U.S. Farm Migration: An Application of the Harris-Todaro Model

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C O N T E N T S

FIGURE

A B S T R A C T ——————————————————————————

Although the Harris-Todaro model has been conventional-
ly used to account for the mechanism of rural-urban migrato-
ry movements in developing countries, it is quite a general
representation of the forces producing farm migration in
relation to economic development that should apply to any
society. In view of this, the author has reformulated the
Harris-Todaro model to apply to the long-term U.S. experi-
ence. Statistically, it has been demonstrated that the
historical movement of U.S. population off farms can be well
represented by a reduced form Harris-Todaro model in which
unemployment is taken as exogenous.

I. Introduction

Historically, steady migration from farm to city has been one of the most obvious concomitants of economic development. Indeed, among characteristics of the world's developing nations, the highest correlation with GNP per capita is the inverse relation to fraction of population found on farms. So great is the urge to desert the farm that the exodus persists even in the face of inadequate urban facilities and high levels of urban unemployment. The consequent rate of growth of the urban population sometimes outstrips the needs of industrialization and is perceived as a problem of "over-urbanization" by policy makers who become concerned about ways to stem the flood.

In a pioneering work, Harris and Todaro tried to account for this propensity of developing populations to move from farm to city in the face of high and continuing urban unemployment. They concluded that the basic cause was an urban wage rate so much higher than rural earnings that city life promised higher expected earnings, even after unemployment is taken into account.

A substantial volume of research has centered on the Harris-Todaro model. (See Todaro, 1976 for a summary and bibliography of some of the important work.)   But most existing studies focus on the experience of very poor nations. To be sure, these are interesting and important cases, but they are special, whereas the Harris-Todaro model is a quite general representation of the forces producing farm migration in connection with economic development that should apply to any society.

The economic history of the United States provides an interesting test of the generality of the Harris-Todaro model. For one thing, although the past century has been one of almost unbelievable economic growth, the U.S. was a highly developed nation even 100 years ago. Moreover, although the U.S. experience of the past nearly 50 years has involved significant governmental intervention in agriculture, migration off American farms proceeded unchecked.

The purpose of this paper is to adapt the Harris-Todaro model to account for U.S. farm migration. The adaptation involves two steps, first the U.S. unemployment rate is taken as exogenous, rather than endogenous as done by Todaro. Secondly, a reduced form is employed. That is, prices and incomes (which are explicit in the Harris-Todaro

model) are here treated as intermediate economic variables whereby the effect of basic changes in technology and population ultimately induce migration. The reduced form eliminates the intermediate variables and forms a direct connection between basic change and observed result.

The research proceeds in two stages. In the first, a reduced form model is fitted to U.S. historical data to show that the equilibrium fraction of the labor force found in agriculture has varied inversely with the productivity of both farm and nonfarm labor and directly with nonfarm unemployment. In the second stage, a dynamic version of the model is constructed and it is shown that annual U.S. net farm migration has varied with the gap between equilibrium and actual farm population. The response of U.S. farm migration to unemployment is shown to be entirely consistent with the Todaro thesis.

The theory is most easily explained in terms of Figure 1, based on the Corden-Findlay exposition of the Harris-Todaro model. The horizontal segment OA represents total labor force divided between,

Figure 1. Corden-Findlay Exposition of the Harris-Todaro Model
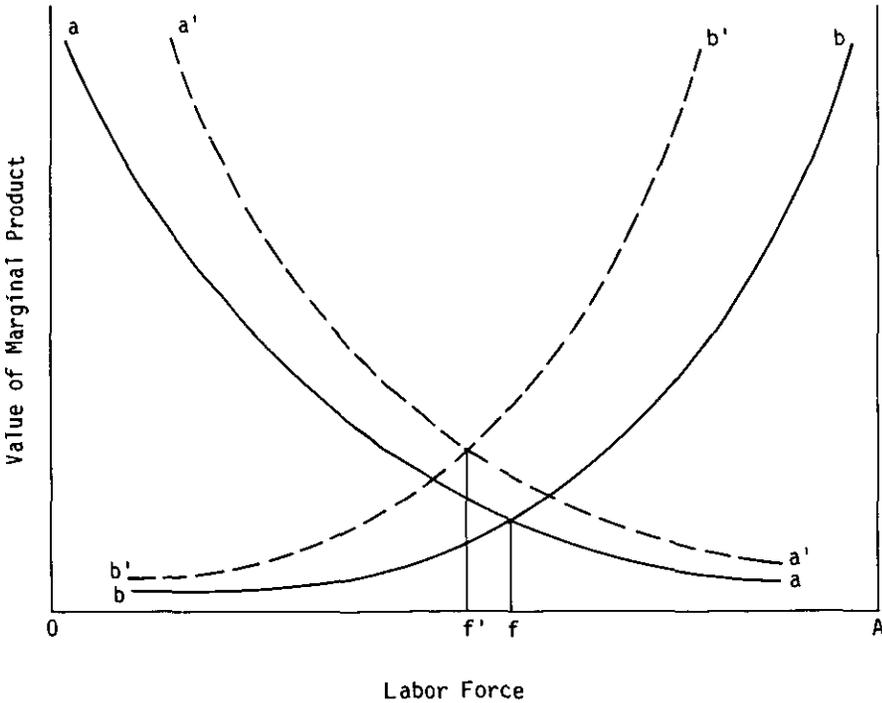
Labor Force

say, Of farm workers, measured to the right from O, and Af nonfarm workers measured to the left from A. Thus, each point on the horizontal axis represents the fraction of the labor force employed in farming. As f moves to the left, labor is transferred from farming to nonfarm occupations, reducing the fraction of the labor force employed on farms.

Marginal productivity of farm labor is measured on the vertical axis, and its relation to farm employment is represented by the curve aa, sloping downward to the right in keeping with diminishing returns in agriculture. It simplifies the exposition to take farm products as numéraire and measure all prices relative to farm prices. When this is done, curve aa represents the value of the marginal product of farm labor as well as the marginal physical product.

The value of the marginal product of nonfarm labor is represented by curve bb. Since movement toward the left represents increasing nonfarm employment, bb slopes downward to the left. The shape of bb depends on two factors. For one thing, the marginal physical product of nonfarm labor may decline with increasing nonfarm employment. More important, however, is that movement toward the left represents increasing production of nonfarm and reduced production of farm products. Given community tastes, the rising proportion of nonfarm products in total output reduces their relative price, so the shape of bb implicitly depends on community tastes and on the productivity of labor in agriculture as well as the productivity of nonfarm labor.

The equilibrium allocation of labor force depends on the relative positions of aa and bb, but in addition is affected by any utility found by workers in the outdoor independent life of the farm, or in the bright lights of the city, but it does no violence to the theory and simplifies the exposition to take the equilibrium allocation of labor force to be at the point f where the value of the marginal product of labor is the same in the two sectors. Shifts in this equilibrium occur as aa and bb shift in response to changes in productivity.

II. Farm Productivity

The effect of rising farm productivity on labor allocation can be shown by example. Suppose marginal productivity of farm labor rises by 10 percent to the dotted line a'a'. This rise also affects the

value of marginal products of nonfarm labor, because any point on OA corresponds to the same nonfarm output as before, but now combined with 10 percent more farm output. The result is a decline in the ratio of farm to nonfarm prices, or with farm prices taken as numéraire, an increase in nonfarm prices, the extent of which depends on demand elasticity. If we take -0.5 as representative of demand elasticity for farm products, a 10 percent increase in quantity should reduce the relative price of farm products by 20 percent, which amounts to a 25 percent increase in the relative price of nonfarm products. In other words, a 10 percent rise in the curve of farm productivity to a'a' automatically generates something like a 25 percent rise in the value of marginal product of nonfarm labor to b'b'. The consequence is clearly a shift of labor from the farm to the nonfarm sector.

III. Productivity of Nonfarm Labor

The effect of a rise in nonfarm labor productivity is not shown in Figure 1, but a similar argument holds. If relative prices were unchanged, an upward shift of 10 percent in the marginal physical product of nonfarm labor would raise the value of the marginal product by this same proportion. Since, however, each point on OA now corresponds to a situation with the same farm output as before, but with 10 percent more nonfarm production, the relative price of nonfarm products must decline.

Demand elasticity for nonfarm products is relatively high. If we take -2 as a hypothetical figure, a 10 percent increase in nonfarm output would result in a five percent decline in relative prices. Thus the 10 percent increase in marginal physical products would be partially offset by a five percent decline in price, but the net effect would still be an upward shift in the curve bb, and again, a shift of labor from farm to nonfarm occupations.

A. Income Effects

Rising productivity not only alters relative prices, but also increases real income. As is well known, however, the income elasticity of demand for nonfarm products is considerably higher than that

for farm products. It follows that rising income increases the demand for nonfarm relative to that for farm products and, given output, this would raise the relative prices of nonfarm output. Thus the income effect of rising productivity provides additional impetus to the shift of labor out of the farm sector. This is true regardless of whether productivity rises in the farm or in the nonfarm sector, but the magnitude of the income effect is determined by the size of the sector where the increase occurs. In the U.S. during the period covered by our data, there were always fewer workers on farms than in the nonfarm sector, so a given percentage increase in farm productivity tended to generate a smaller increase in total income (and hence a smaller income effect on the allocation of labor) than an equal percentage rise in nonfarm productivity.

When both price and income effects are considered together, it is clear that rising productivity in either sector tends to reduce the percentage of labor force employed in agriculture, but there is no obvious theoretical expectation as to the relative magnitudes of the shifts produced by changes in the respective sectors. A given increase in farm productivity exerts a larger price effect but a smaller income effect than an equal increase in nonfarm productivity, but whether the net result is larger or smaller is an empirical question.

IV. Unemployment

The argument to this point can be formalized mathematically by five equations:

$$Q_F = S_f (f, P_F) \tag{0.1}$$

$$Q_{NF} = S_{nf} (f_{NF}, P_{NF}) \tag{0.2}$$

$$p = D (Q_F, Q_{NF}, P_F, P_{NF}) \tag{0.3}$$

$$S_{f'} = p \, S_{nf'} \tag{0.4}$$

$$f_{NF} = 1 - f \tag{0.5}$$

Here, (0.1) and (0.2) are production functions for farm (Q_F) and non-

farm (Q_{NF}) output, with f and f_{NF} the respective fractions of labor force employed, and P_F and P_{NF} indexes of productivity. Equation (0.3) expresses p, the relative price of nonfarm products, in terms of quantities produced and of income as determined by productivities. Equality of value of marginal products in the two sectors is expressed in (0.4), while (0.5) fixes the equilibrium of the system at full employment.

Given P_F and P_{NF}, the five equations determine values for the five unknowns Q_F, Q_{NF}, f, f_{NF}, and p, but with its equilibrium at full employment the system overlooks the very essence of the Todaro model. To incorporate unemployment in the model, equation (0.5) is replaced by

$$f_{NF} / (1 - u) = 1 - f \tag{0.5A}$$

where u is the proportion of the nonfarm labor force unemployed. But now the five equations contain six unknowns, and a solution is no longer possible without either more equations, or further restrictions on the variables.

In the Todaro model, equation (0.4) is changed to

$$S_{f'} = p (1 - u) S_{nf'} \tag{0.4A}$$

that is, in equilibrium, farm earnings are equaled, not to nonfarm earnings, but to the expected value of nonfarm earnings when account is taken of nonfarm unemployment. In this context, (1 - u) represents the probability of a farm migrant finding a job in the city.

Alteration of equation (0.4), of course, still leaves only five equations to determine values for six variables, and Todaro adds the additional equation

$$pS'_{nf} = W \tag{0.6}$$

where W is a "politically determined urban wage rate." The augmented system of equations determines equilibrium values for all variables including the unemployment rate, given P_F, P_{NF}, and W. It is easily shown that any nonfarm wage rate W established above the market equilibrium level of Figure 1 implies the existence of unemployment,

the amount of which rises with the difference between W and the equilibrium nonfarm wage. (Corden and Findlay give a clever graphical demonstration in their article.)

Application of this version of the model to the U.S., however, poses two difficulties. First, until the passage of the minimum wage law (that is, over most of U.S. history) there was no "politically determined urban wage rate." Secondly, serious U.S. unemployment has been understood primarily in terms of fiscal and monetary policy, business outlook, consumer expectations, and investment opportunities, rather than in terms of migration from the farm. In view of these difficulties, it would appear reasonable to apply to the U.S., not the standard Todaro model, but rather a Todaro model that is stood on its head, so to speak, with the unemployment rate, rather than the nonfarm wage rate taken as given.

The resulting model consists of equations (0.1), (0.2), (0.3), (0.4A), and (0.5A). Given farm and nonfarm productivity, P_F and P_{NF}, and the unemployment rate u, the system determines the remaining variables. Since the analysis centers on determination of f, the fraction of labor force engaged in agriculture, the system of equations is reduced by appropriate substitution to the reduced form:

$$f = f (P_F, P_{NF}, u) \qquad (0.7)$$

A. Application to the U.S., 1900-1976

Annual estimates of farm employment, civilian labor force, and average output per worker-hour of farm and nonfarm workers are available together with unemployment rates for the U.S. since 1900, from data sources cited in the appendix to this paper. Using these data, the historical relationship of labor force allocation to farm and nonfarm productivity is approximated by

$$\text{Ln } f_t = a_0 + a_1 \text{ Ln } P_{Ft} + a_2 \text{ Ln } EP_{NFt} + e_t \qquad (1.0)$$

where f_t is the fraction of the labor force engaged in farming in year t, P_{Ft} is average output per worker-hour of farm work (1967 = 100), and $EP_{NFt} = (1 - u) P_{NFt}$ is the expected value of nonfarm labor productivity when account is taken of the nonfarm unemployment rate u_t.

Nonfarm productivity P_{NF} is likewise an index number (1967 = 100). The residual term e_t incorporates the influence of all other factors operating on the fraction of labor force found on farms.

It should be noted that (1.0) relates the fraction of labor force engaged in farming to average labor productivity in the two sectors, whereas the theoretical model underlying Figure 1 involves marginal productivity. The need to employ average productivity is, of course, dictated by the data, but by a familiar property of the Cobb-Douglas production function, (unobservable) marginal productivity is proportional to (observed) average productivity, so the substitution does little violence to the theory.

When (1.0) is fitted to U.S. data, the result is:

$$\text{Ln } f_t = 2.596 - 0.649 \text{ Ln } P_{Ft} - 0.576 \text{ Ln } EP_{NFt} \qquad (1.1)$$
$$\qquad\qquad (0.054) \qquad\quad (0.076)$$
$$\qquad\qquad\qquad (R^2 = 0.98)$$

(Figures in parentheses are standard errors.) The result is completely in accord with theoretical predictions. The proportion of the labor force on farms declined significantly with increases both in farm productivity and in the expected value of nonfarm productivity.

In addition, the result indicates the relative magnitude of the influence of the respective types of productivity. A given increase in farm productivity tended to affect the fraction of labor force on U.S. farms about 12 percent more than did an equal rise in nonfarm productivity. Historically, however, the differential contribution of farm productivity was even greater than this, for over the period covered by the regression, farm productivity grew an average of 2.4 percent per year, compared to only 1.9 percent for nonfarm productivity. As a result, growth of farm productivity contributed nearly 50 percent more to the historical decline in the fraction of labor force located on farms than did rising nonfarm productivity. A similar result is obtained if the respective partial R^2s are compared: 0.66 for farm, compared to only 0.43 for nonfarm productivity.

B. Attempt to Allow for Variation in Income Effects

In an effect to capture the variation in income effect caused by

the changing weight of the respective sectors as farm labor force declined, the model is reformulated as:

$$f_t = A \, P_{Ft}^{(a_0 + a_1 f_t)} \, EP_{NFt}^{(b_0 + b_1 f_t)} + e_t \qquad (2.0)$$

That is, elasticities of f with respect to farm and nonfarm productivities are allowed to vary with the value of f itself. When (2.0) is converted to logarithmic form and fitted to the data, the result is:

$$
\begin{aligned}
Ln \, f_t = -0.543 + (-0.766 + 2.30 \, f_t) \, Ln \, P_{Ft} + (0.170 \\
\qquad\qquad (0.024) \ (0.22) \qquad\qquad\qquad (0.036) \\
\qquad - \, 0.988 \, f_t) \, Ln \, EP_{NFt} \qquad\qquad\qquad (2.1) \\
\qquad (0.193) \\
\qquad\qquad\qquad (R^2 = 0.999)
\end{aligned}
$$

(2.1) agrees with the theoretical expectation that elasticity of f with respect to farm productivity falls, and that with respect to nonfarm productivity rises as f declines and farm workers become a smaller fraction of the total labor force. Nevertheless, the appearance of the variable f on both sides of (2.1), although in different forms, raises serious question about the validity of the procedure, and no further effort is devoted here to pursuit of the shifting income effect.

C. The Dynamics of Net Farm Migration

Up to this point, analysis has been restricted to the comparative statics of labor allocation. Historically, of course, growth of productivity has shifted the equilibrium division of labor force between farm and nonfarm occupations, and the resulting disequilibrium generated a difference between farm earnings and those expected from nonfarm occupations. The difference in earnings induced people to move off the farm.

In general, we can expect farm migration in any given year to be proportional to the difference in earnings, but since earnings do not appear in the reduced form, farm migration is captured as a population stock-adjustment process. The annual net number of people who leave (-) or arrive at (+) farms is taken as proportional to the difference

between equilibrium farm population--the number that would equalize farm and expected nonfarm earnings--and the number of people who would be found on farms without migration. The number of people who would be found on farms in any year t is easily calculated as the sum of F_{t-1}, farm population as of the preceding year, and I_t, the natural increase in farm population. Estimation of the equilibrium farm population, however, presents some difficulty.

If (1.1) could be depended on to generate estimates of the true equilibrium fraction of labor force on farms, the corresponding equilibrium farm population would be given by:

$$F^*_t = \hat{f}_t \ CLF_t \ / \ r_t \tag{3.0}$$

where $\hat{f}_t$ is the value calculated from (1.1), CLF_t is total civilian labor force, and r_t is the ratio of farm workers to farm population. The latter depends on such demographic factors as average size and age structure of farm families, as well as on farm work habits and, to some extent, on agricultural technology.

Unfortunately, (1.1) provides biased estimates of the equilibrium fraction of labor force located on farms. The bias arises because (1.1) is fitted to data drawn from a period of steady and rapid decline in the fraction of labor force on U.S. farms. The decline was, itself, evidence that observed values of f_t were consistently above, and steadily falling toward equilibrium values that were, themselves, declining as productivity rose. In other words,

$$E \ [f_t \ (equilibrium) - \hat{f}_t] = c < 0. \tag{3.1}$$

That is, the expected value of the deviation of calculated f_t from its true equilibrium value is not zero, but some (unknown) negative number c.

It follows that the estimated equilibrium value of f_t can be written as

$$f_t \ (equilibrium) = \hat{f}_t \ e^c = b \ \hat{f}_t \tag{3.2}$$

where $b \ (= e^c)$ is an unknown positive factor less than one. When both sides of (3.0) are multiplied by this unknown factor, we can represent

equilibrium farm population as

$$F_t \text{ (equilibrium)} = b \, F^*_t. \tag{3.3}$$

To estimate the value of b, the year-to-year dynamics of net farm migration are expressed as

$$M_t = k \, [b \, F^*_t - (F_{t-1} + I_t)] \tag{3.4}$$

where M_t is the net number of people migrating to (+) or from (-) farms in year t, F_{t-1} is actual farm population at the end of the preceding year, and I_t is the natural increase of farm population from births and deaths. Values of F^*_t are calculated from (1.1) and (3.0), and values of k and b are to be determined statistically.

Estimates of farm population, natural increase and net farm migration are available from the U.S. Department of Agriculture annually since 1920, but before (3.4) is fitted, it is useful to expand the expression to allow for the effect of military conscription. By its derivation, (3.4) relates only to that portion of net farm migration that is economically motivated. Among other influences on M_t, the most important is military conscription. When farm people are conscripted for military service, they are removed, at least temporarily, from the farm population so the number of people drafted constitutes a (negative) component of farm migration. For example, during a year in which, say, 40,000 people would be expected to leave farms for economic reasons, conscription of an additional 10,000 would bring net farm migration to -50,000. By the same token, when 10,000 discharged veterans return to the farm while 40,000 are leaving for economic reasons, net farm migration would be only -30,000. In other words, net farm migration as actually observed is the difference between net migration for economic causes and the number of farm people conscripted (+) or discharged (-) from the armed services.

Of course, there are no records of the number of farm people who were drafted each year, nor of the number of discharged veterans who returned to farms. A rough estimate is compiled, however, by applying the fraction of population living on farms to the annual change in total numbers in the military for years in which conscription was in effect. To minimize the chance that errors in the resulting estimate

would distort the final regression, the estimated conscription and discharge of farm people is used as a regressor with its own estimated coefficient. The expression for net farm migration then becomes

$$M_t = k [b_1 F^*_t - (F_{t-1} + I_t)] + b_2 a_t + e_t \qquad (3.5)$$

where a_t is the estimated number of farm people drafted (+) or discharged (-) in year t.

From theoretical considerations, the value of k should be positive but less than 1.0 (that is, annual net migration should be some fraction of the difference between equilibrium and observed farm population). As already noted, the adjustment factor b_1 should also be positive and less than one. Finally, if the conscription and discharge of farm people has been well estimated by a_t, the coefficient b_2 should not differ significantly from -1.

When (3.5) is fitted to annual data by least squares, the result is

$$M_t = 0.121 F^*_t - 0.154 (F_{t-1} + I_t) - 1.185 a_t \qquad (3.6)$$
$$(0.024) \qquad (0.025) \qquad (0.220)$$
$$(R^2 = 0.50)$$

Rewritten in the usual stock-adjustment form, this becomes

$$M_t = 0.154 [0.786 F^*_t - (F_{t-1} + I_t)] - 1.185 a_t \qquad (3.6A)$$

All fitted coefficients agree with theoretical expectations both in sign and magnitude. According to (3.6A), annual net farm migration in the U.S. tended to be about 15.5 percent of the difference between equilibrium farm population and the number of people who would reside on farms in the absence of migration. Equilibrium farm population averaged about 78 percent of the value calculated from (3.0). And a appears to be a close approximation to the number of farm people affected by conscription.

The coefficient of determination, $R^2 = 0.50$ is substantially smaller than that for (1.1). In view of the myriad of factors that affect the extent and timing of annual farm migration, however, it is remarkable that the population adjustment model is associated with

over half of the year-to-year variance.

D. A Significance Test for the Effect of Unemployment

The results of the model are consistent with Todaro's thesis that increasing unemployment reduces the flow of population off the farm. This follows because increasing unemployment reduces the expected value of nonfarm earnings (EP_{NF}) via (1.1), which raises the fraction of total labor force employed in agriculture. This, in turn, via (3.0) and (3.1) increases the equilibrium level of farm population and hence, in (3.5) reduces the number of people leaving farms.

Unfortunately, because of the indirect role assigned to unemployment in the model, no significance test of its effect is available, but it is possible to reformulate the model to give unemployment an explicit role that can be tested. One way is to neglect the role of unemployment as a determinant of the fraction of labor force employed in agriculture, but to include it, instead, as part of the dynamics of annual farm migration.

This is accomplished by reformulating the model as:

$$\text{Ln } f_t = a_0 + a_1 \text{ Ln } P_{Ft} + a_2 \text{ Ln } P_{NFt} + e_t \tag{4.0}$$

$$F^*_t = \hat{f}'_t \text{ CLF}_t / r_t \tag{4.1}$$

$$F_t \text{ (equilibrium)} = (b_0 + b_1 u_t) F^*_t \tag{4.2}$$

$$M_t = k[(b_0 + b_1 u_t) F^*_t - (F_{t-1} + I_t)] + b_2 a_t + e_t \tag{4.3}$$

The symbols are defined as above. Note, however, that in the reformulation, unemployment is assigned no role in the determination of the fraction of the labor force found on farms in equation (4.0). To remind us of this, values calculated from (4.0) carry a prime in (4.1). The full force of unemployment is exerted in (4.2) as part of the ratio between F^*_t and the true equilibrium value of farm population. In keeping with earlier remarks about this ratio, it is expected that values of $(b_0 + b_1 u_t)$ will be positive but less than one. In addition since, other things equal, rising unemployment is supposed to increase the equilibrium fraction of labor force on farms, the coef-

ficent b_1 is expected to be positive.

When the reformulated model is confronted with the data, the results are:

$$\text{Ln } f_t = 2.925 - 0.508 \text{ Ln } P_{Ft} - 0.818 \text{ Ln } P_{NFt} \qquad (5.0)$$
$$(0.035) \qquad (0.051)$$
$$(R^2 = 0.98)$$

$$M_t = (0.0763 + 0.109 \, u_t) \, F^*_t - 0.116 \, (F_{t-1} + I_t) - 1.20 \, a_t$$
$$(0.0597) \, (0.035) \qquad (0.057) \qquad (0.22)$$
$$(R^2 = 0.54) \qquad (5.1)$$

Of special interest is the statistically significant coefficient on u_t in (5.1) which establishes the significance of unemployment as a deterent to migration off U.S. farms.

When (5.1) is transformed into the usual stock-adjustment form, it becomes

$$M_t = 0.116 \, [(0.658 + 0.940 \, u_t) \, F^*_t - (F_{t-1} + I_t)] - 1.20 \, a_t.$$
$$(5.1A)$$

The coefficients of (5.1A) agree with theoretical expectations as to both sign and magnitude: annual migration is about 12 percent of the gap between equilibrium and actual farm population. Equilibrium farm population ranges from about 67 percent of F^*_t at three percent unemployment to about 90 percent at unemployment rates near 25 percent. Again, the coefficient of a does not differ significantly from minus one.

E. Magnitude of the Unemployment Effect

In the original Todaro model of developing nations, the response of farm migration to unemployment is so strong that efforts to reduce it by creation of new nonfarm jobs are self-defeating. Given the politically determined urban wage rate, any attempt to lower unemployment in the nonfarm sector merely stimulates increased migration from the farm in such volume that the ranks of the unemployed are promptly refilled. In light of this, it is interesting to estimate the influence of a one percentage-point reduction in the nonfarm unemployment

rate as revealed by U.S. experience. The estimate is formed from the
first derivative of (5.1) with respect to u to yield the approxima-
tion:

$$\Delta M_t = 0.109 \; F^*_t \; \Delta u \qquad\qquad\qquad (6.0)$$

When F^*_t is set at the mean value of farm population over the
data period--about 20 million people--we find that a one percentage-
point reduction (-0.01) in nonfarm unemployment rate implies an in-
crease of about 20,000 in the annual number of people leaving (-) U.S.
farms.   Compared to the number of new jobs involved in the reduction
of unemployment, 20,000 additional new arrivals from the farm is neg-
ligible.   For when U.S. farm population was 20 million, the nonfarm
labor force was about 40 million.   In these circumstances, an attempt
to reduce the unemployment rate by one percentage-point would involve
something like 400,000 jobs. Even if all the extra arrivals from the
farm were job-seekers, it would still take about 20 years for them to
replenish the ranks of the unemployed. In other words, in recent U.S.
experience, the stimulating effect of new nonfarm employment oppor-
tunities on farm migration has been insufficient to constitute even a
minor policy consideration.

Interestingly enough, this finding does not contradict the con-
clusions of the standard Todaro model. In a fully developed nation
like the U.S., farm population is already such a small fraction of the
total that changes in migration are necessarily tiny compared to one
percent of the nonfarm labor force. But quite a different result
emerges when equation (6.0) is applied to a developing economy in
which the large majority of the people still live on farms. For ex-
ample, in a nation with 80 million farm population, but only 20 mil-
lion nonfarm population, a one percentage-point reduction in nonfarm
unemployment would stimulate an additional 80,000 people to leave
farms each year. In comparison, 20 million nonfarm residents would
mean about 10 million in the nonfarm labor force, so the attempt to
reduce nonfarm unemployment by one percentage-point would involve only
about 100,000 new jobs. At this rate, even if only half of the extra
farm migrants were workers, the additional arrivals would rapidly re-
fill the ranks of the unemployed, in complete agreement with Todaro's
contention.

V. Conclusions

It has been demonstrated that the historical movement of U.S. population off farms can be well represented by a reduced form Harris-Todaro model in which unemployment is taken as exogenous. In this reduced form, the equilibrium ratio of farm to total labor force is determined by productivity of labor in both farm and nonfarm employment, with farm productivity exercising the larger influence on the equilibrium allocation of labor, and by the unemployment rate.

Net farm migration in any given year can be accounted for in terms of a dynamic population adjustment in which net migration is proportional to the gap between the equilibrium farm labor force as defined by productivity and nonfarm unemployment and the number of people who would be found on farms in the absence of migration. Nonfarm unemployment tends to raise the equilibrium fraction of labor force located on farms and hence discourages migration off the farm.

Since, properly modified, it accounts for U.S. experience when it was already a highly developed nation, the Harris-Todaro model is not restricted to analysis of the early struggles of poor developing nations, but is applicable to analysis of farm migration in general. The U.S. model does, however, demonstrate that the relative magnitude of the impact of nonfarm unemployment changes during the course of economic development. In a developed nation like the U.S., creation of new nonfarm jobs exerts a negligible effect on the number of people leaving farms. But the same model indicates that, in developing nations with much larger farm populations, efforts to reduce nonfarm unemployment produce a sufficiently great impact on farm migration to constitute a serious policy consideration, in complete agreement with the Todaro thesis.

1/ Farm labor force: farm employment as estimated by U.S. Department of Agriculture. Early years estimated by Legergott as published in U.S. Bureau of the Census, U.S. Historical Statistics, Colonial Times to 1970. Data for years before 1947 were adjusted to conform to a minimum working age of 16 years.

2/ Total civilian labor force: Bureau of Labor Statistics

3/ Farm output per worker hour (1967 = 100): 1900-1965, from Bureau of the Census, Long Term Economic Growth, later years from U.S. Department of Agriculture, Agricultural Statistics.

4/ Nonfarm output per worker hour (1967 = 100): 1900-1970, from U.S. Bureau of Labor Statistics as reported in Long Term Economic Growth. Later years as reported in Economic Report of the President.

5/ Unemployment rate: U.S. Bureau of Labor Statistics. The nonfarm unemployment rate was generated from the total unemployment rate by dividing by the percent of labor force in the nonfarm sector.

6/ Farm population, natural increase in farm population and net farm migration: U.S. Department of Agriculture, Agricultural Statistics.

7/ Number of conscripted persons entering (+) or leaving (-) the U.S. armed services: calculated for the period 1940-1972 from data on size of the armed services from U.S. Bureau of the Census, U.S. Historical Statistics, Colonial Times to 1970. Data for later years from Economic Report of the President, 1979. The number of farm persons involved was estimated by multiplying by the fraction of population living on farms.

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