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Abstract

Production linkages between the rural and urban sectors are incorporated into the Harris Todaro (HT) model. The two sectors interact in goods and labor markets, as in the original model, and directly in production. The input–output framework shows that even when expected urban wage goes up in a small open economy, there may be no outmigration from agriculture. Numerical illustrations for a closed and a small open economy, from a computable general equilibrium model suggest that intermediate goods can significantly alter migration flows and unemployment rates. Production linkages thus can be another policy instrument for dealing with HT–type rural–urban migration.

1. INTRODUCTION

The Harris–Todaro (HT) model of rural–urban migration is by now a well established part of the literature which deals with the curious phenomenon of large scale migration from rural to urban areas in spite of high rates of unemployment in many cities of the third world. The basic idea is that equilibrium in the labor market is characterized by equality of expected wages, rather than actual wages when urban wage is institutionally fixed above the market–clearing level. If something upsets this equilibrium, several adjustments take place to equalize expected wages once again. For example, when the urban minimum wage is raised, number of urban jobs goes down which, combined with in– or outmigration alters the probability of finding a job in manufacturing. Wage rate and output in agriculture then change because of movement of workers, and relative output price also adjusts.[1]

While this model explains several aspects of migration, the problem continues unabated, reaching crisis proportions in many urban areas. According to some U.N. estimates, in 1950 the developing world had six rural people for every urban resident. This ratio fell to three–to–one in the early eighties, and by the end of this century, it would be about two to one. If these estimates are plausible, with growing populations in most countries, large increases in urban populations as well as outmigration of people from rural areas seem inevitable. This might lead to an unprecedented socio–economic problem especially since policies adopted to deal with it in the past have had rather limited effect.[2] Search must go on, therefore, for other policy measures, perhaps other explanations, for a better understanding and control of rural–urban migration.

In this context, this paper focuses on the production structure of an economy and its effects on migration. A key feature of the HT model and its various extensions is that mobile labor provides the main linkage between the two sectors. Another connection is on the demand side, because income earned in one sector might be spent on the output of the other, but that is not a very important part of the analysis. The structure of production, thus, remains extremely simple, essentially consisting of two sectors which produce only final goods.

Models of this type, therefore, can be called final–goods–only (FGO) models. During the last decade or two, increasingly complex patterns of production have been emerging in many developing countries. Several input–output tables are now available which show backward and forward linkages for quite a few activities. Even in a two–sector framework, say, agriculture and manufacturing, it is common to find the former using fertilizer produced in the latter while some agricultural output is used as raw material in the manufacturing sector. Changes in each sector, therefore, will directly affect the other, in addition to the avenues of adjustment postulated in the HT framework. This economy can be called a structured, input–output (SIO) economy to contrast with the FGO specification used in the original HT model. Will migration flows be larger or smaller than in a comparable FGO economy? Will unemployment rates be higher or lower and what will determine them? Should a country promote isolated industries or develop interlinked activities, in both agriculture and industry, as a part of overall employment policy? Such questions will be the main concern of the ensuing analysis.

The issue of isolated versus interlinked activities has been discussed in the literature, although not in a migration context. Morawetz (1974), for example, discusses the employment implications of inter–industry choices. Raj Krishna (1975), Riedel (1975), and Yotopoulos and Nugent (1976), also consider linkages between agriculture and industry. A Malaysian example, to which we shall refer throughout the paper, is quite apropos in this connection. Since the early seventies, Malaysia has promoted a number of export oriented, highly labor intensive, assembly type industries. Located in isolated free–trade zones (FTZs), using mostly imported intermediate inputs and machinery, these industries do not generate much employment in the rest of the economy. By contrast, the traditional, natural–resource–based (NRB) industries, which are more closely linked with other sectors, create considerable employment in other parts of the economy. Verbruggen (1985) points out that in the 1975 input–output table, the new industries are more labor intensive than the NRB ones, but when indirect employment effects are taken into account, electronics, which is a typical new industry, adds only about 10 percent to the direct employment coefficient whereas for sugar, a traditional NRB industry, the "total coefficient" is twenty–five times the direct one.[3] Wage and other manpower policies in these two sectors thus will have very different effects on total employment and perhaps migration.

None of these studies is interested in migration *per se*, and they all assume fixed input–output coefficients which are not open to choice in a flexible, cost–minimizing setting, as in this paper. There is a growing literature in production theory (Khang (1971)), international trade (Burgess (1980)), and public economics (Bhatia (1989)) which deals with intermediate inputs. One common theme in this body of work is that intermediate goods are treated symmetrically with primary factors, all chosen to minimize unit cost. Assumption of fixed coefficients simplifies analytical derivation, but there is hardly any empirical evidence or general support for it in econometric estimates of production functions (Humphrey and Moroney (1975), Berndt and Wood (1975)). We are not aware of any studies of rural–urban migration or the HT model in which production linkages are thus considered.[4]

To anticipate the main argument of this paper, when production linkages are taken into account, the HT migration story changes considerably. Several new analytical results emerge. For example, even when the expected urban wage goes up initially, there may not be any outmigration from agriculture, which contrasts sharply with the original HT model in which there must be outmigration in that situation. Some numerical examples based on a computable general equilibrium (cge) model suggest that rates of urban unemployment and migration flows can vary considerably, by 33 percent or more, depending on particular values of parameters such as elasticities of substitution, etc.

The role of production linkages is illustrated in Section 2 where the analytical framework is also discussed. The production side of the model and the procedure for solving it are discussed in Section 3. Some comparative–static results about raising the urban minimum wage in a small open economy (SOE) are derived in Section 4, where some policy implications of these results and their limitations are also discussed. The closed economy case, turns out to be analytically intractable. In Section 5, therefore, some numerical examples based on a computable general equilibrium (cge) model for both a closed and a small open economy are presented. The main conclusions are summarized in Section 6.

2. THE ROLE OF PRODUCTION LINKAGES

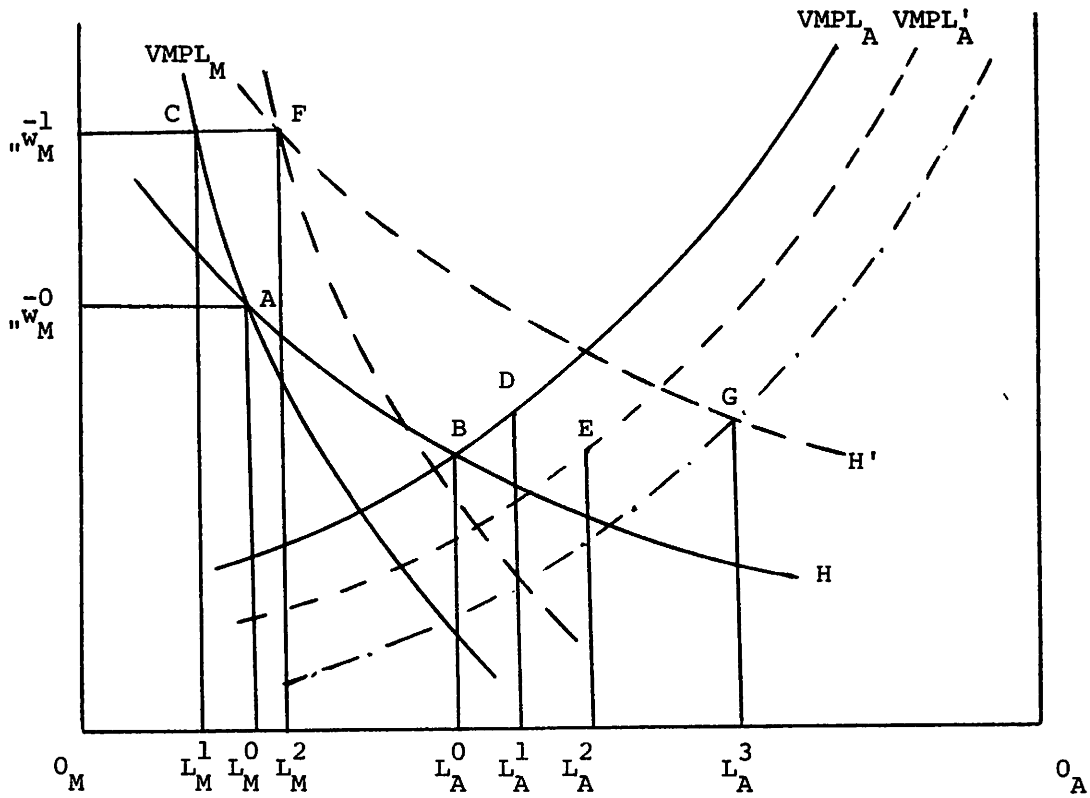
It is assumed that each sector produces output for both intermediate and final usage. Subscripts M and A respectively denote manufacturing (urban) and agriculture (rural) Agriculture produces raw materials with the help of the mobile factor, labor (L_A), a specific factor of production, land or capital (K_A), and the manufactured good (X_{MA}). The manufacturing sector, likewise, uses L_M, sector–specific capital (K_M), and some agricultural output (X_{AM}). The remaining output of the two sectors, x_A and x_M, is for final demand. Real value added in each activity, G^i, is the value of its gross output, F^i, minus its purchases of intermediate inputs X_{ij} (i,j, = A,M, $i \neq j$). Workers are hired such that the value of their marginal product is equal to the wage rate in each sector, and purchases of intermediate inputs, X_{AM} and X_{MA}, are determined by equating the marginal value product of each to its price. The residual in each industry is the rental for its specific factor of production. For the rest, the HT specification is adopted to facilitate comparison with earlier work. There is thus a minimum wage in the urban sector, fixed in terms of the manufactured good. The probability of finding an urban job is given by the actual employment rate, and equilibrium in the labor market is characterized by equality of expected wages in the two sectors.[5]

The part played by production linkages in this framework can be illustrated in Figure 1 where the downward–sloping curves marked VMPL represent the value of marginal product of labor (VMPL) in the two sectors for a given commodity price ratio, expressed in terms of the manufactured good, which is chosen as the numeraire throughout the analysis. These are derived from the partial derivatives of the two real–value–added functions with respect to labor. In the initial equilibrium, $O_A L_A^0$ labor is employed in agriculture, $O_M L_M^0$ in industry, and $L_A^0 L_M^0$ is unemployed labor, all in the urban sector. A rectangular hyperbola, H, passes through points A and B to satisfy the condition of labor–market equilibrium.[6] When the urban minimum wage is raised, at the initial commodity–price ratio, manufacturing employment will drop to $O_M L_M^1$, and the number of workers in agriculture will be $O_A L_A^1$. As before, a rectangular hyperbola (not drawn) will pass through C and D. This is the well–known HT result in which expected urban wage goes up. Outmigration from agriculture then reduces the probability of finding an urban job and restores equilibrium in the labor market.

The points C and D normally would denote different levels of output than A and B. Therefore, unless it is a small open economy, ρ would change (recall that in the original HT specification, ρ depends on the output ratio: $\rho = \rho\ (X_M / X_A)$, $\rho' > 0$). Assume, to illustrate a point, that ρ falls. In the absence of interindustry flows, the urban sector will continue to employ $O_M L_M$ workers, but the VMPL curve in agriculture will shift down; some more workers will move out of agriculture (the equilibrium will be at E), leaving $O_A L^2{}_A$ behind. The level and rate of urban unemployment will go up. Points C and E, however, will not represent the new labor–market equilibrium when agriculture and manufacturing are linked in production. A decline in ρ will alter the cost of using intermediate inputs in both industries. Manufacturing firms will tend to substitute the relatively cheaper intermediate input for labor, while the reverse will happen in agriculture. The VMPL curve for manufacturing will normally shift up, and the other will shift down. In the new equilibrium, $O_M L_M{}^2$ workers will be employed in manufacturing and $O_A L_A{}^3$ in agriculture, determined by the rectangular hyperbola through F and G. Labor has been reallocated to the sector whose relative output price has risen, although it is not definite that urban employment increases *pari passu* with inmigration.

The results shown in Figure 1 are based on the stipulation that the marginal product of labor (mpl) in manufacturing goes up, and that in agriculture goes down, i.e. the cross–partial

FIGURE 1: ALLOCATION OF LABOR AND UNEMPLOYMENT



derivative of mpl with respect to the intermediate input is positive in each industry. However, there is nothing to prevent this derivative from being negative in linear homeogeneous production functions of the sort being used here. The output–price ratio, likewise, might rise, rather than fall as assumed above. In general, therefore, it is difficult to predict the direction and magnitude of migration flows, or changes in the level and rate of unemployment without solving the complete model. It should be obvious nonetheless that results might be very different from those in the FGO case, except in the unlikely event that the VMPL curves do not shift at all.

3. THE MODEL AND ITS COMPARATIVE STATICS

In addition to the real–value–added functions discussed above, the production functions f (for manufacturing) and q (for agriculture) are assumed to be linear, homogeneous, and strictly quasiconcave. The key equation in the HT model is the condition of equilibrium in the labor market:

$$E = \rho \cdot q_1 - f_1 \cdot L_M/(\bar{L} - L_A) = 0 \tag{1}$$

where q_1 is the mpl in agriculture and f_1 in manufacturing. The term post–multiplying f_1 is the urban employment rate, the perceived probability of finding an urban job. Since $\rho = p_A / p_M$, the equation signifies equality of expected wages between the two sectors, expressed in comparable units.

Input–output coefficients involving intermediate goods are determined by all input prices, i.e.

$$a_{MA} = a_{MA}(w_A, r_A, p_M) \tag{2}$$

$$a_{AM} = a_{AM}(w_M, r_M, p_A) \tag{3}$$

Both (2) and (3) are assumed to be homogeneous of degree zero in input prices. When a worker moves, from agriculture to industry for example, changes in a_{ij}s depend on how relative input prices respond to general equilibrium adjustments in the economy. The critical parameters in this process will be various elasticities of substitution in the two industries (σs), especially those involving intermediate inputs, because if these are zero, a_{ij}s simply cannot change, irrespective of changes in input prices. Other elasticities, such as the wage elasticity of demand for labor (η_A,η_M), or the elasticity of ρ with respect to the ratio of two outputs (η_ρ), will also matter, although not quite as strongly as σ^i in all cases. For instance, a_{ij}s can adjust even when $\eta_\rho = 0$, as for a small open economy, but not when the relevant σ^is are zero.

To complete the specification of the model, it is assumed that the economy has a fixed endowment of labor, $\bar{L}$. Workers employed in the two industries have been denoted above by L_A and L_M, and if L_U is the number of unemployed workers in the urban sector, the labor constraint can be written as:

$$L_A + L_M + L_U = \bar{L} \tag{4}$$

Equilibrium conditions for employers of labor in the two sectors, respectively, are $w_A = \rho q_1$, and $w_M = f_1$. Agricultural wage, w_A, is assumed to be flexible, so there will be no unemployment in the rural sector.

For deriving comparative–static results, it is convenient to follow a technique adopted by HT, namely, differentiate the equilibrium condition with respect to L_A and L_M to determine its slope in $L_A L_M$ space while taking the rest of the model into account. This procedure will generate several points of comparison between the two models along the way. In the original HT model, a simple sufficient condition emerges: when wage elasticity of demand for labor in manufacturing (η_M) is less than unity, E has a positive slope, which gives rise to the result shown in Figure 1 that an increase in minimum wage leads to a higher expected urban wage, followed by outmigration from agriculture and higher unemployment in the other sector. With interdependence in production, it will become clear presently, derivation is more complicated, and it is difficult to find any comparable sufficient conditions. To simplify the complex derivations somewhat, the SOE case is taken up first, and it is assumed that the specific factor in each sector is fully employed, so that r_A and r_M are positive. Under these assumptions, the sufficient condition mentioned above about η_M in an FGO economy becomes both necessary and sufficient.[7]

3.1 Effects of changing agricultural labor

Differentiating (1) partially with respect to L_A, holding L_M constant, we get:

$$\left.\frac{\partial E}{\partial L_A}\right|_{L_M \text{ const.}} = \rho \frac{dq_1}{dL_A} - \frac{L_M}{(\bar{L} - L_A)^2} f_1 - \frac{L_M}{\bar{L} - L_A} \frac{df_1}{dL_A} \tag{5}$$

When an agricultural worker moves to the city, mpl in agriculture increases a little, and the proobability of finding an urban job goes down (L_M is held constant in deriving (5)). These changes are captured by the first and second terms, respectively, in (5), and this is as far as an FGO model will go. In the present framework, agriculture's demand for the manufactured intermediate good also alters, increasing if, say, more fertilizer can compensate for reduced labor at the margin, and decreasing if factor proportions are fixed or if labor is complementary to the intermediate input. As X_{MA} changes, VMPL curve in agriculture will shift, number of workers will alter, and so on. In other words, q_1 is affected by L_A, as in the FGO model, and also by X_{MA}, the intermediate input in agriculture. Therefore, recalling that K_A is fixed, $dq_1/dL_A = q_{11} + q_{13} dX_{AM}/dL_A$.

It is easy to see that under the assumptions being made here (L_M, K_M, and p_M constant), $df_1/dL_A = 0$. Equation (5), therefore, can be rewritten as (6):

$$\left.\frac{\partial E}{\partial L_A}\right|_{L_M \text{ const.}} = \rho q_{11} + q_{13}\, dX_{MA}/dL_A - \frac{L_M}{(\bar{L} - L_A)^2} \cdot f_1 \tag{6}$$

Because $q_{11} < 0$ and $f_1 > 0$, equation (6) will be negative so long as its middle term is not positive. Otherwise, all the terms together will determine its sign. It is worth noting that (6) will reduce to the corresponding expression in the original HT model (SOE, ρ exogenous) if $q_{13} = 0$ or $dX_{MA}/dL_A = 0$, but that will not be the case generally.
As derived in the Appendix,

$$\frac{dX_{MA}}{dL_A} = \frac{a_{MA} q_1 [1 + (\sigma^A_{LM} - \sigma^A_{KM}) / \eta_A]}{1 - \rho_{MA} [1 + q_{13} N_A (\sigma^A_{LM} - \sigma^A_{KM}) / q_3]} \tag{7}$$

where ρ_{MA} is the share of the intermediate good in agriculture, σs are Allen–Uzawa partial elasticities of substitution between the intermediate and the primary inputs, and η_A is the wage elasticity of demand for labor in agriculture. The σs in both sectors are defined to be positive, which implies that the inputs are gross substitutes.[8] The sign of dX_{MA}/dL_A is ambiguous in general, although a number of special cases are readily seen.

If $\sigma^A_{LM} = \sigma^A_{KM}$, i.e., the intermediate good is equally substitutable for either primary factor, $dX_{MA}/dL_A > 0$. The same result follows if X_{MA} must be used in fixed proportions, i.e. a_{MA} is a constant, and these σs are zero. Equation (7) will again have a positive sign when the intermediate good is a better substitute for capital than labor $(\sigma^M_{KM} > {}^M_{LM})$ because $\eta_A < 0$. If $q_{13} = 0$, the denominator of (7) is positive, and the three elasticities in the numerator determine its sign. More precisely, $dX_{MA}/dL_M \gtrless 0$, as $[\, 1 + (\sigma^A_{LM} - \sigma^A_{KM})/\eta_A \,] \gtrless 0$. It might be interesting to spell out these conditions further, although so far as equation (6) is concerned, when q_{13} is zero, the sign and magnitude of dX_{MA}/dL_M hardly matter.

3.2 Effects of changing manufacturing labor

Differentiating (1) with respect to L_M, holding L_A constant, yields:

$$\left.\frac{\partial E}{\partial L_M}\right|_{L_A \text{ const.}} = \frac{\rho d q_1}{dL_M} - \frac{L_M}{\bar{L} - L_A}\frac{df_1}{dL_M} - \frac{f_1}{\bar{L} - L_A} \tag{8}$$

Analogous to equation (5) above, a small change in the number of workers employed in the manufacturing sector will alter the marginal product of labor as well as the probability of finding an urban job. These are the last two terms in (8) and apply to an FGO model as well. The first, $\rho dq_1/dL_M$, will be zero because L_A, K_A, and ρ are being held constant. The main question is: "Will demand for the intermediate good used in manufacturing shift?" And the answer lies in df_1/dL_M because f_1 alone is a function of X_{AM} in equation (8). By spelling it out and simplifying we get:

$$\left.\frac{\partial E}{\partial L_M}\right|_{L_A \text{ const.}} = -\frac{f_1}{\bar{L} - L_A}\left(1 + \frac{1}{\eta_M}\right) - \frac{L_M}{\bar{L} - L_A} f_{13}\frac{dX_{AM}}{dL_M} \tag{9}$$

where $\eta_M = f_1 / f_{11} L_M$, the wage elasticiity of demand for manufacturing labor. The first term in (9) depicts the HT sufficient condition discussed earlier: it will be positive if demand for labor in manufacturing is inelastic ($|\eta_M| < 1$). The second, dealing with the use of the intermediate good, is of particular interest. As derived in the Appendix,

$$\frac{dX_{AM}}{dL_M} = \frac{a_{AM}f_1[1 + (\sigma^M_{LA} - \sigma^M_{KA}) / \eta_M]}{1 - \rho_{AM}[1 + f_{13}N_M(\sigma^M_{LA} - \sigma^M_{KA})/f_{13}]} \tag{10}$$

This expression can have any sign. It is, however, symmetrical to (7), so the results derived there have an exact analog here: $dX_{AM}/dL_M > 0$ when $\sigma^M_{LA} \leq \sigma^M_{KA}$ or when the intermediate good is used in fixed proportions to total output. If the relevant cross–derivative of the production function (f_{13}) is zero, various elasticities will determine the sign of dX_{AM} $/dL_M$, but it drops out of equation (9), reducing it to the original HT expression (SOE, ρ exogenous). The two terms in (9) may be called the demand– and the intermediate–good (IG) effect; the former depending on η_M and the latter on the σs as well. The two might reinforce or offset each other. It is useful to recognize, though, that unlike the FGO economy (ρ exogenous), no restriction on η_M, certainly not $|\eta_M| < 1$, is either necessary or sufficient to make $\partial E/\partial L_M$ positive. In fact, it might be positive even when $|\eta_M|$ is unity and the first term in (9) vanishes.

Equations (6) and (9) have to be put together to determine dL_A/dL_M. The obvious case to consider is one in which the urban minimum wage is increased although other changes can also be analyzed without much difficulty.

4. INCREASING THE URBAN MINIMUM WAGE

The slope of E in $L_A L_M$ space is simply $-(\partial E/\partial L_M)/(\partial E/\partial L_A)$. It is clear from the discussion above that without restrictions on various parameters such as η_A, η_M, elasticities of substitution, etc., dL_A/dL_M cannot be signed because both $\partial E/\partial L_M$ and $\partial E/\partial L_A$ can be positive or negative. Therefore, when the initial equilibrium of the economy is perturbed by raising the urban minimum wage, it is not clear what will happen to variables such as migration, unemployment, and agricultural wage in the most general case, except that the outcome will depend on the elasticities, η_M, η_A, and σs. Only the first of these had any role to play in the original model. Cost–minimizing firms will modify their input choices when the minimum wage is increased, and a number of interesting results will emerge, although not when $f_{13} = q_{13} = 0$ because, regardless of what happens to intermediate demand, equations (6) and (9) then will be the same as in the original, FGO model. That will happen again if demand for intermediate inputs is not affected by labor movement (dX_{AM}/dL_M = dX_{MA}/dL_A = 0). In terms of the model as a whole, these two cases are very different, and one does not imply the other, but in the small open economy, they lead to the same conclusion, that intermediate goods do not affect the direction of migration flows.

It is worth noting at this point that although the two intermediate goods are treated symmetrically, and the signs of the terms involving them depend on the same parameters, albeit in different industries, their effect on the results of the model is far from symmetrical. For example, if $dX_{AM}/dL_M = 0$, conditions of labor demand (η_M, precisely) determines the sign of $\partial E/\partial L_M$, whereas when $dX_{MA}/dL_A = 0$, η_A does not appear in equation (6), whose sign, determined by technological factors (f_1 and q_{11}), is always negative. The direction of migration in this case will depend only on η_M. Many other examples of this type will emerge in this section. Unless specified otherwise, it will be assumed that f_{13} and q_{13} are positive, i.e. labor and the intermediate input are technical complements in both sectors.[9] A common point of initital equilibrium is also assumed in all cases, and we consider small changes in its vicinity.

4.1 <u>The Results</u>

We focus first on the manufacturing sector and try to derive some results comparable to the FGO model by setting q_{13} equal to zero. The intermediate good in agriculture now does not affect the sign of equation (6), which is negative and reduces to the corresponding expression in the original model. New results, therefore, mostly follow from (9), particularly from determinants of demand for intermediate goods, using the salient features of three–input production functions.

<u>Result 1</u>. *An increase in urban minimum wage, which increases expected wage immediately, will lead to outmigration from agriculture if there is no decrease in intermediate demand for the agricultural good.*

This result essentially says that, unlike the FGO case, $|\eta_M| < 1$ is not sufficient to make $\partial E/\partial L_M$ positive when intermediate goods are present. A condition is now attached to the well–known HT result from the original model; it holds unequivocally only if X_{AM} remains constant or increases. When the minimum wage is increased, there is a less than proportional decline in the rate of urban unemployment initially, so the expected manufacturing wage goes up. As firms respond to changes in relative input prices, X_{AM} might increase or decrease. The VMPL curve in manufacturing, accordingly, will shift up or down, requiring a further round of adjustments. In terms of equation (9), if $dX_{AM}/dL_A \leq 0$, $\partial E/\partial L_M > 0$ when $|\eta_M| < 1$. The result will still hold when $dX_{AM}/dL_M > 0$, provided that the first term in (9) dominates the second. There is a real possibility nonetheless that no one migrates out of agriculture, or that some workers actually move out of the city.

<u>Result 2</u> When the urban minimum wage increases, but expected wage does not initially change, there will be outmigration from agriculture if intermediate demand for the agricultural good increases.

In this case, $\eta_M = -1$, the first term in (9) zero, and there would have been no migration in either direction in the original HT model. Here the intermediate demand for the agricultural good is assumed to increase, i. e., $dX_{AM}/dL_M < 0$, which is certainly possible in (10), depending on the numerical values of its terms. Increase in minimum wage of, say, 10 percent, reduces urban employment by 10 percent right away, but firms try to substitute X_{AM} for labor, and a larger quantity of X_{AM} will cause VMPL in manufacturing to shift out. More workers will therefore be hired, thereby increasing the probability of urban employment and attracting migrants out of agriculture. If demand for manufacturing labor had been inelastic, the initial outmigration from agriculture would have been reinforced.

We turn next to the elasticities of demand and substitution that essentially determine the sign of dX_{AM}/dL_M. By setting η_M to unity, the first term in (9) becomes zero, and the role of intermediate good appears in sharper relief. A number of important results can then be derived, and we can also ask how they will alter when $|\eta_M| \gtrless 1$.

Result 3. If the intermediate good is equally substitutable for labor and capital in manufacturing, an increase in minimum wage will cause outmigration from manufacturing.

The two primary factors are now seperable from the intermediate input in manufacturing. From equation (10) it is clear that if $\sigma^M_{LA} = \sigma^M_{KA}$, $dX_{AM}/dL_M > 0$. Expression (9), therefore, will be negative (recall that $\eta_M = -1$). Increase in urban wage is exactly offset by a proportional decline in urban employment, so the labor market equilibrium is not upset in the first instance. But decrease in L_M leads to a reduction in X_{AM} as well, thereby causing VMPL curve in manufacturing to shift down. L_M decreases further and the probability of finding an urban job goes down. The gap in expected wages now favors the rural sector, so workers move from the city to the country.[10] The explanation applies *a fortiori* when $|\eta_M| > 1$. The expected urban wage goes down in the first instance, some workers move out of manufacturing, and decrease in the quantity of the intermediate good used there used there will add to the outflow of workers. With $|\eta_M| < 1$, the urban sector will attract migrants in the beginning, but when X_{AM} is reduced, migration flows will be definitely offset, perhaps even reversed in some cases.

Result 4. If the intermediate good is not separable from the primary factors in manufacturing, the direction of migration flows depends crucially on relative magnitudes of η_M and the σs.

This result picks up where the previous one leaves off: if $\sigma^M_{LA} \neq \sigma^M_{KA}$, the size of different elasticities will affect the sign of dX_{AM}/dL_M. Three possibilities can be illustrated in Figure.2 where some ancillary conclusions can also be derived.

First, $(\sigma^M_{LA} - \sigma^M_{KA}) = \eta_M$, i.e., the intermediate good is a better substitute for labor than for capital, but its effect is exactly offset by the elasticity of demand for manufacturing labor. In this situation, $dX_{AM}/dL_M = 0$, and $E = 0$ line – the locus of all equilibrium points –

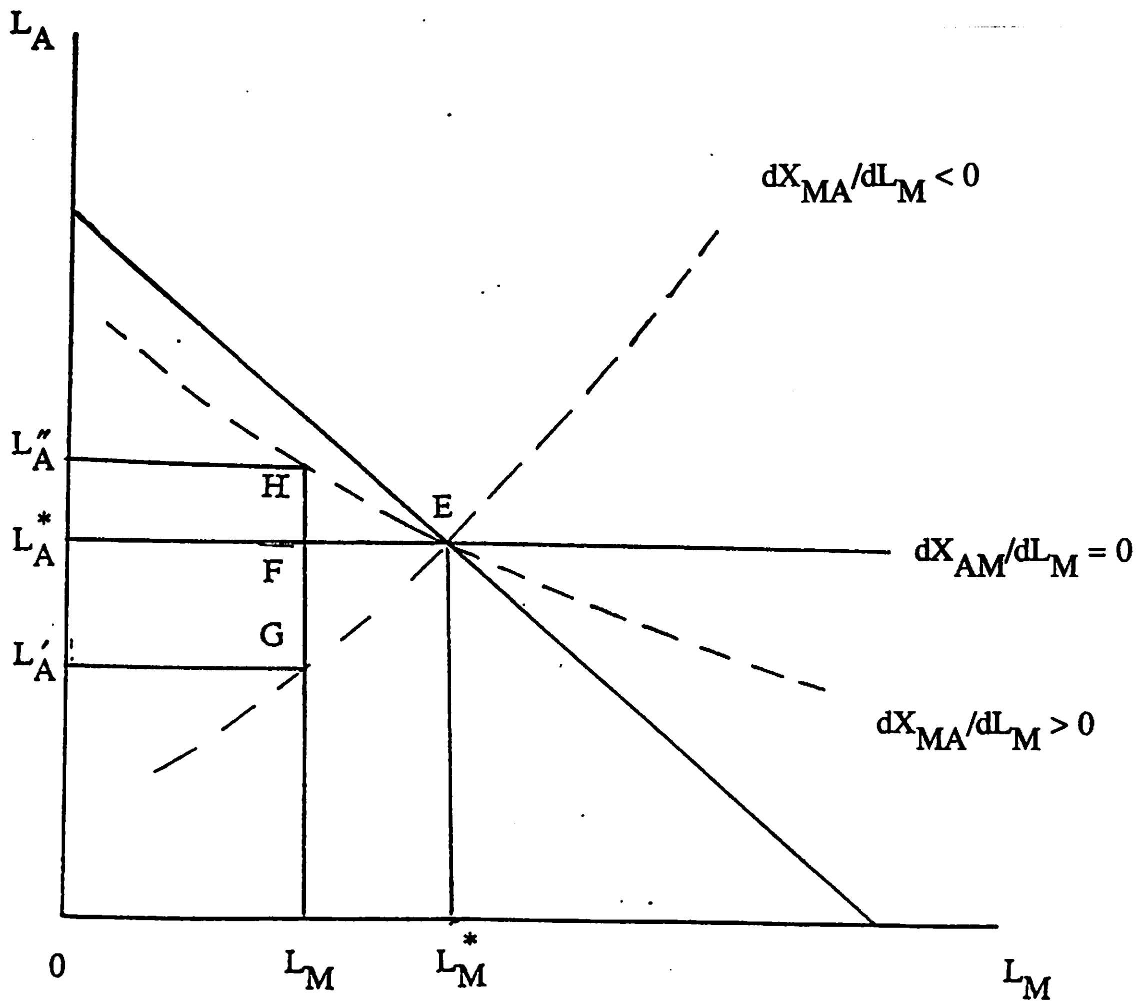
is parallel to the L_M axis. There is no movement of labor in either direction; the allocation of labor in initial equilibrium (L_A^*, L_M^*) prevails. Changing the urban minimum wage merely alters the urban unemployment rate because η_M is assumed to be unity. As the minimum wage is increased, the equilibrium point moves along the solid horizontal line from E to F and beyond in Figure 2.

The other two possibilities arise when dX_{MA}/dL_M is negative or positive. For the former, the upward sloping dashed line applies, and there is outmigration from agriculture. Reduction in L_M due to an increase in minimum wage increases the quantity of intermediate input. Since f_{13} is positive, the mpl curve for labor in that sector shifts out, so more workers are employed at the going minimum wage. Some workers then move out of agriculture to restore equilibrium in the labor market. An analogous explanation applies when dX_{MA}/dL_M is positive, and workers move from manufacturing to agriculture (the downward–sloping dashed line in Figure 2).

Since η_M has been assumed to be unity, the equilibrium at F is reached if $dX_{AM}/dL_M = 0$. In the other two cases, however, OL_M will not be the number of manufacturing jobs in the new equilibrium. When $dX_{AM}/dL_M > 0$, there will be a further reduction in urban jobs when the minimum wage is increased because a smaller quantity of the intermediate good will be used. Therefore, along the downward sloping dashed line in Fig. 2., the new equilibrium will be to the left of H. When $dX_{AM}/dL_M < 0$, some of the initial cut in jobs will be offset, so the new equilibrium will be to the right of G on the upward sloping dashed line in Figure. 2.

<u>Result 5</u>. *If the intermediate good in manufacturing cannot be substituted for labor, there will be outmigration from manufacturing when the minimum wage is increased.*

FIG. 2: URBAN MINIMUM WAGE AND RURAL–URBAN MIGRATION



This is one of several instances in which $dX_{AM}/dL_M > 0$, whose effect on migration flows has been discussed above and illustrated in Figure 2. Verify first that equation (10) will indeed be positive when $\sigma^M_{LA} = 0$. There is no change in expected urban wage, by assumption. As employment in manufacturing falls, the quantity of intermediate good is also reduced, causing the VMPL curve in that sector to shift down. Differential in expected wages now favors agriculture, so workers move out of the urban sector.

It is interesting to observe in this connection that this result will hold so long as the intermediate good is a better substitute for capital than for labor ($\sigma^M_{KA} > \sigma^M_{LA}$). If it cannot be substituted at all for capital, however, ($\sigma^M_{KA} = 0$, instead of σ^M_{LA}), the sign of dX_{AM}/dL_M becomes uncertain, and it is not clear what will happen to migration flows.

<u>Result 6</u> *When the intermediate good must be used in fixed proportions to output, an increase in the urban minimum wage will lead to outmigration from the urban sector.*

In early econometric studies of production functions (Brown (1967), for example), it was often assumed that intermediate goods were a fixed proportion of total output, so they were subtracted from output to compute value added, which then became the dependent variable in the equation to be estimated. Although this approach is not as popular now, there can be activities in which the ratio of intermediate goods to total output is fixed. If the manufacturing sector is like that, workers will move out of the urban sector when the minimum wage is raised even though the expected urban wage does not increase.

Both the proof and economic interpretation of this proposition are straightforward. Note first that fixed proportions in the present context imply that σ^M_{LA} and σ^M_{KA} are zero. In equation (10), therefore, $dX_{MA}/dL_M > 0$, and $\partial E/\partial L_M$ is negative in (9). It follows that the E = 0 line will slope downwards in Figure 2. When the urban minimum wage is increased, L_M declines proportionately ($\eta_M = -1$), expected urban wage does not alter, and no migration in either direction takes place initially. However, manufacturing output falls, and because of the assumption of fixed proportions, X_{AM} is also reduced. Since $f_{13} > 0$, the VMPL curve in manufacturing shifts down, and L_M declines further. The reduced probability of urban employment induces some workers to move from the city to the rural sector.

4.2 Intermediate Good in Agriculture

To examine the role of the intermediate good used by agriculture, it is assumed that q_{13} is positive and $f_{13} = 0$. Equation (9) is now the same as in the original HT model, and the focus shifts to equation (7) where the middle term involving X_{MA} can enhance or ameliorate the effect of the other two, which are negative. The sign of $\partial E/\partial L_A$, invariably negative in the FGO model, could be reversed.

Result 7. If the wage elasticity of demand for urban labor is unity, increase in minimum wage will not lead to migration in any direction.

The expected urban wage remains unchanged in this case, and workers stay where they are, the same outcome as in the original model. Input prices do not adjust (ρ is assumed constant and w_A does not move), so the labor market continues to be in equilibrium is not e of the higher minimum wage. By contrast, η_A, the corresponding elasticity in agriculture, can do litle more than affect the sign of dX_{MA}/dL_A sometimes.

Comparison with Result 2, where also the expected urban wage remains constant, is interesting, because increase in minimum wage does lead to outmigration from agriculture there. As discussed earlier, dX_{AM}/dL_M can be positive in (10) even when $f_{13} = 0$, but that does not cause any more employment in manufacturing or migration. Effects of setting f_{13} or q_{13} equal to zero, thus, are asymmetrical.

For other results, it is necessary to assume that η_M is not unity (otherwise, equation (9) becomes zero). To get a comparable reference case, assume that $|\eta_M| < 1$, so that, barring some complication from the intermediate good, there is outmigration from agriculture when the urban minimum wage is increased (the FGO outcome). Unfortunately, there is no general sufficient condition under which $\partial E/\partial L_A$ will be positive, and the obvious sufficient conditions for its being negative (q_{13} or $dX_{MA}/dL_A = 0$) effectively rule out what we are trying to examine because the model collapses to the FGO specification. We, therefore, assume that $\partial E/\partial L_A$ continues to be negative and concentrate on some special cases to illustrate how migration flows might be affected in this framework. Most of the results are analogous to the ones derived above, emanating from movements along and shifts in the VMPL curve in the vicinity of the initial equilibrium, although in agriculture this time.

Result 8. A given increase in the urban minimum wage will lead to more (less) outmigration from agriculture than in the reference case if there is a decrease (increase) in the quantity of intermediate good used in agriculture.

This is about the sign of dX_{MA}/dL_A in (7). If it is positive, as workers move out of agriculture (recall that expected urban wage is assumed to go up), the quantity of manufactured good used in agriculture goes down. Since $q_{13} > 0$, the VMPL curve in that sector shifts down, agricultural wage falls or does not rise by as much, so more workers move out of the rural sector. In Figure 2, the E = 0 line, still positive because $\partial E/\partial L_A$ has been assumed to be negative, will be steeper than in the reference case. An analogous reasoning applies when dX_{MA}/dL_A is negative.

Result 9. If the intermediate good can be substituted equally for labor and the specific factor in agriculture, there will be greater outmigration from agriculture for a given (small) change in urban minimum wage.

The primary and intermediate inputs are now separable in agricultural production. When $\sigma^A_{LM} = \sigma^A_{KM}$ in (7), $dX_{MA}/dL_A > 0$. In equation (6), therefore, $\partial E/\partial L_A$ will be less negative or smaller in absolute value. Since $\partial E/\partial L_M$ is the same as in the FGO case, it follows that dL_M/dL_A will be steeper, implying greater outmigration from agriculture when the urban minimum wage is increased. In this situation, even without the intermediate good, some workers would have left the rural sector. Now X_{MA} also decreases, the VMPL curve in agriculture shifts downward, and the gap in expected wages between the two sectors is bigger. Further outmigration from agriculture will be needed to restore equilibrium in the labor market.

<u>*Result 10*</u>. *If the intermediate good must be used in a fixed ratio to total output in agriculture, for a given (small) change in the urban minimum wage, more workers will move out of agriculture than in the reference case.*

The two elasticities of substitution are zero, and in equation (7), $dX_{MA}/dL_A = a_{MA}q_1/(1 - \rho_{MA})$ which will be positive. Consequently, $\partial E/\partial L_A$ will be less negative, and the positively sloped E = 0 line in Figure 2 will rotate counter–clock–wise to indicate larger outmigration from agriculture. The outcome will be the same as in Result 9, and the explanation given there applies here as well.

This result is analogous to Result 6 derived earlier, but it is worth emphasizing that there has to be some outmigration initially before the intermediate input has any effect on migration. In Result 6, there would have been outmigration from agriculture even when η_M was unity and the expected urban wage remained unchanged. Here, when $\eta_M = 1$, no one will move out of agriculture, with or without the intermediate good.

<u>*Result 11*</u>. *If the intermediate good cannot be substituted for labor in agriculture, larger outmigration from agriculture will take place than in the reference case.*

In this case, both the numerator and the denominator of (7) will be positive, and so also will be dX_{MA}/dL_A. This result thus is similar to the previous two, although the precise outcome might be slightly different here because dX_{MA}/dL_A would not have the same value as when σ_A and σ_M are zero.

Two elements common to several propositions derived above (Results 9 – 11 here, and 3, 5 and 6 in Section 4.1) are: (i) labor and the intermediate good in each sector are positively correlated, and (ii) migration flows are accentuated. Of course, there will be similar shifts in the underlying VMPL curves in both sectors because of the assumptions about f_{13} and q_{13}. In this section, the denominator of dL_M/dL_A gets smaller in absolute value, whereas in the previous section, the numerator was getting larger. The net effect is the same: for small changes, the E = 0 line in Figure 2 (positively sloped), becomes steeper.

These results give a good idea of how the analysis is enriched when the two sectors are linked together in production. We have by no means exhausted the possibilities, though, because other results can be derived by setting $\sigma^A_{KM} = 0$, or by considering the sign of $(\sigma^A_{LM} - \sigma^M_{KM})/\eta_A$, and so on. The logic, however, will be the same as in the results presented thus far, so it is doubtful that anything startlingly different will come to light. This paper began with the observed phenomenon of rural–urban migration in many developing countries, and went on to incorporate salient features of their production structures into the model. One must ask if these propositions ultimately have any policy content. This issue, rather than more variations on the theoretical results, is taken up next.

4.3 Some Policy Implications

Policies usually recommended in the literature to deal with large migration flows to the cities have centered on taxes and subsidies of various sorts (Bhagwati and Srinivasan (1974), Basu (1980), to name just a few), restrictions on migration (Harris and Todaro (1970), and so on. The analysis here suggests that the structure of production itself might provide some promising avenues to explore.

4.3.1 Production Linkages and Migration Policy

Whenever the urban minimum wage is raised, and expected wage in that sector goes up, the results presented above show that intermediate goods might generate two possible forces to stem outmigration from agriculture: a downward shift in the VMPL curve in manufacturing and an opposite shift in the VMPL curve in agriculture, $dX_{AM}/dL_M > 0$ and $dX_{MA}/dL_A < 0$. The first will make the urban sector less attractive by further reducing urban employment and the probability of finding a job there, while the second will increase the VMPL in agriculture. The gap in expected wages between the two sectors, thus, will tend to diminish. It is clear from equations (7) and (10) that signs of these two terms depend on various elasticities of substitution, and on wage elasticity of demand for labor in the two sectors.

Now, intermediate goods with such properties are well within the realms of current technology. Looking beyond the theoretical confines of the analysis so far, one may think of several situations where intermediate inputs and the primary factors affect each other's marginal product, creating substitution possibilities for both labor and capital. In agriculture, for instance, certain fertilizers and herbicides cut down on the frequency of weeding, thereby reducing the use of labor. For some of them aerial sprays or other capital–intensive applicators will be needed – which would increase capital requirements – while others are more efficacious when applied manually, thereby requiring more labor. Similar opportunities arise in manufacturing as well. Use of robots on automobile assembly lines significantly reduces breakage and spillage of intermediate inputs such as nuts and bolts, batteries, and paint. Even in simple manufacturing activities devoted to processing natural raw materials, say, natural rubber or sugar refining in Malaysia (the group of NRB industries mentioned above), better storage facilities can significantly reduce spoilage in some cases and cut back on raw material required for a given quantity of final output, an example of substituting capital – may be both labor and capital for the intermediate good.

More examples of this sort are possible, perhaps varying from country to country, or across industries or regions within the same country. In agriculture, the determining factors might be the type of crop, sources of irrigation, etc. Which particular mix of industrial and agricultural activities works best in a given situation is by and large an empirical matter. The point worth emphasizing, though, is that there is nothing in the known technology of manufacturing or farming which will *ipso facto* rule out the sort of shifts in VMPL curves in the two sectors which will offset outmigration from agriculture when expected urban wage goes up.

A country can set up urban industries that depend heavily on imported intermediate goods – ranging from telephones and typewriters in the service sector to designs and components for electronics assembly – or those which use domestically produced inputs. Agriculture, likewise, can rely on tractors, fertilizers, and pesticides produced abroad, or some of these can be manufactured within the country. Alternative strategies will have rather different effects on migration flows between the two sectors. For the Malaysian example mentioned in the Introduction, there is no information on the parameters identified in this paper (mainly ηs and σs in various activities), so it is difficult to evaluate the adopted policies from a migration perspective. One can nonetheless surmise that the FTZs did not generate much of what we have called the "IG effect". The NRB industries fared much better in this regard. Malaysia could have opted for more inter–linked activities instead of the relatively isolated FTZ industries.[11]

4.4. The Results: Some Limitations

Although the particular results presented above provide useful insights into how intermediate goods affect migration flows in a HT–type small open economy, and the Malaysian example illustrates some aspects of them, the broad conclusion has to be that in the most general case, migration flows will depend on empirical values of various parameters even under simplifying SOE assumption of given output prices. One intermediate good at a time was introduced above, still a number of restrictions on individual parameters were needed here and there to derive definite results. Analytical tools will be even less efficacious when both sectors use intermediate inputs simultaneously and output prices are endogenous.

Changing output prices will complicate the analysis considerably by providing an additional avenue for relative input prices to change in both sectors. In equations (6) and (9), for instance, varying quantities of labor in one sector do not directly affect the demand for the intermediate good in the other, but that would inevitably happen if output prices adjust. There will be extra terms involving dX_{AM}/dL_A in (6) and dX_{MA}/dL_M in (9), making it even more difficult to sign these expressions and reach any definite conclusions on analytical grounds alone. However, for theoretical analysis as well as policy making, it is important to ask how various SOE results fare in a closed economy because the SOE assumptions will not always hold in the real world. We therefore turn to a simple cge model to illustrate some comparable results for the two types of economies.

5. SOME NUMERICAL EXAMPLES

There are two obvious approaches for constructing numerical illustrations: first, plug in some values for various elasticities, factor shares, etc. in equations (6) – (10) and compute dL_M/dL_A; or second, specify a complete model, determine its equilibrium for various levels of the urban minimum wage, and see what happens to L_A and L_M. The first approach is easier, although there is no way of ensuring that the data will be internally consistent. One can pick factor shares which add up to unity, and elasticities of substitution which satisfy the underlying stability condition for the relevant production functions (see footnote 9 above), but there is no guarantee that an actual production function with the specified σs will in fact generate given factor shares. In these regards, the second approach is much better because, for given σs, factor shares will be computed in the process of reaching an equilibrium instead of being specified arbitrarily. The main difficulty with this approach in the present context is that the equations described above do not define a full general equilibrium model. For example, there are no utility functions, nor any demand functions derived from some maximization rule. Finding numerical approximations of parameters such as η_M and η_A has its own difficulties. Therefore, instead of trying to construct exact numerical examples of the analytical results derived above – many of which are quite straightforward anyhow – we set up a cge model and solve it numerically to determine urban unemployment rate and migration flows for a range of parametric values, allowing both exogenous and endogenous output–price ratios while retaining the essential features of the theoretical structure in this paper.

5.1 The Computable Model

For computational purposes, specific functional forms have to be written down. It is assumed that technology is given by constant elasticity of substitution (CES) production functions, and inputs are chosen so as to minimize unit costs. The urban minimum wage is fixed in terms of the urban good which serves as the numeraire. The probability of finding an urban job and the condition of labor market equilibrium are as given in Section 3 above. A number of new elements nonetheless are needed to specify the model completely and improve it in some respects. For example, in the original HT model, the relative output–price is simply a function of the ratio of two outputs. Here it is assumed that consumption demands are determined by workers who maximize a CES utility function subject to the income produced in the economy. Firms generate intermediate demands for the two goods, and output prices then result from interactions between demand and supply as the model is solved. Again, instead of simply picking a minimum wage ($w_M = \bar{w}_M$), a ratio of urban to rural wages is specified, so the model is homeogeneous of degree zero in all prices. In the SOE case, a given output–price ratio is maintained by exporting the good which becomes relatively cheaper and importing the other, always balancing trade.[12] Workers are assumed to have fixed endowments of labor and the specific factors, all set at unity.

5.2 The Benchmark and Some Results

The benchmark equilibrium is reported in the very first row of each table. For example in Table 2, 62 percent of the labor force is in manufacturing, all employed, ρ is 0.92 and wage rate in either sector is 1.51. For other results, various elasticities of substitution are used, the urban minimum wage is fixed at 1.89 (25 percent above the full–employment wage), and for the SOE case, ρ is assumed to be 0.6, which is roughly in the middle of the values computed for the closed economy in Table 2. There are obviously many possible combinations of σs, ρ, and the urban minimum wage that can be used. We select a dozen of them to see what happens to migration flows and unemployment under alternative specifications in a closed and a small open economy. In two of the twelve cases reported in Tables 1 and 2, when the minimum wage is increased above the full employment level, there are more workers in the urban sector than in the initial equilibrium.

Comparing the two tables, row 1 provides the full employment benchmark in the absence of a minimum wage. When output price ratio is held down to 0.6, a greater proportion of the workforce is in the urban sector. In fact, except in row 5, where the output–price ratios for the two economies are very close, migration flows and unemployment rates are rather different. The most dramatic difference occurs in row 4 where only 31 percent of the workers are in the city when output–price ratio is fixed, but this number goes up to 71 percent when that price ratio is determined within the economy. Urban unemployment rate is about 20 percent higher in the closed economy. This case would be of great interest to a policy maker facing massive outmigration from the rural sector. If output prices are endogenously determined, it would be better to set up urban industries with high rather than low elasticities of substitution (row 3, rather than 4 in Table 2). In this small open economy, manufacturing activities to be avoided are those with unitary elasticities of substitution.

Tables 3 and 4 are parallel to the first two tables, without intermediate goods though. Except in row 1, a greater proportion of all workers is in manufacturing when ρ is endogenous. Unemployment rates are also higher in the closed economy. The biggest difference is in row 6

TABLE 1: URBAN MINIMUM WAGE AND MIGRATION IN A SMALL OPEN ECONOMY (SOE) WITH INTERMEDIATE GOODS [a] ($\bar{w}_M = 1.89, \bar{p} = 0.6$)

	Specification [b]	Urban Labor ($L_M + L_U$)	Unemployment Rate $L_M/(L_M + L_U)$	Rural Wage w_A
1.	ALL $\sigma s_A = 1.0$	0.85	—	1.50
2.	$\sigma^M = \sigma^A = 1.0$	0.52	0.68	0.74
3.	$\sigma^M = 2.5, \sigma^A = 1.0$	0.31	0.64	0.77
4.	$\sigma^M = 0.6, \sigma^A = 1.0$	0.37	0.68	0.66
5.	$\sigma^M = 1.0, \sigma^A = 2.5$	0.64	0.67	0.72
6.	$\sigma^M = 1.0, \sigma^A = 0.5$	0.41	0.68	0.79

a Input shares are assumed to be

	Agriculture	Manufacturing
Labor	0.4	0.6
Specific factor	0.3	0.2
Intermediate Good	0.3	0.2

b σ^M denotes all elasticities of substitution in Manufacturing which are assumed to be equal to each other. σ^A, likewise represents all elasticities of substitution in agriculture, again assumed equal.

TABLE 2: URBAN MINIMUM WAGE AND MIGRATION IN A CLOSED ECONOMY WITH INTERMEDIATE GOODS ($\bar{w}_M = 1.89$) [a]

	Specification	Urban Labor $(L_M + L_U)$	Unemployment Rate $L_U/(L_M + L_U)$	Rural Wage w_A	Output–Price Ratio ρ
1.	ALL σs = 1.0	0.62	—	1.51	0.92
2.	$\sigma^M = \sigma^A = 1.0$	0.62	0.73	0.66	0.51
3.	$\sigma^M = 2.5, \sigma^A = 1.0$	0.32	0.85	0.33	0.28
4.	$\sigma^M = 0.6, \sigma^A = 1.0$	0.71	0.82	0.42	0.34
5.	$\sigma^M = 1.0, \sigma^A = 2.5$	0.64	0.67	0.72	0.62
6.	$\sigma^M = 1.0, \sigma^A = 0.5$	0.61	0.75	0.64	0.48

a Input shares are as in Table 1. $\bar{w}_M = 1.89$ everywhere except in row 1, the full employment case, in which $w_M = w_A = 1.51$.

b σ^M denotes all elasticities of substitution in manufacturing which are assumed to be equal to each other. σ^A, likewise, represents all elasticities of substitution in agriculture, again assumed equal.

TABLE 3: URBAN MINIMUM WAGE, MIGRATION AND UNEMPLOYMENT IN A CLOSED ECONOMY WITH NO INTERMEDIATE GOODS ($\bar{w}_M = 1.89$) [a]

	Specification	Urban Labor $(L_M + L_U)$	Unemployment Rate $L_U/(L_M + L_U)$	Rural Wage w_A	Output–Price Ratio ρ
1.	All σs = 1.0	0.60	—	1.44	1.06
2.	$\sigma^M = \sigma^A = 1.0$	0.60	0.76	0.61	0.45
3.	$\sigma^M = 2.5, \sigma^A = 1.0$	0.36	0.73	0.53	0.50
4.	$\sigma^M = 0.6, \sigma^A = 1.0$	0.70	0.93	0.20	0.12
5.	$\sigma^M = 1.0, \sigma^A = 2.5$	0.66	0.70	0.67	0.56
6.	$\sigma^M = 1.0, \sigma^A = 0.5$	0.55	0.81	0.55	0.36

a Input shares are assumed to be

	Agriculture	Manufacturing
Labor	0.4	0.6
Specific factor	0.6	0.4

σs refer to elasticity of substitution between labor and the specific factor. $\bar{w}_M = 1.89$ everywhere except in row 1, the full employment case, in which $w_A = w_M = 1.44$.

TABLE 4: URBAN MINIMUM WAGE, MIGRATION AND UNEMPLOYMENT IN A SMALL OPEN ECONOMY WITH NO INTERMEDIATE GOODS ($\bar{w}_M = 1.89$, $\bar{p} = 0.6$) [a]

	Specification	Urban Labor ($L_M + L_U$)	Unemployment Rate $L_U/(L_M + L_U)$	Rural Wage w_A
1.	All σs = 1.0	0.77	—	1.30
2.	$\sigma^M = \sigma^A = 1.0$	0.54	0.68	0.75
3.	$\sigma^M = 2.5, \sigma^A = 1.0$	0.33	0.68	0.60
4.	$\sigma^M = 0.5, \sigma^A = 1.0$	0.57	0.68	0.78
5.	$\sigma^M = 1.0, \sigma^A = 2.5$	0.64	0.68	0.70
6.	$\sigma^M = 1.0, \sigma^A = 0.5$	0.48	0.68	0.79

a Input shares are assumed to be

	Agriculture	Manufacturing
Labor	0.4	0.6
Specific factor	0.6	0.4

σs refer to elasticity of substitution between labor and the specific factor. $w_M = 1.89$ except in row 1, the full employment case, where $w_A = w_M = 1.30$.

where outmigration from the urban sector is about 15 percent bigger in the small open economy, and unemployment rate is much higher in the closed economy, but neither is quite as dramatic as row 4 in Tables 1 and 2.

5.3 Comparing the FGO and SIO Economies

It is also useful to compare Tables 2 and 3, and Tables 1 and 4, to see what effect intermediate goods have because the only difference between the two types of economies is in the initial share of such goods. Considering closed economies first, the urban population forms about the same proportion of the total whether there are production linkages or not. The biggest difference is about 10 percent, in row 6, favoring the FGO economy. For anyone interested mainly in migration flows, thus, there is not much to choose between an SIO and an FGO economy in these examples so long as the commodity–price ratio is endogenous outmigration from the city. The biggest adjustment shows up in row 3 where elasticity of input substitution in manufacturing is quite large, although even in this case, intermediate goods do not affect migration flows much. Their main effect seems to be on the urban unemployment rate (0.73 against 0.85 in the FGO economy). In the SOE case, the FGO economy generally has a higher proportion of the total population in the urban sector, although unemployment rates are very similar in Tables 1 and 4.

While these comparisons are interesting, they may not be altogether warranted, for there is no definite way of determining when an FGO economy is strictly comparable to an SIO economy. There are common elements, to be sure: specifications in each row are identical, the share of labor has been kept constant, and the same type of utility and production functions are used. There is also the assumption of perfect competition, unchanged decision rules for all agents, and identical urban minimum wage. All these nevertheless will generally not ensure the same output–price ratio or full employment wage in the two types of economies. For instance, the minimum wage of 1.89 is 26 percent above the full employment wage in Table 1 and 45 percent above the corresponding number in Table 4. Likewise, ρ=0.69 is 65 percent of the commodity–price ratio in Table 3 and 75 percent in Table 2.

It is not clear if setting the minimum wage at 26 percent above the full employment level in Table 4 or at some other number will necessarily yield better comparisons than the ones made here. It is also doubtful that experimenting with different commodity–price ratios, shares of intermediate goods, and minimum–wage levels will prove any general propositions. There are far too many possibilities and really no basis for prefering one set of initial values, parameters, and data to another. The numbers in these tables illustrate some plausible, internally consistent, outcomes in the two types of economies. They are of special interest in situations where theory does not produce clear–cut results or theoretical formulation turns out to be unwieldy and intractable, as in the closed–economy case. The real challenge, both for theory and applications, is to work with an actual input–output table where the data and other empirical information might help to isolate some particularly plausible cases. That must await future work, given the emphasis of this paper on analytical results.

8. CONCLUSION AND SUMMARY

This paper has recast the Harris Todaro model of rural urban migration into an input–output framework so that each sector produces an intermediate input for the other in addition to a final good. The model, although rather simple, is designed to incorporate several aspects of the new and complex production structures which are emerging in many third–world countries. There is thus another linkage, on the production side, in addition to the linkages in final demand and in the labor market postulated in earlier studies. Several results from the original model do not hold in the new framework. For example, when expected urban wage increases initially, there may not be outmigration from agriculture. It is argued that changes in the quantities of intermediate goods will cause VMPL curves to shift. Any alteration in the minimum wage will affect not only the urban workforce but also the intermediate input used in manufacturing. Intermediate demand for the agricultural good thus will adjust which, in turn, will have repercussions on demand for the manufactured good.

Many results are derived in which migration flows and unemployment rates are affected by the structure of production. Some numerical illustrations, based on a computable general equilibrium model, are presented to illustrate the role of intermediate goods for both a closed and a small open economy.

Growing urban populations are posing unprecedented challenges to policy makers in many developing countries. This paper adds another dimension to the analysis of rural urban migration and suggests that the structure of production in itself might hold a key to solving the problem in some cases. Given the right combination of parameters, several situations occur in which large outflows of rural labor do not go hand in hand with increased minimum wage in the urban sector.

APPENDIX

We shall derive some expressions which determine how a change in L_A or L_M affects demand for intermediate goods. These expressions affect most of the results derived in the paper and are needed in equations (10) and (12).

Input choice depend on relative input prices. In particular,

$$a_{AM} = a_{AM}(w_M, r_M, p_A) \text{ and}$$

$$a_{MA} = a_{MA}(w_A, r_A, p_M).$$

Also, $X_{AM} = a_{AM} \cdot X_M$ and $X_{MA} = a_{MA} \cdot X_A$.

Differentiating X_{AM} with respect to L_A we get:

$$dX_{AM}/dL_A = a_{AM}\, dX_M/dL_A + X_M\, da_{AM}/dL_A \quad \text{(A.1)}$$

Since K_M is assumed to be fully employed and L_M is held constant in deriving equation (10) in the paper, we can write:

$$dX_{AM}/dL_A = a_{AM}f_3\, dX_{AM}/dL_A + X_M[(\partial a_{AM}/\partial w_M)(dw_M/dL_A) + (\partial a_{AM}/\partial r_M)(dr_M/dL_A)] \quad \text{(A.2)}$$

The notation is the same as in the paper. For production functions of the type used here, σs, say, σ^M_{LA}, which is the partial elasticity of substitution between labor and the intermediate good in manufacturing, can be defined as:

$$\rho_{LM}\, \sigma^M_{LA} = (\partial a_{AM}/\partial w_M)(w_M/a_{AM})$$

The term between the square brackets in (A.2) then becomes

$$(\rho_{LM}\sigma^M_{LA}a_{AM}/w_M)(dw_M/dL_A) + (\rho_{K2}\sigma^M_{KA}a_{AM}/r_M)(dr_M/dL_A)$$

For further simplification, it is necessary to derive dw_M/dL_A and dr_M/dL_A. Now, $w_M = p_M f_1$ and $f_1 = f_1(L_M, K_M, X_{AM})$

$$\therefore dw_M/dL_A = p_M f_{13} dX_{AM}/dL_A \quad \text{(A.3)}$$

In this model r_M is determined as a residual, i.e.

$$K_M r_M = p_M X_M - w_M L_M - p_A X_{AM}$$

Full employment of K_M is always assumed, so it is set equal to unity by a choice of units. Also, p_A, and p_M are constant because of the SOE assumption. Therefore,

$$dr_M/dL_A = p_M dX_M/dL_A - L_M dw_M/dL_A - p_A dX_{AM}/dL_A \tag{A.4}$$

Substituting (A.3), (A.4), etc. into (A.2) we get:

$$dX_{AM}/dL_A\,[1 - a_{AM}f_3 - \rho_{LM}\sigma^M_{LA}a_{AM}p_M f_{13}X_M/w_M$$
$$- X_M\rho_{KM}\sigma^M_{KA}(p_M f_3 - L_M p_M f_{13} - p_A)/r_M] = 0$$

Since the term within the square brackets generally will not be zero, $dX_{AM}/dL_A = 0$.

A similar procedure yields the expression for dX_{AM}/dL_M, etc., in equations (7) and (10).

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FOOTNOTES

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[1]It is assumed throughout this paper that all jobs in the urban sector are in manufacturing subject to an institutionally fixed minimum wage. The possibility of more than one type of urban job, the "informal" or "urban subsistence sector" has been discussed in a number of studies (Fields (1975), Cole and Sanders (1985)), but it is not considered here in order to focus on production linkages rather than on structure of labor markets.

[2]See, for example, Oberai (1983), or Peek and Standing (1982), although neither of these deals with the HT model per se.

[3]The direct employment coefficient is a_{LM} or a_{LA} in our notation, where M and A denote manufacturing and agriculture, respectively Spread effects measure how a change in one sector affects employment in activities linked with it, and the total coefficient is the sum of the direct–and spread effects. For example, a_{MA} is defined in this paper as the quantity of manufactured good used as an intermediate input for each unit of agricultural output. The total employment coefficient for agriculture, then, will be $a_{LA} + a_{MA} \cdot a_{LM}$. Definitions for the other sector are analogous.

[4]For example, there is no mention of them in two otherwise excellent surveys of employment and migration issues, Yap (1974), and Squire (1981).

[5]Some of these assumptions, although criticized in the literature, are retained for comparability with earlier work, and also because the analysis here is mainly concerned with structure of production, rather than with alternative specification of employment probabilities, rates of labor turnover, etc.

[6]If $\bar{L}$ denotes the total labor force, this condition can be written as $w_M L_M = w_A(\bar{L} - L_A)$, which will be satisfied by a rectangular hyperbola through A and B.

[7]In this case,

$$\frac{dL_A}{dL_M} = - \frac{\frac{f_1}{(\bar{L} - L_A)}(1 + \frac{1}{\eta_{MW}})}{\rho q'' - f_1 L_M/(\bar{L} - L_A)^2}$$

which is invariably positive when $|\eta_{MW}| < 1$ because the denominator is negative.

[8]Definitions of σs are from Allen (1967), pp.504, 505. Some σs can be negative (complementary inputs) when a production function has more than two inputs, but that possibility is ruled out here for simplicity. Also see footnote 9 in this connection.

[9]Neary (1988) shows that this is one of several sufficient conditions for the stability of the model with a three–input production function. Technical complementarity implies that production is "normal," the stability condition discussed by Funatsu (1988). The third input in both cases is land, not an intermediate good produced in the other sector, and it is not clear if the condition still applies. The important point for the ensuing analysis, however, is that there is that restrictions on these cross derivates of the production function do not restrict the Allen–Uzawa elasticities of substitution. For example, $f_{13} = 0$ does not imply that σ^M_{LA} is zero, and so on. The stability condition for factor demands in terms of the σs for, say, manufacturing (Allen (1967, pp. 503 – 505)), is:

$$\rho_{LM}\,\sigma^M_{LA} + \rho_{KM}\,\sigma^M_{KA} > 0.$$

[10]A smaller quantity of X_{AM} will lead to a downward shift in the demand for agricultural good which might entail a reduction in output of that good, a reduction in its net imports (if that is what keeps the output–price ratio constant), or both. There will be a different (additional) adjustment in the labor market corresponding to each outcome. The present model, however, is not rich enough to distinguish between these alternatives. For a closed economy, in such a situation, there will unquestionably be a shift in the demand curve for the agricultural good. Some implications of that for migration flows will be discussed in Section 5 below.

[11]This is not intended to be a criticism of Malaysia's industrial policy which has been designed to address numerous objectives such as export promotion, job creation, and redistribution. Rural–urban migration per se is rarely mentioned as a major policy concern in Malaysia.

[12]The wage premium is actually specified in real terms: $w_M/p_M = (1+\gamma)w_A/p_A$. If output prices are left out, the model will have a constant unemployment rate for each γ, regardless of elasticities of substitution. See, for example, Imam and Whalley (1985), or substitute the relevant terms into equation (1). This and other aspects of the cge model (although without intermediate goods) are discussed at length in Bhatia (1989). The computations here were done with the help of the algorithm MPS.GE written by Tom Rutherford. I am grateful to him and to Carlo Perroni for many helpful discussions about various aspects of these numerical examples.