \frac{1}{L-L^A} \tag{A.4}$$

which is negative if $(L^M + \bar{w}L_2{}^M) = L^M(1 + e_{\bar{w}}{}^{LM}) > 0$, where $e_{\bar{w}}{}^{LM}$ is the elasticity of the labor demand curve for manufacturing with respect to manufacturing wage. In other words,

$$\frac{dL^A}{d\bar{w}}, \text{ if } |e_{\bar{w}}{}^{LM}| \leq 1.$$

Note if $|e_{\bar{w}}^{LM}|>1$, the sign of (A.4) is ambiguous. If $L^M=\frac{\partial^L}{\partial_p}$ is large enough, $dL^A/d\bar{w}$ may still be positive.

Also

$$\frac{dp}{d\bar{w}}=\frac{1}{|D|}\frac{1}{L-L^A}w_1{}^AL^ML(b^N-b^L)-w_1{}^A\bar{w}L_2{}^M(b^LL-b^NL^A)$$
$$+(1-b^N)w^A(L^M+\bar{w}L_2{}^M) \qquad \text{(A.5)}$$

which is greater than zero if $|e_{\bar{w}}^{LM}|\geq 1$. Now, with $b^N=b^L=b$, $\frac{dp}{d\bar{w}}\leq 0$ if and only if,

$$(1-b)w^AL^M(1+e_{\bar{w}}^{LM})-w_1{}^A\bar{w}L_2{}^Mb(L-L^A)\geq 0,$$

i.e., $\frac{1-b}{b}\geq\frac{w_1{}^A}{w^A}L^A\frac{L-L^A}{L^A}\frac{\bar{w}L_2{}^M}{L^M}/(1+e_{\bar{w}}^{LM})$,

i.e., $(1-b)(1+e_{\bar{w}}^{LM})\geq\frac{b}{e_{\bar{w}A}{}^{LA}}\frac{L-L^A}{L^A}e_{\bar{w}}^{LM}$,

i.e., $(1-b)\geq\left[\frac{b(L-L^A)}{L^A}\frac{1}{e_{wA}{}^{LA}}-(1-b)e_{\bar{w}}^{LM}\right]$, (A.6)

i.e., $|e_{\bar{w}}^{LM}|\left(1-b-\frac{L-L^A}{L^A}\frac{b}{e_{wA}{}^{LA}}\right)\leq(1-b)$. (A.7)

From equation (A.5) it is clear that

$$|e_{\bar{w}}^{LM}|\left(1-\frac{L-L^A}{L^A}\frac{1}{e_{wA}{}^{LA}}\right)\leq(1-b)$$

is a sufficient condition for $\frac{dp}{d\bar{w}}<0$.

Similarly one can get conditions for $\frac{dp}{d\bar{w}}<0$ when $b^L(p)\neq b^N(p)$.

APPENDIX B

WITH UNDEREMPLOYMENT

Case 1. $b^L(p)=b^N(p)$ for all $p>0$.

Here, we have a situation where w^A is fixed and $L^A\geq L^E$ with L^E fixed because w^A and the agricultural technology are given. The system, in matrix form, can be written out as follows:

$$\begin{bmatrix}\frac{-\bar{w}L^M}{(L-L_A)^2}-\frac{w^AL^E}{(L^A)^2} & -\frac{\bar{w}L_1{}^M}{L-L^A}\\ 0 & Ib_1+b(M+\bar{w}L_1{}^M)\end{bmatrix}\begin{bmatrix}dL^A\\ dp\end{bmatrix}$$

$$=\begin{bmatrix} -\dfrac{w^A L^E + L^E}{L^A} & \dfrac{\bar{w} L_2{}^M + L^M}{L-L^A} \\ (1-b)w^A L_1{}^E & -b\bar{w}L_2{}^M \end{bmatrix} \begin{bmatrix} dw^A \\ d\bar{w} \end{bmatrix}, \qquad \text{(A.8)}$$

where $I=pM+A$ and $b(p)=b^L(p)=b^N(p)$. Let us denote the matrix on the left hand side of (A.8) by X. Then, clearly $|X|<0$.

$$\frac{dL^A}{d\bar{w}}=\frac{1}{|X|}\frac{1}{L-L^A}[(\bar{w}L_2{}^M+L^M)(Ib_1+bM)+bL^M\bar{w}L_1{}^M],$$

so that $\dfrac{dL^A}{d\bar{w}}\leq 0$ if $|e_{\bar{w}}{}^{LM}|\leq 1$ and $\dfrac{dL^A}{d\bar{w}}\leq 0$ if and only if $(1+e_{\bar{w}}{}^{LM})(Ie_p{}^b+pM)$ $+\bar{w}e_p{}^{LM}L^M\geq 0$ where $e_p{}^b$ is the elasticity for $b(p)$ with respect to price and $e_p{}^{LM}$ is the elasticity of the demand for labor in manufacturing with respect to price.

$$\frac{dL^A}{d\bar{w}}=\frac{1}{|X|}\left(-\frac{\bar{w}L^M}{(L-L^A)^2}-\frac{w^A L^E}{(L^A)^2}\right)(-b\bar{w}L_2{}^M)=\frac{-bwL_2{}^M}{Ib_1+b(M+\bar{w}L_1{}^M)}>0$$

always.

By inspection of (A.8) it is clear that $\dfrac{dL^A}{dw^A}\geq 0$ if $|e_{w^A}{}^{LE}|\leq 1$. Since $\dfrac{\bar{w}L^M}{L-L^A}$ $=Y$, any increase in L^A will increase Y. In other words, contrary to a increase in w^A an *increasing* L^A raises Y. Analogous to the increasing $\bar{w}$ where $|e_{\bar{w}}{}^{LM}|\leq 1$ increases Y, increasing w^A increases Y if $|e_{w^A}{}^{LE}|\leq 1$.

$$\frac{dp}{dw^A}=\frac{(1-b)w^A L_1{}^E}{Ib_1+b(M+\bar{w}L_1{}^M)}<0 \text{ always.}$$

Contrary to the increase in $\bar{w}$ where $\dfrac{dp}{d\bar{w}}$ was always positive, an increase in w^A always leads to a fall in the price of manufacturing.

Case 2. $b^L(p)\neq b^N(p)$.

Here the system can be represented as

$$\begin{bmatrix} -\dfrac{w^A L^E}{(L^A)^2}-\dfrac{\bar{w}L^M}{(L-L^A)^2} & -\dfrac{\bar{w}L_1{}^M}{L-L^A} \\ 0 & b_1{}^L I^L + b_1{}^N I^N = b^L\bar{w}L_1{}^M = b^N M \end{bmatrix} \begin{bmatrix} dL^A \\ dp \end{bmatrix}$$

$$=\begin{bmatrix} -\dfrac{L^e+w^A L_1{}^E}{L^A} & \dfrac{L^M+\bar{w}L_2{}^M}{L-L^A} \\ (1-b^L)w^A L_1{}^E+(b^N-b^L)L^E & (b^N-b^L)L^M-b^L\bar{w}L_2{}^M \end{bmatrix} \begin{bmatrix} dw^A \\ d\bar{w} \end{bmatrix} \qquad \text{(A.9)}$$

and all the results reported in the text can be worked out as in the previous case.