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FAMILY MIGRATION IN AN UNCERTAIN ENVIRONMENT

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Abstract—Migration is risky. The hopes and expectations that motivate a move may not be met. The family provides opportunities to reduce the risks of mobility. This paper analyzes the joint family migration decision and exploits analogies to the traditional portfolio selection problem.

INTRODUCTION

Migration is risky. The expectations that lead an individual to consider moving might not be met. The cost of disappointment can be high, particularly in the context of rural-to-urban labor migrations in developing countries, where most migrants need to find an occupation quickly to support themselves.

When disappointed expectations have potentially disastrous consequences, one expects to observe risk averse behavior. Risk aversion can, of course, take the form of risk avoidance. But if the gains from making risky choices are great, then a strategy of risk reduction is more attractive. An individual's ability to reduce the risk associated with labor migration is limited. The extent to which risk can be spread through diversification is very small; a worker can only be at one location at a time. The family, on the other hand, is better able to reduce risk. If its adult members work in different occupations, and possibly at different locations, the probability that the family income falls below a critical level is reduced. The family may also help to keep open an individual's option to return, should migration yield disappointing benefits.

The superior ability of the family to deal with risk creates an incentive for the individual prospective migrant to coordinate migration decisions within the family. Hence, the family becomes an appropriate unit of analysis for the study of the migration of rural residents in developing countries. While this paper focuses on the family's ability to reduce risks associated with migration, there are other, economic and noneconomic, reasons to consider migration a family decision. For a detailed discussion see Mincer [1] and Schaeffer [2].

These notions motivate the model presented below. The model describes the migration decision under uncertainty for a risk averse family. It shows that there are similarities between the family's joint migration decision problem and a portfolio problem. The paper is organized as follows. Section 2 presents a short review of the literature on rural-to-urban migration in developing countries. It is followed by a discussion of the similarities between portfolio choices and location choice. Section 4 contains the model, and Section 5 gives an interpretation of the first-order necessary conditions. Implications for further research are discussed in the concluding section.

REVIEW OF THE LITERATURE

Migration has the characteristics of an investment [3]. Resources are spent now in return for uncertain future benefits. The nature of the risk is illustrated by the extent of urban unemployment and poverty in many third world countries. Yet, migration to the cities continues at a high rate. Why does high unemployment not serve to discourage newcomers?

Harris and Todaro [4, 5] provide an answer to this question by pointing out that urban wages are often held artificially high through government regulation. Migration-induced changes in labor markets may not, therefore, bring about a gradual convergence of rural and urban labor incomes. A different equilibrating mechanism is thought to be at work instead. As more and more migrants enter the cities in search of work, the competition for well-paying jobs increases, and the probability of success decreases. The earnings which a prospective migrant can expect, therefore, decrease. This trend will continue until the expected income of working in the urban sector is just equal to the income which can be obtained in the rural sector (assuming that migrants are risk neutral).

The work of Harris and Todaro stimulated significant additional research into the nature of rural-to-urban migrations in third world countries (e.g. Bhagwati and Srinivasan [6]; Blomqvist [7]; Collier [8]; Corden and Findley [9]; Fields [10]; Johnson [11]; Neary [12]). Most of these models assume that migration to the urban sector is permanent. Empirical studies in South-East Asia indicate that circular migration is also an important phenomenon (e.g. Elkan [13]; Goldstein [14]; Hugo [15, 16]). It is of interest to investigate why such behavior would arise.

A possible explanation is provided by Stiglitz [17]. Agriculture is the dominant industry in the rural sector of developing nations. The marginal product of labor in agriculture varies significantly with the seasons. It is generally highest during the harvesting and planting seasons. If, in between seasons, the marginal product of labor is higher at jobs elsewhere, a pattern of seasonal circular migration may emerge. Such patterns are observed not only in developing countries, but also in the agricultural sectors of the United States and European countries.

Another explanation centers around the issue of risk in migration. The original contributions by Harris and Todaro assume away any significance of risk by modelling decision-makers as risk neutral individuals. Since risks associated with rural-to-urban migration are so substantial that ruin is a real possibility, it is more reasonable to assume instead that individuals are risk averse. Fan and Stretton [8] present circular migration as a mechanism through which rural residents can benefit from well-paid urban employment without bearing the full risks of a strategy of migration followed by job search. Less risk is involved in searching for employment first and moving only after a satisfactory job has been secured.

This form of risk avoidance requires the existence of a network through which information about urban job opportunities is passed on to rural residents. In many industries, employers save recruitment and screening costs by hiring new workers based on recommendations of foremen or long-time employees. As some of these employees have originally emigrated themselves, they may recommend a trusted relative or friend still living in the rural area. Through such ties, rural residents can secure urban employment before moving. Of course, this strategy limits the access to those urban jobs where relatives or friends are able to provide information and serve as references to employers. The disadvantage of limiting one's choice may be more than offset, however, by avoiding the possibility of prolonged urban unemployment.

This paper presents a model of family migration under uncertainty. By taking the family as the unit of analysis, it is possible to investigate more options to lower risk than if only individuals were studied. An excellent discussion of the importance of family ties in migration is contained in Caces *et al.* [19]. Arguments concerning migration, the family, and the distribution of risk, can also be found in Stark and Levhari [20], and Katz and Stark [21]. A paper by Sen [22] contains interesting insights into the family institution that are also of interest here. He discusses, in general terms, some of the problems that arise in studying the family as an economic decision unit.

The approach taken here assumes that family members may move individually. This contrasts with the work of Mincer [1] which assumes that the family always moves together. We choose to drop this assumption because the focus of the paper is on risk reduction. A family that always moves together gives up many opportunities to reduce the risk of a drop in income. In papers related to the question of family cohesion and migration, Lucas and Stark [23] investigate the forces that keep the family together when family members are living in different locations, while Schaeffer [2] studies the joint migration process between family and individual under two different assumptions concerning the strength of family ties.

THE FAMILY MIGRATION DECISION AS A PORTFOLIO CHOICE PROBLEM

The choice of a location may be regarded as the choice of an asset that yields an uncertain benefit. Associated with the benefit is, therefore, a probability distribution. From a worker's perspective, presence at a particular location opens up job opportunities. Jobs are characterized by a bundle of attributes such as wage rates, proximity to place of residence and the probability of layoff. Assume that the worker is able to rank the jobs in order of preference, and that the ranking takes into consideration search cost as well as the job's attributes and the possibility of layoff. Assume further that the worker's strategy consists of trying to get hired into the most preferred job first; if that is unsuccessful, into the second most preferred job next, and so on. Under such a strategy, there exists a probability distribution for the return that is associated with every available job-location combination (see Schaeffer [24]). The probability distribution may vary among individuals, depending on their qualifications, information network informing them of job openings, and influence of relatives or friends who may serve as recommenders in the labor market.

A family with several members who are of working age has the option to send them to work in different jobs and/or locations, thereby reducing overall risk. The choice of the family thus resembles the choice of assets in putting together a portfolio. As explained above, associated with each possible location choice is a probability distribution of the benefits. In addition, the choice of location involves certain costs of migration which can be interpreted as transaction costs. Of course, if no migration occurs, that is, if the family is satisfied that the initial distribution of its members is optimal, no transaction costs will be incurred.

THE MODEL

Consider the decision of a family with N members. Of these N members, X are of working age. All individuals who are capable of working are assumed to have the same chances in the labor markets. This assumption is made for mathematical convenience. It could easily be relaxed by distinguishing between different groups of working age members, i.e. X_1, $X_2, \ldots, X_k$. No qualitatively different insights are gained from the greater complexity, however.

In studying the decision problem, the family faces a decision-outcome matrix, together with the probability distributions for the outcomes associated with each possible decision. The number of relevant job-location combinations is I, and the number of individuals who are sent to work at a particular choice i is denoted by x_i. The number of family members who are already at i before the decision is made, is given by y_i. The following conditions must be met:

$$0 \leqslant x_i \leqslant X \quad \text{and} \quad \sum_{i=1}^{I} x_i = X \tag{1a}$$

$$0 \leqslant y_i \leqslant Y \quad \text{and} \quad \sum_{i=1}^{I} y_i = Y. \tag{1b}$$

Y is the number of working age family members during the preceding period. It can be smaller, equal to, or larger than X.

It is assumed that all migratory moves originate or end in the family's rural home town, and that the costs of migration are the same for a move from the home town to some other location, as they are for a move back. The cost of migration is given by T_i. The total cost of migration between the rural home town and any other location is given by:

$$T = \sum_{i=1}^{I} |x_i - y_i| T_i. \tag{2}$$

This formulation implies that family members who are at i at the beginning of the period will return home only if the family decides to reduce the number of its members who are working there during the new period.

Migration costs are incurred at the beginning of the period. They have to be financed out of the accumulated wealth of the family. The financial resources that are available at the beginning of the period are represented by W_0. It is assumed that no loans are available to cover the up-front expenses of migration. Hence,

$$W_0 \geqslant T. \tag{3}$$

The earnings of a worker at i are given by the random variable v_i. This random variable is nonnegative. The net earnings, after subtracting migration costs, are given by:

$$V_i = x_i v_i - |x_i - y_i| T_i. \tag{4}$$

V_i is also a random variable, and it may assume negative values. The family's wealth at the end of the period is represented by W. Thus:

$$W = \sum_{i=1}^{I} V_i + W_0. \tag{5}$$

The family's utility is an increasing function of wealth divided by the weighted average $p_1x_1 + p_2x_2 +, \ldots, + p_Ix_I$, where p_i is the cost of living at location i. This defines the per capita purchasing power, w, of the family. The formulation can be further generalized by making the per capita cost of living at i a function of x_i. That is, $p_i = p_i(x_i)$, which has a nonpositive first derivative. This allows us to consider possible cost savings from sharing a residence. The family's utility function is, therefore, given by $U = U(w)$. Since it is assumed that the family is risk averse, the second derivative of the utility function with respect to w must be negative. While this formulation is reasonably general, it considers only the monetary benefits of jobs. It is possible to incorporate other factors into an index which measures returns from a job/location combination i. The additional complexity would not lead to qualitatively different insights, however. The family's decision problem can now be stated rigorously as:

$$\underset{\{x_i\}}{\text{MAXIMIZE}}\; E[U(w)]$$
$$\text{SUBJECT TO (1a) and (2)–(5),} \tag{6}$$

E denotes the expectations operator.

Attitudes towards risk can be expressed by the Arrow–Pratt measures of absolute and relative risk aversion, respectively [25]. The measure of absolute risk aversion is denoted by $A(w)$, while the measure of relative risk aversion is represented by $R(w)$.

$$A(w) = -\frac{\dfrac{d^2U(w)}{dw^2}}{\dfrac{dU(w)}{dw}} > 0, \tag{7a}$$

$$R(w) = -w\frac{\dfrac{d^2W(w)}{dw^2}}{\dfrac{dU(w)}{dw}} = wA(w) > 0. \tag{7b}$$

The signs of $A(w)$ and $R(w)$ follow from our assumption that $dU(w)/dw > 0$, and from risk aversion, which requires that $d^2U(w)/dw^2 < 0$.

Two cases of particular interest occur when $A(w) = A$ or $R(w) = R$ are constants. In the case of constant absolute risk aversion, integration of (7a) yields the following class of utility functions which satisfy $A(w) = A$.

$$U_A(w) = a - be^{-Aw}, \quad b > 0. \tag{8a}$$

If $A(w)$ is constant, then $R(w)$ is increasing with wealth w. This seems counter-intuitive. A wealthy family is in a better position to bear risks than one with few resources. It seems more reasonable to assume that $R(w)$ is constant, or even decreasing. If $R(w) = R$, then integration of (7b) gives the following classes of utility functions [25].

$$\begin{aligned} U_R(w) &= w^{-(1-R)}, && R < 1; \\ U_R(w) &= \ln w, && R = 1; \\ U_R(w) &= c - dw^{-R+1}, && d > 0,\ R > 1. \end{aligned} \tag{8b}$$

In the case of $dR(w)/dw < 0$, the solution depends on the particular functional relationship between $R(w)$ and w. It must still be true that $R(w) > 0$ because the assumption of risk aversion is retained. It is easily checked that the utility function:

$$U_D(w) = e^{kw^q}, \quad \text{where} \quad q < 0 \quad \text{and} \quad k > 0; \tag{8c}$$

satisfies those conditions. In fact, for this particular formulation, the measure of relative risk aversion is:

$$R_D(w) = -(q-1) - kqw^q > 0$$
$$\text{with} \quad \frac{dR_D(w)}{dw} = -q^2kw^{q-1} < 0.$$

The general decision problem of the family can be solved by formulating the following Lagrangean function.

$$L(x_i, \lambda, \tau; X, Y, y_i, v_i) = E[U(w)]$$
$$+ \lambda\left(X - \sum_{i=1}^{I} x_i\right) + \tau\left(W_0 - \sum_{i=1}^{I} |x_i - y_i| T_i\right). \tag{9}$$

The first-order conditions are:

$$\frac{dE[U(w)]}{dx_i} - \lambda \pm \tau T_i \begin{cases} \leqslant 0 & \text{if } x_i = 0 \\ = 0 & \text{if } 0 < x_i < X \text{ and } |x_i - y_i| T_i < W_0 \\ \geqslant 0 & \text{if } x_i = X \text{ or if } |x_i - y_i| T_i = W_0. \end{cases} \tag{10}$$

$$X - \sum_{i=1}^{I} x_i = 0. \tag{11a}$$

$$W_0 - \sum_{i=1}^{I} |x_i - y_i| T_i \geqslant 0. \tag{11b}$$

It is clear from (10) that if more than one location is chosen the marginal expected utilities must be equal for all i for which $x_i > 0$. Condition (11a) ensures that all working family members are placed somewhere. Condition (11b) says that migration costs cannot exceed the family's initial wealth. In the case of risk aversion, the first-order necessary conditions are also sufficient for an optimum to exist.

Condition (10) requires some additional explanation for the case when $|x_i - y_i|T_i < W_0$. Under these circumstances, the exact form of (10) depends on whether $x_i < y_i$ or $x_i \geqslant y_i$. In the former case, increasing x_i by one saves transportation cost because it has the effect of decreasing overall family migration, as fewer members who were at i during the previous period need to move to another location. By contrast, if $x_i \geqslant y_i$, then increasing x_i even further means more migration and higher transportation cost.

Condition (10) also incorporates the effects of cost of living differences between locations. This is easily seen when the derivative of $E[U(w)]$ with respect to x_j is written out.

$$\frac{\mathrm{d}E[U(w)]}{\mathrm{d}x_j} = \frac{\mathrm{d}E[U(w)]}{\mathrm{d}w}\frac{\mathrm{d}w}{\mathrm{d}x_j}, \tag{12a}$$

where

$$\frac{\mathrm{d}w}{\mathrm{d}x_j} = \frac{v_j \pm T_j}{\sum_{i=1}^{I} p_i x_i} - \frac{p_j(x_j) + x_j \dfrac{\mathrm{d}p_j(x_j)}{\mathrm{d}x_j}}{\sum_{i=1}^{I} p_i x_i} w. \tag{12b}$$

The first term shows the additional per capita earnings, net of transportation cost, which result from adding to the working population at j. The plus sign holds in the numerator if $x_j < y_j$; otherwise the negative sign holds. If it is assumed that the derivative of p_j with respect to x_j is negative, then the second term shows the change in the cost of living, corrected for economies resulting from shared residence.

INTERPRETATION OF FIRST-ORDER NECESSARY CONDITIONS

Further analysis of the model requires that the expectation $E[U(w)]$ is known. This is not usually the case, however, Fortunately, it is possible to obtain an approximation that is fairly good if the variance of w is reasonably small. It is well known that if the covariance of v_i and v_j is σ_{ij}, then:

$$\sigma_w^2 = \frac{1}{\left(\sum_{i=1}^{I} p_i x_i\right)^2} \sum_{i=1}^{I}\sum_{j=1}^{I} x_i x_j \sigma_{ij}. \tag{13}$$

Recalling that

$$\left(1 \Big/ \left(\sum_{i=1}^{I} p_i x_i\right)^2\right) x_i x_j < 1$$

in general, it will often be true that σ_w^2 will be relatively small.

An approximation to $E[U(w)]$ is obtained by taking the Taylor expansion of $U(w)$ around the value $E[w] = \bar{w}$, and then taking the expectation of the resulting expression. This operation yields

$$E[U(w)] = U(\bar{w}) + E[w - \bar{w}]\frac{\mathrm{d}U(\bar{w})}{\mathrm{d}w} + \frac{1}{2}E[w - \bar{w}]^2 \frac{\mathrm{d}^2U(\bar{w})}{\mathrm{d}w^2} + \cdots.$$

The second part of the sum on the right-hand side is zero, while the third part is $\frac{1}{2}\sigma_w^2(\mathrm{d}^2U(\bar{w})/\mathrm{d}w^2)$. Assuming that the higher moments of the distribution of w are small, the Taylor expansion can be cut after the third term of the sum to give the following approximation for $E[U(w)]$.

$$E[U(w)] \approx U(\bar{w}) + \frac{1}{2}\sigma_w^2 \frac{\mathrm{d}^2U(\bar{w})}{\mathrm{d}w^2}. \tag{14}$$

Since, by assumption, $\mathrm{d}^2U(w)/\mathrm{d}w^2 < 0$, (14) provides the theoretical basis for the commonly assumed tradeoff between mean and variance.

It is now possible to analyze in more detail the cases of constant absolute and relative risk aversion, respectively, as well as the case of decreasing relative risk aversion.

Case 1

If it is assumed that $A(w)$ is constant, then the family's utility function is of the form given by (8a). To obtain the expected utility, one may use the approximation given by (14). In this particular case, however, it is possible to obtain an exact expression by applying the expectations operator to (9a). It follows from the definition of a moment generating function that the expected utility in the case of constant absolute risk aversion is:

$$E[U_A(w)] = a - bM_w(-A), \quad b > 0; \tag{15}$$

where $M_w(-A)$ is the moment generating function of the distribution of w. Note that only $M_w(-A)$ is a function of the family's decision variables x_i. The maximization of $E[U_A(w)]$, therefore, need only consider $M_w(-A)$.

Expression (15) is very useful if the distribution of w is known. Assume that the v_i are normally distributed with mean $E[v_i] = \bar{v}_i$ and variance σ_i^2, and that the covariance between v_i and v_j, $i \neq j$, is given by σ_{ij}. Under these assumptions, w is also normally distributed, and the moment generating function is given by the following expression:

$$M_w(-A) = \exp\left\{\frac{-A}{\sum_{i=1}^{I} p_i x_i}\left(\sum_{i=1}^{I} x_i \bar{v}_i - \sum_{i=1}^{I} |x_i - y_i| T_i + W_0\right) + \frac{1}{2}\left(\frac{A}{\sum_{i=1}^{I} p_i x_i}\right)^2 \sum_{i=1}^{I}\sum_{j=1}^{I} x_i x_j \sigma_{ij}\right\}$$

$$= \exp\left\{-A\bar{w} + \frac{A^2}{2}\sigma_w^2\right\}. \tag{16}$$

To maximize $E[U_A(w)]$ it is sufficient to minimize the exponent of expression (16), which shows the tradeoff between risk (variance) and expected per capita wealth.

Let us solve the family's decision problem under the assumption that only two choices are available, e.g. rural sector and urban sector employment, respectively. First-order conditions equivalent to those in (10) and (11) can be derived. Under what conditions will the family keep members working in both sectors, i.e. under what conditions are both x_1 and x_2 positive? To simplify subsequent expressions, the derivative of σ_w^2 with respect to x_j is stated first.

$$\frac{d\sigma_w^2}{dx_j} = 2\left\{\frac{x_j}{\left(\sum_{i=1}^{I} p_i x_i\right)^2}\sum_{i=1}^{I} x_i\sigma_{ji} - \frac{p_j + \frac{dp_j}{dx_j}x_j}{\sum_{i=1}^{I} p_i x_i}\sigma_w^2\right\}. \quad (17)$$

The first part of the derivative shows the effect of a change in location on the variance of v_i, while the second part represents the effect of the change in the cost of living. Note that a high p_i has the effect of decreasing σ_w^2. This effect is countered if $dp_i/dx_i < 0$.

If both x_1 and x_2 are positive, then the following equality results from the first-order conditions.

$$\frac{d\bar{w}}{dx_1} - \frac{A\,d\sigma_w^2}{2dx_1} \pm \tau T_1 = \frac{d\bar{w}}{dx_2} - \frac{A\,d\sigma_w^2}{2dx_2} \pm \tau T_2. \quad (18)$$

Assume that $\bar{v}_1 > \bar{v}_2$, i.e. the expected urban wage is higher than expected rural earnings. The equality in (18) shows that, at equilibrium, the gain from sending an additional family member to the urban area will be exactly balanced by the change in the variance of w, and by changes in transportation cost weighted by the shadow price τ, which is a measure of the tightness of the initial financial constraint. This last term (on both sides) is positive if $x_i < y_i$, and negative otherwise. It is positive if $x_i < y_i$ since increasing x_i saves transportation cost as fewer family members need to move from i to another location. This shows how decisions made in the past influence actions in the present. Put differently, there is some inertia in changing the allocation of working age family members. This effect becomes more pronounced the higher the transportation costs. Since there are only two sectors assumed here, it is clear that both can have the same sign only if $X \neq Y$, or if $x_i = y_i$, $\forall i$. If $\tau = 0$, then it follows from $d\bar{w}/dx_1 = -d\bar{w}/dx_2$ and $d\sigma_w^2/dx_1 = -d\sigma_w^2/dx_2$ that $d\bar{w}/dx_1 = (A/2)(\sigma_w^2/dx_1)$. In other words, if x_1, x_2, and $d\bar{w}/dx_1$ are positive, then increasing x_1 yields an increase in $\bar{w}$ and the variance of w.

Equations (17) and (18) together show that a high variance of v_1 discourages migration to the urban area. This effect can be offset if the covariance σ_{12} is negative. In this case, the net effect can be both higher per capita wealth and a lower variance of w, σ_w^2. It is also clear that high costs of living in the urban area, p_1, have a negative effect on rural-to-urban migration. If the economies of shared residence in the urban area are significant, this effect will be alleviated, however. Equation (18) shows that a high value of A will act more strongly to discourage migration to locations with a high earnings variance, but (17) and (18) together illustrate how this tendency becomes weaker the higher the number of working members, X.

Initial wealth W_0 does not affect migration behavior unless it imposes a binding constraint on decision making, i.e. unless $\tau > 0$. This result is a consequence of the assumption of constant absolute risk aversion. This assumption implies that a decision unit which has the choice between one asset that is risky and one that is not, will dedicate the same amount to the purchase of the risky asset, regardless of wealth.

Case 2

Constant relative risk aversion means that the family's utility function is given by (8b) and that the approximation (14) must be used to interpret the first-order conditions. We only consider the case $R > 1$. The other cases show similar characteristics. For further simplification, we also assume that $c = 0$, $d = 1$, $X = Y$, and $x_1 \geqslant y_1$. For both x_1 and x_2 to be positive, the following condition must be met.

$$\begin{aligned}&\{(R+1)\bar{w}^R + \tfrac{1}{2}\sigma_w^2(R-1)R(R+1)\bar{w}^{-(R+2)}\}\frac{d\bar{w}}{dx_1} \\ &-\tfrac{1}{2}\{(R-1)R\bar{w}^{-(R+1)}\}\frac{d\sigma_w^2}{dx_1} \pm \tau T_1 \\ &= \{(R+1)\bar{w}^R + \tfrac{1}{2}\sigma_w^2(R-1)R(R+1)\bar{w}^{-(R+2)}\} \\ &\times\frac{d\bar{w}}{dx_2} - \frac{1}{2}\{(R-1)R\bar{w}^{-(R+1)}\}\frac{d\sigma_w^2}{dx_2} \pm \tau T_2. \quad (19)\end{aligned}$$

As in the previous cases, the sign before the term τT_i depends on the relationship between x_i and y_i. The derivative of σ_w^2 with respect to x_i is written out in expression (17), and the derivative of $\bar{w}$ with respect to x_i is given in (12b).

Equation (19) clearly shows the tradeoff between the mean and the variance. This is particularly easy to see here since $dx_1 = -dx_2$. It is obvious that x_1 and x_2 can both be positive if and only if $d\bar{w}/dx_i$ and $d\sigma_w^2/dx_i$ have the same sign. Otherwise, the whole family would migrate if such a move would increase $\bar{w}$ and decrease the variance of w. In conjunction with equations (13) (definition of σ_w^2) and (17) ($d\sigma_w^2/dx_i$), (19) also shows that increasing X permits the family to make riskier choices. Recall that

$$w = \left(1\Big/\sum_{i=1}^{I} p_i x_i\right)\left(\sum_{i=1}^{I} V_i + W_0\right).$$

Assuming that $dp_i/dx_i \approx 0$ for large x_i, i.e. assuming that there are decreasing returns to shared residence, it follows directly from (12b) that increasing W_0 will decrease $d\bar{w}/dx_i$. If both x_1 and x_2 are positive, it follows from (19) that this permits more members to be allocated to the more lucrative but riskier labor markets.

As in the previous case, there is some inertia inherent in the family's decision in the sense that past allocation of members to locations influences the optimum in the present. As a result of positive migration costs, locations already having family members present will have an advantage over other locations.

The qualitative results in cases 1 and 2 are very similar. It is possible, however, for the actual numbers

x_1 and x_2 to differ rather substantially from case to case.

Case 3

It has been argued that a wealthy family can better afford to take risks than can a poor family. This possibility is explored here, making use of the utility function (8c) which displays decreasing relative risk aversion. The first-order conditions are given below for the case of just two locations, when $x_1 > 0$ and $x_2 > 0$. Under these conditions, the following equality must hold.

$$\frac{d\bar{w}}{dx_1}\left\{\frac{dU_D(\bar{w})}{dw} + \sigma_w^2 \frac{d^3U_D(\bar{w})}{dw^3}\right\} + \frac{1}{2}\frac{d\sigma_w^2}{dx_1}\frac{d^2U_D(\bar{w})}{dw^2} \pm \tau T_1 = \frac{d\bar{w}}{dx_2}\left\{\frac{dU_D(\bar{w})}{dw} + \sigma_w^2 \frac{d^3U_D(\bar{w})}{dw^3}\right\} + \frac{1}{2}\frac{d\sigma_w^2}{dx_2}\frac{d^2U_D(\bar{w})}{dw^2} \pm \tau T_2. \qquad (20)$$

Note that the derivatives of U_D with respect to $\bar{w}$ change signs: the first derivative is negative, the second positive, the third negative, etc. Equation (20), therefore, shows the tradeoff between a change in $\bar{w}$ and the variance of w, as in the previous two cases. It can be shown in the same fashion as case 2, that an increase in W_0 leads to an increase in the number of family members allocated to the riskier location if that also increases $\bar{w}$.

IMPLICATIONS AND SUMMARY

The presence of risks in migration creates opportunities for the family to engage in risk sharing. The individual by himself or herself is more likely to experience serious loss of income and will find it more difficult to finance a migratory move.

The model presented above shows that the family can gain from cooperation. That is, decisions affecting individual members may be coordinated by the family unit. While this principle is simple, its implementation raises many questions. First, how are the decisions made by the family? Each individual might be giving up some of his or her decision-making power to the family. There could be a democratic procedure, or the family could be organized patriarchically. Little research exists in this area, Sen's [22] and Schaeffer's [2] contributions being exceptions. A second issue concerns the family's decision criteria. In the current model, it was assumed that the family attempts to maximize average wealth weighted by the cost of living. This implies that all family members share equally. This is often far from the observed reality. Murray [26, 27, 28], in a discussion of migration in Southern Africa, presents evidence that a husband will send money to his wife who stays behind. The wife has considerable freedom in allocating the funds, so that personal likes and dislikes and blood relationships may influence the final outcome (see also Showers [29]). Sen [22] cites evidence from India which shows systematic differences in the treatment of children based on gender. Migration and distribution of wealth decisions will, therefore, vary from place to place according to the influence of culture and tradition.

These comments make it clear that the model cannot be regarded as applicable to very conceivable case. The questions of how migration and distribution issues are resolved within the family unit must be considered anew for different situations to be studied. In other respects, however, the model is of considerable generality. It incorporates risks from a variety of sources, and it allows for as many discrete choices as one wishes. Thus, the model can deal with circular migration easily. The case of rural-to-urban migration must then be considered as consisting of three choices: staying, moving and then searching, and searching through informal networks of relatives and friends, with a move being made only after a job has been secured. The access to informational networks can be represented by an increase in expected per capita earnings, $\bar{w}$, and/or a decrease in the variance of earnings at location i, σ_i^2. More generally, one can represent changes as changes in the underlying probability distributions.

The model has some practical implications. Even if all rural residents were identical, not all of them would necessarily move, or move to the same location. The reason for this is that, as decisions are made within the family, it becomes possible to gain from distributing risks more widely. This possibility cannot be modeled if the individual is treated as the decision unit, except in a limited fashion in the context of circular migration. In that sense, this paper represents a generalization of Fan and Stretton [18].

The model also has implications for empirical research. It points to the importance of the location of other family members, particularly those of working age. The results indicate that the presence of family members at a particular location has an ambiguous effect on the migration of additional members to the same location. The easier availability of information, and the possibility of achieving savings through sharing of a residence, will encourage additional migration. Interest in risk reduction may discourage it, however.

The model was analyed for the case of constant absolute risk aversion, constant relative risk aversion (which implies decreasing absolute risk aversion), and decreasing relative risk aversion. It was shown that the basic underlying behaviors are not very different across these three cases. Probably the most significant difference involves initial wealth. Thus, while it plays no role when $A(w) = A$ (except when it limits access to desired locations), it does play a role in the other two cases. This similarity of results is noteworthy since it suggests that it is not necessary to make very specific assumptions about a family's utility function with respect to per capita wealth, as long as the family is risk averse.

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REFERENCES

1. J. Mincer. Family migration decisions. *J. Polit. Econ.* **86**(5), 749–773 (1978).
2. P. V. Schaeffer. A family model of migration. *Socio-Econ. Plann. Sci.* **21**(4), 263–269 (1987).
3. L. A. Sjaastad. The costs and returns of human migration. *J. Polit. Econ.* **70**(5, Part 2), 80–93 (1962).
4. J. R. Harris and M. P. Todaro. Urban unemployment in East Africa: an economic analysis of policy alternatives. *E. Afr. Econ. Rev.* **4**(2), 17–36 (1968).
5. J. R. Harris and M. P. Todaro. Migration, unemployment and development: a two-sector analysis. *Am. Econ. Rev.* **60**(1), 126–142 (1970).
6. J. N. Bhagwati and T. H. Srinivasan. On reanalyzing the Harris–Todaro model: policy rankings in the case of sector-specific sticky wages. *Am. Econ. Rev.* **64**(3), 502–508 (1974).
7. A. G. Blomqvist. Urban job creation and unemployment in LDCs. Todaro vs Harris and Todaro. *J. Dev. Econ.* **5**, 3–18 (1978).
8. P. Collier. Labour mobility and labour utilization in developing countries. *Oxf. Bull. Econ. Statist.* **37**(3), 169–189 (1975).
9. W. M. Corden and R. Findley. Urban employment, intersectoral capital mobility and development policy. *Economica* **42**(February), 59–78 (1975).
10. G. S. Fields. Rural–urban migration, urban unemployment and underemployment, and job-search activity in LDCs. *J. Dev. Econ.* **2**(2), 165–187 (1975).
11. G. E. Johnson. The structure of rural–urban migration models. *E. Afric. Econ. Rev.* **3**(1), 21–28 (1971).
12. P. J. Neary. On the Harris–Todaro model with intersectoral capital mobility. *Economica* **48**, 219–234 (1981).
13. W. Elkan. Circular migration and the growth of towns in East Africa. *Int. Labor Rev.* **96**(6), 581–589 (1967).
14. S. Goldstein. Circulation in the context of total mobility in Southeast Asia. *Papers of the East–West Institute* No. 53. East–West Center, Honolulu, Hawaii (1978).
15. G. J. Hugo. Population mobility in West Java. Ph.D. Dissertation, Australian National University, Department of Demography, Canberra (1975).
16. G. J. Hugo. *New Conceptual Approaches to Migration in the Context of Urbanisation: A Discussion Based on Indonesian Experience.* Paper presented for a seminar by the International Union for the Scientific Study of Population's Committee on Urbanisation and Population Redistribution. Bellagio, Italy, 30 June–3 July (1978).
17. J. E. Stiglitz. Rural–urban migration, surplus labour and the relationship between urban and rural wages. *E. Afr. Econ. Rev.* **1**(2), 1–27 (1969).
18. Y.-K. Fan and A. Stretton. Circular migration in South-East Asia: some theoretical explanations. In *Labour Circulation and the Labour Process* (Edited by G. Standing). Croom Helm, London (1985).
19. F. Caces, F. Arnold, J. T. Fawcett and R. W. Gardner. Shadow households and competing auspices. Migration behavior in the Philippines. *J. Dev. Econ.* **7**, 5–25 (1985).
20. O. Stark and D. Levhari. On migration and risk in LDCs. *Econ. Dev. Cult. Change* **31**(1), 191–196 (1982).
21. E. Katz and O. Stark. Labor migration and risk aversion in less developed countries. *Journal of Labor Economics* **4**(1), 134–149 (1986).
22. A. Sen. Economics and the family. *Asian Dev. Rev.* **1**, 14–26 (1983).
23. R. E. B. Lucas and O. Stark. Motivations to remit: evidence from Botswana. *J. Polit. Econ.* **93**(5), 901–918 (1985).
24. P. Schaeffer. Barriers and foresight in international labor-migration. *Envir. Plann. A* **16**, 451–466 (1984).
25. J. W. Pratt. Risk aversion in the small and in the large. *Econometrica* **32**(1–2), 122–136 (1964).
26. C. Murray. Marital strategy in Lesotho: the redistribution of migrant earnings. *Afr. Stud.* **35**(2), 99–121 (1976).
27. C. Murray. The effects of migrant labour: a review of evidence from Lesotho. *S. Afr. Labour Bull.* **6**(4), 21–39 (1980).
28. C. Murray. Migrant labour and changing family structure in the rural periphery of Southern Africa. *J. S. Afr. Stud.* **6**(2), 139–156 (1980).
29. K. Showers. A note on women, conflict and migrant labour. *S. Afr. Labour Bull.* **6**(4), 54–57 (1980).

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