

The Pattern of Migration with Variable Migration Cost^{*†}

Nancy H. Chau[‡]

This version September, 1995.

Abstract: In this paper, we examine the role of migrant network in determining patterns of outmigration. Conditions under which migration equilibrium may permit multiple steady states are identified. Our analysis discusses instances where migration generates its own demand and explains differences in migration propensities across potential sources of outmigration.

JEL Classification: F22 International migration, R23 Regional labor migration.

^{*}Forthcoming in the *Journal of Regional Science*.

[†]I thank M. Ali Khan, M. Patricia Fernández-Kelly, Oded Stark and two anonymous referees for helpful discussions and comments on an earlier draft of this paper.

[‡]Department of Economics, Southern Illinois University at Carbondale, IL62901.

1 Introduction

Determinants of the movements of people across national borders have been one of the central themes of recent research on labor migration. To this end, transnational migrant network is shown to play a significant role in the promotion of new and repeated migration. These networks are sets of interpersonal ties that connect migrants, former migrants and workers in the source country, interwoven within patterns of institutions such as the family, friendship, work relationships and shared community origin. In a series of studies pertaining to outmigration behavior of Mexican communities¹, the concept of social network is applied to account for differential migration propensities of otherwise similar locales. The key differentiating factor across these communities is attributed to the timing of the first trips abroad by pioneering migrants. The success of these pioneers in turn renders outmigration a feasible option for the set of non-migrants to which the pioneers are linked through a variety of social ties. Various other studies² also confirm that undocumented migrants in particular, are able to secure their footholds in the host countries primarily through family and work ties established through prior contacts. The existence of such networks may facilitate migrant flows through the reduction in expenses involved in the initial stages of settlement, assistance in job search, as well as alleviating the psychological toll of leaving friends and family behind.

Despite mounting empirical evidence, attempts to incorporate the concept of migrant network in theoretical analysis of labor migration remain scanty. In this paper, we shall explore the cost-saving aspect of migrant networks and accordingly characterize the resulting pattern of migration in a dynamic setting³. Our findings explore the existence of migration thresholds which suggests that extensive cost-reducing migrant networks offer a plausible explanation for the apparent link between past experiences of recruitment from certain source countries and the extent of both documented and undocumented migration from the same countries. Indeed, if simple cost benefit calculation is to be employed to explain labor movements across countries, there should be no reason to believe that selectivity of migration propensities across geographic regions should in any way be related to initial conditions or the foreign employment history of the source country's workers.

The theoretical framework constructed in this paper discusses instances where migration gener-

¹ See Massey-Goldring (1992), Massey-España (1987), de Janvry-Mines (1982) and the references therein.

² See de Janvry-Mines *op. cit.*, Gregory (1986), Lomnitz (1977), Portes-Borocz (1989), Portes-Sensenbrenner (1993) and Taylor (1986).

³ For an analysis of the *informational* role of social networks in employment selection and wage setting decisions, see Rees (1966) and Montgomery (1991).

ates its own demand and explains differences in international migration propensities across potential sources of outmigration. We distinguish between the stock and flow concepts of migration and emphasize the relationship between the stock of migrants in the destination country and the cost of migration for subsequent chains of migrant flows. To keep our analysis simple we postulate a world with perfect capital and labor markets with no institutional constraints on voluntary labor migration. We wish to underscore this set of assumptions, since as a matter of fact, contemporary migration from less developed to developed countries are seldom free and the presence of credit market imperfection necessarily constrains voluntary labor movements. Including elements of market imperfections in our model may, however, suggest that freeing markets from restrictive practices is a feasible policy option. To demonstrate the contrary, we shall show that even in such a flawless world, equilibrium migration may nevertheless be inefficient.

This paper is organized as follows: Section 2 examines the role of migrant networks, the individual's decision to migrate is discussed and the cost reducing nature of migrant networks is explicitly accounted for. Accordingly, we work out possible configurations of migration equilibrium that are consistent with the patterns of migration discussed above where each individual's decision to migrate depend crucially on the migration decisions of every one else within the community. Finally in section 3, we discuss some possible extensions of the model presented.

2 The Model

The two-region setup

Consider a discrete time two region setting (respectively the home and the foreign region). The home region is endowed with a stock of inelastically supplied labor normalized to unity. At any time t , let the share of home country workers who are employed in the foreign region be m_t . Employment at home guarantees a per period wage $w(1 - m_t)$ where, by full employment, $1 - m_t$ is just the share of home country workers who are employed domestically. The foreign host country pays a per period wage $w^*(m_t)$. $w^*(\cdot)$ and $w(\cdot)$ are taken to be continuously differentiable with $w^{*\prime}(\cdot) \leq 0$ and $w'(\cdot) \leq 0$ ⁴.

Preferences

The preferences of workers over income sequences $\{y_{t+\tau}\}_{\tau=0}^{\infty}$ at any time t is given by $Y_t = \sum_{\tau=0}^{\infty} \beta^{t+\tau} y_{t+\tau}$. At the beginning of each period, a worker has two options. He can remain in the home country and receive the domestic wage. Otherwise, he may migrate abroad. Individual workers differ only in terms

⁴A prime ($'$) denotes the first derivative with respect to m .

of their propensity to migrate (a) which takes on any value between 0 and 1. The proportion of workers in this economy endowed with an $a \leq \bar{a}$ is $F(\bar{a})$. $F(\cdot)$ is therefore a cumulative distribution function which has both its range and domain as the closed unit interval with an associated density function $f(\cdot)$ ⁵. For tractability, we assume that $F(\cdot)$ is continuous and the associated density function $f(\cdot)$ is strictly positive.

The Cost of migration and Network Externality

Migration involves cost. Such cost of migration may be due to the physical cost of transportation and the initial expenditure needed for settlement in the host country. Other perceived costs of migration may well be purely psychological such as the toll of leaving friends and families behind. In view of these considerations and to incorporate the cost reducing aspect of migrant networks, we shall denote the cost of migration at time t for any individual worker with migration propensity a from the home to the foreign region as $C(a, m_{t-1}) + \bar{C} \geq 0$, where m_{t-1} measures the stock of migrant in the foreign region in the previous period. The cost function $C(\cdot, \cdot)$ exhibits the following properties: (A1) $C(\cdot, \cdot) \geq 0$ for all a, m_{t-1} , (A2) $C(\cdot, \cdot)$ is taken to be continuously differentiable, increasing in a and decreasing in m_{t-1} .

As such, the cost of migration, can be perceived as composed of a fixed and a variable component. The first component \bar{C} , which may be interpreted as the physical cost of migration, is constant and equal across individuals. Condition (A1) requires that the variable component of the cost of migration be positive and condition (A2) requires that the cost of migration is decreasing in the stock of migrants in the foreign region m_{t-1} ⁶. Finally, everything else equal, a worker with a higher value of a faces a higher cost of migration. These individuals are therefore *followers* in adopting migration as an income augmenting innovation. Those with low values of a , on the other hand are *leaders*, and as we shall elaborate below, with a given level of net benefit offered to potential migrants, individuals with low a 's always initiate migration flows. Finally, the cost of return migration is taken to involve only the physical cost of migration, \bar{C} .

Denote the expected lifetime utility of a worker in the home and the foreign region at any time t

⁵For a discussion of how such propensities to migrate can be a result of labor and credit market structure of the source region, see Section 4.

⁶In addition, the marginal cost of migration may decrease (increase) as m_{t-1} increases, implying that the larger the stock of veteran migrants, the more (less) effective is the migrant network in reducing the cost of migration. While the precise specification of the sign of the second derivative of the migration cost function with respect to m_{t-1} does not affect the results of our analysis in the sequel, see figure 1 for a graphical illustration of the case where migrant network reduces the migration costs for future migrants more than proportionately only in the initial stages of migration flows.

as $Y_t^h(a, m_{t-1})$ and $Y_t^f(a, m_{t-1})$ respectively, we have,

$$\begin{aligned} Y_t^h(a, m_{t-1}) &= E_t(\max\{w(m_t) + \beta Y_{t+1}^h(a, m_t), \\ &\quad w^*(m_t) + \beta Y_{t+1}^f(a, m_t) - \bar{C} - C(a, m_{t-1})\} | m_{t-1}), \\ Y_t^f(a, m_{t-1}) &= E_t(\max\{w(m_t) + \beta Y_{t+1}^h(a, m_t) - \bar{C}, w^*(m_t) + \beta Y_{t+1}^f(a, m_t)\} | m_{t-1}). \end{aligned} \quad (1)$$

where E_t is the expectation operator. Migration in this framework depends, therefore, not only on the income sequences of the two regions, but also the stock of migrants in the foreign region as well as the way in which the expectation of future income flows is formed. In this section, we shall impose two assumptions which allows us to completely characterize the relationship between Y_t^h and Y_t^f and thus the dynamics of migration which ensue⁷: (A3) $E_t(m_t | m_{t-1}) = m_{t-1}$, (A4) $w^*(m_t) - w(m_t) - \bar{C} > 0$ for any m_t .

Condition (A3), which requires that expectations be static, captures the notion that each individual takes the observed foreign wage and the stock of established migrants as given at the time of migration. Condition (A4) accounts for the fact that the home region (a village, for instance) is sufficiently small compared to the foreign region, so that the wage equalization across these two regions does not occur whatever be the degree of outmigration from the home region⁸.

With these assumptions the lifetime income of a home and a foreign worker at any time t can be simplified as

$$\begin{aligned} Y_t^h(a, m_{t-1}) &= \max\left\{\frac{1}{1-\beta}w(m_{t-1}), \frac{1}{1-\beta}w^*(m_{t-1}) - \bar{C} - C(a, m_{t-1})\right\}, \\ Y_t^f(a, m_{t-1}) &= \max\left\{\frac{1}{1-\beta}w(m_{t-1}) - \bar{C}, \frac{1}{1-\beta}w^*(m_{t-1}) - \bar{C} - C(a, m_{t-1})\right\}. \end{aligned} \quad (2)$$

Figure 1 depicts three possible relationships between Y_t^h and Y_t^f . Curve YY depicts the income differential across the home and the foreign region net of the physical cost of migration. Curve CC , on the other hand, denotes the variable component of the cost of migration as a function of the extent of outmigration. Note in particular that from assumption A2, both YY and CC are downward sloping. Figure 1a depicts the situation where the network effect dominates, namely, that the reduction in migration cost as migration progresses is always greater than the concurrent reduction in income differential. In this particular case, migration is not feasible for all values of $m < \bar{m}$ and thereafter,

⁷We shall relax both of these assumptions in subsequent sections and discuss their significance.

⁸That the size of the source region may play a functional role in determining the pattern of outmigration is an issue that we shall discuss in subsequent sections. I am grateful to an anonymous referee for pointing out this aspect of the model.

the benefits of migration is strictly higher than the physical and the variable costs of migration combined.

Figure 1b depicts the opposite scenario where the incentive reduction effect dominates as the CC curve is strictly flatter than the YY curve. In this case, migration is feasible for all values of $m \leq \bar{m}$ although thereafter, the benefits of migration no longer induce outmigration from the source country. Finally, figure 1c depicts the intermediate scenario where the network effect dominates for small values of m and this effect is overtaken by the incentive reduction effect as migration proceeds. As we shall elaborate in the sequel, each of these cases represents benchmark situations which has an important bearing on the dynamics of migration.

To see this, note that migration from the home to the foreign region takes place at time t if, for some a and a given stock of previous migrants,

$$\frac{1}{1-\beta}w(m_{t-1}) - \left(\frac{1}{1-\beta}w^*(m_{t-1}) - \bar{C} - C(a, m_{t-1})\right) \leq 0.$$

By assumption (A2), the monotonic relationship between a and the cost of migration guarantees that for all $a' < a$,

$$\frac{1}{1-\beta}w(m_{t-1}) - \left(\frac{1}{1-\beta}w^*(m_{t-1}) - \bar{C} - C(a', m_{t-1})\right) < 0.$$

Finally, denote the propensity to migrate of a marginal migrant $a(m_{t-1})$ as follows⁹:

$$\frac{1}{1-\beta}w(m_{t-1}) - \left(\frac{1}{1-\beta}w^*(m_{t-1}) - \bar{C} - C(a(m_{t-1}), m_{t-1})\right) = 0. \quad (3)$$

Accordingly, the degree of outmigration at any time t given m_{t-1} can be written as:

$$m_t = \max\{F(A(m_{t-1})), m_{t-1}\}. \quad (4)$$

where $(A(m_{t-1})) = \min\{a(m_{t-1}), 1\}$. The law of motion of the dynamic process of migration consists of two elements. First, since the expected income differential across the two regions at any time t depends on the stock of previous migrants both through the cost reduction effects of migrant network and the role it plays on the expectation of future income flows, $F(a(m_{t-1}))$ is accordingly the measure of home country workers with a propensity to migrate which is at least as high as the marginal migrant. In addition, since m_{t-1} is itself determined by the degree of outmigration at time $t-2$, equation (4) depicts

⁹That $a(m_{t-1})$ is well defined follows from A2 and the continuity of the wage and cost functions with respect to m_{t-1} and a .

a cumulative process of migration in such a way that each act of migration on the part of home country workers induces a chain of subsequent outmigration, which is otherwise impossible had the pioneers remained in the village.

Secondly, while the marginal migrant is just indifferent between migration or staying put at the time of migration, the same may no longer hold once migration at time t is completed. Namely, $\frac{1}{1-\beta}w(m_t) - (\frac{1}{1-\beta}w^*(F(m_t)) - \bar{C} - C(a(m_{t-1}), m_t))$ may be of either positive or negative sign. Since migration cost is a one time payment at the time of migration, we obtain, by invoking (A4), the second term of equation (4) which requires that the measure of migrants at any time t be no less than that in the previous period irrespective of the degree of outmigration.

It follows straightforwardly that a migration equilibrium \tilde{m} is a rest point to equation (4) with

$$\tilde{m} \geq F(A(\tilde{m})).$$

With this in mind, a simple application of Brouwer's fixed point theorem¹⁰ gives part (1) of the following proposition:

Proposition 1 (1) *If $F(A(\cdot))$ is continuous, a migration equilibrium exists.*

(2) *A migration equilibrium m^* is locally stable if and only if $F(A(m^*)) \geq m^*$ and¹¹*

$$f(A(m^*))\phi(m^*) < 1 \tag{5}$$

where $\phi(m^*) = (w^{*'}(m^*) + w^{*'}(1 - m^*) - (1 - \beta)C_m(A(m^*), m^*)) / ((1 - \beta)C_a(A(m^*), m^*))$.

Proof: See Appendix.

Figure 2 graphically depicts the dynamic process of migration as in equation (4). The horizontal and the vertical axis respectively denote the degree of outmigration at time $t - 1$ and t . The 45° line is the set of all possible steady state solutions to equation (4). The slope of curve MM on figure 2a is given by:

$$\frac{dm_t}{dm_{t-1}} \Big|_{MM} = \begin{cases} f(A(m_{t-1}))\phi(m_{t-1}) & \text{if } F(A(m_{t-1})) \geq m_{t-1}; \\ 1 & \text{otherwise.} \end{cases} \tag{6}$$

¹⁰See Debreu (1959).

¹¹ C_a and C_m denote respectively the first derivative of migration cost with respect to the first and second arguments.

Accordingly, curve MM is respectively upward and downward sloping depending precisely on whether the network effect or the incentive reduction effect dominates. Furthermore, the frequency distribution $f(\cdot)$ also affects the slope of the MM curve in that the smaller the frequency of individuals for any particular value of $A(m_{t-1})$ and thus the smaller the density of the marginal migrant, the flatter the MM curve. Finally, the larger the discount rate (the smaller is β), the flatter the MM curve.

Let us begin with the case where the network effect dominates¹². One such scenario is depicted in figure 2a. As shown, the MM is always upward sloping and in this particular scenario, it intersects the 45° line twice. There is a continuum of steady states for all initial rates of outmigration where $m_0 \leq m^*$ with $m_0 = m^*$. That this should be the case is due to the fact that voluntary migration cannot take place prior to the point m^* . Any exogenously determined initial rates of outmigration which satisfy this criterion is itself a steady state due to the migration decision calculus described above. m^* is a equilibrium migration threshold whereby for any initial rates of outmigration greater than m^* , migration takes on its own momentum as network externality gives rise to sufficient reductions in the cost of migration for subsequent rounds of migrants. Voluntary migration will proceed until the stable equilibrium m^{**} is reached.

In fact, it can be shown that if the migration equilibrium nearest to the origin is locally unstable and that the same condition guaranteeing instability is satisfied for any m between zero and m^* , there exists an \bar{m} with $0 < \bar{m} < m^*$ such that $A(\bar{m}) = 0$ ¹³. Put another way, the existence of a migration equilibrium m^* with strictly positive rate of outmigration, does not necessarily imply that for all levels of outmigration less than m^* , migration is a feasible option. Notice that starting from a point like $m = 0$, equilibrium is one where no migration takes place at all. In other words, outmigration becomes feasible only when the stock of established migrants exceeds a threshold level (point m^*). Migration then perpetuates due to equation (4) since the cost saving role of migrant networks outweighs the reduction in net benefits as migration proceeds. The pattern of migration, therefore depends crucially on initial conditions.

Our previous discussions on employer recruitment as well as those immigration policies which encourage the reunion of families and relatives thus play an active role in determining these initial conditions. As a result, even in those circumstances where wages and income are similar in potential source communities, the pattern of outmigration may turn out to be drastically different. Notable examples

¹²Equivalently, we have $\phi(\cdot) > 0$

¹³See Appendix II.

include the deliberate migrant recruitment which led to the onset of the Irish labor migration to the United States in the mid-nineteenth century as well as from Brazil, Argentina and Mexico to the same destination country later in the century¹⁴. It bears emphasis that while the chain migration phenomenon and nationwide selectivity in migration flows are widely noted, evidence also exists for differences in migration propensity on a regional level where rates of outmigration are markedly different across otherwise equally poor regions or villages within the same source country¹⁵. Along a similar vein, Greenwood (1970) shows that failure to include the stock of migration variable conceal the true effect of other migration determinants in the context of US interstate migration.

A contrasting situation is depicted in figure 2b. That curve MM is downward sloping for all values of m_{t-1} is a result of the fact that the incentive reduction effect dominates and hence, $\phi(\cdot) \leq 0$. Note in particular that the 45° line and the MM curve may intersect once only (at m^*) and thus for all initial rates of outmigration $m_0 \leq m^*$, $F(a(m_0)) \geq m_0$. As the MM curve is downward sloping, $F(a(m_0))$ is a stable steady state. In fact, it can be easily confirmed by figure 2b that the type of chain migration described figure 2a simply does not occur and we are back to the neoclassical world where any incentive to migrate from the home to the foreign country is wiped out within one period in a situation where network externality is insignificant. Finally, figure 2c illustrates the third case where the relative dominance of network and incentive reduction effect varies over the course of migration. Migration equilibrium may be stable or unstable depending once again on the initial stock of migrants from the home region.

The multiplicity of equilibria is possible, precisely due to the favorable externalities engendered by the stock of established migrants in the foreign country. Everything else constant, each act of migration generates a *chain* of further movements of labor in ways that spread migration within the source community. Nevertheless, when migration decisions are based on cost-benefit calculations undertaken by the individual worker, the potential gain to the source community at large will not be internalized when each agent maximizes his / her lifetime utility. Migrant networks, therefore, exhibit a public good property. The next section is thus devoted to study the welfare implications of migrant networks.

¹⁴See for instance, Piore (1975), pp. 19-27. In the context of Turkish migration to West Germany, see also Waldorf et. al (1990) which gives evidence for the importance of prior migrant contacts through information acquisition, assimilation of newcomers and family reunification .

¹⁵See also Cornelius (1993), Gregory *op. cit.* and Hugo (1981) for discussions of differential migration propensities from various Mexican municipals to the U.S.

3 Welfare Analysis

Consider a social planner who may choose an optimal path of outmigration in order to maximize discounted societal welfare of the home region. The planner's problem is thus

$$\max_{\{a_\tau\}_{\tau=1}^{\infty}} \sum_{\tau=1}^{\infty} (\beta^\tau w^*(F(a_\tau))F(a_\tau) + w(1 - F(a_\tau))(1 - F(a_\tau)) - \int_{a_{\tau-1}}^{a_\tau} (\bar{C} + C(a, F(a_{\tau-1}))f(a)da. \quad (7)$$

subject to $a_\tau \geq 0$. Denoting the optimal path as $\{\tilde{a}_\tau\}_{\tau=1}^{\infty}$, it follows that:

$$w^*(F(\tilde{a}_t)) + w^{*'}(F(\tilde{a}_t))F(\tilde{a}_t) + \beta(\bar{C} + C(\tilde{a}_t, F(\tilde{a}_t))) - \beta \int_{\tilde{a}_{t-1}}^{\tilde{a}_t} (\bar{C} + C_m(a, F(a_{t-1}))f(a)da = \quad (8)$$

$$w(1 - F(\tilde{a}_t)) + (w'(1 - F(\tilde{a}_t)))(1 - F(\tilde{a}_t)) + (\bar{C} + C(\tilde{a}_t, F(\tilde{a}_{t-1}))).$$

Along the optimal path of migration, \tilde{a}_t equalizes the marginal benefits and costs of migration where the marginal benefits should take into account the change in foreign wage as well as the reduction in the cost of migration as a result of an incremental increase in the outmigration rate. The marginal cost of migration, on the other hand, should take into account the change in the home income as a result of outmigration as well as any increase in the cost of migration as workers with higher a migrates.

That this socially optimal path may not coincide with the competitive outcome should be clear by comparing equation (3) and (5). In particular, since at any time t , voluntary migration takes place until

$$w^*(m_{t-1}) - (1 - \beta)(\bar{C} + C(a(m_{t-1}), m_{t-1})) = w(1 - m_{t-1}),$$

which states that migration equalizes the expected lifetime income across the two regions for the marginal migrant. The deviation of this privately optimal rule of migration and equation (8) depends on the rate at which domestic and foreign wages change in response to migration flows, as well as the size of the network effect $C_m(\cdot, \cdot)$. Ceteris paribus, the larger the network effect, the larger will be the deviation of voluntary migration from the social optimum. The source of the suboptimality of voluntary migration, is two-fold. Social optimum entails migration decision making in the form of marginal as opposed to average income comparisons. Secondly, the socially optimal rate of outmigration also take into account the network externality that each act of migration engenders. It can also be confirmed straightforwardly that if this source village is a "price-taker" in the domestic as well as the foreign labor market and if network externality is absent, the privately optimal degree of outmigration coincides with the socially optimal one.

4 Discussion

In this section, we shall relax some of the assumptions made in the previous section and examine the pattern of migration and its welfare implications.

1. The suboptimality of decentralized migration decisions arises when the benefits of each act of migration extends to all members of the source community at large. Nevertheless, instances where such external benefits can be internalized in migration decision making need not be farfetched. For example, when family decisions take on an important role in migration behavior, a family member may well be sent abroad even when costs exceeds benefits - an oft noted puzzle in the migration literature¹⁶ - in anticipation of lower expenses for successive outmigration of family members¹⁷.

To illustrate how our model can be extended to this context and the resulting dynamics of outmigration, consider a single family as the source region. Let such a family consists of L members. Family production in the migration origin yields a per period output of $y(L - M_t)$ where M_t denotes the stock of family members abroad. $y(\cdot)$ satisfies all the conditions of a standard production function with $y(\cdot)$ strictly increasing in its argument and exhibiting diminishing marginal returns. The foreign country pays a wage w^* which this family takes as given¹⁸. As before, preferences are represented by the expectation of the discounted lifetime income of this household over the infinite horizon. At the beginning of each time period, the problem of the household involves the decision of how many additional family members to send abroad given the stock of family members already employed in the foreign region. The cost of migration for one member of this household at time t is $\bar{C} + C(M_{t-1})$ where $C(\cdot)$ is decreasing and strictly positive for all possible values of M_{t-1} .

The problem of the household at any time t is thus

$$\max_{\{M_{t+\tau}\}_{\tau=0}^{\infty}} \sum_{\tau=0}^{\infty} \beta^{t+\tau} (w^* M_{t+\tau} + y(L - M_{t+\tau}) - (M_{t+\tau} - M_{t+\tau-1})(\bar{C} + C(M_{t+\tau-1}))). \quad (9)$$

subject to $L \geq M_{t+\tau} \geq 0$. Denoting the optimal path of outmigration from this family as $\{\tilde{M}_{t+\tau}\}_{\tau=0}^{\infty}$.

The first order condition of this problem is:

¹⁶See, for instance, Stark (1991).

¹⁷See Findley *op. cit.* for an illustrative survey of family and community profiles with regards to migration from the Philippines.

¹⁸An alternative interpretation of this assumption is that the family unit is sufficiently small so that the foreign wage is invariant to any change in labor allocation of this household across the domestic and foreign country.

$$w^* + \beta(\bar{C} + C(\tilde{M}_{t+\tau})) - \beta(\tilde{M}_{t+\tau+1} - \tilde{M}_{t+\tau})C_m(\tilde{M}_{t+\tau}) = \quad (10)$$

$$y'(L - \tilde{M}_{t+\tau}) + (\bar{C} + C(\tilde{M}_{t+\tau-1})).$$

Equation (10) thus specifies the relationship between the degree of previous family migration and the degree of outmigration in successive periods. Note in particular that unlike the competitive outcome which suffers from the public good property of migrant network as illustrated in the previous section, the same no longer applies in this case. Along the optimal path of outmigration, the degree of outmigration depends not only on the gains and losses in household income for the marginal migrant, family income maximization also guarantees that the cost reductions for subsequent family outmigration are fully taken into account.

A further manipulation of equation (10) also confirms that any migration steady state (m^*) is locally stable for any household with a sufficiently low rate of discount and a sufficiently effective migrant network. To see this, note that the more patient households will be willing to sacrifice the payment of migration costs in the current period in exchange for an increase in the flow of future benefits. On the other hand, such benefits would be worthwhile only if the effectiveness of the migrant network is sufficiently large.¹⁹

2. Another important assumption we made in the previous section pertains to the size of the home region, namely, that the size of the migration origin is sufficiently small so that wage equalization never occurs irrespective of the degree of outmigration from the source region. As discussed, a migrant network is a set of interpersonal ties which render the psychological costs of migration variable with respect to the stock of veteran migrants who indeed belong to the network. To incorporate the fact that the source region may indeed be large without compromising the above characteristic of migrant networks, the model may be modified in the following way. Consider a source region which consists of a large (say N) number of villages. Population and preference structure pertaining to the individual worker in each village satisfy the all the assumptions made in the previous section. Clearly, there are a number of parameters in this model which may be utilized to distinguish between heterogeneous villages, such as the domestic wages, the distribution of migration propensities ($F(a)$) and the rate of time preference. While a detailed analysis of each of these cases is beyond the scope of this paper, in this section, we shall only consider the latter.

¹⁹For a proof of this result, see part III of the appendix.

Let individual villages differ from one another in terms of their rate of time preference β . Further, let the fraction of villages with rate of time preference less than or equal to $\bar{\beta}$ and with an initial stock of migrant $m_0 \leq \bar{m}$ as $G(\bar{\beta}, \bar{m})$. Workers are homogeneous in terms of their productivity. It follows that per period foreign wage payment at any time t depends on the measure of the stock of migrants in the foreign country, that is $w_t^* = w^*(M_t)$. Internal migration across villages is assumed to be costless and thus domestic wages also depend on the aggregate degree of outmigration from the source region, or,

$$w_t = w(N - M_t).$$

The main element of this extended version of our model is that the cost of migration for any individual belonging to a village with rate of discount β is decreasing in the stock of migrants from this village alone. That is, if the stock of migrants from a village at time $t - 1$ is m_{t-1} , the cost of migration for any individual with propensity to migration a is just $\bar{C} + C(a, m_{t-1})$. Accordingly, the lifetime expected utility of such an individual currently residing respectively in the home country ($Y_t^h(\beta, a, m_{t-1}, M_{t-1})$) and the foreign country ($Y_t^f(\beta, a, m_{t-1}, M_{t-1})$) is just

$$\begin{aligned} Y_t^h(\beta, a, m_{t-1}, M_{t-1}) &= \max\left\{\frac{1}{1-\beta}w(N - M_{t-1}), \frac{1}{1-\beta}w^*(M_{t-1}) \right. \\ &\quad \left. - \bar{C} - C(a, m_{t-1})\right\} \\ Y_t^f(\beta, a, m_{t-1}, M_{t-1}) &= \max\left\{\frac{1}{1-\beta}w(N - M_{t-1}) - \bar{C}, \frac{1}{1-\beta}w^*(M_{t-1}) - \bar{C} - C(a, m_{t-1})\right\}. \end{aligned} \quad (11)$$

In the appendix, we shall derive the set of difference equations which governs the dynamic process of migration in this case. Several comments are in order. Our previous analysis points out that in the presence of migration thresholds, initial conditions in the form of the stock of existing migrants from the source region determines the dynamics of outmigration which ensue. In the present case, where domestic wages are determined by the aggregate degree of outmigration from the host country, it is only natural that migration thresholds are dependent on aggregate outmigration from the source region. Referring to figure 3 which is just the analogue of figure 2 for the present case, curve YY and $Y'Y'$ depicts the dynamics of migration for two different levels of the stock of migrants from the rest of the villages. In fact, as the stock of migrants from other villages increases, the migration threshold moves from m^* a higher value, m^{**} . Namely, the concomitant reduction in the wage differential across the two regions now entails a much higher initial stock of migrants in the foreign region in order for voluntary migration to take place. It

bears emphasis that the selectivity of outmigration pattern across apparently identical villages can be explained not only through the difference in the initial stock of migrants, from figure 3, we also find that the *timing* of initial outmigration relative to the rest of the potential migrant pool is equally important.

As discussed in the previous section, a necessary and sufficient condition which precludes the occurrence of return migration is that, for any m ,

$$w^*(m) - (1 - \beta)\bar{C} \geq w(1 - m),$$

which can be justified on the grounds that the source region is sufficiently small so that migratory movements does not give rise to substantial fluctuations in regional wage differentials. While this justification no longer applies in the present case, one can no longer undermine the possibility of return migration either. That this is so is due to the fact that when each act of migration generates a set of favorable externalities on potential migrants from the same village, it also engenders a negative incentive for migrants originating from different source villages. In addition, heterogeneity across villages in terms of the rate of time preference leads to the possibility that return migration by some villages may entail additional outmigration from others. In essence, simultaneous two-way flow of migrants may occur whenever return migration takes place. Finally, welfare implications of migrant networks we elaborated above still applies. Since private migration decisions in this setting does not take into account the positive (negative) externality it imposes on other members of the source region, migration may entail both under and / or over migration of labor, depending once again on the marginal migration benefits and costs to the source region at large.

3. In addition to reducing migration costs, having prior contacts in a foreign country may also allow the potential benefits of migration to increase. The provision of assistance during job search as well as accurate information about labor market characteristics, opportunities and skill requirements (Gibbs (1994)) are all important ingredients in guaranteeing successful migration. One might also note the information asymmetry which arises when foreign employers are imperfectly informed about the true productivity of migrants. Consequently, employers may favor those new workers with recommendation through previous contacts (Montgomery (1991)).

The benefit enhancing effect of migrant networks can be easily incorporated to our framework by appropriately modifying our specification of w^* . Note, however, that the qualitative outcome

of our analysis need not change. In particular, the three cases we identify in the section 2 still depend both on the combined effect of domestic and foreign wage as well as migration cost changes with respect to the stock of migrants. The stronger the network effect, both through benefit enhancement and cost reduction, the steeper the *MM* curve and thus the more likely that the network effect is the dominating factor in the dynamic process of migration.

4. In a typical less developed country setting where inequality in the distribution of wealth and heterogeneity of preferences are rules rather than exceptions,²⁰ selectivity in migration propensities in response to a given set of opportunities, prices, and the changes in these variables thereof, takes on additional importance in determining the pattern of outmigration from the region as a whole²¹. In Lipton's terms²², migration may take the form of a "leader-follower", "innovator-imitator" relationship, which are in turn synonyms for the young and the elderly, the resourceful and the resourceless. Accordingly, those who have few assets must rely on social contacts and the exchange of favors through networks, in order for migration to become a feasible option.

To mention one such possible interpersonal heterogeneity, ownership of assets, such as land, has two distinct roles in determining an agent's propensity to migrate. In a setting where rural labor market is completely absent²³ or when transactions costs in labor hiring activities are high, outmigration from families of large landowners becomes more expensive than say, the landless, since the absence of a family member can only be replaced at a cost higher than the prevailing market wage. On the other hand, imperfections in rural credit markets prohibit those who are incapable offering family owned assets as collateral from financing the cost of migration²⁴. In this case, it is thus the poor who are more reliant on foreign contacts and other cost-saving means of migration.

Within this framework, the distribution of willingness to migrate may be appropriately translated as the distribution of assets. The precise mechanism under which these two opposing effects of asset ownership operate and hence the sequence of migration of the resourceless versus the resourceful will in turn depend on the institutional framework one has in mind. These conclusions

²⁰See also Smith (1979) for an analysis of the role of the distribution of risk averseness in the context of inter-regional migration.

²¹See Connell et al. (1976) and Findley (1987).

²²See Lipton (1982).

²³See, for instance, Bhattacharyya (1985).

²⁴There is by now a large theoretical literature on the role of transaction costs on the formation of agricultural institutions. See, for instance, Jaynes (1984), Eswaran-Kotwal (1986) and the references therein. See also Danesh (1987) for a case study on the migration patterns in Iran.

will, in turn, determine the impact of migration on the income distribution across home region workers.

5 Conclusion

To summarize, we have singled out an example where regional migration propensities may differ even if the domestic wages are identical throughout the source country. Conditions under which migration may be suboptimal from the source communities point of view are identified. These conclusions are drawn by postulating that the cost of migration is endogenously determined by the degree of outmigration itself, and in addition, the stock of *experienced* migrants pertaining to a particular region is a parameter specific to each region. In the case where the cost-saving role of migrant networks dominates, we identify a threshold level of migration such that once the number of experienced migrants exceeds this level, voluntary movements of labor, which is otherwise an infeasible endeavor, commence and perpetuates.

Reference

- Bhattacharyya, B. 1985. "The role of family decision in internal migration," *Journal of development economics*, 18, 51-66.
- Connell, J., B. DasGupta, R. Laishley and M. Lipton. 1976. *Migration from rural areas*. Delhi: Oxford University Press.
- Cornelius, W.A. and P.L. Martin. 1993. *The Uncertain Connection - Free Trade and Mexico - U.S. Migration*. Center for U.S.- Mexican Studies. University of California, San Diego.
- Danesh, A.H. 1987. *Rural exodus and squatter settlements in the third world*. University Press of America, Inc.
- Debreu, G. 1959. *Theory of value*, New Haven and London: Yale University Press.
- de Janvry, A. and R. Mines. 1982. "Migration to the United States and Mexican rural development: A case study," *American Journal of Agricultural Economics*, 56, 444-52.
- Eswaran, M. and A. Kotwal. 1984. "Access to capital and agrarian production organization," *Economic Journal*, 96, 482-98.
- Findley, S.E. 1987. *Rural development and migration*. Brown University studies in population and development. Boulder: Westview Press.
- Gibbs, R. M. 1994. "The information effects of origin on migrants' job search behavior," *Journal of Regional Science*, 34, 163-178.
- Greenwood, M. J. 1969. "An analysis of the determinants of geographic labor mobility in the United States," *The Review of Economics and Statistics*, 51, 189-194.
- Greenwood, M. J. 1970. "Lagged response in the decision to migrate" *Journal of Regional Science*, 10, 375 - 384.
- Gregory, P. 1986. *The Myth of Market Failures*. Johns Hopkins University Press.
- Hugo, G.H. 1986. "Village-community ties, village norms and ethnic and social networks: A review of evidence for the third world," in G.F. De Jong and R.W. Gardner (eds.) *Migration decisionmaking: Multidisciplinary approaches to micro-level studies in developed and developing countries*. New York: Pergamon Press.

- Jaynes, G.D. 1984. "Economic theory and land tenure," in H.P. Binswanger and M.R. Rosenzweig (eds.), *Contractual arrangements, employment, and wages in rural labor markets in Asia*, New Haven: Economic Growth Center, Yale University.
- Lipton, M. 1982. "Migration from rural areas of poor countries: the impact on rural productivity and income distribution," in H. Sabot (ed.), *Migration and the labor market in developing countries*, Boulder: Westview Press.
- Lomnitz, L.A. 1977. *Networks and marginality: Life in a Mexican shanty town*. New York: Academic Press.
- Massey, D.S. and F. García Expaña. 1987. "Social process of international migration," *Science*, August, 733 - 38.
- Massey, D.S. and L. Goldring. 1992. "Continuities in transnational migration: An analysis of 13 Mexican communities," paper presented at the Workshop on U.S. Immigration Research: An assessment of data needs for future research. National Research Council, Washington, D.C.
- Montgomery, J.D. 1991. "Social Networks and Labor-Market Outcomes: Toward an Economic Analysis," *American Economic Review*, 81, 1408 - 1418.
- Piore, W. 1977. *Birds of Passage*. Massachusetts: Cambridge University Press.
- Portes, A. and J. Borocz. 1989. "Contemporary Immigration: Theoretical Perspectives on its Determinants and Modes of Incorporation," *International Migration Review*, 23, 606-28.
- Portes, A. and J. Sensenbrenner. 1993. "Embeddedness and immigration: notes on the social determinants of economic action," *American Journal of Sociology*, 98, 1320-50.
- Rees, A. 1966. "Information Networks in Labor Markets," *American Economic Review*, 56, 559-566.
- Smith, T.R. 1979. "Migration, Risk Aversion, and Regional Differentiation," *Journal of Regional Science* 19, 31 - 45.
- Taylor, E.J. 1986. "Differential Migration, Networks, Information and Risks," in *Research in Human Capital and Development* vol. 4. O. Stark (ed.), Greenwich Connecticut: JAI Press Inc.
- Waldorf, B.S., A. Esparza and J.O. Huff. 1990. "A behavioral model of international labor and nonlabor migration: the case of Turkish movements to West Germany, 1960-1986," *Environment and Planning*, 22, 961-973.

Appendix

I. Proof of Proposition 1: A migration equilibrium is locally stable if and only if $dm_t/dm_{t-1} < 1$, where

$$\frac{dm_t}{dm_{t-1}} = f(A(m^*)) \left[\frac{w^{*'}(m^*) + w'(1 - m^*) - (1 - \beta)C_m(A(m^*), m^*)}{(1 - \beta)C_a(A(m^*), m^*)} \right]. \square$$

II. In section 3, it is claimed that the existence of a strictly positive rate of equilibrium migration m^* does not necessarily imply that for all levels of outmigration less than m^* , migration is a feasible option. To show that this is indeed the case, suppose otherwise. Notice first of all that for any $m = m^* - \epsilon$,

$$f(A(m)) \left[\frac{w^{*'}(m) + w'(1 - m) - (1 - \beta)C_m(A(m), m)}{(1 - \beta)C_m(A(m), m)} \right] > 1. \quad (12)$$

if and only if $F(A(m + \epsilon)) - F(A(m)) > \epsilon$ for any $\epsilon > 0$ and $m^* = m + \epsilon$. It follows that

$$\begin{aligned} F(A(m^*)) - F(A(m)) &> \epsilon \\ m^* - \epsilon &> F(A(m)) \\ m &> F(A(m)). \end{aligned}$$

A contradiction. \square

III. To determine the parameters which affect the stability of household migration, note that from equation (10), we have

$$w^* - y'(L - M_t) - (\bar{C} + C(M_{t-1})) + \beta((\bar{C} + C(M_t)) - \beta(M_{t+1} - M_t)C_m(M_t)) = 0.$$

It follows that at any point along the optimal path of migration,

$$\frac{dM_t}{dM_{t-1}} = \frac{w''(N - M_t) + 2\beta C_m(M_t) - \beta(M_{t+1} - M_t)C_{mm}(M_t)}{C_m(M_{t-1})}.$$

which is greater than 1 for sufficiently large β and if $C_{mm}(\cdot) > 0$ since $M_{t+1} \geq M_t$ for any t . \square

IV. This section offers a characterization of the dynamic process of migration in section III.2. For any village with a rate of time preference β , let $\psi(\beta)$ be the maximum degree of outmigration from the home country without inducing return migration from this village:

$$w^*(\psi(\beta)) - (1 - \beta)\bar{C} = w(1 - \psi(\beta)),$$

Since $w^*(\cdot)$ and $w(\cdot)$ are decreasing in their arguments, it follows that $\psi(\beta)$ is decreasing in β . Hence, given m_{t-1} and the total degree of outmigration from the migrant source country, M_{t-1} , we obtain,

$$m_t(\beta, m_{t-1}, M_{t-1}) = \begin{cases} \max\{F(A(\beta, m_{t-1}, M_{t-1})), m_{t-1}\} & \text{if } M_{t-1} \leq \psi(\beta); \\ 0 & \text{otherwise.} \end{cases} \quad (13)$$

where $A(\beta, m_{t-1}, M_{t-1})$ is the analogue of equation (3) and (4) in the text. Aggregate outmigration at any time t from the source country is thus

$$\int_0^1 \int_0^1 N m_t(\beta, m_{t-1}, M_{t-1}) g(m_{t-1}, \beta) d\beta dm_{t-1}$$

where $g(\cdot, \cdot)$ is the density function associated with $G(\cdot, \cdot)$ \square