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Barriers and foresight in international labor-migration

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Abstract. In the presence of barriers to mobility, migration behavior depends importantly on a worker's planning horizon. Although a myopic worker will accept the job offer promising the greatest immediate utility, a worker with foresight also values the opportunities that a job offers, to gain access to more highly valued alternatives. A model of labor migration based on these ideas, shows the importance of institutional arrangements and lends itself to the discussion of policy measures to influence labor migration.

1 Introduction

Barriers to mobility are a fact of life. Not every application for work results in a job offer, and frequently the job finally obtained is not the one that was ranked highest by the applicant. The ranking of jobs is not independent from the applicant's planning horizon. A myopic worker will accept the job offer with the greatest immediate utility, a worker with foresignt will choose the offer which yields the greatest expected return over a period of time. Consequently, the latter will value not only the immediate utility that can be obtained from a particular job/location available to him, but also the opportunities that the job offers to gain access to more highly valued alternatives.

These ideas form the basis of the model presented below. It is a model of large-scale international labor-migration. The so-called guestworker programs in Europe, the Middle East, and in a few African nations are well-known examples of such movements. Compared with internal migrations, they have not been studied much. The model proposed here provides a useful framework for the study of international labor-migrations, because of the prevalence of barriers to movements across national boundaries. Almost universally, immigration laws are formulated to protect the domestic labor force and to keep out individuals who are expected to become a burden to society.

The model proposed here is one of large-scale labor-migration. It focuses on the availability of jobs, the worker's planning horizon, and how these factors affect his migration decisions. The model allows for the possibility of repeat migration and return migration. The model contributes ideas and insights to an analysis of guest-worker programs, which are built on the assumption that the foreign workers eventually return to their home countries. However, the generality of the model goes beyond international labor-migrations. I will show that it contains the models of Sjaastad (1962) and Harris and Todaro (1968; 1970) as special cases.

The presentation is organized as follows. A model of myopic migration-behavior is introduced in section 2. The relationship between job availability and migration decisions is made explicit, and illustrated with the help of two examples. In section 3 I drop the assumption of myopic decisionmaking, and in section 4, the implications of this model on immigration policies are evaluated. In section 5 I discuss the generality of the model. Last, in section 6 I briefly summarize the results.

2 Myopic migration-behavior

2.1 *The model*

The first assumption specifies the utility function of a prospective migrant.

Assumption 1. A location, j, is characterized by a vector of attributes, X_j. Each job, i, is characterized by its real wage, Y_i. Let U_{ij} be the utility derived from the combination of job i and location j.

$$U_{ij} = \mathrm{U}(Y_{ij}, X_j) .$$

Governments and agencies are concerned with large-scale migrations because such movements are not easily absorbed. This is a model of mass migration. Because of the 'beaten path effect', the properties of the choices are well known. The basis for making migration decisions is therefore given. To form a ranking among job/location combinations, it is not necessary that one first receives a job offer. As in consumer theory, the rankings are among hypothetical choices. The job offers define the opportunity set.

Assumption 2

$$U_{ij} > U_{ik} \quad \text{iff} \quad Y_{ij} > Y_{ik} .$$

Of two jobs at the same location, the worker prefers the one that pays more.

The presence of family members and friends, acceptance of the emigrant in the new community, his location-specific human capital, all play an important role in the determination of locational preferences. They are accounted for by the vector X_j.

Assumption 3. The vector of locational attributes, X_j, is assumed to be constant.

Among regions and industries substantial wage differentials persist over long periods of time. This has been noted by Lewis (1954; 1958) and has also been discussed by Ranis and Fei (1961) and by Reynolds (1965). The same observation forms the basis of the famous Harris–Todaro model (1968; 1970).

Assumption 4. The preference ordering among job/location combinations is assumed to be time invariant.

Assumption 4 is weaker than the assumption that wages remain constant. Wages are allowed to change, but not to the point where the ranking of the job/location combinations is affected.

The first four assumptions together imply that the worker does not become integrated in the labor-importing country. The migrant's perception of the location characteristics does not change. More formally, this can be expressed as follows.

Assumption 5. If j is the worker's region of origin, then, for a fixed income $\bar{Y}$,

$$\mathrm{U}(\bar{Y}, X_j) > \mathrm{U}(\bar{Y}, X_r) , \qquad j \neq r .$$

The existence of a financial reward is a necessary condition for emigration.

The choice of the most preferred job/location combination is restricted by the availability of jobs. The chance of being able to realize a particular choice can be expressed by a probability.

Assumption 6. Associated with each job/location combination is the probability of actually getting a job there. Hiring is assumed to take place only at the beginning of each period.

To simplify matters, the available choices are aggregated such that only three relevant alternatives remain. Some justification for this aggregation will be provided below. The following terminology will be used. The number 1 denotes the origin and 2 the destination country of a worker.

Assumption 7. Workers from country 1 will choose from among the following three job/location alternatives.
Sector (1,1) industrial (high-wage) sector in country 1.
Sector (2,1) traditional (low-wage) sector in country 1.
Sector (1,2) labor market (high-wage) in an economically more advanced country 2.

Assumption 8. The order of preference among these choices is as follows:

$$U_{11} > U_{12} > U_{21} \ .$$

This ranking implies the following: A worker employed in sector (1,1) will never leave this sector on his own free will. A worker in sector (2,1) will try to leave this sector. He will apply for a job in sector (1,1). If he is turned down, he will try to find employment in sector (1,2). Only if he is turned down there as well, will he stay in sector (2,1). A worker in sector (1,2) will not go back to sector (2,1) voluntarily. But he will try to be accepted for a job in sector (1,1). If he cannot find employment in the industrial domestic sector, he will remain in the foreign country. In other words, emigration to a foreign country does not imply that (1,2) is the most preferred location/job combination. Rather, it is a move made because of the lack of adequate job opportunities in the home country. The desire to return back home does not diminish, and its timing depends on the job availability in the high-wage sector of country 1. Experience with Italian migration lends support to these assumptions. Parallel with the expansion of the industrial sector in Northern Italy, emigration from that region decreased significantly. Southern Italian emigration to foreign countries also slowed down, but to a lesser degree. The contention that emigrants retain the ties to their home countries and hope one day to return, is also supported by the research of Baca and Bryan (1980). In internal migrations, this consideration is much less important (for example DaVanzo and Morrison, 1978a; 1978b).

Assumption 9. The monetary cost of migration is negligible, and job applicants do not have to be physically present to be awarded a job.

In the manufacturing and construction industries it is quite common that a job is filled based on the recommendation from workers already employed there (Rees, 1966). It is in the interest of the person making the recommendation to suggest a worker he believes will be a good colleague, so that the company can save the costs of the screening of applicants. This system of hiring is also observed in international labor-migrations. Further, some European countries have signed bilateral agreements, regulating the recruitment of foreign workers in their respective home countries. For example, the Federal Republic of Germany signed such treaties with Italy in 1955, with Greece and Spain in 1960, with Turkey in 1961, with Morocco in 1963, with Portugal in 1964, with Tunisia in 1965, and with Yugoslavia in 1968. These recruitment procedures tend to keep the cost of finding a job low.

Assumption 10. The probability of finding a job in secton (2,1) is equal to 1. This assumption is justified if unemployment is counted as part of what is called the 'domestic traditional sector'.

Assumption 11. A worker hired into sector (1,1) gets immediate tenure.

The question of job security is important in this model. Assumption 11 is one of two possible extreme assumptions. I could have stipulated that a worker is hired for one period only, and has to reapply for employment at the beginning of the next period. However, empirical evidence does not support such a specification. Layoffs do not occur so frequently. In many countries, labor laws make the termination of employment a difficult and costly affair. Even in the United States of America where this is not the case, long-term jobs are important (Hall, 1982). Assumption 11 is therefore a realistic approximation.

Given assumptions 1–11, the model can be written as a Markov process. Because of assumptions 8, 10, and 11, an absorbing Markov process is obtained, where sector (1,1) is the absorbing or trapping state. Let $P(x, y \mid i, j)$ be the probability that a worker currently employed in job i at location j, will move to a job x at location y, (i, j) and (x, y) = (1,1), (1,2), and (2,1). The transition matrix is given by table 1.

Assumption 7, that there are only three relevant job/location alternatives to choose from, is less restrictive than it initially appears. To show this, the definition of a mergeable Markov process is presented.

Table 1. The transition matrix **P**.

		Job/location at time $t+1$		
		(1,1)	(2,1)	(1,2)
Job/location at time t	(1,1)	1	0	0
	(2,1)	$P(1,1\mid 2,1)$	$[1-P(1,1\mid 2,1)]\,[1-P(1,2\mid 2,1)]$	$[1-P(1,1\mid 2,1)]P(1,2\mid 2,1)$
	(1,2)	$P(1,1\mid 1,2)$	$P(2,1\mid 1,2)$	$1-P(1,1\mid 1,2)-P(2,1\mid 1,2)$

Definition 1. Mergeable Markov process. If the states in a Markov process can be divided into groups that have the property that the transition probabilities from each state in a group G_k to each of the states in another group G_l, when summed over all states in group G_l, are the same for each state of group G_k, then the states in group G_k can be merged into one state, and similarly for the states in group G_l.

$$\sum_{j \in G_l} P_{ij} = \sum_{j \in G_l} P_{i'j} , \qquad i, i' \in G_k .$$

When this relation holds for any pair of groups, k and l, the process is said to be mergeable with respect to the grouping of states (see Howard, 1971). In other words, if the chance to get into a job that belongs to group G_l is the same from any job that belongs to group G_k, then the above condition is satisfied. This condition is likely to be met for jobs requiring similar skills, even if these jobs are in different industries. If the process is mergeable, then the states can be aggregated, and the groups, satisfying definition 1, can be taken as the states of the resulting new Markov process. The price to be paid for this simplification is the loss of information about the job mobility between alternatives which have been merged. However, for policy purposes it is often sufficient to know the movements between the aggregated states, and in those cases, the possibility of merging is a way to simplify the model and reduce the data requirements.

2.2 *Interpreting the transition probabilities*

The probabilities reflect the conditions in the labor markets. In the simplest case, it can be assumed that the probability is the ratio of the demand for labor divided by the supply of labor, given the wage rate (Harris and Todaro, 1968; 1970).

This implies that at the end of each period, everyone is laid off. As the new period begins, labor is hired again at random, so that everyone has the same chance of getting a job, regardless of the previous position. In such a labor market there is no tenure. As discussed in conjunction with assumption 11, this is not compatible with empirical observations. We will therefore develop an expression for the probabilities using assumption 11, which, although not a perfect representation of reality, is a better approximation.

The calculations will first be undertaken for sector (1,1). The following notation will be used.

$P(1,1|i,j)$ is the probability of getting a job in (1,1) at time $t+1$, if the employment at time t is in the set given by $(i,j) = (1,1), (2,1), (1,2)$. Similar probabilities are defined for sectors (2,1) and (1,2).

N_{ij} is the demand for labor in sector (i,j).

L_{ij} is the current labor force in sector (i,j).

L is the total labor force of country 1, including nationals of country 1 employed in country 2.

$$L = L_{11} + L_{21} + L_{12} \, .$$

The demand for labor depends on the real wage and the production function. In a competitive market, hiring stops when the marginal product of labor is equal to the wage rate. This information is sufficient to derive the demand for labor.

Assumption 12. Production in sector (1,1) can be represented as a function of capital, K_{11} and labor, N_{11}. Let Q_{11} be the output of sector (1,1). Then,

$$Q_{11} = F(K_{11}, N_{11}) \, . \tag{1}$$

Then, assuming competitive labor and output markets, we have

$$N_{11} = f(K_{11}, Y_{11}) \, , \tag{2}$$

where $\partial f/\partial K_{11} > 0$ if $\partial^2 F/\partial N_{11}\partial K_{11} > 0$, and $\partial f/\partial Y_{11} < 0$.
By the assumption of tenure in sector (1,1),

$$P(1,1|1,1) = 1 \, . \tag{3}$$

Assumption 13. The probabilities of a worker in sector (2,1) or (1,2) being hired by a firm in sector (1,1), can be expressed as follows.

$$P(1,1|2,1) = \begin{cases} 0 \, , & \text{if } N_{11} < L_{11} \, , \\ Z\left(\dfrac{N_{11}-L_{11}}{L_{21}}\right) , & \text{if } L_{11} \leqslant N_{11} \leqslant L \, , \\ 1 \, , & \text{if } N_{11} > L \, ; \end{cases} \tag{4a}$$

$$P(1,1|1,2) = \begin{cases} 0 \, , & \text{if } N_{11} < L_{11} \, , \\ (1-Z)\left(\dfrac{N_{11}-L_{11}}{L_{12}}\right) , & \text{if } L_{11} \leqslant N_{11} \leqslant L \, , \\ 1 \, , & \text{if } N_{11} > L \, ; \end{cases} \tag{4b}$$

where $0 \leqslant Z \leqslant 1$.

This formulation reflects the assumption that the workers in sector (1,1) have tenure. If the demand for labor in the domestic industrial sector is such that not all of its present labor force can be used efficiently, then certainly no new labor will be hired.

But, if the demand for labor in sector (1,1) exceeds L, where $L = L_{11}+L_{21}+L_{12}$, then everybody can get a job in this sector. For the cases in between, some variation in the access to the labor market in sector (1,1) is allowed for. Z set equal to $L_{21}/(L_{21}+L_{12})$ represents the special case of equal access to jobs in sector (1,1) for workers in sectors (2,1) and (1,2). If $Z > L_{21}/(L_{21}+L_{12})$, then access to sector (1,1) is better from sector (2,1). If the inequality sign is reversed, sector (1,2) is favored. Z need not be a constant.

The remaining probabilities to be computed are P(1,2|2,1) and P(2,1|1,2).

Assumption 14. There is no tenure in sector (1,2), but workers already in sector (1,2) will be employed before any new workers will be admitted. More formally, if $\mathrm{P}(1,2|2,1) > 0$, then $\mathrm{P}(2,1|1,2) = 0$. N_{12} is assumed to be given exogenously.

Define

$$q_{21} = \frac{N_{12} - [1-\mathrm{P}(1,1|1,2)]L_{12}}{L_{21}}\,; \qquad \text{if } q_{21} < 0\,,\ q_{21} = 0\,.$$

Then

$$\mathrm{P}(1,2|2,1) = \begin{cases} q_{21}\,, & \text{if } 0 \leqslant q_{21} \leqslant 1\,, \\ 1\,, & \text{if } q_{21} > 1\,, \quad \text{or } L_{21} = 0\,. \end{cases} \tag{5a}$$

Define

$$q_{21} = -q_{21}\frac{L_{21}}{L_{12}}\,; \qquad \text{if } q_{12} < 0\,, \quad \text{or } L_{12} = 0\,, \quad q_{21} = 0\,.$$

Then

$$\mathrm{P}(2,1|1,2) = \begin{cases} q_{12}\,, & \text{if } 0 \leqslant q_{12} \leqslant 1\,, \\ 1\,, & \text{if } q_{12} > 1\,. \end{cases} \tag{5b}$$

Given the wage rate in sector (1,2), N_{12} can be determined in the same way as N_{11}. It is possible and likely, however, that political considerations also contribute to the determination of N_{12}. Here, N_{12} is assumed to be given exogenously. Note that we do not need to define N_{21}. By assumption 10, the 'demand for labor' in N_{21} is infinitely elastic.

As an alternative to assumption 14 we could assume that there exists perfect tenure in sector (1,2). The truth lies somewhere between assumption 14 and this alternative. Many of the European guestworkers have obtained permanent residency and are protected by the same laws as the domestic labor force. Even if they lose their jobs, they cannot be expelled at will. But, there is still a large number of workers on annual permits. During a recession their permits may not be renewed.

2.3 *The expected duration of stay in a labor market*

Markov processes allow the calculation of some very useful information about migration behavior. The probability that a person will be in sector (i, j) in t periods from now, can be obtained simply by calculating $\mathbf{P}^t$, where $\mathbf{P}$ is the transition probability matrix. The theory of Markov processes also allows the calculation of the expected time which will elapse before a person passes through a given state for the first time. In the special case of an absorbing Markov process, we can find the expected duration of stay in each transient (nonabsorbing) state, conditional to the current state. The associated variances can also be calculated. The derivation and proof of the mathematical results used in this section can be found in any good text on Markov processes (for example, Howard, 1971).

Let $\mathrm{E}(i, j|x, y)$ be the expected duration of stay in transient state (i, j), given that (x, y) is the transient starting state. The results for our three-state absorbing Markov process are given below. To calculate the expectations, partition the transition matrix **P** as follows.

$$\mathbf{P} = \left[\begin{array}{c|c} \mathbf{I} & \mathbf{0} \\ \hline \mathbf{R} & \mathbf{Q} \end{array}\right],$$

where **I** is a unit matrix and **0** is a zero matrix.
Define $\mathbf{E} = (\mathbf{I}-\mathbf{Q})^{-1}$. **E** is called the fundamental matrix. The elements of **E** yield the expectations $\mathrm{E}(i,j \mid x,y)$. Denote by k the value of the determinant of $\mathbf{I}-\mathbf{Q}$,
$k = \mathrm{P}(1,1 \mid 1,2)[\mathrm{P}(1,1 \mid 2,1)+\mathrm{P}(1,2 \mid 2,1)-\mathrm{P}(1,1 \mid 2,1)\mathrm{P}(1,2 \mid 2,1)]+\mathrm{P}(1,1 \mid 2,1)\mathrm{P}(2,1 \mid 1,2)$.

$$\mathrm{E}(2,1 \mid 2,1) = \frac{1}{k}[\mathrm{P}(1,1 \mid 2,1)+\mathrm{P}(2,1 \mid 1,2)]\,. \tag{6}$$

Expression (6) gives us the total expected duration of stay in sector (2,1), given this is the sector where the person started from. However, it need not be the duration of a consecutive stay. It is quite possible that some time in between is spent in sector (1,2). The expected duration of stay is a function of the transition probabilities, that is, of the labor market conditions:

$$\mathrm{E}(1,2 \mid 2,1) = \frac{1}{k}[1-\mathrm{P}(1,1 \mid 2,1)]\mathrm{P}(1,2 \mid 2,1)\,, \tag{7}$$

$$\mathrm{E}(2,1 \mid 1,2) = \frac{1}{k}\mathrm{P}(2,1 \mid 1,2)\,, \tag{8}$$

$$\mathrm{E}(1,2 \mid 1,2) = \frac{1}{k}[\mathrm{P}(1,1 \mid 2,1)+\mathrm{P}(1,2 \mid 2,1)-\mathrm{P}(1,1 \mid 2,1)\mathrm{P}(1,2 \mid 2,1)]\,. \tag{9}$$

$\mathrm{E}(2,1 \mid 2,1)+\mathrm{E}(1,2 \mid 2,1)$ is the total expected time for a worker to get a job in sector (1,1), given that he starts in sector (2,1). Similarly, $\mathrm{E}(2,1 \mid 1,2)+\mathrm{E}(1,2 \mid 1,2)$ is the total expected time for a worker initially employed in sector (1,2) to get a job in sector (1,1). Denote the first sum by E(2,1) and the second sum by E(1,2).

$$\mathrm{E}(2,1) = \frac{1}{k}\mathrm{P}(1,1 \mid 1,2)+\mathrm{P}(2,1 \mid 1,2)+[1-\mathrm{P}(1,1 \mid 2,1)]\mathrm{P}(1,2 \mid 2,1)\,. \tag{10}$$

$$\mathrm{E}(1,2) = \frac{1}{k}[\mathrm{P}(1,1 \mid 2,1)+\mathrm{P}(2,1 \mid 1,2)+\mathrm{P}(1,2 \mid 2,1)-\mathrm{P}(1,1 \mid 2,1)\mathrm{P}(1,2 \mid 2,1)]\,. \tag{11}$$

The two expressions are different only if $\mathrm{P}(1,1 \mid 1,2) \neq \mathrm{P}(1,1 \mid 2,1)$.

Denote the variance of $\mathrm{E}(ij \mid xy)$ by $\mathrm{V}(ij \mid xy)$. I will not present the derivation of the variances. The procedure is described by Howard (1971).

$$\mathrm{V}(2,1 \mid 2,1) = \frac{1}{k^2}[\mathrm{P}(1,1 \mid 1,2)+\mathrm{P}(2,1 \mid 1,2)]\,[\mathrm{P}(1,1 \mid 1,2)+\mathrm{P}(2,1 \mid 1,2)-k]\,. \tag{12}$$

$$\begin{aligned}\mathrm{V}(1,2 \mid 2,1) = \frac{1}{k^2}\langle\{\mathrm{P}(1,2 \mid 2,1)[1-\mathrm{P}(1,1 \mid 2,1)]\}^2+2\mathrm{P}(1,1 \mid 2,1)\mathrm{P}(1,2 \mid 2,1)\\ \times[1-\mathrm{P}(1,1 \mid 2,1)]-[1-\mathrm{P}(1,1 \mid 2,1)]\mathrm{P}(1,2 \mid 2,1)k\rangle\,.\end{aligned} \tag{13}$$

$$\mathrm{V}(2,1 \mid 1,2) = \frac{1}{k^2}\mathrm{P}(2,1 \mid 1,2)[2\mathrm{P}(1,1 \mid 1,2)+\mathrm{P}(2,1 \mid 1,2)-k]\,. \tag{14}$$

$$\begin{aligned}\mathrm{V}(1,2 \mid 1,2) = \frac{1}{k^2}[\mathrm{P}(1,1 \mid 2,1)+\mathrm{P}(1,2 \mid 2,1)-\mathrm{P}(1,1 \mid 2,1)\mathrm{P}(1,2 \mid 2,1)]\\ \times[\mathrm{P}(1,1 \mid 2,1)+\mathrm{P}(1,2 \mid 2,1)-\mathrm{P}(1,1 \mid 2,1)\mathrm{P}(1,2 \mid 2,1)-k]\,.\end{aligned} \tag{15}$$

The variance of the total time before absorption, starting from a given state, is not equal to the sum of the variances, that is, the variance of E(2,1) is not usually equal to $V(2,1|2,1)+V(1,2|2,1)$. The equality holds only for the special case when the states are entered sequentially. In this model, this is the case when $P(2,1|1,2)$ is set equal to 0. If the states are not entered sequentially, the variance of E(2,1) requires a separate calculation.

The measures that have been obtained are certainly of great interest for the analysis of migration and its effects. It should also be noted that it is possible to estimate the probabilities econometrically, using either microdata or macrodata [see Lee et al, 1970). To illustrate the usefulness of the information that the model yields, two numerical examples will be presented.

Example 1

For the sake of simplicity it is assumed that the probability of obtaining employment in sector (1,1) does not depend on the current sector of employment, that is, $P(1,1|2,1) = P(1,1|1,2)$. It is also assumed that $P(2,1|1,2) = 0$. In 1977 the Turkish labor force had a reported size of 16.33 million workers, 1.60 million of which were unemployed. An additional 0.71 million Turkish workers had found employment abroad (SOPEMI, 1976). About 60% of the jobs in Turkey were in the agricultural sector. Assume that these jobs correspond to the jobs in sector (2,1). The other 40%, or 5.89 million jobs in Turkey are considered to belong to sector (1,1). Assume that the turnover in sector (1,1) is 20% each year, that is, that about 1.8 million jobs become available every year in this sector. The probability of obtaining a job in sector (1,1) can then be calculated as follows.

$$P(1,1|2,1) = P(1,1|1,2) = \frac{1.18}{16.33+0.71-5.89+1.18} = 0.0957 \,.$$

Assume that $P(1,2|2,1) = 0.10$. Then

$$E(2,1|2,1) = 5.26 \text{ years} \,,$$

$$E(1,2|2,1) = 4.74 \text{ years} \,,$$

$$E(2,1|1,2) = 0.00 \text{ year} \,,$$

$$E(1,2|1,2) = 10.00 \text{ years} \,.$$

In this example, the workers in sectors (2,1) and (1,2) have to wait an average of 10.00 years before they find employment in the Turkish industrialized sector. A worker currently unemployed or employed in the agricultural sector expects to be 5.26 years in that sector, and then 4.74 years in a foreign country, before finding a high-wage job in Turkey. A Turkish worker abroad, is expected to stay there for an average of 10.00 years. This is a long average stay, given the comparatively high probability of getting a job in sector (1,1). The variances are

$$V(2,1|2,1) = 22.44 \text{ years} \,,$$

$$V(1,2|2,1) = 67.56 \text{ years} \,,$$

$$V(2,1|1,2) = 0.00 \text{ year} \,,$$

$$V(1,2|1,2) = 90.00 \text{ years} \,.$$

The size of the variances indicates that under these conditions a substantial number of the workers employed abroad will stay there for an indefinite time.

Example 2
Retain all the assumptions of the first example, except that the probability of obtaining a job in sector (1,1) is not the same for workers currently employed in the low-wage sector in Turkey or abroad. Recall that the difference in access to the job market in sector (1,1) from sectors (1,2) and (2,1) can be expressed by Z. Since $L_{21}/(L_{21}+L_{21}) = 0.96$, we choose $Z = 0.98$, thus giving the workers in sector (2,1) a better chance of obtaining a job in sector (1,1). Thus,

$$\mathrm{P}(1,1|2,1) = (0.98)\frac{1.18}{16.33-5.89+1.18} = 0.0995 \ ,$$

$$\mathrm{P}(1,1|1,2) = (0.02)\frac{1.18}{0.71} = 0.0332 \ .$$

Thus, the advantage of staying at home is very significant in terms of access to the labor market in sector (1,1).

$$\mathrm{P}(1,2|2,1) = 0.10 \ ,$$

then,

$$\mathrm{E}(2,1|2,1) = 14.29 \text{ years} \ ,$$

$$\mathrm{E}(1,2|2,1) = 12.93 \text{ years} \ ,$$

$$\mathrm{E}(2,1|1,2) = 0.00 \text{ year} \ ,$$

$$\mathrm{E}(1,2|1,2) = 27.23 \text{ years} \ .$$

The variances are very large, indicating a relatively low chance of return for many:

$$\mathrm{V}(2,1|2,1) = 18.02 \text{ years} \ ,$$

$$\mathrm{V}(1,2|2,1) = 549.90 \text{ years} \ ,$$

$$\mathrm{V}(2,1|1,2) = 0.00 \text{ year} \ ,$$

$$\mathrm{V}(1,2|1,2) = 714.04 \text{ years} \ .$$

It is rather startling to see the significance of a small change of an institutional parameter. The change in accessibility to the labor market in sector (1,1) has left P(1,1|2,1) almost unchanged, whereas P(1,1|1,2) was reduced to about a third of its value in example 1. Since P(2,1|1,2) is assumed to be 0, k was reduced by the same factor as P(1,1|1,2), thus causing $1/k$ to increase by a factor of about 3. The two examples suggest very strongly the need for further research in the influence of institutional arrangements in the labor market in general, and in labor migration in particular.

3 Market access and the migration decision: migrants with foresight

The examples in the previous section point to the importance of institutional arrangements in the labor market. If the current job/location combination influences the chance of obtaining a desired job, migrants will respond. The access to the labor market cannot be influenced by an individual worker. It is given to him and can be expressed as the probability of being hired for the job. However, the worker can use the opportunity and apply for a job, or he can reject it. This decision can be expressed by a variable S; $S = 1$ if the worker decides to apply, $S = 0$ otherwise. Which one it will be depends on the utility that rewards each possible action.

Access to a particular labor market becomes even more important, if the planning horizon of a worker is longer than one period. We shall denote the planning horizon by T, with 0 being the current period. If we retain our previous assumptions, a worker will always apply for a job in sector (1,1). The question is, whether this should be done from sector (2,1) or from sector (1,2). Thus, we shall take $S = 0$ to mean that a worker rejects the opportunity to emigrate and work in sector (1,2). How is this decision reached? Suppose that P(1,2|2,1) is positive. Hence, P(2,1|1,2) = 0. If the worker responds to the opportunity, then migration is unidirectional between jobs. Once a worker has left sector (2,1), he will not return there. Consequently, E(2,1|2,1) denotes a consecutive stay in sector (2,1), before sector (1,1) or sector (1,2) is reached.

Suppose the worker is currently in sector (2,1). In reaching a decision on whether or not to consider emigration to sector (1,2), the worker has to compare the expected utility that he would obtain from either decision. If he decides against emigrating, that is, if $S = 0$, then, for all practical purposes, we can treat our model as if it were a two-sector model, the two sectors being (1,1) and (2,1). The relevant transition matrix, $\mathrm{P}_{S=0}$, is given in table 2.

The expected duration of stay in sector (2,1) before absorption into sector (1,1) can be obtained by the procedure described above. Here, $\mathrm{Q}_{S=0} = [1-\mathrm{P}(1,1|2,1)]$, and the fundamental matrix $\mathrm{E}_{S=0}$ is easily obtained.

$$\mathrm{E}(2,1|2,1)_{S=0} = \frac{1}{\mathrm{P}(1,1|2,1)} \,. \tag{16}$$

To reach a decision, the worker now compares the expected utility if he chooses $S = 0$ with the expected utility if $S = 1$. Denote these respective outcomes by $\mathrm{E}(U^{21}_{S=0})$ and $\mathrm{E}(U^{21}_{S=1})$. Let the subjective discount rate be ρ.

$$\mathrm{E}(U^{21}_{S=0}) = \sum_{t=0}^{\mathrm{E}(2,1|2,1)_{S=0}} \frac{\mathrm{U}(Y_{21}, X_1)}{(1+\rho)^t} + \sum_{t=\mathrm{E}(2,1|2,1)_{S=0}+1}^{T} \frac{\mathrm{U}(Y_{11}, X_2)}{(1+\rho)^t} \,, \tag{17a}$$

$$\mathrm{E}(U^{21}_{S=1}) = \sum_{t=0}^{\mathrm{E}(2,1|2,1)} \frac{\mathrm{U}(Y_{21}, X_2)}{(1+\rho)^t} + \sum_{t=\mathrm{E}(2,1|2,1)+1}^{\mathrm{E}(1,2|2,1)} \frac{\mathrm{U}(Y_{12}, X_2)}{(1+\rho)^t}$$
$$+ \sum_{t=\mathrm{E}(1,2|2,1)+1}^{T} \frac{\mathrm{U}(Y_{11}, X_1)}{(1+\rho)^t} \,. \tag{17b}$$

In those cases where T is smaller than the expected time before absorption into sector (1,1), the two expressions have to be adjusted accordingly. The above decision rule is the same as the one proposed by Sjaastad (1962), except that it allows for more than one move, and considers the probability of obtaining work at a given job.

We have defined the rule to decide whether or not a worker should even consider emigration. $S = 0$ if $\mathrm{E}(U^{21}_{S=0}) > \mathrm{E}(U^{21}_{S=1})$, $S = 1$ otherwise. In a similar fashion, a worker already employed in sector (1,2) can decide whether or not he should return to his home country. If he returns, with probability P(1,1|1,2) he will return to sector (1,1). The probability that he will return to sector (2,1) is equal to [1 − P(1,1|1,2)]. Then $S = 0$ denotes the decision to return home even if a job in

Table 2. The transition matrix $\mathrm{P}_{S=0}$.

		Job/location at time $t+1$	
		(1,1)	(2,1)
Job/location at time t	(1,1)	1	0
	(2,1)	P(1,1|2,1)	1 − P(1,1|2,1)

section (1,1) is not guaranteed, and $S = 1$ stands for the decision to remain abroad under this condition.

$$\mathrm{E}(U_{S=0}^{21}) = \mathrm{P}(1,1|1,2) \sum_{t=0}^{T} \frac{\mathrm{U}(Y_{11}, X_1)}{(1+\rho)^t} + [1 - \mathrm{P}(1,1|1,2)]\mathrm{E}(U_{S=0}^{21}) \, , \tag{18a}$$

$$\mathrm{E}(U_{S=1}^{21}) = \sum_{t=0}^{\mathrm{E}(1,2|1,2)} \frac{\mathrm{U}(Y_{12}, X_2)}{(1+\rho)^t} + \sum_{t=\mathrm{E}(1,2|1,2)+1}^{T} \frac{\mathrm{U}(Y_{11}, X_1)}{(1+\rho)^t} \, . \tag{18b}$$

Notice that $\mathrm{E}(1,2|1,2) = 1/\mathrm{P}(1,1|1,2)$ in the case of $\mathrm{P}(2,1|1,2) = 0$.

I have shown how access to a labor market influences the migration decision of an individual who is not myopic. We can also say something about equilibrium. Equilibrium in all labor markets simultaneously is not possible unless $N_{11} = L$. Workers keep trying to find a job in sector (1,1). Although employment in sector (1,1) will always remain an attractive opportunity, net emigration from country 1 to country 2 may cease. This is the case when $\mathrm{E}(U_{S=0}^{12}) \geqslant \mathrm{E}(U_{S=1}^{12})$. If the strict inequality holds, return migration from country 2 to country 1 occurs even though the returning workers are not assured of a job in sector (1,1). The return movement will continue until equality is restored. If $\mathrm{E}(U_{S=0}^{12}) = \mathrm{E}(U_{S=1}^{12})$, we have an equilibrium in sector (1,2). Net emigration between the two countries is 0. The equilibrium is not necessarily a stable one. In the case described above, the advantages of return migration may be so overwhelming that equality is not restored before everybody has left country 2. Conversely, emigration may be so attractive relative to staying in sector (2,1) that $\mathrm{E}(U_{S=1}^{12})$ will always remain greater than $\mathrm{E}(U_{S=0}^{12})$. This will always be the case if $\mathrm{U}(Y_{21}, X_1) < \mathrm{U}(Y_{12}, X_2)$, and if access to sector (1,1) is better from sector (1,2) than from sector (2,1).

One of the most hotly debated questions about guestworkers concerns the duration of their stay in the foreign country. We encounter the apparent contradiction that many workers express a desire to return to their home country, yet they do not. This model provides a possible explanation. A worker's lifetime is limited. Let T be the number of years remaining. It is quite possible that T is smaller than the expected time before the worker would find a job in sector (1,1). A worker in sector (1,2) therefore could not improve his expected utility by returning home, that is, $\mathrm{E}(U_{S=1}^{12} > \mathrm{E}(U_{S=0}^{12})$. If the worker were aware of this, he might even change his attitude and declare himself a permanent immigrant to country 2. This is more likely to be the case for older workers, not only because they usually will have resided in country 2 for a longer time, but also because hiring practice favors younger workers. This change in attitude can be compared to the phenomenon of the discouraged unemployed worker, who drops out of the labor market.

4 Implications for immigration policy

Immigration policy has two basic thrusts. The conventional approach is to control immigration through the admissions policy. Labor migration can also be influenced through measures aimed at changing the attractivity of jobs that employ immigrants relative to jobs in other countries. This course of action is being considered in France. To encourage voluntary return migration, the establishment of a training program for foreign workers has been proposed, which would increase their marketable skills in the high-wage sector of their home countries (Wagner, 1980). In our model, this increased access to the labor market (1,1) results in a shorter average stay for the foreign workers, as intended. However, the greater access to sector (1,1) from sector (1,2) is gained at the expense of the workers in sector (2,1). This shift in Z increases the attractivity of emigrating to sector (1,2), relative to staying in sector (2,1).

The proposed policy would therefore have the effect of decreasing the number of foreign workers in country 2, only if the supply of trained workers returning to country 1 would stimulate faster growth of sector (1,1) than would occur otherwise.

A more effective way of decreasing immigration into country 2 would be to decrease the demand for foreign workers. This could be achieved by imposing a tax on the employer for each guestworker on his payroll. If the supply of immigrant labor is inelastic, the effect of such an approach may not be very significant, however. In addition, such a policy poses some serious human and political questions, since it would result in lower pay for guestworkers for equal work. Political repercussions would have to be expected, not only from those directly involved, but also from the governments of the foreign workers' home countries.

Last, consider the traditional approach to restricting immigration: quotas or other upper limits on legal entires. As the experience of the United States of America shows, this is not without problems either. The effect of numerical restrictions is a decrease in P(1,2|2,1). This has the desired effect of reducing the expected return from emigration from country 1 to country 2. However, if $U(Y_{12}, X_2) \gg U(Y_{21}, X_1)$, then a reduction in P(1,2|2,1) may not be enough. If the government of country 2 allows no new migrants at all, illegal immigration may occur. In that case, P(1,2|2,1) has to be reinterpreted as the product of the probability of being caught, times the probability of getting a job in sector (1,2). For an illegal alien, P(2,1|1,2) is the probability of being caught and deported. To stop illegal immigration, P(2,1|1,2) has to be reduced to the point where $E(U_{S=0}^{21}) = E(U_{S=1}^{21})$. This may be very costly. The optimum level of enforcement may include the acceptance of a certain level of illegal immigration. Illegal entry to a country is not equally difficult for all potential immigrants. Applied to the United States of America, it is likely that Mexican workers find crossing the border without permit easier than workers from other nations. This is not only because of geographical proximity, but also because of the long history of this movement, which has resulted in an organized business of getting workers into the United States of America. It may therefore be justified on economic grounds to formulate an immigration policy which does discriminate against immigrants by country of origin. This conclusion will not hold, if controlling undocumented immigration is not a major policy goal.

5 Generality of the model

The model presented above has been introduced in the context of international labor-migration. The purpose of the following discussion is to demonstrate its wider applicability. I will do this by deriving the famous Harris–Todaro model (1968; 1970) of rural–urban migration in developing countries as a special case.

The Harris–Todaro model is a two-sector model of a developing economy. The two sectors are the rural agricultural sector and the urban manufacturing sector. Migration between the two is a function of the difference between the expected urban wage-rate and the agricultural wage-rate. The following additional notation will be used:

N_m is the total labor requirement in the manufacturing sector,
L_u is the total urban labor force, including most recent immigrants,
Y_m is the wage rate in the manufacturing sector, assumed to be fixed,
$E(Y_u)$ is the expected urban wage-rate,
Y_a is the agricultural wage-rate.

All wage rates are given in real terms. Harris and Todaro make the following assumptions,

$$Y_m \geqslant Y_a \, , \qquad (19)$$

and

$$\frac{N_m}{L_u} = 1 . \tag{20}$$

The model is interesting if equations (19) and (20) hold as strict inequalities, and, in that case, there are actually three sectors in the model: agriculture, manufacturing, and urban unemployment. Harris and Todaro define the expected urban wage-rate by

$$\mathrm{E}(Y_u) = \frac{Y_m N_m}{L_u} . \tag{21}$$

This implies that there is no tenure in the urban job-market. I will use the alternative assumption that the workers are awarded immediate tenure in the manufacturing sector. Let L_m be those currently employed in the manufacturing sector. The expected urban wage-rate is then defined by the following expression:

$$\mathrm{E}(Y_u) = \frac{Y_m(N_m - L_m)}{L_u - L_m} . \tag{22}$$

Expression (22) retains Harris and Todaro's assumption that only workers physically present in the urban area will be considered for manufacturing jobs (that is, $Z = 1$).

Under these assumptions, migration will be strictly one-way from the rural to the urban area.

$$\Delta L_u = \psi[\mathrm{E}(Y_u) - Y_a] = \left\{ \begin{array}{ll} 0 , & \text{if } \mathrm{E}(Y_u) - Y_a = 0 , \\ >0 , & \text{if } \mathrm{E}(Y_u) - Y_a > 0 , \\ <0 , & \text{if } \mathrm{E}(Y_u) - Y_a < 0 . \end{array} \right\} \tag{23}$$

In other words, the equilibrium condition is that the expected urban wage-rate be equal to the agricultural wage-rate, that is,

$$Y_a = \mathrm{E}(Y_u) . \tag{24}$$

If equation (19) holds as a strict inequality, then the manufacturing sector is the most preferred job/location choice. Nobody will leave that sector on their own free will. As long as Y_a is strictly less than $\mathrm{E}(Y_u)$, it is also implied that the workers prefer temporary unemployment to work in the agricultural sector, which is the least preferred sector. This is a formulation analogous to the theoretical framework development above. The manufacturing sector corresponds to sector (1,1), the agricultural sector to sector (2,1), and urban unemployment to sector (1,2). The transition matrix is given in table 3. It is a special case in the sense that labor mobility is sequential, first from sector (2,1) into sector (1,2) with probability 1, and then from sector (1,2) into sector (1,1). Sector (1,1) is the trapping state. $S = 1$ because sector (1,1) is completely inaccessible from sector (2,1).

Table 3. The transition matrix for the Harris-Todaro model with tenure in the manufacturing sector.

		Job/location at time $t+1$		
		(1,1)	(2,1)	(1,2)
Job/location at time t	(1,1)	1	0	0
	(2,1)	0	0	1
	(1,2)	$(N_m - L_m)/(L_u - L_m)$	0	$(L_u - N_m)/(L_u - L_m)$

Sector (1,1) is a trapping state because of the assumption that workers receive immediate tenure. Although this assumption is not perfectly true, it corresponds much better to the facts observed in the real world than the opposite extreme assumption that workers are rehired at random every period. If the assumption of immediate tenure is relaxed, the resulting Markov process will cease to be an absorbing process. Assume that the Harris–Todaro assumption as given by expression (21) holds, that is, there is no tenure at all in the urban sector. At the beginning of each period, every member of the urban labor force has the same chance to be employed for the period. The resulting transition matrix is presented as table 4. The matrix shows that the usual Harris–Todaro assumption about tenure implies a special type of Markov process. Recalling the definition of a mergeable process, we can see that table 4 represents such a case. The states can be merged into two groups $G_1 = \{(1,1), (1,2)\}$ and $G_2 = \{(2,1)\}$. This provides the mathematical justification for Harris and Todaro to aggregate what is essentially a three-sector model, into a two-sector model. Notice that S is still equal to 1.

The merged Markov process is represented by the transition matrix in table 5. This is an absorbing process, and the trapping state, G_1, is entered with probability 1 in the first period, if the starting state is in G_2.

The techniques employed here can be used to gain even further insights into the Harris–Todaro model (see Miron, 1978). Consider the urban sector by itself. Let p be the probability of finding a job in the urban sector, and let q be the probability of being laid off from a currently held urban manufacturing job. The transition probability matrix between urban employment and urban unemployment is given in table 6.

Howard (1971) shows that the multistep transition matrix $\mathbf{P}^t$ assumes the following form,

$$\mathbf{P}^t = \begin{bmatrix} q/(p+q) & p/(p+q) \\ q/(p+q) & p/(p+q) \end{bmatrix} + (1-p-q)^t \begin{bmatrix} p/(p+q) & -p/(p+q) \\ -q/(p+q) & q/(p+q) \end{bmatrix} . \tag{25}$$

Let u_t be the probability that the urban worker is unemployed at time t, and let e_t be the probability that he is employed. Then

$$e_t = u_0 \frac{p}{p+q} [1-(1-p-q)^t] + e_0 \frac{1}{p+q} [p+(1-p-q)^t q] , \tag{26}$$

Table 4. The transition matrix for the Harris–Todaro model with no tenure.

		Job/location at time $t+1$		
		(1,1)	(2,1)	(1,2)
Job/location at time t	(1,1)	N_m/L_u	0	$(L_u-N_m)/L_u$
	(2,1)	0	0	1
	(1,2)	N_m/L_u	0	$(L_u-N_m)/L_u$

Table 5. The transition matrix for the two-sector Harris–Todaro model with no tenure.

		Sector	
		G_1	G_2
Sector	G_1	1	0
	G_2	1	0

Table 6. The transition matrix for urban employment and urban unemployment in a Harris–Todaro model.

$$\begin{array}{l|cc} & \text{Unemployed} & \text{Employed} \\ \text{Unemployment} & (1-p) & p \\ \text{Employment} & q & (1-q) \end{array} = \mathbf{P}$$

where u_0 and e_0 are equal to 0 or 1, depending on whether at $t = 0$, the urban worker is employed or not. If at $t = 0$ the employment status is not known, u_0 and e_0 are set equal to $1-N_m/L_u$ and N_m/L_u, respectively;

$$u_t = u_0\frac{1}{p+q}[q+(1-p-q)^t p]+e_0\frac{p}{p+q}[1-(1-p-q)^t]\ . \tag{27}$$

Probabilities e_t and u_t can be used to calculate the expected discounted flow of income in the urban area. Let T be the worker's planning horizon. If Y_e is the annual income earned when employed in the urban sector, and Y_s the income obtained when unemployed (or employed in a 'murky urban sector'), then the expected present value of the urban income stream is:

$$\mathrm{E}(Y_u) = \sum_{t=0}^{T}\frac{e_t Y_e+u_t Y_s}{(1+\rho)^t}\ . \tag{28}$$

This provides a better basis for decisionmaking than expression (21), which can be obtained as a special case from expression (28), with $e_0 = N_m/L_u$, $Y_s = 0$, and $T = 0$. It also demonstrates the theoretical relationship between the Harris-Todaro model, and the model presented above. The Harris-Todaro model is obtained from our model by setting $Z = 0$, $\mathrm{U}(Y_{ij}, X_j) = Y_{ij}$, $Y_{12} = Y_s = 0$, and $T = 0$. The implications of the Harris-Todaro model are sensitive to changes in these assumptions. For example, if we do allow for access to the urban manufacturing sector from the rural agricultural sector, then it is possible that a laid-off manufacturing worker would wait for a new manufacturing job in the rural area, instead of choosing urban unemployment.

6 Summary

Relatively little research has been done to develop a model that would permit us to analyze the effect of barriers on migration behavior. I propose a framework that yields information about the average duration of stay of a migrant, and his responses to opportunities to migrate. For a migrant with foresight, the accessibility of one labor market from another plays a significant role. A worker may decide to stay at a location that appears inferior to an alternative available to him, because he values the opportunity it provides to enter a labor market even more desirable than the alternative currently available.

The model has been used to analyze immigration policies. I was able to show that measures to promote the voluntary return migration of guestworkers by preparing them for jobs in their home countries are unlikely to reduce the supply of foreign labor. It will result in a higher turnover rate of the foreign work force, however.

From a theoretical point of view, the model is in the tradition of the work of Sjaastad (1962), as well as Harris and Todaro (1968; 1970). It expands Sjaastad's contribution by including job availability and access to labor markets and, by allowing for repeat migration, it extends the work of Harris and Todaro by demonstrating the sensitivity of their results to changes in the assumption about job access.

No empirical tests of the model have yet been performed. The data requirements to estimate the elements of the transition matrix are relatively modest (see Lee et al, 1970). It seems, therefore, that the proposed model provides an interesting framework for investigating international labor-migrations in depth, and for contributing to our understanding of migration behavior in general.

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