RURAL-URBAN MIGRATION : ON THE HARRIS-TODARO MODEL[1]

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Abstract : The study of migration in general and rural-urban migration in particular has for long been an important area of research in development economics.

Assuming potential migrants indeed respond to the urban employment probability and treating rural-urban migratio Todaro Paradox). From the theoretical point of view, the model leaves its driving force, the disparity of urban and rural wages and the fixity of urban wage, unexplained. However, the model, with or without fixed wages, can be modified in a number of ways to introduce many interesting aspects (risk aversion, priority hiring, informel sector, travel costs ...) which probably will reduce the level of unemployment as predicted by the starting model.

This paper presents an overview of the HT model and discusses the various extensions and the generalizations of the

JEL Classification : J61; O15.

Keywords : Harris-Todaro; LDC; Rural-Urban Migration.

I. Introduction

The study of migration in general and rural-urban migration in particular has for long been an important area of research in development economics. A large body of literature has grown up in recent years around the topic in contemporary less developed

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[1] Received December 1996, final version received March 1998.

[2] I am grateful to the anonymous referees for helpful comments and suggestions. The usual disclaimer applies.

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countries (LDCs). We focus here on one of the particular influence theoretical works, that of Todaro (1969) and Harris-Todaro (1970).

When in the early 1950s economists turned their attention to the problems of population growth and economic development in the LDCs, it was thus natural to think that policies which emphasized industrialization would not only increase national incomes, but also relieve the overpopulation of the countryside. However, during the 1960s this view came to be increasingly challenged when it became apparent that inequality and poverty has persisted despite respectable growth in GNP. This challenge has now led to the new orthodoxy in which rural-urban migration in the LDCs is viewed as " a symptom of and a countributing factor to underdevelopment ". The new orthodoxy is due mainly to Todaro (1969) and Harris-Todaro (1970) which models has provided a widely accepted theoretical framework for explaining the urban unemployment in many LDCs[3].

Assuming potential migrants indeed respond to the urban employment probability and treating rural-urban migration primarily as an economic phenomenon, the Harris-Todaro model (HT) then demonstrates that, in certain parametric ranges, an increase in urban employment may actually result in higher levels of urban unemployment and even reduced national product (the Todaro Paradox).

The paradox is due to the assumptions that in choosing between lobour markets, risk-neutral agents consider expected wages; that the probability of obtaining urban employment is approximated by the ratio of urban jobs to the urban labor force; and that the urban wage rate is considerably and consistently higher than the rural wage rate. Under these assumptions, inter-lobour market (rural-urban) equilibrium mandates urban unemployment. This unemployment ensures that the expected urban wage is equal to the rural wage (which is assumed constant throughout). The repercussion of this simple set of assumptions is that contrary to received wisdom, once the migration response is factored in, several policies aimed at reducing urban unemployment will raise urban unemployment rather than reduce it.

In the HT model migration is regarded as the adjustement mechanism by which workers allocate themselves between different labor markets, some of which are located

[3] According to Stark et al (1991), the most vivid illustration of the widespread belief in the HT model (Todaro paradox) can be provided by reading through the development economics textbooks covering the two last decades.

in urban areas and some in rural areas, while attempting to maximize their expected incomes.

The model led to many applied studies[4] most of which confirmed that the relative wages and the perceived probability of finding a job were indeed important determinants of a decision to move. Also, the main conclusion of HT model has had considerable influence on policy formulation in LDC's.

From the empirical point of view, the HT model generates unemployment rates which are implausibly high. From the theoretical point of view, the model leaves its driving force, the disparity of urban and rural wages and the fixity of urban wage, unexplained. However, the model, with or without fixed wages, can be modified in a number of ways to introduce many interesting aspects (risk aversion, priority hiring, informel sector, travel costs ...) which probably will reduce the level of unemployment as predicted by the starting model.

This paper, mainly concerned by the HT model, is organized as follows. Section 2 below presents an overview of the HT model. Section 3 discusses the various extensions and the generalizations of the basic model.

II. In connection with Todaro model

II.1 The basic HT model[5]

The burden of the Todaro model was to explain why masses of workers moved from the countryside to the city in the face of sizeable urban pools of unemployed and underemployed. To accomplish this, the model focused attention on the present value of expected earnings rather than current wage rates[6]. The rate of rural-urban migration was

[4] Yap (1977) and Williamson (1988) have surveyed some of the empirical work around the topic of rural-urban migration in LDCs. See also the excellent theoretical survey of Bhattachayya (1993).

[5] The HT model is in fact more general. The authors formulated a two-sector internal trade model whith agricultural goods and modern sector goods being exchanged at some flexible price ratio. They specified the agricultural wage as equal to the marginal product of labor in agriculture and depending inversely on the size of the agricultural labor force. The purpose of both these specifications was for them to be able to analyze the output effects of various economic and social policies which might influence rural-urban migration.

[6] The reason workers compare expected wages is that the urban wage is set institutionally above the market-clearing level and urban unemployment results. It is also assumed that there is always full

held to be a function of the difference between the present values of expected urban earnings and expected rural earnings, with the size of the flow of expected urban earnings significantly affected by the probability of obtaining employment in the urban modern (UM) sector : Suppose that P(t) represents the probability of securing a job in the UM sector in period t; Y_u and Y_r represent average real income in the UM and rural sectors, respectively; C is the one-time cost of the move; and r is the migrants time preference rate of discount. So the Todaro's basic behavioral equation can be shown as :

$$V(0) = \int_{t=0}^{n} \left[P(t)Y_u(t) - Y_r(t) \right] e^{-rt} dt - C(0)$$

where V(0) is the discounted present value of the net gain from a rural-urban move, and n the planning horizon.

So the individual's decision to migrate from the rural to the UM area depends on two principal variables : the real income differences between the urban and the rural areas, and the probability of obtaining an urban job.

In cases where V(0) is positive, the economically rational potential migrant will decide to move. HT model assume that open rural unemployment is nonexistent. A probability of unity is therefore used when calculating expected rural earnings.

Even though there might exist an urban pool of underemployed and unemployed lobor, a potential migrant would decide to make the cityward trek if the expected UM earnings, properly discounted by the probability factor, exceeded the expected stream of rural earnings. Todaro defines the probability of being selected for a job during period t as being equal to the ratio of new modern sector employment openings in period t relative to the number of accumulated job seekers in the urban traditional sectot in time t.

Those migrants not obtaining UM employement in the immediate period are said to accept temporary employment in the urban surplus labor pool (urban informel sector). Although sometimes referring to the surplus labor pool as the traditionnel sector, the Todaro model clearly assumes that all members of the pool, as well as all migrants, are intent upon eventual UM sector employment (this assumption is imbedded in Todaro's treatment of the probability of employment in the UM sector). The Todaro

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employment in agriculture. Rural-urban migration is thus the equilibrating force which equates rural and urban expected incomes and as such is a disequilibrium phenomenon.

model thus explains why there may be more migrants than modern sector job openings and accounts for the growth of the urban pool of surplus labor.

The HT model predict that, in response to the creation of extra urban jobs, additionnal rural lobourers attracted by the increased employment probability will swell the urban lobor force until the new ratio of jobs to urban lobour force is restored to the earlier ratio. However, for this as well as for similar paradoxical results to hold, it must be assumed that the urban wage rate is fixed or that it changes only by a negligible amount. But this requires explicit assumptions about the elasticity of migration.

II.2 The functional form of migration flow

One of the predictions of HT model was that the proportional equilibrium size of the urban traditional sector will vary inversely with the rate of job creation. Arellano (1981) has showen that this prediction refers to the steady state and is warranted by a specific assumption about the elasticity of the migration rate.

Following Todaro (1969) and Arellano (1981) the flow of migration is presented as directly related to the probability of finding a job and to the wage differential :

$$\frac{M}{L} = m = F(P, W) \text{ with } \frac{\partial F}{\partial P} > 0, \frac{\partial F}{\partial W} > 0; \qquad (1)$$

where M, L, P and $W = (W_M / W_A)$ are respectively, the number of migrants per period, the urban labor force, the probability of finding a job and the wage ratio between modern urban and rural sector.

The probability of finding a job is defined as the ratio between the number of new openings and the number of unemployed workers. This means that the potential migrant sees his job opportunities as if he was competing with the unemployed for the new jobs available. To be more realistic we should include the turn over rate. But for simplicity this aspect has been omitted, since it does not alter the analysis :

$$P = \frac{\dot{E}}{U} = g\frac{E}{U} = g\frac{1-u}{u}; \qquad (2)$$

where $g = \dot{E} / E =$ rate of urban job creation in the modern sector ($\dot{E} = dE / dt$), E the urban employment in the modern sector, U the urban unemployment and u (where $u \equiv U / L = 1 - e$) the unemployment rate.

The change in the level of the urban unemployment will be at a given moment of time :

$$\dot{U} = \dot{L} - \dot{E} = M + \beta L - \dot{E}, \tag{3}$$

where β is the natural rate of growth of the urban labor force.

Using equations (1)-(3) :

$$\dot{U} = LF\left(g\frac{1-u}{u}, W\right) + \beta L - gE \tag{4}$$

The change in the rate of urban unemployment is given by :

$$\dot{u} = -\dot{e}(1-u)\left[F\left(g\frac{1-u}{u}, W\right) + \beta - g\right] \tag{5}$$

The equilibrium steady-state condition is reached when $\dot{u} = 0$. If we solve for the rate of urban unemployment we find u as a function of g, W and β :

$$\tilde{u} = H(g, W, \beta) \tag{6}$$

These relations can determine the effects of a change in urban job opportunities (g) on the level and the rate of urban unemployment. These effects depend crucially on the functional form chosen to represent the migration function (1).

At the level of urban unemployment (Short-run effect) :

In the flow model considered here, the number of unemployed workers will always be changing. Thus the point in question is whether as a result of the higher rate of job creation, the number of unemployed workers will rise above its trend or not. To provide an answer we use equation (4) :

$$\begin{aligned}\frac{d\dot{U}}{dg} &= LF'\frac{1-u}{u} - E \quad \text{where } F' = \frac{\partial F}{\partial P} \\ &= L\left[F'\frac{1-u}{u} - \frac{E}{L}\right] = L\left[F'\frac{1-u}{u} - (1-u)\right].\end{aligned} \tag{7}$$

We note that :

$$F' = \frac{dm}{dP} = \frac{d(M/L)}{dP} = \frac{1}{L}\frac{dM}{dP} = \frac{1}{L}\frac{dM}{dg}\frac{dg}{dP} = \frac{1}{L}\frac{dM}{dg}\frac{U}{E}.$$

The general condition for an increase in the level of unemployment above its trend is ($d\dot{U}/dg > 0$) is :

$$F' > u, \tag{8}$$

Using the remark mentioned above :

$$F' = \frac{1}{L}\frac{dM}{dg}\frac{U}{E} > \frac{U}{L} \text{ if } dM > Edg;$$

i.e, the number of additionnal migrants (dM) is larger than the number of additional jobs (E.dg).

We will see now that the conditions for an increase in level of unemployment as a result of a higher rate of urban job creation depend on the functional form chosen to represent the migration function :

(i) Todaro (1969) assumes that the probability of finding a job is separable in a multiplicative form :

$$m = Pf(W).$$

So condition (8) is equivalent to : $f > u$.

(ii) Todaro (1976) assumes that the migration rate has a constant elasticity (η) with respect to the probability. This assumption can be represented by :

$$m = P^{\eta} f(W), \text{ with } \eta > 0.$$

General condition (8) is equivalent to :

$$\eta P^{\eta-1} > u;$$

and the possibility of an increase in the steady-state rate of unemployment as a result of a rise in g is open.

At the level of the rate of urban unemployment (Long-run effect) :

dH/dg >0 is the general condition for an increase in the rate of unemployment from equation (6) : In Todaro (1969) it is impossible to have a steady-state increase in the rate of unemployment.The increase in g always generates a decrease in the rate of urban unemployment. Indeed, the equilibrium steady-state reached from equation (5) combined with the Todaro (1969) functional form of migration demand lead to :

$$(1-u)\left[F\left(g\frac{1-u}{u}, W\right) + \beta - g\right] = 0;$$

$$g\frac{1-u}{u}f(W) = g - \beta \Rightarrow u = \frac{f(W)}{g(f(W)+1)-\beta} = H(g, W, \beta);$$

Thus :

$$\frac{\partial H}{\partial g} = -\frac{f(W)[f(W)+1]}{[g(f(W)+1)-\beta]^2} < 0.$$

In Todaro (1976) the steady-state rate of unemployment will increase only if the elasticity of migration (η) is greater than the ratio between the rate of job creation (g) and this rate net of the natural growth of the labor force in the cities ($g - \beta$) :

$$\eta > \frac{g}{g-\beta}.$$

In conclusion, the results depend crucially on the functional form chosen to represent the migration flow and on the period of time allowed for adjustment[7]. Todaro's (1969) conclusion that the unemployment rate would not rise as a result of more jobs being opened in the modern sector refers to the steady-state and suppose a unity elasticity of migration flow. The different conclusion reached by Todaro (1976) refers to the short-run, and to the case when the elasticity of migration is constrained to be constant but not necessarily equal to one.

III.Extensions and generalizations of HT model

III.1 Towards a formal validation of the Todaro paradox

Following Stark *et al* (1991), we will see that the prevalence of a Todaro Paradox is not an automatic feature of the model but rather a possible result of a specific body of assumptions which generates a specific sub-model.

Denote by L_i , i = u, r, the urban labor force, u; and the rural labour force, r; such that $L_u + L_r = L$ where L is the total given labour force. Denote by E the number of job opening in the urban sector and by P the probability of urban employment where $P = E/L_u$. The sectoral wages are denoted by W_i, i = u, r. We focus attention on W_u where $W_u = W_u(E)$ with $W_u' < 0$. We treat W_r as if it were a constant. The intersectoral equilibrium condition is thus :

$$PW_u(E) = W_r \Leftrightarrow EW_u(E)/L_u = W_r. \qquad (1)$$

[7] According to Arellano (1981) the differences in the functional form chosen to represent the migration flow in Todaro (1969), Zarembka (1970), Mazumdar (1975), Todaro (1976) and Blomqvist (1978) explain primarily the conflict between the conclusions and predictions of these different papers (see Arellano (1981) for references).

To find out how urban unemployment changes when extra urban jobs are created, we check how the urban labor force changes. If the creation of new jobs were to be accompanied by a decline in the urban labour force, we would conclude that urban unemployment has necessarily fallen. From equation (1) we obtain :

$$\frac{dL_u}{dE} = \frac{1}{dE}\left[EW_u(E)\right]\frac{1}{W_r} = \frac{W_u(E)}{W_r}\left[1+\frac{1}{\eta}\right], \text{ where } \eta = \frac{dE/E}{dW_u(E)/W_u(E)}. \quad (2)$$

η is the elasticity of the demand for labour. Thus, we can consider 3 cases :

(i) if the demand is inelastic, $|\eta| < 1$, $dL_u/dE < 0$;

(ii) if the demand is unielastic, $|\eta| = 1$, $dL_u/dE = 0$;

(iii) if demand is elastic, $|\eta| > 1$, $dL_u/dE > 0$.

Only in the latter case the creation of new urban jobs result in an increase in the urban labour force. That is, rural-to-urban migration is induced. It is however impossible to say if in this case unemployment will rise. In the two first cases creation of new urban jobs is associated with migration away from the urban sector, a result which is exactly the opposite of the response predicted by Todaro.

To show that in the expected wage migration model, the urban rate of unemployment will always decline as a result of job creation, we need examine the change in the urban rate of employment (E/L_u) arising from the creation of extra urban jobs :

$$\frac{d}{dE}\left(\frac{E}{L_u}\right) = \left(d\frac{W_r}{W_u(E)}\right)/dE = \frac{-W_r W_u'(E)}{\left[W_u(E)\right]^2} > 0, \text{ where } W_u'(E) < 0; \quad (3)$$

thus the urban rate of employment increase as a result of the creation of extra urban jobs; or, the urban rate of unemployment must decline even if induced rural-to-urban migration arises.

Then the prevalence of a " Todaro paradox " is not automatic feature of the model but rather a possible result of a specific configuration of assumptions. Of course, whether or not the real world corresponds to these specific assumptions is an empirical question.

We examine now if the suppression of the rural-urban wage gap is sufficient to reduce urban unemployment.

Let U the number of urban residents who are unemployed and look for urban employment, M the number of rural-to-urban migrants who also look for urban employment, and E the number of urban job openings with $0 < E < U$. If all E jobs are equally open to all job seekers (U + M), the probability of urban employment will be given by :

$$P = \frac{E}{U + M} \tag{4}$$

Since the equilibrium rural-to-urban migration condition is :

$$PW_u = W_r; \tag{5}$$

the equilibrium level of urban unemployment will be :

$$U + M = \frac{E}{P} = \frac{W_u}{W_r} E,$$

Suppose the E jobs are randomly allocated to job seekers whose number is (U + M). So [U/(U + M)]E jobs will go to U-type job seekers, [M/(U + M)]E will go to M-type job seekers. Then, when E new jobs open up, job seekers will be left to compete for them. To restore equilibrium, that is, to have U in equilibrium, we must have M = E, we obtain :

$$U = \left(\frac{W_u}{W_r} - 1 \right) E. \tag{6}$$

Since $E > 0, U = 0 \Leftrightarrow \frac{W_u}{W_r} = 1;$ urban unemployment can be eliminated only through elimination of the urban-rural gap.

However, the assumption that all urban job openings are equally open to all urban job seekers is quite unrealistic. Typically, access to new urban jobs is an increasing function of the duration of stay in the urban economy, as if all job seekers were to register upon their entry into the urban labor market and be given the chance to secure a job based on the order of their registration. So it is appropriate to assume that the E job openings are offered first to E urban residents, with the left-overs being then offered to all remaining job-seekers.

Suppose that E new jobs are offered to the first registered E urban residents such that the probability of success, assumed identical for all candidates, is given by p. If m ($E \geq m$) of these job candidates succeed, the remaining E - m jobs are opened up to the

rest of the U + M - E job seekers, in a manner connected to that postuled by the received, expected income model of rural-to-urban migration. These jobs are taken up by a random drawing with a probability :

$$p_{rm} = \frac{E - m}{U + M - E}.$$

Since the probability of exactly m of the first E job candidates passing the interview (following a binomial distribution) :

$$p_{um} = \binom{E}{m} p^m (1-p)^{E-m}, \text{ where } \binom{E}{m} = \frac{E!}{m!(E-m)!},$$

the probability that the rural-to-urban migrant will end up with a job is :

$$\begin{aligned} p &= \sum_{m=0}^{E} p_{um} p_{rm} = \frac{E}{U + M - E} \sum_{m=0}^{E} p_{um} - \frac{1}{U + M - E} \sum_{m=0}^{E} p_{um} m \\ &= \frac{E}{U + M - E} - \frac{pE}{U + M - E} = \frac{E(1-p)}{U + M - E} \end{aligned} \qquad (7)$$

With a rural-to-urban equilibrium condition analogous to (5) : $p W_u = W_r$, the equilibrium level of urban unemployment will be given, using this last condition and equation (7) :

$$\frac{W_r}{W_u} = \frac{E(1-p)}{U + M - E} \Leftrightarrow U = \frac{W_u}{W_r} E(1-p).$$

Thus, we can mention these points : $\partial U / \partial p < 0$, the less clement the job interview (more selective), the higher the level of unemployment in migration equilibrium; second, $U = 0 \Leftrightarrow p = 1$ (since $W_u > 0$ and $E > 0$). In this case the E new arrivals are filled up according to the order of registration only. Since there are U unemployed urban residents (U > E), rural-to-urban migration will not take place. And finally, in the case in which $p < 1$, $U > 0$ even if $W_u = W_r$; thus elimination of the urban-rural wage gap is not sufficient to delete urban unemployment.

III.2 The fixed urban wage assumption

According to HT model framework, the expected urban wage is defined to be the product of a fixed urban wage and the probability of employment in the urban sector. The fixed wage assumption is not realistic; the fact that labor markets are better characterized by wage dispersion is well known both theoretically and empirically in

the labor economics literature[8]. Various informational imperfections present in the labor market are commun causes of equilibrium wage dispersions (firm's ignorance about worker productivity, worker's imperfect job search strategies,etc.). Indeed, dispersion of wages for economically homogeneous workers and uncertain knowledge about labor market conditions are common urban conditions in LDCs[9]. Urban wage dispersion plays a significant role in the formation of premigration expectations and thus on the migration decision.

In a recent work, Vishwanath (1991) has studied an individual model of rural-urban migration emphasizing the effects of information flow and urban wage dispersion. Migration is viewed in the context of a lifetime program of job search. It is shown in this analysis that migration can occur even when the mean urban wage is less than the rural income flow, a fact which has been observed in many empirical studies but cannot be explained by the popular Todaro expected income hypothesis. Both the spread and the shape (induced from the hazard function properties) of the urban wage dispersion are shown to effect migration behavior significantly.

III.3 Dynamic aspects of HT model : the question of stability.

We find in the literature many relatively recent contributions dealing with the dynamic aspects of the HT model. Amano (1983) shows that in his model, where migration is governed by the HT mechanisim but the urban wage rate, unlike in the HT model, is endogenously determined, the dynamic system has a unique equilibrium (steady-state) which contains, depending upon the parameter values of the model, either full employment with equal wage rates between the two sectors (urban, rural), or urban unemployment with a wage differential. In add, the equilibria turns out to be either stable or unstable, again depending upon parameter values. Barlett (1983) uses a dynamic version of the Todaro (1969) migration mechanism and shows that in this model the steady-state growth equilibrium is characterized by a positive unemployment rate and is unstable. Day et al (1987) find that in the framework of the basic HT model instability is indeed a possibility and that regular or irregular, nonperiodic fluctuations can be propagated. Funatsu (1988) and Neary (1988) have shown that, when land is explicitly included as a third scarce factor (with capital and labor) in agriculture, the stability condition when land is ignored is no longer either necessary or sufficient for stability.

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[8] See, for example, Axell (1977,1984), Burdett and Judd (1983), Mortensen (1986).

[9] See Harris and Sabot (1982).

We consider a two-sector closed economy, with capital, land and technology fixed. The agricultural and industrial production functions are given respectively by :

$$(1) \qquad PA_t = f(LA_t)$$

$$(2) \qquad PI_t = g(LI_t)$$

where PA and PI are outputs in agriculture and industry respectively and where LA et LI are employment in agriculture and industry respectively (to simplify the analysis we do not take into account the capital stock in the two sectors).

Taking agricultural good as the numeraire, the relative price of the industrial good is noted p; we suppose that p is determined by the relative outputs (PA/PI). We assume as did Harris and Todaro a simple linear function :

$$p_t = m\frac{PA_t}{PI_t}, \text{ where m is a positive constant..} \qquad (3)$$

We suppose that the agricultural wage, WA, is equated to the average product of labour :

$$WA_t = \frac{PA_t}{LA_t}. \qquad (4)$$

The manufacturing wage, WI, is supposed fixed in terms of consumption goods.

The total endowment of labour, L, is allocated between agricultural employment, LA, and the industrial labour force, FT, in the modern sector, with :

$$FT_t = LI_t + CHOM_t;$$

where CHOM is the unemployment in the modern industrial sector.

Thus :

$$LA_t + FT_t = LA_t + LI_t + CHOM_t = L_t.$$

The expected wage rate in the modern urban sector is supposed equal to WI weighted by the probability of employment in the same sector, and we take as a proxy of this probability LI/FT (the probability of employment for a person drawn at random from the urban modern sector) :

$$WE_t = WI_t\frac{LI_t}{FT_t}. \qquad (5)$$

Industrial employment is assumed to be determined by the profit-maximising marginal productivity condition, which combined with the previous equations yields to :

$$m\left(\frac{f(L_t - FT_t)}{g(LI_t)}\right)g'(LI_t) - WI_t = 0\,; \qquad (6)$$

thus we can derive :

$$LI_t = h(FT_t)\,. \qquad (7)$$

In HT model, migration is a function of the gap between the expected urban wage rate and the agricultural (rural) wage rate :

$$\Delta FT_{t+1} = FT_{t+1} - FT_t = \lambda(WE_t - WA_t)\,. \qquad (8)$$

Using equation (1)-(7), we obtain :

$$FT_{t+1} = FT_T + \lambda\left(WI_t h(FT_t)/FT_t - \frac{f(L_t - FT_t)}{L_t - FT_t}\right). \qquad (9)$$

This equation will be used for the stability analysis. But a more specific results can be obtained by specifying the production function in agricultural rural and industrial modern sectors. For this purpose we use the Cobb-Douglas assumption :

$$PA_t = f(LA_t) = aLA_t^{\alpha} = a(L_t - FT_t)^{\alpha}\,; \qquad (10)$$

$$PI_t = g(LI_t) = bLI_t^{\beta}\,; \qquad (11)$$

Thus :

$$\begin{cases} WE_t = m.\beta.a(L_t - FT_t)^{\alpha}/FT_t & (12) \\ WA_t = a(L_t - FT_t)^{\alpha-1} & (13) \end{cases}$$

The adjustment equation (9) is now :

$$FT_{t+1} = FT_t + \lambda\left(m.\beta.a(L_t - FT_t)^{\alpha}/FT_t - a(L_t - FT_t)^{\alpha-1}\right). \qquad (14)$$

The analysis is simplified if we transform (14) to get the dynamic structure in terms of the proportion $f_t = FT_t / L_t$. Deviding both sides of (14) by L we get :

$$f_{t+1} = f_t + \lambda\left(m.\beta.a(L_t - f_t)^{\alpha}/f_t - a(L_t - f_t)^{\alpha-1}\right) = \Omega(f_t)\,. \qquad (15)$$

To find steady-states of equation (15), we set $f_{t+1} = f_t$ and obtain :

$$\bar{f} = \bar{f} + \lambda\left(m.\beta.a(L-\bar{f})^{\alpha} / \bar{f} - a(L-\bar{f})^{\alpha-1}\right).$$

Thus :

$$\bar{f} = \frac{m\beta}{1+m\beta}; \qquad (16)$$

To check stability we compute $\frac{\partial\Omega(f_t)}{\partial f_t}$ and evaluate it at the steady-state $\bar{f} = \frac{m\beta}{1+m\beta}$. This yields :

$$\frac{\partial\Omega(f_t)}{\partial f_t} = 1 - \lambda a L^{\alpha-2}(1-m\beta)^{3-\alpha} / m\beta. \qquad (17)$$

We have than four possibilities for this fixed point, depending on the value of the production functions and migration parameters :

- an unstable spiral point if $\frac{\partial\Omega(\bar{f})}{\partial\bar{f}} \in]-\infty,-1]$;
- a stable spiral point if $\frac{\partial\Omega(\bar{f})}{\partial\bar{f}} \in]-1,0]$;
- a stable node if $\frac{\partial\Omega(\bar{f})}{\partial\bar{f}} \in]0,1]$;
- an unstable node if $\frac{\partial\Omega(\bar{f})}{\partial\bar{f}} \in]1,+\infty[$.

Thus $\frac{\partial\Omega(\bar{f})}{\partial\bar{f}}$ must be less than 1 to get locally unstable oscillations around the stationnary state, a condition equivalent to :

$$\Omega'(\bar{f}) < -1 \Leftrightarrow \lambda a L^{\alpha-2} > 2\bar{f}(1-\bar{f})^{2-\alpha}. \qquad (18)$$

Consequently a wide range of parameter values is compatible with instability.

III.4- Job search strategies, information flow and migration decisions

An understanding of the search strategy in the decision to migrate can be of considerable help in understanding how individuals are likely to structure their decision-making process.

The literature on job search represents, as is well known, a breakthrough in modeling the labor market. In the search framework, uncertainty is explicitely handled in the theoretical treatment of the worker's behavior. Much of this literature is concerned with deriving " optimal stopping rules " for search, commonly in the form of a " reservation wage " which the searcher uses as a criterion for accepting or rejecting offers as they arise. From a macroeconomic theory point of view, the search framework is attractive because it admits the existence of unemployment.

Analyzing unemployment and underemployment in LDCs within a quantity adjustement framework, Fields (1975) has presented four extensions[10] of HT model using " a more generalized formulation of the job-search process ".The result of these extensions is a much lower predicted unemployment rate. In a more recent work, Fields (1989) has built a multi-sector labor model including on-the-job search with many others interesting labor market features. The innovative aspect of this model is the distinction between the ex ante allocation of the labor force among search startegies and the ex post allocation of the labor among labor market outcomes. Three principal results are derived : more efficient on-the-job search lowers the equilibrium unemployment rate; in a rational expectations equilibrium, the average rural and urban wages will not be equal; modern sector enlargement may leave labor market conditions in one of the sectors unchanged, even when wages and employment in that sector are fully flexible.

By introducing optimal search behavior, à la Stigler, into a dual sector urban economy of the Todaro-type, Mohtadi (1989) derive the probability of urban-formal sector entry as a function of the rural-urban migrants' optimal search intensity. One crucial finding is that a higher formal sector wage, not only induces the usual Todaro effect of reducing the chance of entry (by increasing migration and thus urban unemployment), but also an opposite " incentive effect " which increases this chance, by a more intensive search on the part of those able to afford additional search.

Vishwanath (1991) present a search theoretic model of migration, in which migration behavior, of an individual, is viewed as spatial relocation which may occur as an integral part of finding jobs through a continuous lifetime program of search. Migration decision is analyzed, emphasizing the proper formation of future expectations, incorporating into the model realistic and important factors[11] such as

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[10] Four extensions including allowances for more generalized job-search behavior, an urban traditional or informel sector, preferential hiring by education level, and labor turnover considerations.

[11] In the HT framework, the probability of urban employment is assumed to be independent of time. However, potential migrants may not think of the possibility of employment in terms of a given

urban wage dispersion and information flow. In this framework, it is demonstrated that migration can occur even when the mean urban wage is less than the rural income.

III.4.1- Temporal dimension to urban prospects in a job search model

In the Todaro framework, the expected urban wage is defined to be the product of a fixed urban wage and the probability of employment. The fixed wage assumption is too simplistic; various informational imperfections present in the labor market are commun causes of equilibrium wage dispersions. Indeed, as Harris and Sabot (1982) point out, dispersion of wages for economically homogeneous workers and uncertain knowledge about labor market conditions are common urban conditions in developing countries.

In the same framework, the probability of urban employment is assumed to be independent of time. However, potential migrants may not think of the possibility of employment in terms of a given probability of getting a job that is independent of time, but in terms of an uncertain period of waiting after which they can expect to obtain job offers. Indeed, studies of unemployment in several developing countries have indicated that the way the labor market adjusts to variations in supply is through a variation of the length of time taken before a person gets an acceptable job. Therefore, potential migrants receive from time to time information about specific job opportunities and it is to such specific information that the individuals respond. A person engaged in rural-based search usually acquires such specific information about jobs through communication channels (friends and contacts, previous migrants from the same rural location, etc.). This urban-to-rural information flow, for an individual, is influenced by several factors such as the number of contacts he has, the level of search effort he chooses, and the urban labor demand conditions.

Vishwanath (1991) has formulated a theoretical model where temporal dimension to urban prospects as well as the urban wage dispersion are considered. In this model, a rural individual, who is taken to be the decision-making entity, has three options : stay at home (rural location) forever, engage in rural-based search for a city job, or move to the city and engage in urban-based search[12]. In addition, once employed

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probability of getting a job that is independent of time, but in terms of an uncertain period of waiting after which they can expect to obtain job offers.

[12] In the previous section, we have presented Fields (1975) model which allows for the possibility of rural-based search (strategy S1). However, in this model, the author does not consider the effect urban wage dispersion and information flow has on migration.

in the city he can expect to further engage in employee or on-the-job search. The various search strategies are characterized by their respective rates of information flow, viewed as a random processes, and search costs. The expected-income maximizing individual takes his optimal decision in an environment characterized by urban wage dispersion.

A- The model

Given his skills, the risk-neutral potential migrant, initially located in the rural area, is admissible for a certain set of urban jobs. He has access to both general information about the relevant labor market conditions and, from time to time, information about specific job availabilities. Through the general information, he is able to construct a picture of the set of prevailing wages, their likelihoods and the urban wage dispersion. Let F(x) denote this probability distribution of urban wages (supposed adjusted for the urban cost of living), with the interval $[\underline{w}, \overline{w}]$ being its support. This wage offer distribution will be assumed exogenous and fixed. The model considered is a Markov process model in which the state of the potential migrant is characterized by the triple, the location (rural or city), the current income flow, and the employment status when in the city (employed or unemployed).

If engaged in rural-based search, it is assumed that the individual receives job offers according to a Poisson process[13] with rate λ_r, by paying a search cost c_r. The wage attached to each job offer is assumed to be a random draw from the distribution F(x). If the mean rural income flow is w, an expecsted-income maximizing individual can assess the returns to rural-based search as follows. Let V_r denote the expected lifetime discounted income from rural-based search. If ρ represents the instantaneous discount rate, considering a short interval time [t,t + dt] and letting $dt \to 0$, Vishwanath (1991) obtain this equation :

$$\rho V_r = \underbrace{w - c_r}_{\substack{\text{rural income net} \\ \text{of search costs}}} + \underbrace{\lambda_r \int_{\underline{w}}^{\overline{w}} \max\{V(x) - V_r, 0\} dF(x)}_{\text{the expected benefits per instant from search}}, \qquad (1)$$

[13] A random variable X is defined to have a Poisson distribution if the density of X is given by :

$f(x,\lambda) = \frac{e^{-\lambda}\lambda^x}{x!} I_{\{0,1,\ldots\}}(x) = \begin{cases} \frac{e^{-\lambda}\lambda^x}{x!} & \text{for } x = 0,1,2,\cdots, \text{ where the parameter } \lambda \text{ satisfies } \lambda > 0, \text{ with} \\ 0 & \text{otherwise} \end{cases}$

$\lambda = E(x) = var(x)$.

where $V(x)$ is the expected future income from accepting a job with wage x. It should be clear that rural-based search is preferable to just staying in the rural area forever if and only if $\rho V_r > w - c_r$.

The individual have also the option of moving to the city without employment and then engaging un urban-based search. Let $b \geq 0$ denote the non-employment income in the city. This could be the murky sector income. Let λ_u and c_u respectively represent the rate of arrival of job offers and the search cost when engaged in urban-based search. If V_u denotes the premigration expectation of the discounted future income from urban-based search, then :

$$(\rho + \lambda_u)V_u = b - c_u + \lambda_u \int_{\underline{w}}^{\overline{w}} \max\{V(x), V_u\} dF(x). \qquad (2)$$

Given the three options, staying in the rural location forever, engaging in rural-based search, and urban-based search, the individual chooses the one corresponding to the largest of the three values, w/ρ, V_r and V_u. It remains to describe how the value, $V(x)$, of holding a job at the wage x is determined. Let λ and $c \geq 0$ denote respectively the average rate of offers and the cost per instant due to on-the-job search. Let $\mu > 0$ denote the rate of layoffs or separation from urban employment. For simplicity, we will not consider the possibility of return migration to the rural location upon separation. In this situation the worker resumes search from the urban unemployment state. If the individual contacts another offer that pays higher than his current wage, he instantaneously moves to the new job. Thus the expected discounted lifetime income from holding urban jobs is, for all x, :

$$(\rho + \mu)V(x) = x - c + \lambda \int_{x}^{\overline{w}} \{V(y) - V(x)\} dF(y) + \mu V_u \qquad (3)$$

Search while employed at wage x is undertaken if and only if $\rho V(x) > x$.

Equations (1)-(3) characterize the returns from search activity in the various strategies. They serve to analyze the migration decision.

$$V'(x) = \partial v(x) / \partial x = 1 / \left[\rho + \mu + \lambda(1 - F(x))\right] > 0,$$
$$V''(x) = \lambda f(x)\left[V'(x)\right]^2 \geq 0.$$

The fact that $V(x)$ is increasing in x has the following implication. When engaged in rural-based search, there exists a reservation (urban) wage offer w_{Res}, at which the potential migrant is indifferent between accepting this offer and rejecting it

for continued rural-based search. Any wage offer greater (lesser) than w_{Res} is accepted (rejected). This reservation wage satisfies the equation :

$$V_r = V(w_{Res}).$$

Furthermore, since $V_u = V(b)$, it follows that the reservation wage in the urban unemployment state equals b.

The migration decision can be characterized as follows : since $V_r = V(w_{Res}) > V(b) = V_u$ (resp. $V_r = V(w_{Res}) < V(b)$) as $w_{Res} > b$ (resp. $w_{Res} < b$) urban-based search is preferred to rural-based search if $w_{Res} < b$, and the converse holds if $w_{Res} > b$.

B-

The effect of urban wage dispersion : case of two urban wages

Suppose there are only two urban wages w_1 and w_2, such that $w_1 > w_2 \geq b$. Given an offer is received, let α (respectively 1 - α) denote the probability of contacting w_1 (respectively wage w_2), with $0 < \alpha < 1$. hus :

$$F(x) = \begin{cases} 0 & \text{if } x < w_2 \\ 1 - \alpha & \text{if } w_2 \leq x < w_1 \\ 1 & \text{if } x \geq w_1. \end{cases}$$

Since there are no returns to on-the-job search when employed at the higher wage w_1, and setting $\lambda = c = 0$ in equation (3), we have :

$$(\rho + \mu)V(w_1) = w_1 + \mu V(b).$$

Assuming search is profitable in other states, the values of the states of employment at wage w_2 and urban unemployment search now reduce to :

$$(\rho + \mu)V(w_2) = w_2 - c + \lambda\left[\alpha\left(V(w_1) - V(w_2)\right)\right] + \mu V(b)$$
$$(\rho + \mu)V(b) = b - c + \lambda\left[\alpha\left(V(w_1) + (1-\alpha)V(w_2)\right)\right]$$

due to the fact that the reservation wage in the urban unemployment state equals b. Solving the above system of equations yields :

$$\rho V(b) = \frac{\mu + \rho}{\lambda + \mu + \rho}(b - c) + \frac{\lambda}{\lambda + \mu + \rho}(m + S),$$

$$\text{where } \begin{cases} m = \alpha w_1 + (1 - \alpha) w_2 \\ S = \beta(w_1 - w_2) - \gamma c \\ \beta = \lambda\alpha(1 - \alpha) / [\lambda\alpha + \mu + \rho] \\ \gamma = (1 - \alpha) - \beta. \end{cases}$$

The imputed income flow from urban-based search is a weighted sum of income flow net of search cost in the urban unemployment state and the mean employment wage plus a surplus, S > 0, attributable purely to wage dispersion and the worker's intentions of a continous program of search. This surplus is reduced to zero if the wage dispersion disappears or if there is no search activity in the employment state.

First, consider the preference between urban-based search and staying in the rural area for ever which is characterized by :

$$\rho V(b) > w \Leftrightarrow \delta S > \delta(w - m) + (1 - \delta)(w - (b - c)), \qquad \text{(C1)}$$

where $\delta = \lambda / [\lambda + \mu + \rho]$. If S = 0, which is the case in the absence of wage dispersion, and if the net urban non-unemployment income is zero (b = c), then this last condition reduces to a criterion analogous to that of Todaro (1969) :

$$\delta\, m > w, \qquad \text{(C2)}$$

which implies that migration to the urban unemployment state is induced if the mean urban wage discounted by a factor reflecting the rates of contacting jobs and layoffs, and the rate of time preference, is greater than the mean rural wage.

If the mean urban-rural wage differential (m - w) is negative, migration cannot be explained by (C2) whereas it can be explained under criterion (C1). Indeed, given all other parameters, as λ increases, both S and δ increase. As $\lambda \to \infty,\ S \to (1 - \alpha)(w_1 - w_2)$ and $\delta \to 1$. Since $(1 - \alpha)(w_1 - w_2) > w - m \Rightarrow w_1 > w$, it follows that for sufficiently high values of λ, the urban unemployment state is preferred to staying in the rural area for ever, regardless of (sans se soucier de) the mean urban-rural wage differential.

The analysis establishes that positive migration can occur even when the mean of the prevailing wages is less than the rural wage. This is due to the intertemporel tradeoff that exists in the premigration evaluation : a lower current income from moving may be preferred in the expectation of contracting better jobs in future. Thus, it is not merely the mean wage offer, but the entire distribution of prevailing offers that

influences the migration decision. This analysis pertains to the decision between moving to the urban unemployment state and not moving. In the case where rural-based search is profitable, positive migration can also occur in terms of move to the urban unemployment state even if the mean wage is less than the rural wage.

III.4.2- Migration rate and effects of information flow

We resume the most important results of Vishwanath (1991) formalised analysis concerning the effects of information flow on migration[14].

While the risk in the urban income due to layoffs and hiring rates affects the migration rate negatively, the wage dispersion[15] influences premigration expectations and the migration rate positively, when viewed in the context of a continous program of job search. Several other relationships between migration behavior and underlying parameters are derived which are useful in empirical studies :

- For a person engaged in rural-based search, the migration rate is decreasing in rural wage (w), layoff rate (μ) and urban search cost (c), and increasing in c_r (rural search cost), urban rate of contracting jobs (λ) and mean urban wage (m). Furthermore, migration rate is increasing in rural-urban information flow (λ_r), if the wage distribution has an increasing hazard property.

- Relocation costs deter migration. Among those who face the same urban wage distribution those with a higher reservation wage suffer a higher percentage decrease in the migration rate with an increase in relocation costs, and among those with similar reservation wages, those with a higher discount rate (ρ) are deterred more from the decision to migrate.

[14] Most of the detailed derivations and demonstrations are carried out in the appendix of Vishwanath (1991) paper

[15] The mean urban wage and the wage distribution are respectively the mean and the distribution of wage offers by firms. These quantities are, in general, different from the mean and distribution of earnings derived from cross-section wages of employed at a point in time.

III.5 - Migration as a family decision and risk aversion in the HT model context

In many communities the migration of one member of a family is often a family decision and recent field studies strongly suggest that interdependencies between family members and the existence of ties with the place of origin are of great importance to reach a better understanding of the decision-making process generating migration and transfers in the context of socioeconomic development (Collier and Lal , 1984 ; Banerjee, 1981 ; Ulack, 1986 ; Stark, 1995).

According to the new portfolio investment theory, families spread their labour assets over geopgraphically dispersed and structurally different markets to reduce risks (Ghatak *et al*, 1996). After migration, members of the family are supposed pooling and sharing their incomes as a form of insurance against uncertain flows from specific markets.Thus, if future earnings are uncertain and imperfectly but positively related in a geographically specific area, and taking into account the roles of risk aversion and imperfect capital and insurance markets, the migration decision of a member family regarded as an investment implies a risk-reducing portfolio diversification of income sources (Stark and Katz, 1986 ; Stark, 1991).

According to Ghatak *et al* (1996), these ideas can be formalised by the following generalisation of the Harris-Todaro model. We consider a concave utility function of a representative family *U(Y)* where *Y* is income with *U' > 0, U''< 0*. The family choose a proportion *m* of the family to emigrate so as, if $\overline{L}_r$ represents the rural labor force, $m\overline{L}_r$ is total migration. The family choose a prportion *m* of its members to migrate at a cost *C* per period who obtain employment with probability *p* at an urban wage W_u or are unemployed with probablity *(1 - p)*. The remaining proportion, *1 - m*, receives a certain rural wage W_r.

The family maximises its expected per period income :

$$E\big(U(Y)\big) = pU(m\tilde{W}_u + (1-m)W_r) + (1-p)U(-mC + (1-m)W_r)$$

where $\tilde{W}_u = W_u - C$ is the net urban wage after paying for migration costs.

The first and second order conditions for an internal solution $m \in [0,1]$ are respectively :

$$p(\tilde{W}_u - W_r)U'(m\tilde{W}_u + (1-m)W_r) + (1-p)(-C - W_r)U'(-mC + (1-m)W_r) = 0 \quad (1)$$

$$p(\tilde{W}_u - W_r)^2U''(m\tilde{W}_u + (1-m)W_r) + (1-p)(-C - W_r)^2U''(-mC + (1-m)W_r) < 0 \quad (2)$$

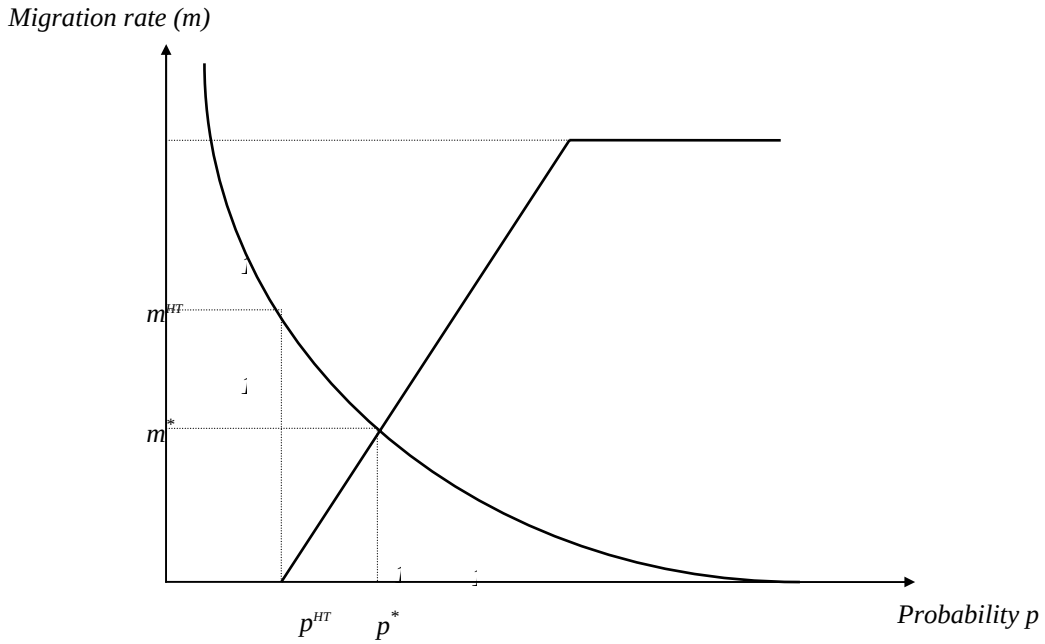
Condition (2) holds by the concavity assumption. Thus the internal solution to (1) maximises expected utility. If the utility function is of the logarithmic type, solving (1) for *m* gives :

$$m = \left(\frac{p(\tilde{W}_u - W_r) - (1-p)(W_r + C)}{(W_r + C)(\tilde{W}_u - W_r)} \right) W_r ; \quad m \in [0,1] \qquad (3)$$

As in Harris-Todaro model we require that $\tilde{W}_u > W_r$. Migration takes place ($m \geq 0$) if and only if :

$$p(\tilde{W}_u - W_r) \geq (1-p)(W_r + C) \Leftrightarrow W_r \leq pW_u - C \qquad (4)$$

The condition for exactly zero migration is precisely the HT arbitrage condition which equates the gain and loss from migration. If the probability of obtaining employment is given by the ratio of the urban employment prior to any migration to the total urban labour force (urban employment and the number of migrants in equilibrium), than (3) gives the equilibrium migration rate illustraded in the following figure :



OABC is the family decision given the probability of employment. The line *AB* is the *(m,p)* relationship given by (3) and *OA* and *BC* are the corner solutions *m = 0* and *m = 1*. The curve *DE* is the *(p,m)* relationship in the basic HT model. The risk-averse family arrives at an equilibrium migration rate m^* . In the HT basic model with risk-

neutral individuals the equilibrium probability of urban employment resulting in a higher equilibrium migration rate.

According to Xu (1992) the presence of risk may lead to insufficient rural-urban migration causing a labor shortage problem. There are several plausible explanations for this result. The first one is the high cost of migration. If people are risk neutral and without liquidity constraints, rural residents should migrate to cities if in the long run the accumulated rural income is lower than the accumulated urban income minus the fixed cost of migration. However, in order to insure themselves, risk averse rural households would keep more labor input in agriculture, i.e. reduce the number of rural-urban migrants, compared with risk neutral households. If poorer households are more risk averse than rich households, then concerning their insurance, a poor rural household will have fewer rural-urban migrants than a richer rural household.

Conclusions

Our survey and appraisal has, by and large, stayed within the Harris-Todaro model framework of analysis. The survey begins with a brief presentation of the Todaro and HT models before going on to discuss the large literature which these models have spawned. We have presented many extensions of the basic probabilistic HT model including the risk averse behaviour within families where the migration of members of families serves to diversify risk.

The analysis of the rural-urban migration in contemporary LDCs however requires us to go beyond the HT framework and to consider, among others, the following considerations. First, our review has not discussed some of the very recent and rapidly developing research on migration within the family context, the economic analysis of transfers and exchanges (altruism) within families and groups (Stark, 1995) : how do altruistic links affect allocative behavior and wellbeing ? Does the timing of the intergenerational transfer of the family's productive asset affect the recipient's incentive to acquire human capital ? Why do migrants remit?

Second, migration could be the product of imperfect and incomplete markets and financial institutions in many LDCs. In this context migration in the absence of a significant wage-gap between the advanced and the backward region, or the lack of migration in the face of a sustantial wage-gap, does not mean irrationality.

Finally, the endogeneity of the rural-urban migration decision, in both unobservable and observable characteristics, affects labour market performance (Borjas 1987). The welfare impact of immigrants is crucially dependent on the degree of

transferability of their observable and/or unobservable skills, on the relative income inequality and on the comparative levels of mean earnings between the advanced and the backward region. Characteristics of migrants and the process of self-selection could be an important determinants of the rate of migration.

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