

Guests Who Stay

This paper presents a model of legal international labor migration, particularly temporary migration. It explores the likelihood of voluntary return of a majority of foreign workers to their home countries. The approach chosen is that of deterministic simulation. The results of the simulation suggest that a relatively quick labor turnover as required for a true guestworker system is unlikely under most conditions.

1. INTRODUCTION

Immigrants change the social and economic fabric of a country. No wonder that countries exercise control over who may enter and under what conditions. One of the primary concerns of migration policy is the economic effects of migration. This is particularly true for the assessment of international migration.

The purpose of the model presented here is the study of legal international labor migration. In particular, we are interested in temporary migration. Some of the most important of the new immigration destination countries that emerged after 1945 refuse to be considered immigration countries and are still, officially at least, counting on the eventual return of the majority of the foreign workers (for example, Federal Republic of Germany, Switzerland, Saudi Arabia). Under what conditions is this a realistic attitude? With our model we are trying to explore the likelihood of voluntary return as a function of economic conditions in the migrants' home country. The model does not address problems of illegal entrants or visa abusers. This limitation is purposeful. If voluntary compliance is not the norm, the goals of migration policy are very difficult to achieve.

A shortcoming of many studies of the welfare effects of international migration is that they regard migration as final (for example, Reder 1963; Föhl 1967; Berry and Soligo 1969; Borjas 1989; Felderer 1972; Romans 1974; Rodriguez 1975; Lucas 1977; Robertson and Wellisz 1977; Papademetriou 1984; Bond and Chen 1987; see also Macmillen 1982 for a survey of the literature). Theoretical papers dealing with the duration of the migrants' stay abroad are the exception (for example, Casas and Scully 1972; Djajić and Milbourne 1988). The model presented here incorporates

An earlier version of this paper has been presented at the 27th Meeting of the Western Regional Science Association in Napa, California, February 1988. The author thanks participants of the conference who have commented on the paper. Special thanks are due to Peter A. Rogerson of SUNY Albany. The author also received constructive and detailed comments from the anonymous referees of this journal that have lead to substantial improvements.

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duration of stay and the possibility of voluntary return. The question of return is at the heart of the politics of foreign worker migrations in the new immigration countries. The approach taken here is that of deterministic simulation to study the dynamic relationships between emigration, duration of stay abroad, and economic development in the migrants' origin country.

Traditional immigration countries of the nineteenth and early twentieth century welcomed newcomers as permanent settlers. The new immigration destination countries accepted immigrants only because their stay was expected to be of short duration. The label guestworkers given to foreign workers in northern Europe expresses this expectation. Migrants did not return home voluntarily, however, and new applicants replaced those who did. As long as demand for labor was strong, the governments of the destination countries tolerated, or even welcomed, the longer-than-expected duration of stay. But as economic performance declined, this attitude changed (Kubat 1984). Large numbers of foreign workers returned home because their residency or work permits expired. Thus, the number of Yugoslavian workers in northern Europe fell from 850,000 in 1973 to 590,000 in 1976 (Tanić 1979). Indian workers in the Persian Gulf region numbered 850,000 in 1983–84 but only 650,000 in 1984–85 (*India Abroad* 1986).

The foreign labor migrations in Europe have received much attention from migration scholars. Their research shows how policy concerns change over time as a function of economic conditions. Föhl (1967) and Felderer (1972), under the impression of the German labor shortages of the 1960s, were asking whether the net effect of immigration might not be a further tightening of the labor markets. By contrast, more recent contributions (e.g. Martin and Richards 1980) studied the possible displacement of native workers by immigrants. The concerns of scholars in the United States about the effect of immigration on the incomes of the native population (Simon 1982) and the fiscal impact of immigrants (Muller and Espenshade 1985) received less attention in Europe, but the social and economic effects of return have been studied intensively in recent years (e.g. Kubat 1984; see ILO 1986 for additional references). Stahl (1982) provides a comprehensive theoretical discussion of most welfare issues.

Sassen (1988) presents a theoretical framework to explain why international labor migration occurs. She links large international migration movements to foreign direct investments. Her conclusions differ from those of Hiemenz and Schatz (1979) who regard trade liberalization and foreign direct investment in poorer countries as substitutes for emigration from those countries. Sassen argues that foreign direct investments may encourage emigration. A related study is that of Morrison (1982). The approach taken in this paper implies that foreign direct investment works to reduce emigration.

Piore (1979) investigates the specific economic roles played by immigrant labor (see also Castles and Kosack 1972). Our model does not distinguish between different groups of immigrants. It also limits itself to legal guestworker migration only. Important differences exist in the behaviors of legal and illegal immigrants [for example, Reichert and Massey (1979); for a detailed description of the behaviors and constraints of migrants' households, legal and illegal, in a Mexican village, see Dinerman (1978)]. Concerns about guestworkers are not unique to Europe. Similar policy problems exist in other new immigration destination countries such as the oil-producing countries in the Middle East, and in Nigeria, Venezuela, and South Africa. Origin countries of large guestworker movements are no longer limited to the Mediterranean countries, but include Columbia, South Korea, Sri Lanka, India, and the Philippines.

The paper is organized as follows. Section 2 presents the basic model of international migration. Section 3 describes the nature of labor mobility between

two countries and between sectors within a country. The demand for labor, and constraints on immigration, are discussed in section 4. Section 5 describes investment behavior, and section 6 derives the labor market changes that result from migration. The whole model is simulated and representative results are discussed in section 7. The paper concludes with a short summary (section 8).

2. THE BASIC MODEL OF INTERNATIONAL LABOR MIGRATION

The basic approach to international labor migration used in this paper has been developed in Schaeffer (1984, 1987). This section summarizes the most important features of that approach. The interested reader is referred to Schaeffer (1984) for details and a discussion of the relationship between foresight and ranking of jobs, and for proof that the model is in the tradition of Sjaastad (1962) and Harris and Todaro (1968, 1970). We also note similarities to the work of Todaro (1986).

This study differs in important ways from the earlier papers, however (Schaeffer 1984, 1987). The discussion on labor market mobility (section 3), the demand for labor (section 4), and investment behavior (section 5) are new additions. The equations in section 6 are generalized versions of accounting identities presented in Schaeffer (1987). Section 7 is again completely new.

Consider a country H (home country) with a dual labor market. Sector 1^H is the industrial (high-wage) sector and sector 2^H the traditional (low-wage) sector. In addition to employment opportunities in one of these two sectors, workers living in country H can apply for jobs in the labor market 1^F (high-wage) of an economically more advanced country F (foreign country).

The utility derived from a job depends on wage and location. It is given by $U_{i\mathcal{C},t}^H = U(W_{i\mathcal{C},t}^H, |X_{\mathcal{C}} - X_{\mathcal{C}}^H|)$. $W_{i\mathcal{C},t}^H$ is the real wage obtained by a native of country H from working in sector $i = 1, 2$ in country $\mathcal{C} = H, F$. $X_{\mathcal{C}}$ is a vector of attributes of location \mathcal{C} . The absolute difference $|X_{\mathcal{C}} - X_{\mathcal{C}}^H|$ is an index for the "goodness of fit," or match, between a worker's personal characteristics and preferences and the locational attributes. It captures the influence of family or friends, location-specific human capital (for example, language skills), climate, and other environmental factors. The match is perfect if this index is 0. $U_{i\mathcal{C},t}^H > U_{j\mathcal{C},t}^H$ iff $W_{i\mathcal{C},t}^H > W_{j\mathcal{C},t}^H$: of two jobs at the same location, workers prefer the one that pays more. The initial order of preference of workers from country H is: $U_{1H,t}^H > U_{1F,t}^H > U_{2H,t}^H$. The monetary costs of, and constraints to, migration do not affect the ranking among job/location combinations. It is assumed that $U_{1H,t}^H \geq U_{1F,t}^H \geq U_{2H,t}^H$ and $U_{1F,t}^H > U_{2H,t}^H$ always. This implies that a worker employed in sector 1^H will not voluntarily leave that sector, and will not voluntarily return from sector 1^F to sector 2^H . A worker in sector 2^H will try to get into sector 1^H . If no offers are obtained, then emigration to sector 1^F may be tried as the next best alternative. If that is also unsuccessful, then the worker will remain in sector 2^H .

Associated with each sector is the probability of obtaining a job in that sector. Hiring is assumed to take place at the beginning of each period. Job applicants do not have to be physically present to be awarded a job, though presence in a particular labor market may enhance workers' chances.

3. LABOR MARKET MOBILITY

Labor market mobility is constrained by the availability of jobs. Workers may also encounter legal barriers. Some mobility occurs in response to opportunities, other moves are the consequence of lack of choice. The effect of constraints and choice on migration behaviors is reflected in the transition matrix (Table 1). The

TABLE 1
The Transition Matrix P_t

	Job/location at time t		
	1^H	2^H	1^F
1^H	$P(1^H 1^H)_t$	$[1 - P(1^H 1^H)_t][1 - P(1^F 1^H)_t]$	$[1 - P(1^H 1^H)_t]P(1^F 1^H)_t$
2^H	$P(1^H 2^H)_t$	$[1 - P(1^H 2^H)_t][1 - P(1^F 2^H)_t]$	$[1 - P(1^H 2^H)_t]P(1^F 2^H)_t$
1^F	$P(1^H 1^F)_t$	$[1 - P(1^H 1^F)_t][1 - P(1^F 1^F)_t]$	$[1 - P(1^H 1^F)_t]P(1^F 1^F)_t$

matrix implies that choice 2^H is always available. This is justified by including unemployment as part of this sector. Hence,

$$P(2^H|1^H)_t = P(2^H|2^H)_t = P(2^H|1^F)_t = 1. \tag{1}$$

Table 1 summarizes the transition matrix P_t . The elements of P_t denote the probabilities that an attempt to move from sector i^e to sector j^e will be successful. The subscript t denotes the period (time). Let $L_{i^e,t}^H$ be the number of workers of country H in sector i , country e during period t . Let $N_{1^e,t}^e$ be the total demand for labor from country e in sector 1^e at the beginning of period t . Workers who obtain a job in sector 1^e are given immediate tenure. Tenure is revoked only if market conditions force employers to reduce their labor force below the size of the previous period minus turnover. Offspring of country H workers in sector 1^H start their careers in sector 2^H . Hence, if $s_{1H,t}$ is the survival rate of workers in sector 1^H , then $q_{1H,t}^H = N_{1H,t}^H - s_{1H,t}L_{1H,t-1}^H$ gives the number of job openings at the beginning of period t . In the event that $N_{1H,t}^H < s_{1H,t}L_{1H,t-1}^H$, that is $q_{1H,t}^H < 0$, some of the workers who were in sector 1^H during period $t - 1$ will no longer find employment there. The probability that a worker can stay in sector 1^H is 1.00 if $q_{1H,t}^H \geq 0$. If there are fewer job openings than workers already present ($q_{1H,t}^H < 0$), each worker stands the same chance of retaining the job. This assumption is necessary because this model formulation makes no distinction among workers in sector 1^H . Thus,

$$P(1^H|1^H)_t = \begin{cases} 1 & \text{if } q_{1H,t}^H \geq 0. \\ \frac{N_{1H,t}^H}{s_{1H,t}L_{1H,t-1}^H} & \text{if } q_{1H,t}^H < 0. \end{cases} \tag{2}$$

Access to a labor market may depend on a worker's current location. Geographical proximity generally enhances the chances of moving to sector 1^H . Experience working in an economically more advanced country may be valued by sector 1^H employers. They may, therefore, prefer hiring migrants returning from sector 1^H . Differences in access to sector 1^H are expressed by the variable $0 \leq Z_t^H \leq 1$. This variable denotes the proportion of the $q_{1H,t}^H$ job openings available to workers in sector 2^H . The parameter $g_{2,t}^H - 1$ is the growth rate of the sector 2^H population, and $b_{1H,t}^H$ is the birth rate in sector 1^H . For notational convenience denote the number of workers who are trying to get from sector 2^H into sector 1^H by $DL_{2H,t}^H = g_{2H,t}^H L_{2H,t-1}^H + b_{1H,t}^H L_{1H,t-1}^H$. If $Z_t^H = DL_{2H,t}^H / [DL_{2H,t}^H + g_{1F,t}^H L_{1F,t-1}^H]$, then access to 1^H is independent of a worker's current location. The probability that a worker in sector 2^H will succeed in getting into sector 1^H in period t is given by equation (3).

The first line in equation (3) expresses that no additional workers are admitted to sector 1^H if there are no job openings. The second term defines the probability

$P(1^H|2^H)$ if there are fewer job openings in sector 1^H than applicants from sectors 2^H and 1^F . The third term accounts for the possibility that more jobs may be offered to workers in sector 1^F than there are applicants from that sector. In that case all applicants from sector 1^F will be able to move to 1^H . The remaining jobs in sector 1^H are given to workers in sector 2^H . Finally, if there are openings in sector 1^H for all applicants, the probability of moving into that sector is 1.

$$P(1^H|2^H)_t = \begin{cases} 0 & \text{if } q_{1H,t}^H \leq 0. \\ \frac{Z_t^H q_{1H,t}^H}{DL_{2H,t}^H} & \text{if } 0 \leq Z_t^H q_{1H,t}^H \leq g_{2H,t}^H L_{2H,t-1}^H \text{ and} \\ & 0 \leq (1 - Z_t^H) q_{1H,t}^H \leq g_{1F,t}^H L_{1F,t-1}^H. \\ \frac{q_{1H,t}^H - g_{1F,t}^H L_{1F,t-1}^H}{DL_{2H,t}^H} & \text{if } 0 \leq q_{1H,t}^H - g_{1F,t}^H L_{1F,t-1}^H \leq DL_{2H,t}^H \\ & \text{and } (1 - Z_t^H) q_{1H,t}^H > g_{1F,t}^H L_{1F,t-1}^H. \\ 1 & \text{if } Z_t^H q_{1H,t}^H > DL_{2H,t}^H \text{ or} \\ & q_{1H,t}^H \geq DL_{2H,t}^H + g_{1F,t}^H L_{1F,t-1}^H. \end{cases} \quad (3)$$

The probability of an individual moving from 1^F to 1^H is defined analogously; $g_{1F,t}^H - 1$ is the growth rate among nationals of country H who are working in country F .

$$P(1^H|1^F)_t = \begin{cases} 0 & \text{if } q_{1H,t}^H \leq 0. \\ \frac{(1 - Z_t^H) q_{1H,t}^H}{g_{1F,t}^H L_{1F,t-1}^H} & \text{if } 0 \leq (1 - Z_t^H) q_{1H,t}^H \leq g_{1F,t}^H L_{1F,t-1}^H \\ & \text{and } 0 \leq Z_t^H q_{1H,t}^H \leq DL_{2H,t}^H. \\ \frac{q_{1H,t}^H - DL_{2H,t}^H}{g_{1F,t}^H L_{1F,t-1}^H} & \text{if } 0 \leq q_{1H,t}^H - DL_{2H,t}^H \leq g_{1F,t}^H L_{1F,t-1}^H \\ & \text{and } Z_t^H q_{1H,t}^H > DL_{2H,t}^H. \\ 1 & \text{if } Z_t^H q_{1H,t}^H > DL_{2H,t}^H \text{ or} \\ & q_{1H,t}^H \geq DL_{2H,t}^H + g_{1F,t}^H L_{1F,t-1}^H. \end{cases} \quad (4)$$

Access to sector 1^F can be described in similar terms. Denote the total demand for guestworkers from country H in country F by $N_{1F,t}^H$. It is assumed that the children of foreign workers are given sector 1^F jobs before additional foreign workers are admitted. If demand for labor should fall below the present number of foreign workers, then some of them will be asked to leave country F . Since all foreign workers are assumed to be identical, the probability of forced return is the same for all. This probability is zero whenever $P(1^F|2^H)_t > 0$. The number of job openings for additional foreign workers in sector 1^F is given by $q_{1F,t}^H = N_{1F,t}^H - g_{1F,t}^H L_{1F,t-1}^H$. This figure can be positive, zero, or negative.

It is common practice in destination countries that the children of foreign workers are given preferential treatment when job openings are available. When there are cultural differences between origin and destination countries, hiring the children of migrants benefits employers, as the migrants' children will be familiar with language and work attitudes. That foreign workers leave the country when

jobs disappear has also been observed.

$$\begin{aligned}
 & P(1^F|2^H)_t \\
 &= \begin{cases} 0 & \text{if } q_{1F,t}^H \leq 0. \\ \min \left\{ 1; \frac{q_{1F,t}^H}{DL_{2H,t}^H [1 - P(1^H|2^H)_t] + [1 - P(1^H|1^H)_t] s_{1H,t} L_{1H,t-1}^H} \right\} & \text{if } q_{1F,t}^H > 0 \text{ and } P(1^H|2^H)_t < 1. \end{cases} \quad (5)
 \end{aligned}$$

$$P(1^F|1^H)_t = \begin{cases} 0 & \text{if } q_{1F,t}^H < 0. \\ P(1^F|2^H)_t & \text{otherwise.} \end{cases} \quad (6)$$

$$P(1^F|1^F)_t = \begin{cases} 1 & \text{if } q_{1F,t}^H \geq 0. \\ \frac{N_{1F,t}^H}{\xi_{1F,t}^H L_{1F,t-1}^H} & \text{if } q_{1F,t}^H < 0. \end{cases} \quad (7)$$

There are differences among foreign workers with respect to their legal (visa) status. Some have permanent residency permits while others hold only annual or otherwise restricted work and residency permits. The latter usually do not enjoy much protection against forced return migration. An accurate modeling of the different legal, political, and economic forces, and of the behavior of migrants, is a formidable task. The assumptions incorporated in equation (7) provide a reasonable approximation to observed aggregate behaviors.

4. THE DEMAND FOR LABOR

Since unemployment is included in sector 2^H , it is only necessary to derive the demand for labor in sectors 1^H and 1^F . To determine the demand in sector 1^H , assume that the production process can be represented by a CES (constant elasticity of substitution) production function. Let $Q_{1H,t}$ be the total production in sector 1^H during period t , and let $A_{1H,t}$ be a technical coefficient measuring the state of technology. The parameter ρ_{1H} is constant with $\rho_{1H} > -1$. $\delta_{1H,t}$ may vary over time but is limited to values between 0 and 1 ($0 < \delta_{1H,t} < 1$). $K_{1H,t}$ is the available stock of capital, and $N_{1H,t}$ is the total number of workers employed. We assume that only natives of country H work in sector 1^H . Hence, $N_{1H,t} = N_{1H,t}^H$.

$$Q_{1H,t} = A_{1H,t} (\delta_{1H,t} K_{1H,t}^{-\rho_{1H}} + (1 - \delta_{1H,t}) (N_{1H,t}^H)^{-\rho_{1H}})^{-1/\rho_{1H}}. \quad (8)$$

The elasticity of substitution, ϵ_{1H} , changes with the value of ρ_{1H} : $\epsilon_{1H} = 1/(1 + \rho_{1H})$. In the limiting case when $\rho_{1H} \rightarrow 0$, equation (8) becomes the Cobb-Douglas production function. The marginal product of labor is given by expression (9).

$$MP_{N_{1H,t}} = \frac{1 - \delta_{1H,t}}{A_{1H,t}^{\rho_{1H}}} \left[\frac{Q_{1H,t}}{N_{1H,t}} \right]^{1+\rho_{1H}}. \quad (9)$$

In a competitive economy labor is hired until the marginal product of labor is equal to the real wage rate. Let $W_{1H,t}$ be the real wage rate in sector 1^H . Total output must equal total demand for the economy to be in equilibrium. Let $D_{1H,t}$ be the total demand for the output of sector 1^H . Then the demand for labor can be expressed as a function of demand for output, production technology, real wage rate, the distribution parameter $\delta_{1H,t}$ (denoting the share of the product going to owners of capital), and the elasticity of substitution.

$$N_{1H,t} = D_{1H,t} \left[\frac{W_{1H,t} A_{1H,t}^{\rho_{1H}}}{1 - \delta_{1H,t}} \right]^{1 + \rho_{1H}} \tag{10}$$

If country H is a small open economy, then the demand for goods produced in sector 1^H may be assumed to be infinitely elastic. Under that assumption $Q_{1H,t} = D_{1H,t}$, and equation (10) always holds. We can therefore replace $D_{1H,t}$ by $Q_{1H,t}$ for a complete specification of the demand for labor. Using equations (8) and (10) leads to the following expression for the demand for labor in sector 1^H in period t .

$$N_{1H,t} = K_{1H,t} \left(\frac{1}{\delta_{1H,t}} \right)^{1/\rho_{1H}} \times \left[\left(\frac{W_{1H,t}}{(1 - \delta_{1H,t}) A_{1H,t}} \right)^{-\rho_{1H}/1 + \rho_{1H}} - (1 - \delta_{1H,t}) \right]^{1/\rho_{1H}} \tag{11}$$

In many poor countries the lack of risk capital poses a hindrance to economic development. To focus on the problem of capital availability, it is assumed that the real wage rate in sector 1^H is constant. Other important issues, such as the possible lack of managerial and entrepreneurial skills, are not considered in this analysis.

The demand for labor in sector 1^F is more complicated to model. The number of jobs offered by employers at a given wage $W_{1F,t}$ sets an upper bound, but political authorities may impose a lower limit on hiring. Thus, not all demand for labor may be satisfied. Let $\mathcal{N}_{1F,t}^H$ be the maximum number of foreign workers permitted in country F during period t . Let $N_{1F,t}^{HE}$ be the employers' demand for foreign workers, and let $N_{1F,t}^{HP}$ be the politically imposed limit on the number of such workers. Hence,

$$\mathcal{N}_{1F,t}^H = \min. \{ N_{1F,t}^{HE}; N_{1F,t}^{HP} \}. \tag{12}$$

For practical, legal, and political reasons, not all foreign workers are admitted, or asked to leave, at once. Rather, the limit is approached gradually. Let $N_{1F,t}^H$ denote the actual number of foreign workers in country F during period t , and let $\Delta N_{1F,t}^H$ denote the change in their numbers. $\nu_{1F,t}$ is a parameter. Then $\Delta N_{1F,t}^H$ obeys the following rule.

$$\Delta N_{1F,t}^H = \nu_{1F,t} (\mathcal{N}_{1F,t}^H - \mathcal{N}_{1F,t-1}^H). \tag{13}$$

The limit $\mathcal{N}_{1F,t}^H$ will be approached asymptotically.

A further difficulty in modeling the demand for labor in sector 1^F is created by the presence of foreign and native workers. Do employers reveal preferences based on national origin? Profit-maximizing employers will make a distinction only if there is a difference in the workers' productivity. The formulation of the

employers' demand for labor will, therefore, have to be able to account for possible productivity differences.

To finish the representation of the demand for labor, $N_{1F,t}^{HE}$ and $N_{1F,t}^{HP}$ must be specified. If production in country F can also be represented by a CES function, the formulation of the total demand for labor is similar to that of sector 1^H , except that we distinguish between native workers and immigrants. Let $N_{1F,t}^E = \mu_{F,t} N_{1F,t}^{HE} + N_{1F,t}^{FE}$ be the total demand for labor services in country 2. The parameter $\mu_{F,t} > 0$ measures productivity differences between native and foreign workers. The subscript t shows that such differences may change over time. The marginal products of labor for guestworkers and native workers, respectively, are given by the following expressions.

$$MP_{N_{1F,t}}^F = \frac{1 - \delta_{1F,t}}{A_{1F,t}^{\rho_{1F}}} \left[\frac{Q_{1F,t}}{N_{1F,t}^E} \right]^{1+\rho_{1F}}, \quad MP_{N_{1F,t}}^H = \mu_{F,t} MP_{N_{1F,t}}^F, \quad \mu_{F,t} > 0 \quad (14)$$

Unless $\mu_{F,t} = 1$, guestworkers and native workers will not command the same real wage in equilibrium.

If we assume that the demand for the product of country F is perfectly elastic at a given world price, then the demand for labor can be defined analogously to that of sector 1^H [see equation (11)]. It is clear from (15a) and (15b) that employers will hire workers from both groups only if $W_{1F,t}^H = \mu_{F,t} W_{1F,t}^F$. If $W_{1F,t}^H < \mu_{F,t} W_{1F,t}^F$, then employers will hire only foreign workers [equation (15a)].

$$N_{1F,t}^E = N_{1F,t}^{HE} = K_{1F,t} \left(\frac{1}{\delta_{1F,t}} \right)^{1/\rho_{1F}} \left[\left(\frac{W_{1F,t}^H}{(1 - \delta_{1F,t}) A_{1F,t}} \right)^{-\rho_{1F}/1+\rho_{1F}} - (1 - \delta_{1F,t}) \right]^{1/\rho_{1F}}. \quad (15a)$$

Conversely, if $W_{1F,t}^H < \mu_{F,t} W_{1F,t}^F$, then employers hire only native workers. (15b) shows how many are offered jobs.

$$N_{1F,t}^E = N_{1F,t}^{FE} = K_{1F,t} \left(\frac{1}{\delta_{1F,t}} \right)^{1/\rho_{1F}} \left[\left(\frac{W_{1F,t}^F}{(1 - \delta_{1F,t}) A_{1F,t}} \right)^{-\rho_{1F}/1+\rho_{1F}} - (1 - \delta_{1F,t}) \right]^{1/\rho_{1F}}. \quad (15b)$$

Finally, if $W_{1F,t}^H = \mu_{F,t} W_{1F,t}^F$, then employers are indifferent between hiring native and foreign workers. The demand for labor services is then given by any linear combination of equations (15a) and (15b).

$$N_{1F,t}^E = \phi N_{1F,t}^{HE} + (1 - \phi) N_{1F,t}^{FE}, \quad 0 \leq \phi \leq 1. \quad (15c)$$

This leaves the demand $N_{1F,t}^{HE}$ for guestworkers indeterminate. To overcome this

problem we assume that native (country F) workers are hired first if $W_{1F,t}^H = \mu_{F,t} W_{1F,t}^F$. Such preference is politically motivated. Hence, the demand for the labor services of guestworkers is

$$N_{1F,t}^{HE} = \frac{1}{\mu_{F,t}} (N_{1F,t}^E - N_{1F,t}^{FE}) \quad \text{with } N_{1F,t}^{HE} \leq 0 \text{ if } N_{1F,t}^E - N_{1F,t}^{FE} \leq 0. \tag{16}$$

Guestworkers are laid off before any worker native to country F .

The political constraint is formulated as an upper limit on the number of foreign workers in the form of a percentage of the size of the native labor force. The percentage is denoted $\beta_{1F,t}$.

$$N_{1F,t}^{HP} = \beta_{1F,t} L_{1F,t}^F. \tag{17}$$

5. INVESTMENT BEHAVIOR

The growth of sector 1^H is financed out of savings from sector 1^H and from remittances from workers in sector 1^F . Sector 2^H is assumed to be unable to make a significant contribution to financing sector 1^H 's growth. $\Delta K_{1H,t}$ describes the investment rule in sector 1^H until country H has achieved full modernization. I_{1H} is a fixed proportion of the production of sector 1^H that is reinvested, and $R_{1F,t}^H$ is the proportion of the earnings of citizens of country H employed in country F that are remitted *and* invested productively. $W_{1F,t}^H$ is the real wage earned by nationals of country H working in country F 's sector 1^F .

$$\Delta K_{1H,t} = I_{1H} Q_{1H,t} + R_{1F,t}^H W_{1F,t}^H L_{1F,t}^H. \tag{18}$$

Once the economy of country H is fully developed, a new investment rule will be followed. In the long run, this investment rule should provide full employment for all who are willing to work at the real wage rate $W_{1H,t}$, and it should provide for the replacement of depreciated capital. Denote this new investment rule by $\Delta^* K_{1H,t}$ and the rate of depreciation by $\lambda_{KH,t}$. The time subscript t allows for the possibility of accelerated depreciation because of technical progress. $L_t^H = L_{1H,t}^H + L_{2H,t}^H + L_{1F,t}^H$ is country H 's total labor force.

$$\Delta^* K_{1H,t} = \max \left\{ 0; \frac{L_t^H}{\rho_{1H}} \left(\left(\frac{A_{1H,t} W_{1H,t}}{1 - \delta_{1H,t}} \right)^{-\rho_{1H}/1 + \rho_{1H}} - (1 - \delta_{1H,t}) \right)^{\rho_{1H}} - (1 - \lambda_{KH,t}) K_{1H,t-1} \right\}. \tag{19}$$

The capital stock available in sector 1^H in period t is then given by the following expression.

$$K_{1H,t} = (1 - \lambda_{KH,t}) K_{1H,t-1} + \min\{\Delta K_{1H,t}; \Delta^* K_{1H,t}\}. \tag{20}$$

The growth rate of capital is variable and depends on the composition of the labor force. This allows consideration of two often-claimed benefits of foreign labor

migration. First, emigration relieves some of the unemployment included in sector 2^H and second, remittances from nationals abroad contribute to the means of an accelerated expansion of sector 1^H .

To close the model, the investment behavior of sector 1^F employers must be specified. We assume that the competitive rate of return on capital in country F is r_t . If the rate of return is above r_t , the capital stock is added to. It will be decreased at the rate of depreciation, $\lambda_{1F,t}$, otherwise. The marginal product of capital must be equal to the rate of return in a competitive economy. The marginal product of capital is

$$MP_{1F,t}^K = \frac{1 - \delta_{1F,t}}{A^{\rho_{1F}}} \left(\frac{Q_{1F,t}}{N_{1F,t}^E} \right)^{1 + \rho_{1F}}.$$

Since the CES function is homogeneous of degree one, the marginal product, and hence the rate of return, can remain the same only if labor and capital are increased at the same rate. Hence, as long as labor is abundant because additional guestworkers are readily available, employers will expand the capital stock at the same rate at which they are able to hire additional guestworkers. In the long run, therefore, the wage rate is constant if competitive markets exist. In the short run, constraints on the speed of capital expansion may lead to temporary changes in the wage rate.

6. LABOR FORCE DYNAMICS

The number of workers in any particular country and sector is determined by the rate of natural increase and migration. The natural growth rate is given by $g_{i^c,t}^c - 1$. If fertility and death rates are affected by economic variables, then the natural growth rates should differ between sectors and may change over time. For workers of country H in sector 1^H we use the definition $g_{1H,t}^H - 1 = b_{1H,t}^H - d_{1H,t}^H$ where $b_{1H,t}^H$ is the birth rate and $d_{1H,t}^H = 1 - s_{1H,t}^H$ is the death rate. Equations (21)–(23) are accounting identities. The labor force $L_{1H,t}^H$ is given by the following expression:

$$L_{1H,t}^H = P(1^H|1^H)_t s_{1H,t}^H + P(1^H|2^H)_t DL_{2H,t}^H + P(1^H|1^F)_t g_{1F,t}^H L_{1F,t-1}^H. \quad (21)$$

The size, and development over time, of $L_{2H,t}^H$ and $L_{1F,t}^H$ can be defined in similar fashion.

$$\begin{aligned} L_{2H,t}^H = & [1 - P(1^H|1^H)_t][1 - P(1^F|1^H)_t] s_{1H,t}^H L_{1H,t-1}^H \\ & + \{1 - [P(1^H|2^H)_t + [1 - P(1^H|2^H)_t] P(1^F|2^H)_t]\} DL_{2H,t-1}^H \\ & + [1 - P(1^H|1^F)_t][1 - P(1^F|1^F)_t] g_{1F,t}^H L_{1F,t-1}^H. \end{aligned} \quad (22)$$

$$\begin{aligned} L_{1F,t}^H = & [1 - P(1^H|1^H)_t] P(1^F|1^H)_t s_{1H,t}^H L_{1H,t-1}^H \\ & + [1 - P(1^H|2^H)_t] P(1^F|2^H)_t DL_{2H,t-1}^H \\ & + \{1 - [P(1^H|1^F)_t + [1 - P(1^H|1^F)_t] \\ & \quad \times [1 - P(1^F|1^F)_t]]\} g_{1F,t}^H L_{1F,t-1}^H. \end{aligned} \quad (23)$$

Equations (21)–(23) form a system of difference equations. If the transition probabilities were constant, an analytical solution could be obtained (Schaeffer 1987). Since the assumptions permit labor market conditions to change over time, however, this is not possible here. To gain insights into the effects of migration, simulation is employed to generate paths of population and economic change under a variety of assumptions. We assume that there is no migration out of country F . Hence, the growth of country F 's native work force is ruled by just one equation:

$$L_{1F,t}^F = g_{1F,t}^F L_{1F,t-1}^F \quad (24)$$

7. DISCUSSION OF SIMULATION RESULTS

The simulations have been performed under different assumptions. Some parameters were held constant for all runs. These parameters are summarized here.

Sector 1^H : The technical coefficient $A_{1H,t}$ was set equal to 1.00. $W_{1H,t}$, the real wage in sector 1^H was assumed to be fixed and also set equal to 1.00. The exact value does not matter since the dimension has been left unspecified. The crude birth rate $b_{1H,t}$ was set equal to 0.06, and the survival rate $s_{1H,t}$ was set equal to 0.95. Hence, sector 1^H contributed to population growth at the rate of 1 percent per year. The capital stock $K_{1H,t}$ was made just large enough to provide jobs for $L_{1H,t}$ workers, given $W_{1H,t}$.

Sector 2^H : The labor force growth coefficient $g_{2H,t}^H$ was assumed to be equal to 1.02. In other words, the natural rate of growth in this sector was assumed to be 2 percent per year.

Sector 1^F : The parameter $\nu_{1F,t}$ sets the speed at which the quota of foreign workers $\mathcal{N}_{1F,t}^H$ is permitted to be filled. It was set equal to 0.10. The rate of natural growth of workers from country H in country F was assumed to be 1 percent per year. Hence $g_{1F,t}^H$ was set equal to 1.01. The wage rate $W_{1F,t}^F$ was set to 1.3, the productivity differential between workers native to country F and immigrant workers from country H , denoted by $\mu_{F,t}$, was set to 0.80. This resulted in a real wage $W_{1F,t}^H$ of 1.04, just slightly above the wage rate in sector 1^H .

The total number of workers of country H , including those nationals working in country F , was set equal to two million as the starting point. The total labor force of country F , not counting immigrant workers, was also set equal to two million. The natural rate of growth in country H is variable. It changes with the distribution of its labor force between sectors 1^H and 2^H and the extent of emigration to country F . The initial size of sector 1^H was set to five hundred thousand. Different assumptions were used about the initial distribution of workers of country H between sectors 2^H and 1^F . The relative size of the modern sector 1^H is representative for countries such as Turkey or Algeria. The rate of depreciation was set to 7 percent per period. A period was taken to be one year. The maximum size of migration was set equal to 25 percent of the native labor force of country F ($\beta_{1F,t} = 0.25$).

Emigration alone was not very effective in bringing about sustained economic growth. Only under ideal conditions—a large share of remittances are productively invested in country H , and migration to country F is large and easy—did emigration work to bring about full development of country H . Even then, the transition to the point when all workers can find employment in the modern sector 1^H took several decades. Less ideal assumptions resulted in the growth of the share of sector 1^H of total employment for a while, often for many years. Some simulation

runs showed that sector 1^H 's share of the economy increased for more than seventy years. But under these less ideal assumptions, the growth of the share of employment of the modern sector eventually peaked and started to decrease again. Even in these runs, the share of income remitted by workers from country H in sector 1^F and spent on productive investments was never set lower than 10 percent ($R_{1^F,t}^H \geq 0.1$).

The results indicated that successful growth requires a critical level (threshold) of development as the starting point, even under rather favorable conditions. A practical problem for policy exists in determining whether such a level is present, because the modern sector's share of total employment can grow for a long time before it peaks and begins to decline. Even with careful monitoring, therefore, policymakers could justifiably feel that the economy is on course towards full development when, in fact, it had not yet reached a path that will guarantee success.

The effect of immigration on development was twofold. First, it increased the risk capital that is available for investing in sector 1^H and, second, it lowered the rate of population growth. As long as the probability of return $P(1^H|1^F)_t$ was very low, however, there was little turnover among the guestworkers in country F ; the average duration of stay is long. The effect on country H 's growth rate was, therefore, only temporary, as sector 2^H started growing again after the short-lived initial emigration rush.

If employers have a strong preference for workers with experience in sector 1^F , then the value of $P(1^H|2^H)_t$ will be high (Z_t^H is very small or zero). If the number of workers from country H in sector 1^F is small relative to job openings in sector 1^H , then $P(1^H|2^H)_t$ may even assume the value 1.00. If this probability is large, then it makes sense to speak of "guestworkers."

The results of the simulation underline the potential importance of remittances (for example, Appleyard 1989). Surprisingly, therefore, many countries with large numbers of emigrants have no effective policies pertaining to remittances. Among the home countries of European guestworkers, Turkey has made the most determined efforts towards establishing such a policy (Lieberman and Gitmez 1979; Chandavarkar 1980). Stahl and Arnold (1986) discuss the experience of Asian (exclusive of Turkey) labor-exporting countries. They report that Asian workers in the Middle East remit a very high share of their income, generally more than 50 percent. Not all remittances are used for investment, but to support family members left behind. In recognition of the importance of remittances in the national balance of payment, some Asian countries have established regulations and incentives.

The political constraint imposed on immigration by country F eventually became binding whenever country H failed to move towards successful development. Once the politically acceptable level was reached, emigration from country H was dependent on turnover in sector 1^F . As a consequence, if initial emigration was not sufficient to provide the "big push" needed to move toward complete development, then it was never able to do so.

8. CONCLUSION

Emigration is most likely to contribute to development in the sending countries during its early stages, when the outmigration stream is large. In general, however, emigration is not the major force in bringing about development. The model presented here indicates that successful development requires a threshold or "take off" level. The availability of emigration does lower the threshold level.

The simulation results point to a policy problem. A country can experience many years of progress towards development. In some simulation runs, the share of sector 1^H increased for more than seventy years before it peaked and started to decline. This suggests that identifying a successful development strategy may be difficult, particularly during the first years of its implementation, when it leads to strong and sustained growth.

If people move in pursuit of job opportunities not available in their home country, quick turnover of guestworkers should not be expected. The European experience has made this clear. For a true guestworker migration to occur, development in the migrants' home country must be rapid enough to absorb those workers over a relatively short period. Alternatively, the destination countries could admit mostly contract workers who come with firms from their home countries for a specific project and return once that project is completed. This is an approach that is to some extent followed by Persian Gulf countries (for example, firms from South Korea). It is not a practicable approach in the industrialized countries of Europe, where immigrants are employed by firms of the destination country. The empirical evidence and theoretical works suggest that guestworker migration, based on quick turnover of foreign workers, is likely to occur under special circumstances only.

LITERATURE CITED

- Appleyard, R. T. (1989). "Migration and Development: Myths and Reality." *International Migration Review* 3, 486-99.
- Berry, R. A., and R. Soligo (1969). "Some Welfare Aspects of International Migration." *Journal of Political Economy* 77, 778-94.
- Bond, E. W., and T-J. Chen (1987). "The Welfare Effects of Illegal Immigration." *Journal of International Economics* 23 (3/4), 315-28.
- Borjas, George J. (1989). "Economic Theory and International Migration." *International Migration Review* 23, 457-85.
- Casas, F. R., and G. S. Scully (1972). "Temporary Labour Migration and the Theory of Optimal Intervention." *Oxford Economic Papers* 24, 166-79.
- Castles, St., and G. Kosack (1972). "The Function of Labour Immigration in Western European Capitalism." *New Left Review* 23 (July), 3-21. (Reprinted in Castles, St. (1989), *Migrant Workers and the Transformation of Western Societies*. Ithaca, N.Y.: Cornell University, Center for International Studies.)
- Chandavarkar, A. G. (1980). "Use of Migrants' Remittances in Labor-Exporting Countries." *Finance and Development* 17 (June), 36-39.
- Dinerman, Ina R. (1978). "Patterns of Adaptation among Households of U.S.-Bound Migrants from Mchoacán, Mexico." *International Migration Review* 12 (4, Winter), 485-501.
- Djajić, S., and R. Milbourne (1988). "A General Equilibrium Model of Guest-Worker Migration: The Source Country Perspective." *Journal of International Economics* 25 (3/4), 335-51.
- Felderer, B. (1972). "Wirtschaftliches Wachstum bei Einsatz von Gastarbeitern." *Zeitschrift für Nationalökonomie* 32, 307-16.
- Föhl, C. (1967). "Stabilisierung und Wachstum bei Einsatz von Gastarbeitern." *Kyklos* 20, 119-46.
- Harris, J. R., and M. P. Todaro (1968). "Urban Unemployment in East Africa: An Economic Analysis of Policy Alternatives." *East African Economic Review* 4, 17-36.
- _____. (1970). "Migration, Unemployment and Development: A Two-Sector Analysis." *American Economic Review* 60, 126-42.
- Hiemenz, U., and K. W. Schatz (1979). *Trade in Place of Migration*. Geneva, Switzerland: International Labour Office.
- India Abroad* (1986, June 13). "Asian Workers Leaving Gulf."
- ILO (1986). *Bibliography on International Return Migration* (2d revised ed.). Geneva, Switzerland: International Labour Office, International Migration for Employment Branch.
- Kubat, Daniel, ed. (1984). *The Politics of Return: International Return Migration in Europe*. Staten Island, N.Y.: Center for Migration Studies and Rome, Italy: Centro di Studi Emigrazione-Roma.
- Lieberman, S. S., and A. S. Citmez (1979). "Turkey." In *International Labor Migration in Europe*, edited by R. E. Krane, pp. 201-20. New York: Praeger Publishers.

- Lucas, R. E. B. (1977). "Internal Migration and Economic Development: An Overview." in *Internal Migration: A Comparative Perspective*, edited by A. A. Brown and E. Neuberger. New York: Academic Press.
- Macmillan, Malcolm J. (1982). "The Economic Effects of International Migration: A Survey." *Journal of Common Market Studies* 20, 245-67.
- Morrison, Thomas K. (1982). "The Relationship of U.S. Aid, Trade and Investment to Migration Pressures in Major Sending Countries." *International Migration Review* 16 (1, Spring), 4-26.
- Martin, Philip L., and A. Richards (1980). "International Migration of Labor: Boon or Bane?" *Monthly Labor Review* 103 (10), 4-9.
- Muller, T., and T. J. Espenshade (1985). *The Fourth Wave*. Washington, D.C.: The Urban Institute Press.
- Papademetriou, D. G. (1984). "Dilemmas in International Migration: A Global Perspective." *Environment and Planning C: Government and Policy* 2, 383-98.
- Piore, Michael J. (1979). *Birds of Passage. Migrant Labor and Industrial Societies*. Cambridge, G. B.: Cambridge University Press.
- Reichert, Josh and Douglas S. Massey (1979). "Patterns of U.S. Migration from a Mexican Sending Community: A Comparison of Legal and Illegal Migrants." *International Migration Review* 13 (4, Winter), 599-623.
- Reder, M. W. (1963). "The Economic Consequences of Increased Immigration." *Review of Economics and Statistics* 45, 221-30.
- Robertson, P., and St. Wellisz (1977). "Steady-State Growth in an Economy with Intersectoral Migration." *Oxford Economic Papers* 29, 370-88.
- Rodriguez, C. A. (1975). "On the Welfare Aspects of International Migration." *Journal of Political Economy* 83, 1065-72.
- Romans, J. T. (1974). "Benefits and Burdens of Migration (with Specific References to the Brain Drain)." *Southern Economic Journal* 40, 447-55.
- Sassen, Saskia (1988). *The Mobility of Labor and Capital. A Study of International Investment and Labor Flow*. Cambridge, G. B.: Cambridge University Press.
- Schaeffer, P. (1984). "Barriers and Foresight in International Labor-Migration." *Environment and Planning A* 16, 451-66.
- _____. (1987). "A Dynamical Model of Labor Market Change in International Migration When Demand for Labor is Exogenous." *Environment and Planning A* 19, 1051-57.
- Simon, J. L. (1982). "The Overall Effect of Immigrants on Natives' Incomes." In *The Gateway. U.S. Immigration Issues and Policies*, edited by B. R. Chiswick, pp. 314-38, Washington, D.C.: American Enterprise Institute for Public Policy Research.
- Sjaastad, L. A. (1962). "The Costs and Returns of Human Migration." *Journal of Political Economy* 70 (Supplement), 80-93.
- Stahl, Charles W. (1982). "Labor Emigration and Economic Development," *International Migration Review* 16 (4, Winter), 869-99.
- Stahl, Charles W., and Fred Arnold (1986). "Overseas Workers and Remittances in Asian Development." *International Migration Review* 20, 899-925.
- Tanić, Živan (1979). "Yugoslavia." In *International Labor Migration in Europe*, edited by R. E. Krane, pp. 173-86. New York: Praeger Publishers.
- Todaro, Michael P. (1986). *International Migration, Domestic Unemployment, and Urbanization: A Three-Sector Model*. Working paper #124. New York: The Population Council, Center for Policy Studies.