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June 1994

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Abstract

The experience of several host countries shows that small initial inflows of migrants from a particular source country have a perpetuating effect on further migration from that country of origin. However, not much is known about the interplay of the factors that determine the dynamics of such migration flows. The theoretical literature on labor migration is largely based on the assumption that migrants form a homogeneous entity, thereby abstracting from the influence of social relationships on the migration decision. But a given migrant is different from the previous migrant by the very nature of his or her order. Thus, we propose a refined concept in order to differentiate between migrants conditional on their position in the chain. Within a two-countries model with one sending and one receiving country we derive an analytical solution that explains the dynamics of migration. Simulations illustrate some of the findings. By means of an extended model with two sending countries we investigate the phenomenon of competition between migrants from different countries and identify several factors influencing the further inflow of migrants. Their non-linear interaction gives rise to the phenomenon of hysteresis wherein factors with temporary occurrence persistently affect the dynamics of migration. Elaborating several policy implications, our analysis indicates a limited significance of income differentials for the dynamics of the migratory movement, while the destination countries' receptivity for migrants turns out to be the crucial factor.

1. Introduction

The experience of several host countries shows that small initial flows of migrants from a particular source country have a perpetuating effect on further migration from that country. However, not much is known about the interplay of the underlying factors that determine the dynamics of such migration flows. The theoretical literature on labor migration is largely based on the assumption that migrants form a homogeneous entity (GRUBEL and SCOTT, 1966; KEMP, 1969; RIVERA-BATIZ, 1982; ETHIER, 1983). But a given migrant is different from the previous migrant by the very nature of his or her order. As some recent work by economists as well as sociologists indicates, social relationships play a central role in shaping the migration pattern. Thus, we propose a refined concept in order to differentiate between migrants conditional on their position in the chain (MACDONALD and MACDONALD, 1964; TILLY and BROWN, 1967; RITCHEY, 1976; MASSEY and GARCÍA ESPAÑA, 1987; LITWAK and MESSERI, 1989; MASSEY 1990a; MASSEY, 1990b; GURAK and CACES, 1992; MASSEY ET AL., 1993).

Chain migrants exhibit essentially different features than single migrants. Contrary to single migrants, chain migrants enjoy the advantage of receiving information about labor market opportunities from their network abroad as well as assistance in finding a job. A chain migrant can also reduce the accommodation expenditures by sharing housing with members of the network. The income equivalent of such benefits reduces the expenditures necessary to maintain a baseline consumption level, that is the required expenditures to reach a certain utility level are likely to be lower for chain migrants than for single migrants. If follows that faced with a choice of destination countries, an individual who has a network in one country but none in another may choose the former even if wage rates in the latter are higher. Reductions of expenditures may also occur if several single migrants decide to share a flat. If this is the case, the single migrant's categorization would have to shift to the group of chain migrants. However, by assumption, the creation of a network involves more time than the time available to decide whether to stay or to return to the home country. For the first period after immigration such shifts in a migrant's categorization are therefore ruled out subsequently.

Using LEE's basic idea (1966) of various push and pull factors as causes of migration, the paper intends to explain the dynamics of migration from the viewpoint of the destination country depending on the presence of chains between a source and a destination country. According to SPEARE, GOLDSTEIN and FREY (1975, p. 175), three mental steps precede the act of migrating: first, the development of a desire to consider moving, second, the selection of an alternative location, and third, the decision to move or to stay. As our model inquires the dynamics of actual movements across borders, we concentrate on the third stage of the decision process, assuming the two initial stages of the decision problem as exogenously given. Based on our findings how the decision to move or to stay is affected by the existence of a network abroad, we study the resulting pattern of the migration dynamics. We will demonstrate that, from the viewpoint of the destination country, the classification of migrants into two categories contributes to clarify the significantly different dynamics of migration inflows.

We assume that the individual follows the rational-choice approach during the first two stages of the decision process. The core of the rational-choice approach is formed by a utility maximization calculus. Prima facie, this fundamental principle seems to be in contradiction to the empirical phenomenon of inertia (KALTER, 1994, p. 14), that is the occurrence of small utility differentials does not initiate a process of mass migration. Yet inertia is the basis for an analysis of the dynamics of migration, as without it the adjustment to a change in exogenous variables occurs instantaneously.

In order to explain inertia, two approaches have been suggested. The assumption of increasing adjustment costs with an increasing number of migrants provides a mechanism to prevent an adjustment within one period. Apart from this approach to implement inertia, the principle of satisficing as established by SIMON (1957, pp. 241) instead of the utility maximization calculus has been proposed. According to RIKER and ORDESHOOK (1973, pp. 20-23), however, the principle of satisficing is a special case of the maximizing principle. The permanent evaluation of alternatives involves high information, search and decision costs that can be avoided as long as the individual sticks to his or her former habits (MOLHO, 1986, p. 399). The contradiction between the phenomenon of inertia and the approach used to explain it vanishes if the decision whether to migrate is preceded by a decision whether to engage in a process to collect and evaluate information about alternatives. In this case it can be optimal for an individual not to engage in a search for alternatives as the costs for doing so might exceed the expected gain. Three variables enter this criterion: The utility differential, information costs and the probability to find an alternative that is better than all other alternatives. In our model the decision to move or to stay, resulting from a multi-dimensional set of factors, corresponds to α, which will subsequently be called push mechanism. Alpha equals the percentage of people per unit of time who come to the conclusion that migration is advantageous, even without having a network abroad. The push mechanism therefore shows the fraction of people in the home population per unit of time who feel attracted to move because of a sufficiently high utility differential.

After immigration every migrant becomes a center of attraction with a certain *potential pull capacity* β per unit of time. Taking into consideration that the number of immigrants negatively correlates with the equilibrium wage in the destination country, a variable fraction of the newly immigrating individuals is unsuccessful in finding a job generating an income sufficient to cover the baseline consumption expenditures with the consequence of their immediate return. This renders the *actual pull capacity* of former migrants endogenous but of equal size, irrespective whether the attracting individual herself or himself migrated as a single or a chain migrant.[1]

The paper is organized as follows. In the next chapter we expose a dynamic model with one sending and one receiving country for which we derive an analytical solution which explains the dynamics of migration. In the following section we extend this basic model to the case of two sending countries and one receiving country. In this context we study the phenomenon of labor market competition between migrants from different countries. We identify several factors influencing the further inflow of migrants. Their non-linear interaction gives rise to the phenomenon of hysteresis, revealing that factors with temporary occurrence persistently affect the dynamics of migration. Among these factors the size of the network abroad plays a prominent role in providing migrants from particular countries of origin with a comparative advantage for further migration relative to migrants from other countries of origin. Various policy implications of the model are presented in the fourth chapter. Concluding remarks complete the paper.

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[1] For further details see equation (3) below.

2 The dynamics of migration: a two-country model

2.1 Basic assumptions

a. We consider migration flows between two countries and abstract from interactions with all migratory movements connected with any third country. This assumption will be relaxed later on.

b. Given the labor demand and supply schedules in a certain economy, the inflow of migrant workers enlarges the total supply of labor and thereby, with given normal wage elasticities of labor supply and demand, pushes wages downwards.

c. According to the neoclassical paradigm, in the case of perfectly flexible wages labor markets are cleared at any point of time. In contrast to this presumption, in this paper we will assume that the migrant obtains a job with a certain probability as he or she is confronted with a given wage distribution over the vacancies. On the microeconomic level a migrant faces a non-zero probability to receive a wage that exceeds the subsistence minimum. As a migrant intends to maximize the income, from the vacancies offered he or she chooses that one which gives the best income opportunity.

2.2 The case of one sending and one receiving country

The population of the home country is denoted by N_H and assumed to exhibit zero natural population growth. The annual flow of migrants in year t is measured by n(t). The share of migrants with a network abroad is defined by h(t). Hence, [1-h(t)] is the share of single migrants. A migrant with network is facing minimal costs of living C_h which are lower than those for a single migrant: $C_h < C_s$.

Without migrants, labor demand in the host country is described by the function $w_0(t)$. We assume this function to be country-specific and constant. Immigration pushes the equilibrium wage downwards so that the new equilibrium wage w_1 is given by the formula

$$w_1(t) = w_0(t) + \frac{dw(L_0)}{dL} \cdot n(t). \tag{1}$$

In the context of wage distributions the concept of equilibrium wages w_i defines the lower border of the wage distribution of vacancies. It represents a certain, constant percentage of the average wage in the economy and equals the wage of the lowest paid vacancy that implies zero search costs. During the search period we assume that every migrant receives only one offer with a wage above $w_1(t)$.

If we ignore growth arising from technological progress or capital accumulation, the production function is supposed to be constant over time ($w_{0k+1} = w_{0k}$). As the first partial derivative of the production function towards labor is the labor demand function, according to HOTELLING's law, zero immigration implies that the equilibrium wage remains unchanged. Any changes of the equilibrium wage are therefore due to changes of labor supply.

The parameter θ denotes the slope of the labor demand curve in the destination country,

$$w_L = -\theta. \tag{2}$$

w_L stands for dw/dL. θ can be interpreted as an elasticity in the pre-migration labor market equilibrium of two countries of equal population size.

The use of a single labor demand curve with the slope θ deserves some comment. The existence of a probability distribution of vacancies with different wages implies a spectrum of different labor markets, each of which might exhibit a specific slope of the labor demand function. Various empirical studies in labor economics suggest that the elasticity of labor demand is higher for low skilled labor than for high skilled labor (ELMESKOV, 1993; SNESSENS, 1993; HAMERMESH, 1986; JOHNSON and LAYARD, 1986). However, assuming that the skills of migrants are unobservable immediately after entry, firms view migrants as a pooled group with average skills. Because of asymmetric information, firms therefore offer the same wage to migrants irrespective of their skills, that is the wage offers are related to the migrant's average product (STARK, 1991, p. 196). As the average migrant's product varies depending on factors like a position's endowment with physical capital, payment for a given job differs, while there is an economy-wide identical slope of the labor demand function for migrant labor.

For a linear labor demand curve labor demand becomes more and more inelastic with downward moving market-clearing wages as migration continues. When the sizes of the sending and the receiving country differ, the wage elasticity has to be corrected by a factor of the relative population sizes of the countries.

Every migrant has an opportunity to find a job with a wage w higher than w_1 with probability

$$p(w, t) = \frac{\lambda}{w_1(t)} \cdot e^{-\lambda\left(\frac{w}{w_1(t)}-1\right)}. \tag{3}$$

This formula shows the distribution of vacancies as a function of wage which is assumed subsequently. In a given point of time w is variable while w_1 is constant. As we abstract from transportation costs, only those migrants who obtain jobs with wages $w > C_i$ (i = h, s) stay, while the others return immediately to their home country. Equation (3) has strong implications for the skill-composition of the migrants staying in the country in the long run. Due to the fact that the time span available after entry for searching a job that generates an income above the baseline consumption level is limited for legislative as well as monetary reasons, single migrants are bound to find a job shortly after immigration or to return. Taking into consideration that the baseline expenditures of chain migrants are lower than those of single migrants, single skilled migrants might have to return while unskilled chain migrants might be able to remain in the destination country. Although one period after the migrants´ entry skills become evident so that wages are differentiated accordingly, those migrants who left the country due to an unsuccessful job search are not reached by competitive wage setting any more. To avoid such an outcome, the country of destination, if it cares about the skill level of the migrants who are there to stay, might wish to spend resources in order to preselect migrants according to their skills and, as appropriate, compensate high-skill migrants for the lack of "chain-migration capital" (MARKUSEN, 1988, BECKER, 1990, STRAUBHAAR and ZIMMERMANN, 1991).

Subsequently, the probability that a single and a chain migrant find an employment with a wage higher than the subsistence level is defined by p_s and p_h respectively. Three cases of the wage distribution for vacancies relative to the survival minimum abroad can be distinguished (see figures I-III). In case a) the minimal payment for vacancies exceeds the survival minimum for both single migrants and chain migrants. Thus, both categories of migrants are able to obtain earnings sufficient for survival with probability 1. In case b) the lower border w_1 falls between the survival minimum of a chain migrant and a single migrant, $C_h < w_1 < C_s$. In this case chain migrants always receive an income which exceeds their survival minimum while for single migrants this is only true with a certain probability. In case c) for both categories of migrants there is no guarantee to find a job with an income sufficient to reach the survival minimum,

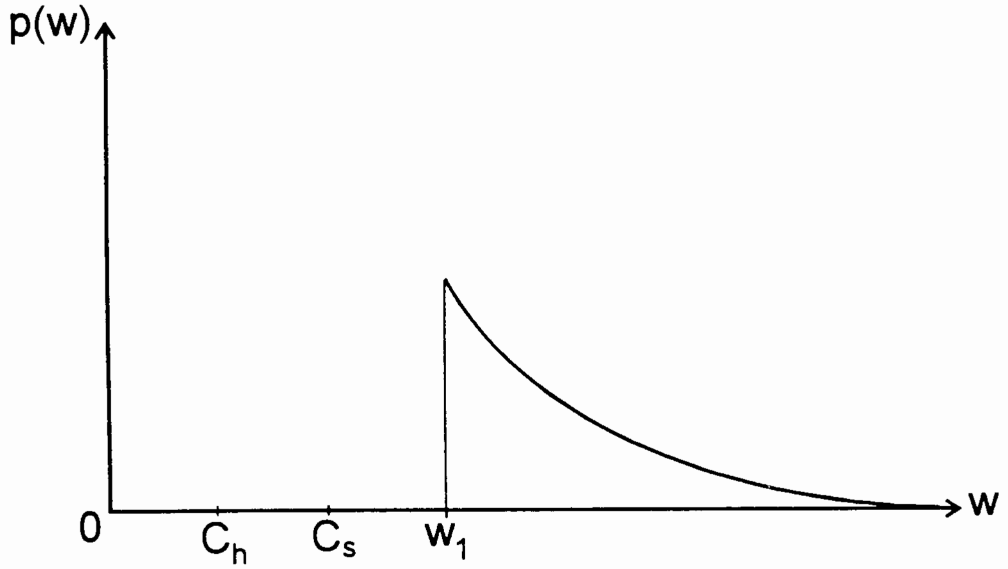

Fig. I: Wage distribution of vacancies available for migrants (case a).

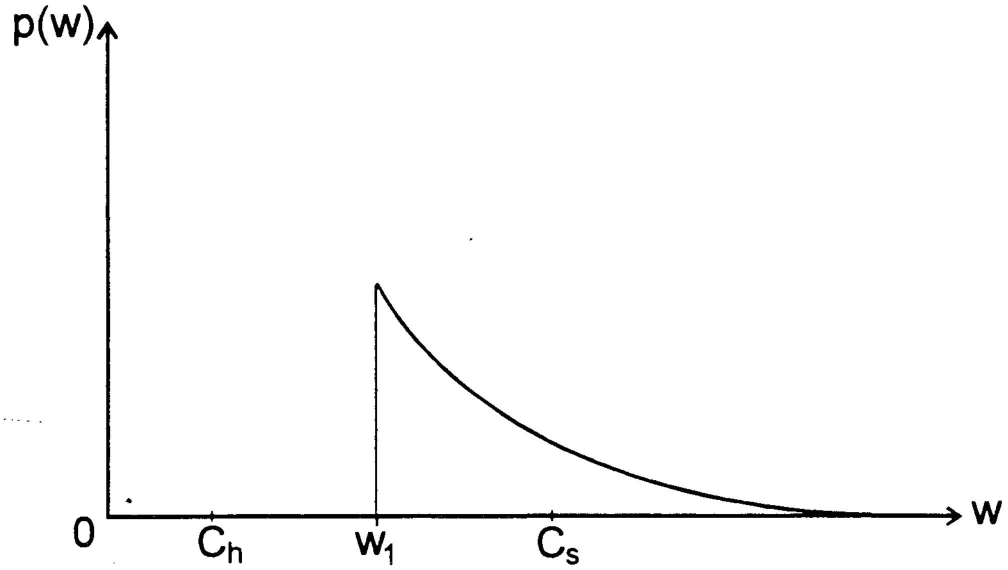

Fig. II: Wage distribution of vacancies available for migrants (case b).

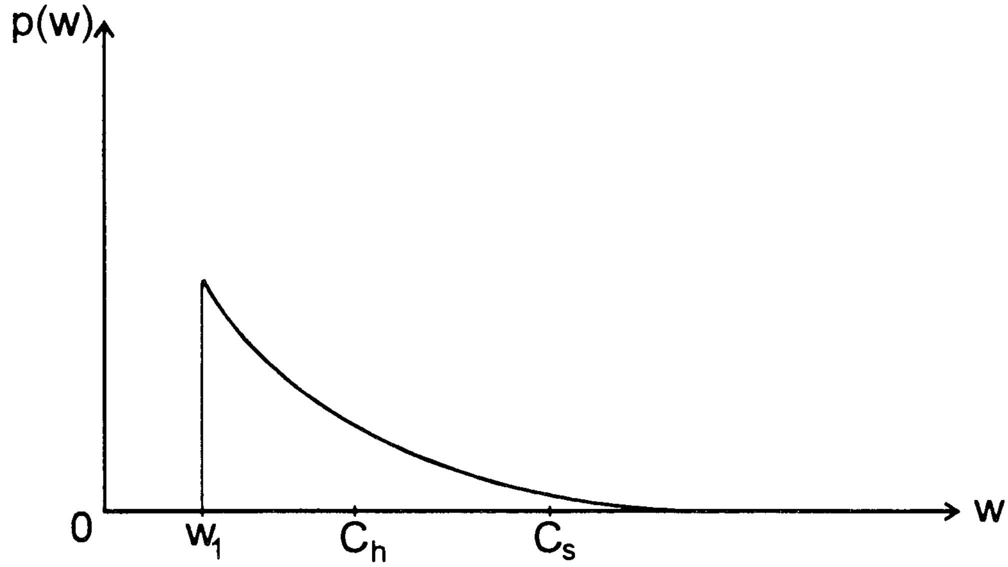

Fig. III: Wage distribution of vacancies available for migrants (case c).

$$a)\quad p_s = 1, \qquad p_h = 1;$$

$$b)\quad p_h = 1, \qquad p_s = \int_{C_s}^{\infty} p(w,t)\,dw = e^{-\lambda\left(\frac{C_s}{w_1} - 1\right)}; \tag{4}$$

$$c)\quad p_h = e^{-\lambda\left(\frac{C_h}{w_1} - 1\right)}, \qquad p_s = e^{-\lambda\left(\frac{C_s}{w_1} - 1\right)}.$$

The ratio of the probabilities to find a job is given by

$$\frac{p_s}{p_h} = e^{-\lambda\frac{(C_s - C_h)}{w_1}}, \tag{5}$$

where λ is a parameter of order 1. The distribution

$$p(w) = e^{-\lambda\left(\frac{w - w_1}{w_1}\right)}, \qquad w \geq w_1 \tag{6}$$

defines how the probability to obtain a job with certain payment decreases with increasing wage. If λ is equal to 1, the probability to get a job with a wage twice higher than the minimal wage is e times less than to receive one with the minimal wage.

As C_s is greater than C_h, for a single migrant the probability to find a job sufficient to maintain the baseline consumption level is less than that for a chain migrant ($p_s < p_h$). Suppose that the ratio p_s/p_h is equal to 0.4. Then the chances for a chain migrant to find a job are 2.5 times higher than those for a single migrant. For the purpose of illustration assume that the number of single and chain migrants offering their work on the labor market is equal. Suppose also that 75% of the chain migrants are able to find a job. Then only 30% ($\triangleq$ 40% of 75%) of the single migrants are able to obtain a job.

By definition, in the first period all migrants are single migrants: n_1 = flow of migrants, $h_1 = 0$ and $(1-h_1) = 1$. h_j is the share of chain migrants in year j. Using formula (5) and equalizing the ratio of the probabilities to the ratio of chain to single migrants, the share of single migrants in the flow of migrants in the second period is proportional to

$$1 - h_2 = \gamma\, e^{-\lambda \frac{(c_s - c_n)}{w_2}} = \gamma\, e^{-\lambda \frac{(c_s - c_n)}{w_{02} + w_L \cdot n_2}}, \qquad \textbf{(7)}$$

where

$$\gamma = h_2 = \frac{1}{1 + e^{-\lambda \frac{(c_s - c_n)}{w_{02} + w_L \cdot n_2}}}. \qquad \textbf{(8)}$$

w_{02} gives the minimal equilibrium wage on the labor market without immigration during the second year while w_2 similarly denotes the minimal equilibrium wage with immigration of n_2 people.

We define:

$$\begin{aligned} m_{h,k} &\sim \text{flow of chain migrants in year } k, \\ m_{s,k} &\sim \text{flow of single migrants in year } k. \end{aligned} \qquad \textbf{(9)}$$

These flows of potential migrants are a result of the push and pull factors which will be outlined subsequently. Formula (10),

$$p_h \cdot m_{l,k} \qquad \textbf{(10)}$$

denotes the inflow of chain migrants who do not have to return immediately because their earnings exceed the survival minimum. Similarly,

$$p_s \cdot m_{s,k} \tag{11}$$

gives the inflow of single migrants staying in the destination country. The share of single migrants to chain migrants during the second year is expressed by

$$1 - h_2 = \frac{p_s \cdot m_{s,k}}{p_h \cdot m_{h,k}}. \tag{12}$$

For the stock of migrants in year k we have

$$n_k = p_s \cdot m_{s,k} + p_h \cdot m_{s,k}. \tag{13}$$

First, the pull mechanism to be introduced is denoted by parameter β in

$$m_{h,k} = \beta N_F. \tag{14}$$

β describes the average pull capacity of a migrant already residing abroad, that is how many additional migrants are attracted by this migrant from the home country per year on average. In formula (14) N_F is the stock of foreign population in the country of destination which is given by the sum of net migrant inflows in all previous years:

$$N_F = \sum_{j=1}^{K} n_j. \tag{15}$$

The push mechanism is summarized by formula (16),

$$m_{s,k} = \alpha N_H. \tag{16}$$

α is the share of potential migrants among the people without a network abroad, that is the constant share of persons in any source country deciding to migrate per year because of exogenously given push factors such as poor living conditions, relatively high wages abroad, ethnical and political conflicts etc. In general, equation (16) can be replaced by a slightly more complicated expression,

$$m_{s,k} = \alpha(t)\,(N_H - N_F - \beta\, N_F)\,. \tag{17}$$

This expression covers two aspects of the migration process: the evolution of the push factor α as time passes and the decreasing number of the home population due to former migration which is corrected by the number of those who are induced to migrate anyway because of the pull factor. For simplicity, subsequently formula (16) will be employed. This decision is formally justifiable if $N_F \ll N_H$. For case c)[2] the following formula which describes the dynamics of the inflow of migrants can be obtained,

$$n_k = \alpha\, N_H\, e^{-\lambda\left(\frac{c_s}{w_{1,k}} - 1\right)} + \beta\, N_{F,k}\, e^{-\lambda\left(\frac{c_n}{w_{1,k}} - 1\right)}. \tag{18}$$

In the case of a constant slope of the labor demand function the wage decreases according to the following formula:

$$w_{1,k} = w_0 - \theta \cdot N_{F,k}\,. \tag{19}$$

While the function n_k shows the flow, $N_{F,k}$ represents the stock of the foreign population in the destination country. Every year the stock of migrants changes according to

$$N_{F,k+1} = N_{F,k} + n_{k+1}\,. \tag{20}$$

The total inflow of migrants consists of single migrants and of chain migrants. The share of single migrants l_k is given by

Formulae (18)-(21) show the dynamics of migration in discrete time. While N_F changes from one period to the next, all other parameters are held

2 cf. page 11.

$$I_k = \frac{\alpha N_H e^{-\lambda \frac{c_s}{w_{1,k}}}}{\alpha N_H e^{-\lambda \frac{c_s}{w_{1,k}}} + \beta N_{F,k} e^{-\lambda \frac{c_h}{w_{1,k}}}}. \tag{21}$$

constant. The transformation of the discrete time model into a continuous time model is achieved by a standard limiting procedure. In continuous time the dynamic process of migration is described by the following differential equation,

$$\frac{dN_F(t)}{dt} = \alpha N_H e^{\lambda - \lambda \frac{c_s}{w_0 - \theta \cdot N_F(t)}} + \beta N_F(t) \cdot e^{\lambda - \lambda \frac{c_h}{w_0 - \theta \cdot N_F(t)}}. \tag{22}$$

This equation expresses the dynamics of the foreign population in the destination country as a function of time and different parameters. The first term of the right hand side of the equation represents the push mechanism while the second term represents the pull mechanism. In order to solve differential equation (22) we proceed as follows. After the transformation

$$N_F - \frac{w_0}{\theta} = -\frac{1}{y}, \tag{23}$$

where y is a new variable, equation (22) can be solved. The variables t and y can now be separated, and the solution can be found as an inverse function analytically. The solution has the form of an indefinite integral,

$$t(y) = \int_{\frac{\theta}{w_0}}^{y} \frac{dy_1}{\alpha N_H y_1^2 e^{-\lambda c_s \theta y_1 + \lambda} + \beta \left(\frac{w_0}{\theta} y_1^2 - y_1 \right) e^{-\lambda c_h \theta y_1 + \lambda}}. \tag{24}$$

This integral can be calculated numerically for any set of parameters. The solution gives the relationship between time and the stock of immigrants. In the subsequent chapter various numerical experiments depict the effects of different sets of parameters on the inflow of migrants, the equilibrium wage and the share of single migrants in the inflow. The rather large number of free parameters (C_h, C_s, λ, θ, N_H, α, β) requires to determine some of them in advance in order to isolate the effects of parameter changes on the endogenous variables.

If we normalize N_H to 1, then N_F denotes the stock of migrants as a percentage of the total home population. C_h is also set to 1 supposing that a chain migrant can initially ($t = 0$) find a work with $w > C_h$ with probability 1. On the contrary, this is not the case for a single migrant. In the case $C_s > w_{min}$ the single migrant can only obtain an income below the survival minimum with the consequence of immediate return home. With a growing number of immigrants, the wage will be affected negatively. Hence, chain migrants might also face the necessity to return home.

Parameter α measures the strength of the push mechanism. It expresses the share of the population in the home country that migrates per unit of time (for example within one year). These migrants are assumed to have no links abroad. Parameter β represents the strength of the pull mechanism, that is how many persons per year on average each migrant will be able to attract after immigration. In the simulations we define $\alpha = 0.05$ and $\beta = 0.5$. For figures 4-6 we have $C_s = 1.5$ and $\theta = 1$ or $\theta = 2$. Thus, the influence of the wage elasticity on the dynamics of migration and the relative difficulty for a single person to migrate can be studied.

2.3 Numerical experiments

The main results of the numerical experiments are depicted in figures 4-10. For figures 4-6 the following set of parameters was selected: $C_h = 1$, $C_s = 1.5$, $\lambda = 1$, $N_H = 1$, $\alpha = 0.05$, $\beta = 0.5$.

For figure 4 a dominant influence of the wage elasticity on the dynamics of migration is registered. If labor demand is inelastic, two effects occur: First, entering the labor market becomes more difficult for a migrant initially. Second, a smaller number of chains emerges, the total pull capacity of chain migrants is reduced and, thus, the total migration flow decreases significantly.

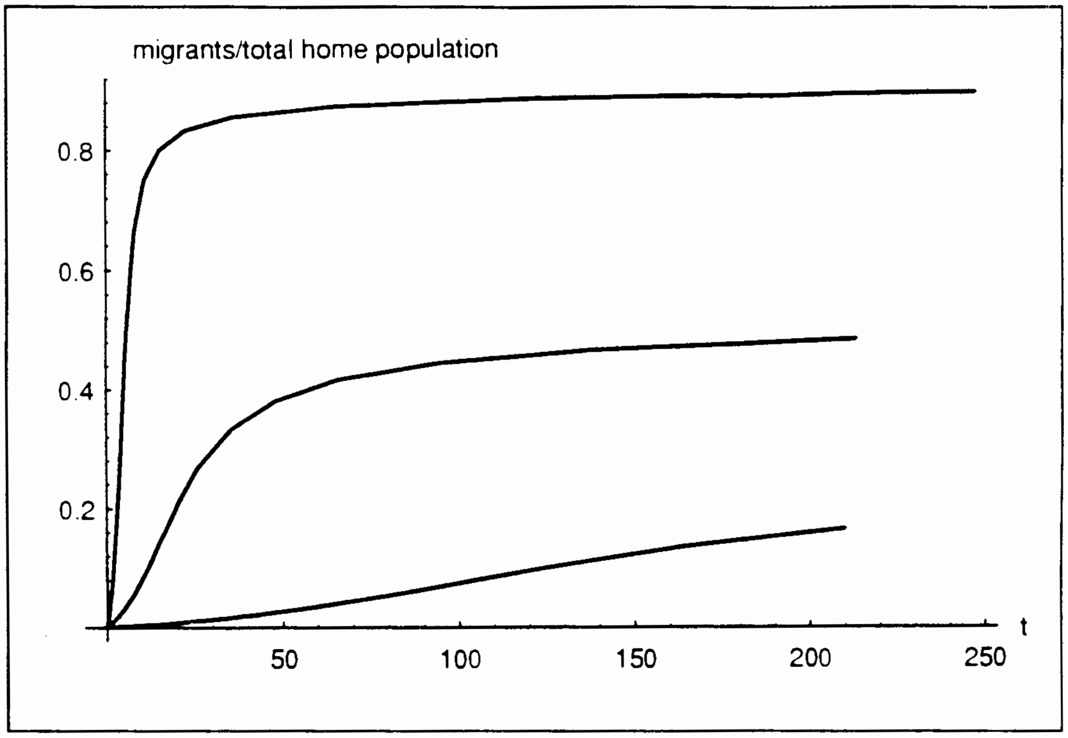

Figure 4: Dynamics of migration for different θ. Upper curve corresponds to $\theta = 1$, middle to $\theta = 1.5$, lower to $\theta = 2$.

Figure 5 shows the wage dynamics for different values of θ. The more inelastic labor demand is the smaller is the decline in the wage level due to migration. This effect occurs because with inelastic labor demand it is more difficult to find a job that generates enough income to secure the baseline consumption level. This implies that a newly arriving immigrant may find himself or herself unemployed with the consequence of immediate return as no immigrant accepts a wage below minimal living costs. In this model a relatively inelastic labor demand acts as an effective regulator for immigration. However, in the destination country there might be vacancies with wages below the survival minimum which natives might be able to accept. The reason is that their income might be supplemented by other sources (for example by monetary transfers as well as by transfers in kind from spouses, parents, other relatives etc.).

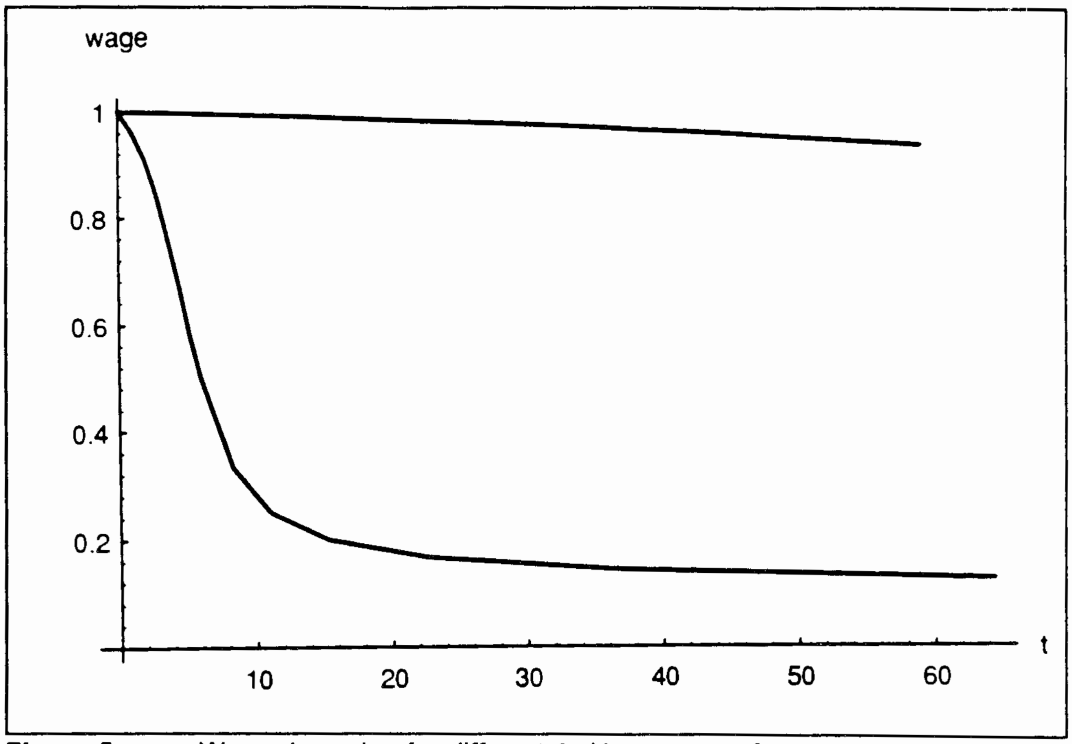

Figure 5: Wage dynamics for different θ. Upper curve for $\theta = 2$, lower curve for $\theta = 1$.

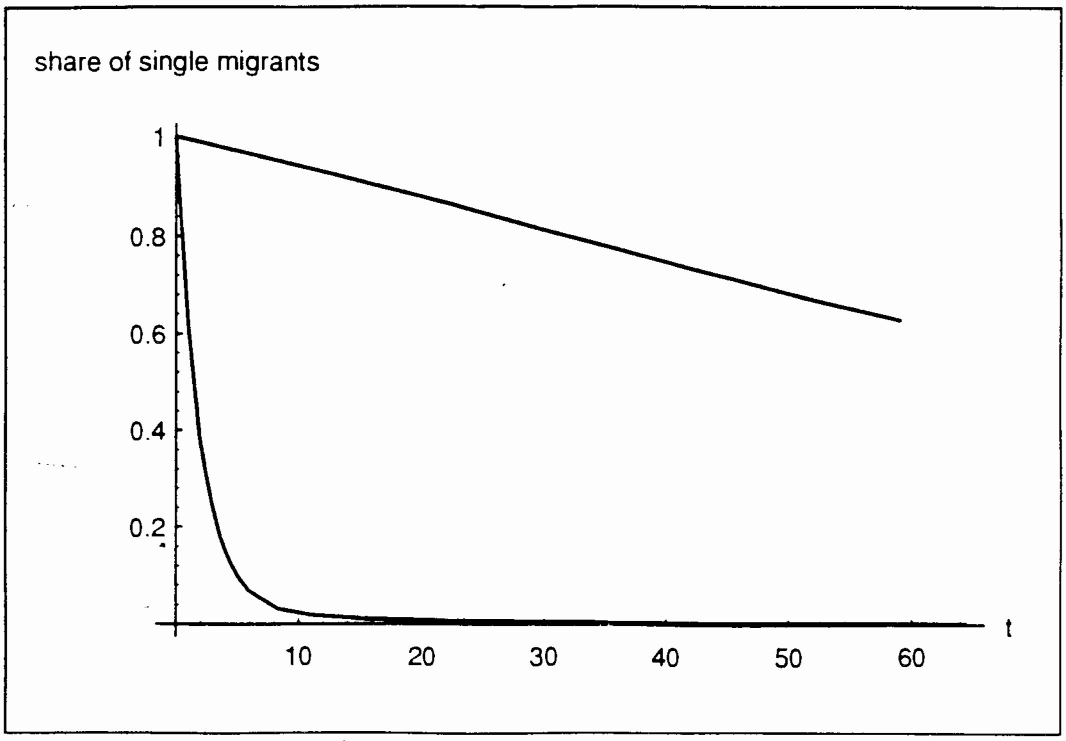

Figure 6: Dynamics of the share of single migrants in the total immigration flow for different θ: upper curve for $\theta = 2$, lower curve for $\theta = 1$.

For figures 6-9 the parameters α, β, λ, C_h, N_H are as before but θ and C_s are changed. Figure 6 reveals the dynamics of the share of single migrants in the annual inflow of total migrants. For high θ ($\theta = 2$) the share of single migrants remains relatively high while for low θ ($\theta = 1$) it reaches almost 0 during the first few years. In this case immigrants without chains cannot enter the foreign labor market. The host country may lose potential welfare gains because of this process as some of the single immigrants might have higher skills than the native-born population which makes them more productive.

Figures 7-9 show how the change of living costs of single migrants affects the inflow of new migrants, thereby influencing the equilibrium wages over time. In addition, the costs of living affect the share of single migrants in the total inflow of migrants as well. By definition, migrants from a country that opens its borders for emigration are single migrants in the first period. These migrants therefore face a disadvantage in comparison to migrants from countries with an emigration history.

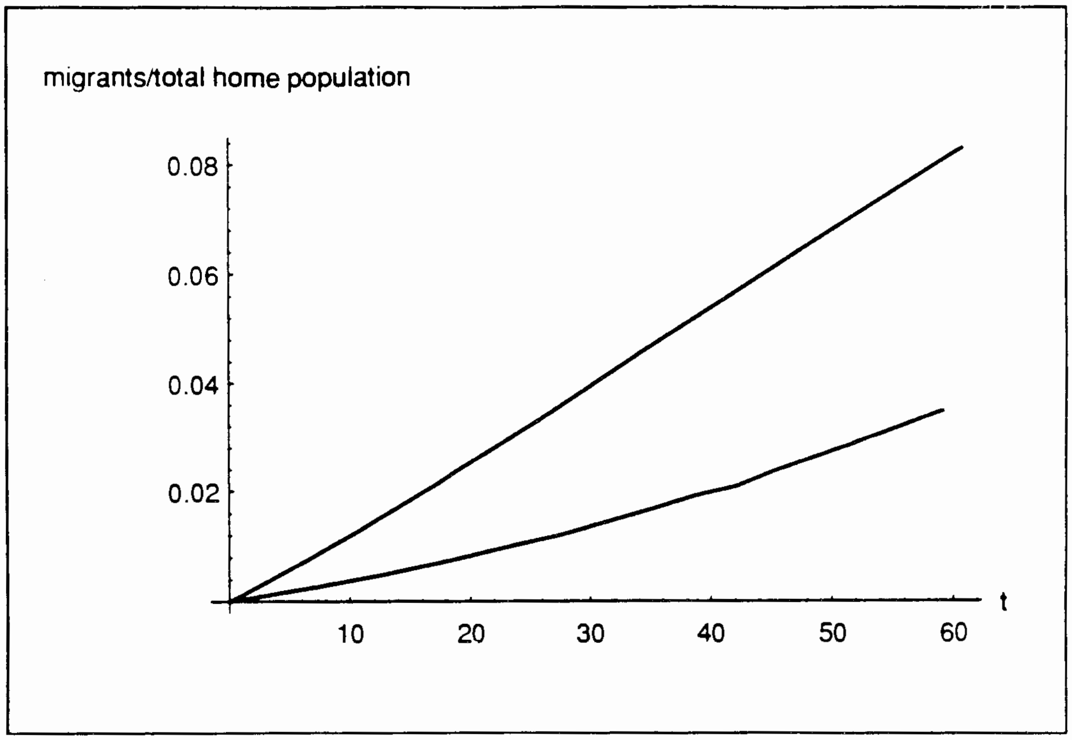

Figure 7: Dynamics of migration for different C_s and $\theta = 2$. Upper curve for $C_s = 1.2$, lower curve for $C_s = 1.5$.

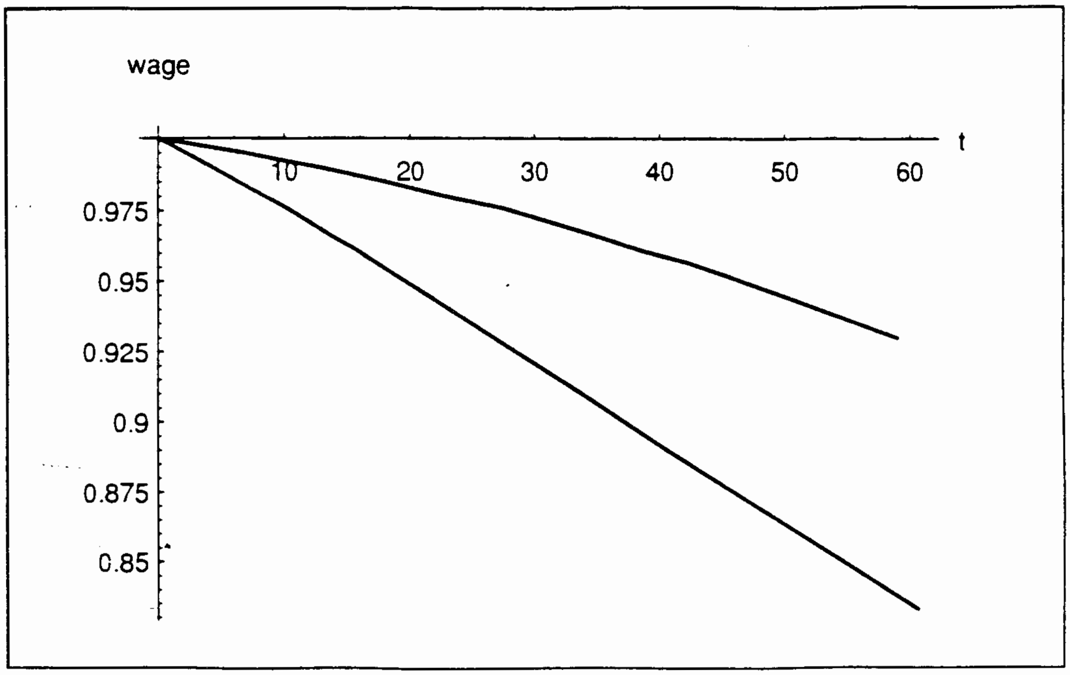

Figure 8: Wage dynamics for different C_s, $\theta = 2$.
Upper curve for $C_s = 1.5$, lower curve for $C_s = 1.2$.

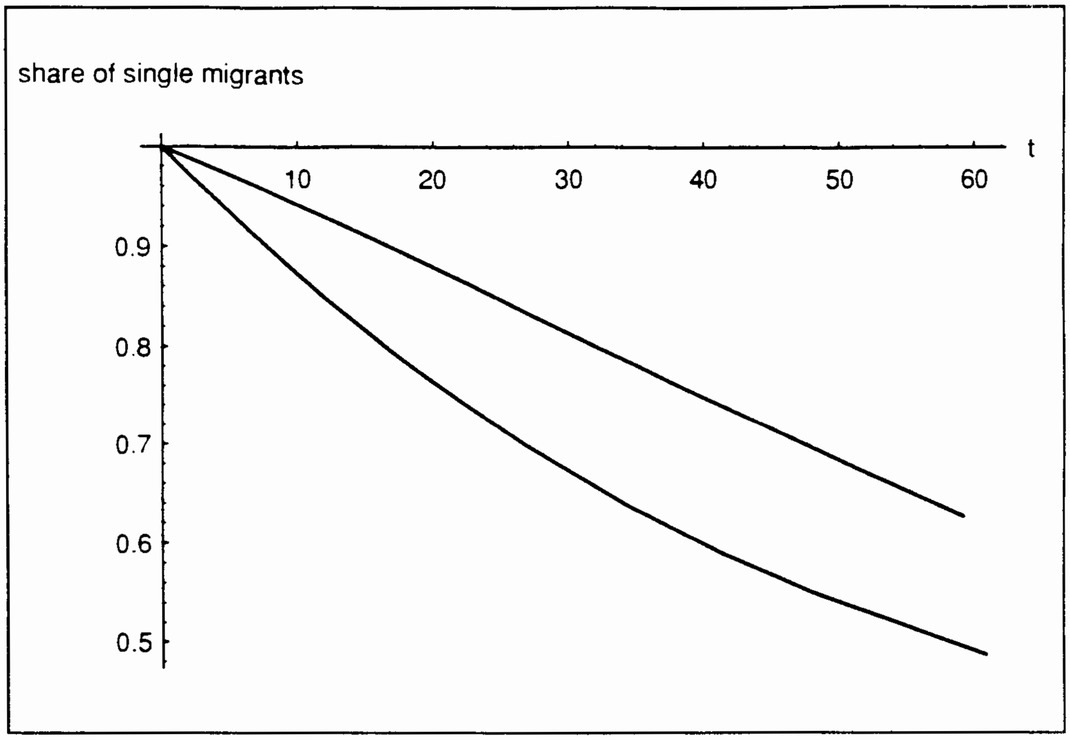

Figure 9: Dynamics of the share of single migrants ($\theta = 2$).
Upper curve for $C_s = 1.5$, lower curve for $C_s = 1.2$.

Figure 10 demonstrates the development of the share of single migrants if the intensity of the push factors increases, while that of the pull factors decreases. In this case the share of single migrants is higher than in the original case.

Figure 11 compares the case of pure single migration with the case of single combined with chain migration. The dynamics of migration evolves for the parameters $C_h = 1$, $C_s = 1.5$, $\alpha = 0.1$ and $\lambda = 1$. For the upper curve $\beta = 0.2$, for the lower curve $\beta = 0$. This implies that the pull mechanism is not effective in the second case, that is all migration is single migration. It appears that even for single migration the dynamics is non-linear because of the diminishing equilibrium wage. As time passes, the difference between both paths becomes more and more pronounced.

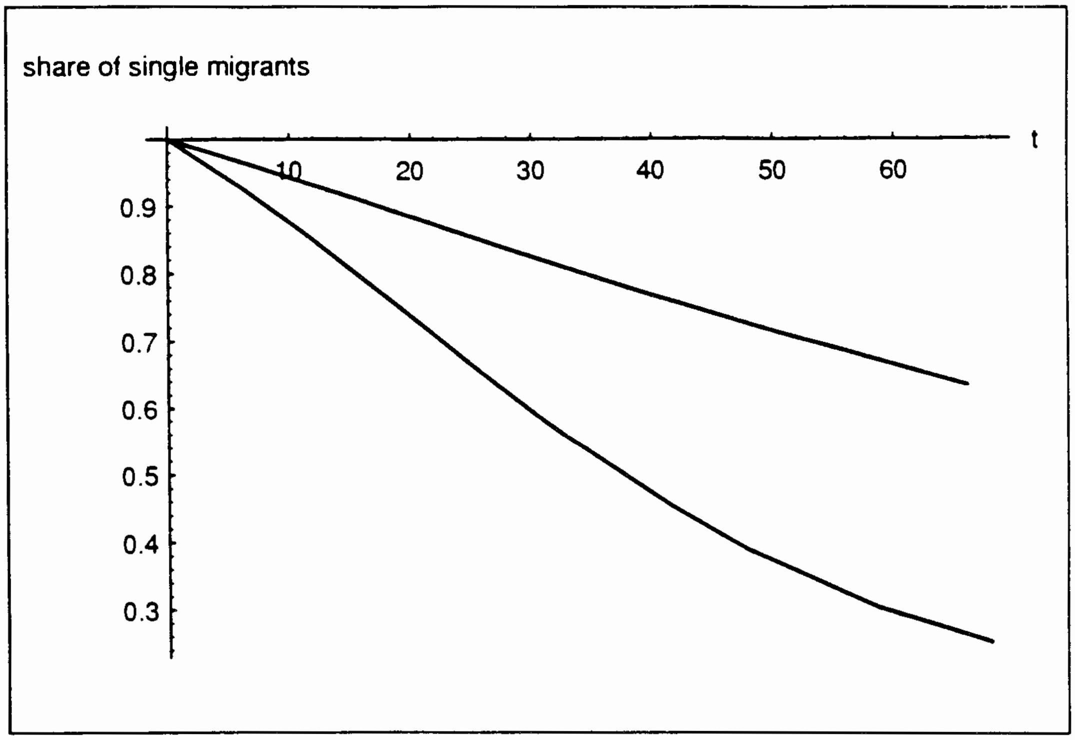

Figure 10: Share of single migrants as a function of time. Upper curve for $\alpha = 0.1$, $\beta = 0.5$, lower curve for $\alpha = 0.05$, $\beta = 1$.

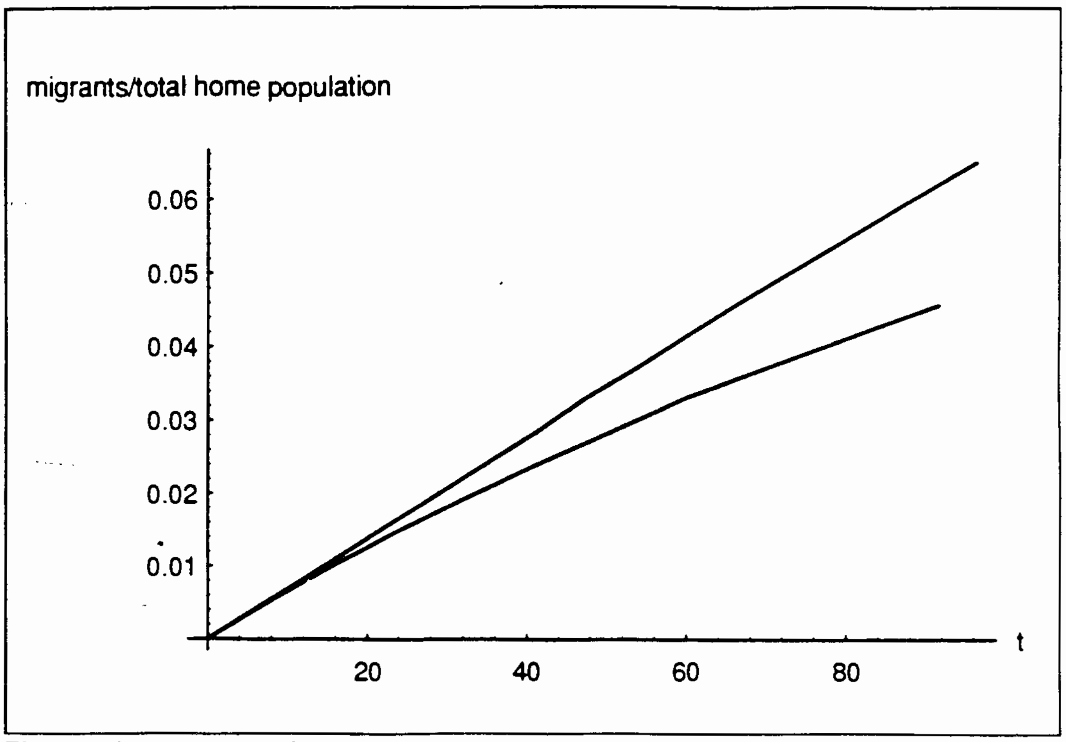

Figure 11: Comparison of two cases: Single migration versus single combined with chain migration. Upper curve for β = 0.2, lower curve for β = 0.

3 The dynamics of migration: a three-country model

3.1 The case of two sending countries and one receiving country

In the case of several *receiving* countries the results of the previous section remain valid if the overall push mechanism can be decomposed in country-specific push factors. The pull factors are approximately the same across various receiving countries as they are mainly dependent on cultural and ethnic traditions of the population of a given sending country. That is to say, the probability to migrate successfully is dependent on the culturally and ethnically determined pattern of behavior of the network abroad. In contrast to this, the analytical part of the model as presented above cannot be generalized to account for the case of several *sending* countries. In the case of more than one sending country there exists a non-linear interaction between the inflows from different sending countries with respect to their labor market effects. Thus, it is necessary to extend the analysis of the previous section in order to study the dynamics of labor migration for the case of two-sending countries as well.

Subsequently, we will relax the assumption that the labor demand curve exhibits a constant negative slope. Instead of a linear approximation of the labor demand curve, we will employ a constant elasticity labor demand curve. From the definition of elasticities we have

$$\frac{dw}{dL} = -\varepsilon \frac{w}{L} \qquad (25)$$

The working force is treated as being equal to the total population except for a rescaling parameter. For this to hold, two assumptions are necessary. First, job participation rates are identical across countries. Second, the ratio of non-participants to participants as assumed before is maintained in the group of migrants, too. The parameters α and β show the push and the pull mechanism respectively for the labor force only, that is the non-participating children of migrants are not included in parameter β, while adult relatives are covered thereby. The pull capacity of non-labor migrants is assumed to be zero.

We now introduce the following notations:

N_N ~ Native labor of the immigration country
N_F^A ~ Stock of foreign labor originating in country A, resident in the immigration country
N_F^B ~ Stock of foreign labor originating in country B, resident in the immigration country
N_H^A ~ Native labor in country A
N_H^B ~ Native labor in country B
α_A ~ Push factor for country A
α_B ~ Push factor for country B
β_A ~ Pull factor for country A
β_B ~ Pull factor for country B
C_h^A ~ Subsistence minimum of chain migrants from country A
C_h^B ~ Subsistence minimum of chain migrants from country B
C_s^A ~ Subsistence minimum of single migrants from country A
C_s^B ~ Subsistence minimum of single migrants from country B

The total labor force is the sum of the native and the foreign labor force,

$$L = N_N + N_F^A + N_F^B \qquad \textbf{(26)}$$

Then, at any time the equilibrium wage is given by

$$w(t) = \left(1 + \frac{N_F^A(t) + N_F^B(t)}{N_N}\right)^{-\varepsilon} \tag{27}$$

Implementing the pull and push mechanisms as before, we can write equation (27) similar to (22). As an analytic solution of the system of non-linear differential equations is unlikely to be obtained, we write this equation in the form of differences in order to prepare the application of numerical methods, that is

$$\Delta N_F^A(t) = \alpha_A N_H^A e^{-\lambda\left(\frac{C_S^A}{w(t)} - 1\right)} + \beta_A N_F^A(t) e^{-\lambda\left(\frac{C_n^A}{w(t)} - 1\right)} \tag{28}$$

$$\Delta N_F^B(t) = \alpha_B N_H^B e^{-\lambda\left(\frac{C_S^B}{w(t)} - 1\right)} + \beta_B N_F^B(t) e^{-\lambda\left(\frac{C_n^B}{w(t)} - 1\right)} \tag{29}$$

The annual inflow of migrants from country A and country B depends on the point of time, the wage, and the stock of migrants who are already resident in the immigration country. The stock of migrants in the next period is then given by

$$N_F^A(t+1) = N_F^A(t) + \Delta N_F^A(t) \tag{30}$$

$$N_F^B(t+1) = N_F^B(t) + \Delta N_F^B(t) \tag{31}$$

Numerical solutions for the system (27)-(31) are presented in chapter 3.2.

3.2 Numerical Experiments

In the case of the three-country model two groups of different types of numerical experiments are provided. The first group is based on the assumption that all parameters except for one have identical numerical values for both sending countries (A, B). Merely the initial stock of the foreign population in the receiving country differs. We assume that initially $N_F^A \neq 0$, while $N_F^B = 0$. Due to the reasons described above, this gives migrants originating from country A a comparative advantage in migration vis-à-vis migrants from country B.

In order to keep the influence of the natural population growth of the foreign population in the destination country on the wages at a minimum, we choose a period of 20 years for the simulations as we assume that the newly born will not enter the labor market before that age.

According to DE NEW and ZIMMERMANN (1993), a 1%-point increase from 8.5% to 9.5% in the share of foreigners reduces wages across the board by 4.1 %. Hence, we have the following set of parameters: $\varepsilon = 4$, the initial share of migrants $N_F^A = 0.5\%$ and $N_F^B = 0$. For α we use values between 0.5% and 1%, for β we use 10%, 20% and 40%. To illustrate, $\alpha_A = 1\%$ implies that each year 1% of the population of country A tries to enter the labor market of the destination country. However, not all of the immigrants are successful to find a job with a sufficiently high wage. For this reason, some of them return home. $\beta_A = 10\%$ means that every migrant from country A attempts to attract an additional migrant in every 10 years on average. Similarly as before, with some probability the migrant's job search is successful.

The results of four experiments will be described below. Each consecutive experiment differs from the previous one by the variation of only one parameter. Initially, $\alpha_A = \alpha_B = 0.01$ and $\beta_A = \beta_B = 0.2$. All three countries are of equal population size, that is $N_N = N_H^A = N_H^B = 1$. The subsistence minima for single migrants are $C_s^A = C_s^B = 1.5$, while for chain migrants they are $C_h^A = C_h^B = 1$. For λ we have 5, while ε is equal to 4.

The initial wage is of order 1. Within the simulation period the wage decreases by approximately 24% due to immigration. This result is not surprising because the models abstract from any wage increasing effects due to productivity gains. Therefore the labor demand curve is fixed in time, so that only short run labor market effects are analyzed. At any point of time a number of vacancies exists, though with rather low wages which are not accepted by natives. For this reason there is always a positive inflow of migrants and the derivative of wage towards time is always negative.

In case 1 the share of the population in the destination country originating from country A increases from 0.5% to 5.1% within 20 years, while the share of migrants from country B rises from 0% to 1.9% only. The cumulated inflow from B after 20 years reaches approximately 41% of the inflow of A due to the disadvantage in the starting conditions.

In case 2 the living costs of chain migrants are shifted from 1.0 to 1.2. This leads to a decrease of the relative advantage of country A vis-à-vis country B. Now the cumulative inflow for country A (B) is 1.98% (1.32%). Hence, the inflow for country B amounts up to 65% of A which is greater than in the previous case. The wage decreases by 14%.

The push mechanism is half the value as before in case 3, $\alpha_A = \alpha_B = 0.005$. After 20 years the share of the foreign population from country A is 2.1%

and from country B it is 0.8% of the native population. While the parameter α has been halved in value, the total inflow from both countries together is more than half (2.4% of the native population) of the previous case (3.3%).

In case 4 the pull mechanism becomes stronger for both countries (0.4). At the end of the simulation period N_F^A = 3.5% and N_F^B = 1.0%. During this period migration from country B reaches only one third of that from country A. The wage decreases by 17%.

Subsequently, the second type of numerical experiments has the aim to examine to what extent the migration dynamics is affected by differences in the push and pull mechanisms across countries. Initially, there is no foreign population in the destination country at all. In case 5 the push factors are identical for both countries, $\alpha_A = \alpha_B = 0.005$, but the pull factors

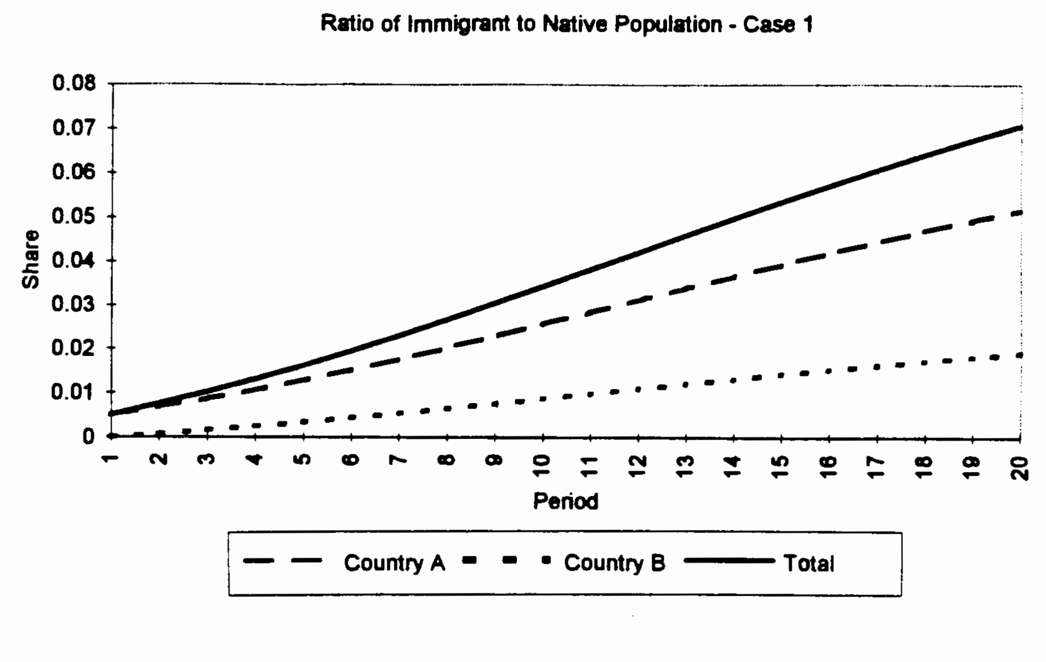

Figure 12 : Ratio of immigrant to native population for initial values $N_F^A = 0.5$ and $N_F^B = 0$.

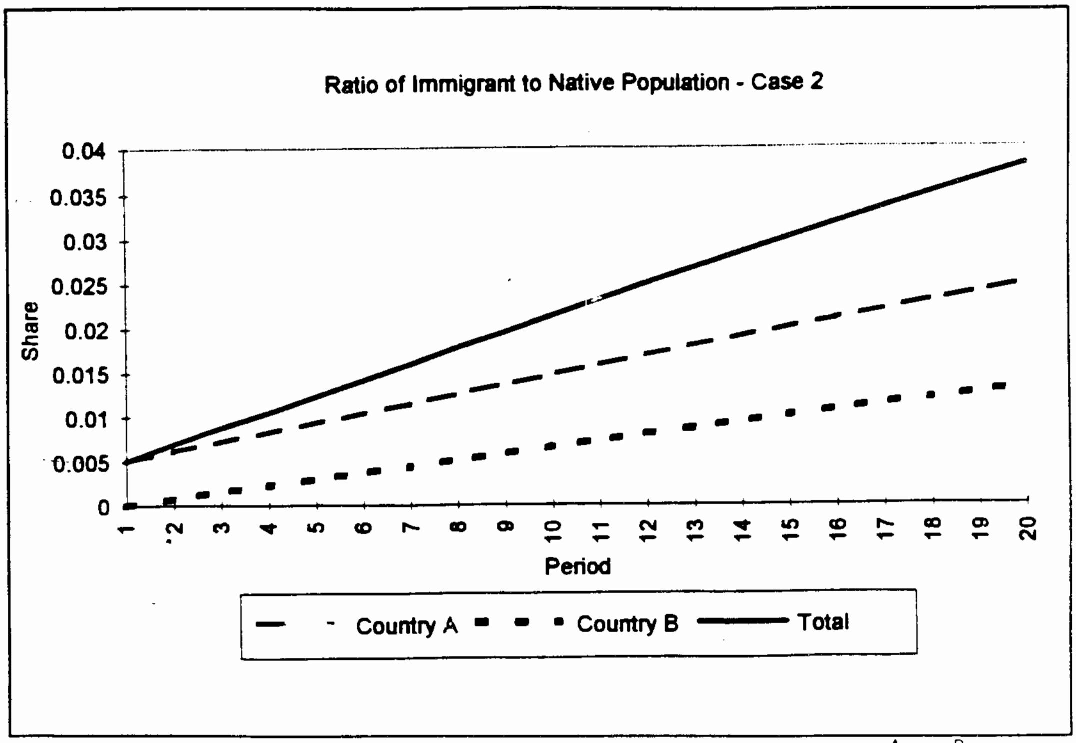

Figure 13 : Ratio of immigrant to native population for initial values $C_h^A = C_h^B = 1.2$.

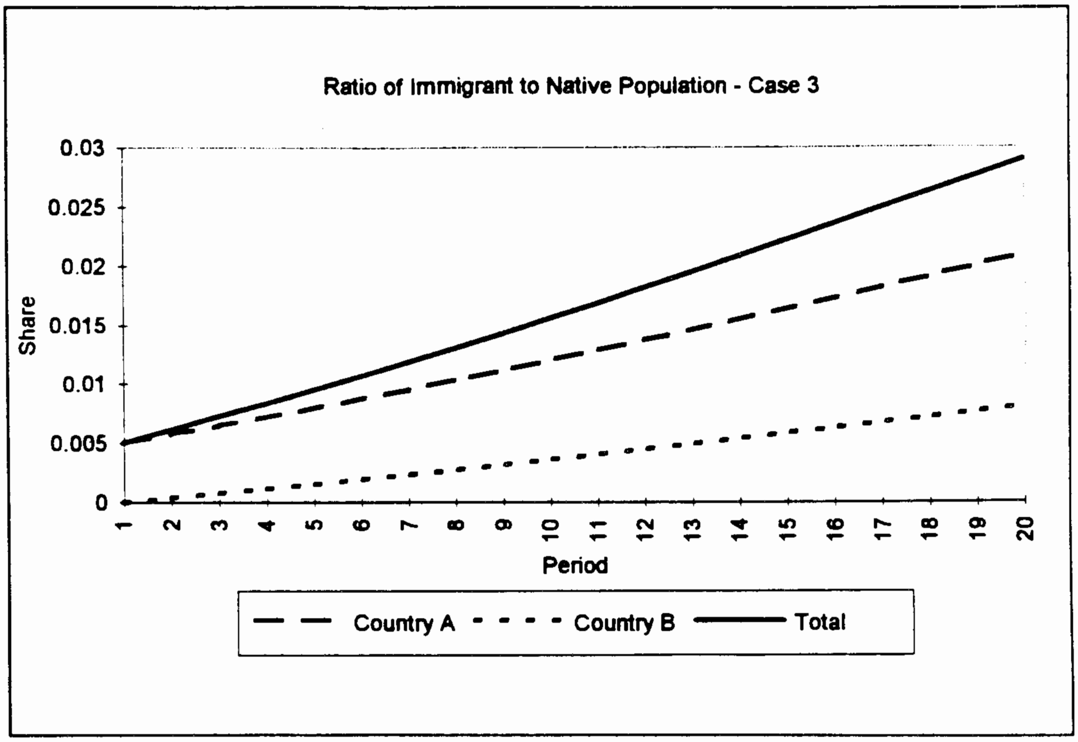

Figure 14: Ratio of immigrant to native population for initial values $\alpha_A = \alpha_B = 0.005$.

differ, $\beta_A = 0.1$, $\beta_B = 0.4$. The other parameters are as before, $N_N = N_H^A = N_H^B = 1$, $C_s^A = C_s^B = 1.5$, $C_h^A = C_h^B = 1$, $\lambda = 5$, $\varepsilon = 4$. Figure 16 illustrates the dynamics. Annual migration inflows, while being identical initially, differ more and more as time passes. After 20 years immigrants from country A amount to only 0.83% of the population of natives, while immigrants from country B account for 6.86%. Hence, the final share of immigrants from country B exceeds that of immigrants from country A eight times, while the ratio of the intensities of the pull factors is only four.

Case 6 compares the relative significance of the pull and push mechanisms. Here $\alpha_A = 0.01$, $\alpha_B = 0.005$ and $\beta_A = 0.2$, $\beta_B = 0.4$, that is, for country A the push mechanism is twice stronger than for country B, while for country B the pull mechanism is twice stronger than for country A. This system evolves in the following way. During the initial periods the inflow of migrants from country A prevails. However, as the inflow from country B

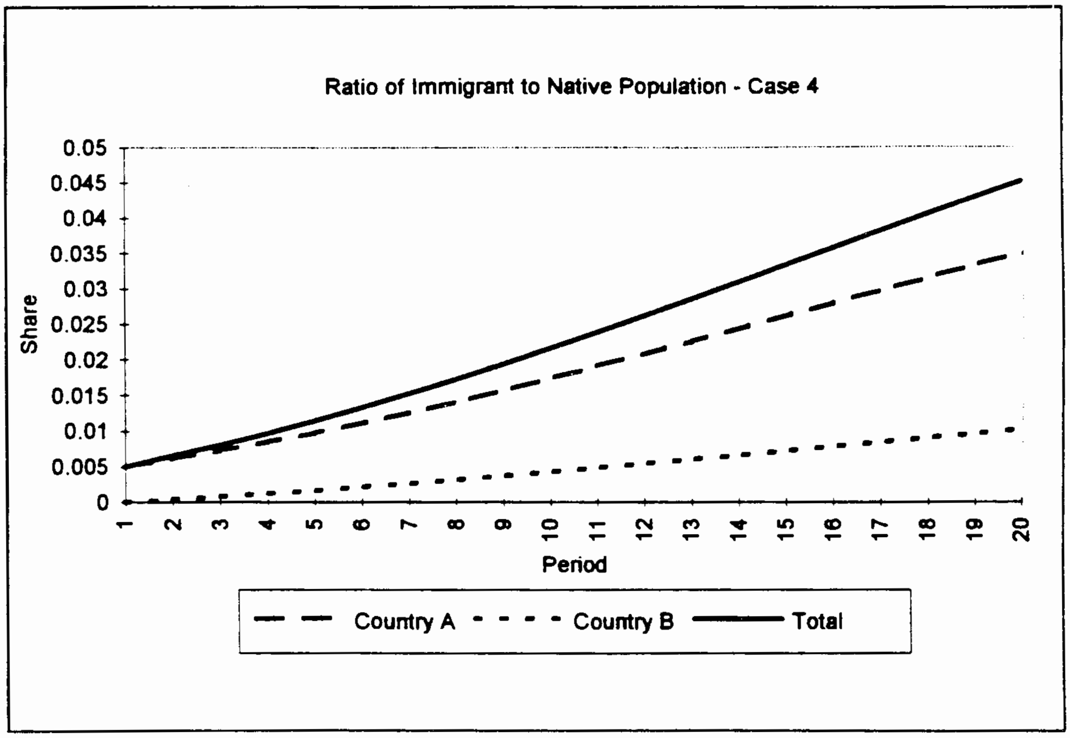

Figure 15 : Ratio of immigrant to native population for initial values $\beta_A = \beta_B = 0.4$.

increases faster after some point of time, in the ninth year the shares of both groups of migrants are of equal size (about 1% for each country) and subsequently the share of immigrants from country B is larger than that of country A. After 20 years, the share from B is 5.2%, while from A it is 2.7%. This example demonstrates the dominating significance of the push mechanism in the short run and of the pull mechanism in the long run.

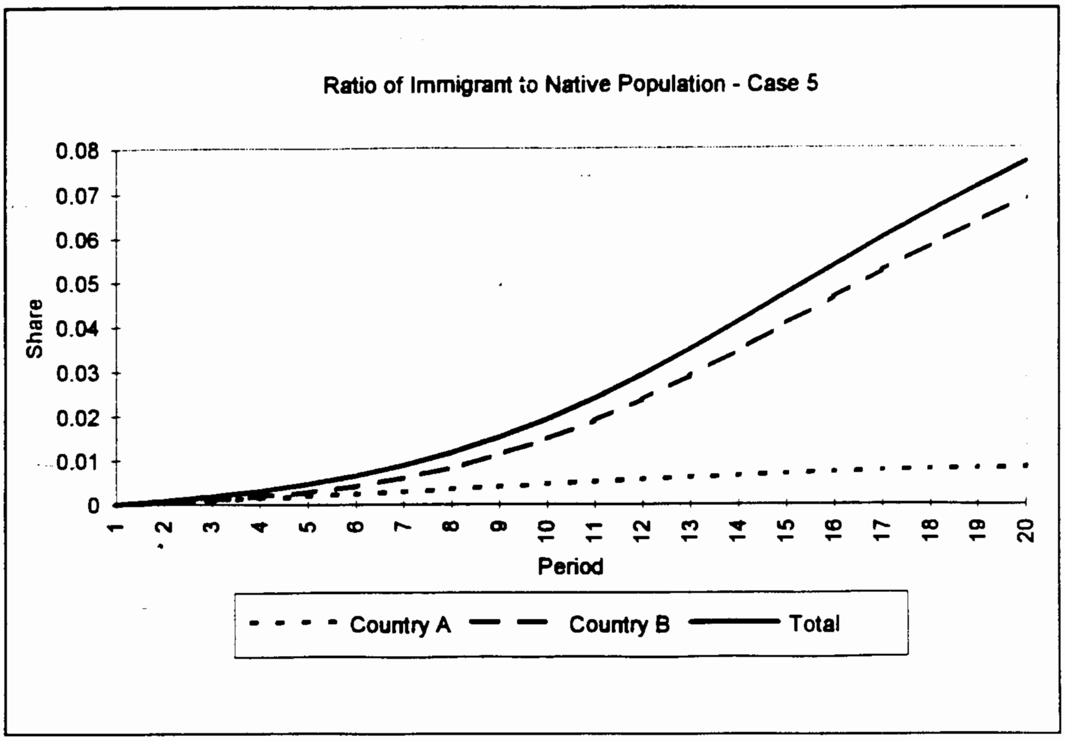

Figure 16: Ratio of immigrant to native population for $\alpha_A = \alpha_B = 0.005$, $\beta_A = 0.1$, $\beta_B = 0.4$.

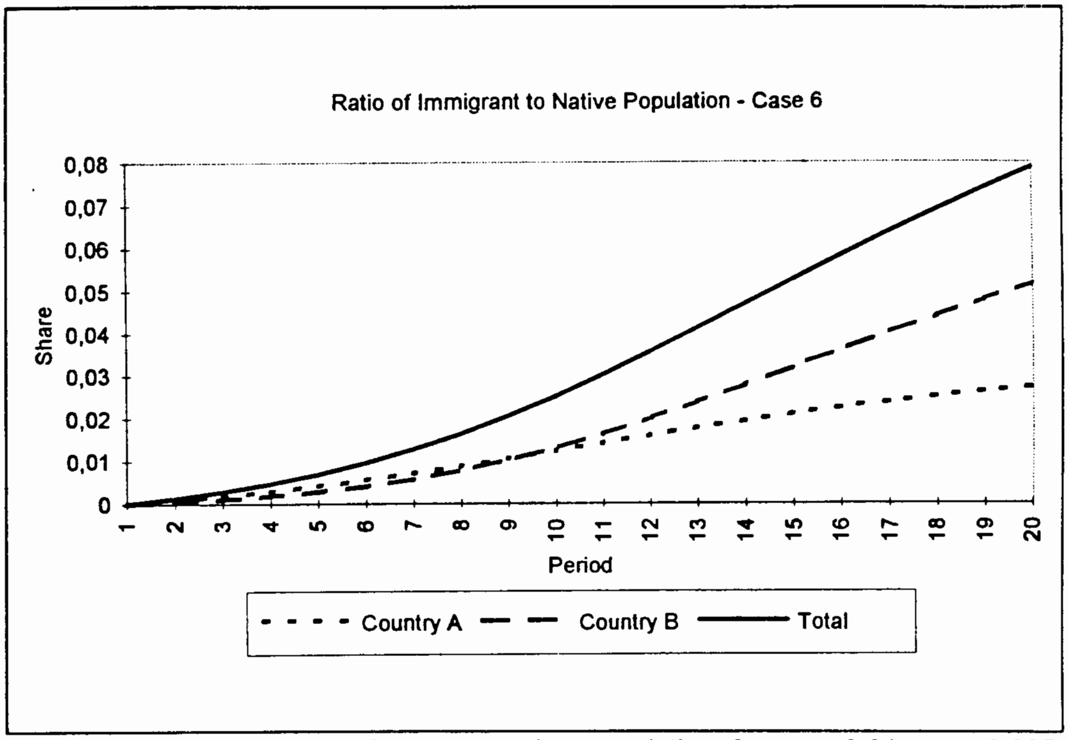

Figure 17: Ratio of immigrant to native population for $\alpha_A = 0.01$, $\alpha_B = 0.005$, $\beta_A = 0.2$, $\beta_B = 0.4$.

4 Policy Implications

Being featured by a positive approach to the issue of chain migration, the foregoing analysis abstains from any evaluation of the welfare implications of migration flows. Instead, the above calculations appear to have strong policy implications by suggesting a menu of options how to influence migration flows as well as by assessing their effectiveness.

Subsequently, we will briefly discuss three different policy measures: Legislation on family unification, immigration taxes, and measures to improve the living conditions in the countries of origin.

a. Legislation on family unification

Figure 16 reveals the non-linear interaction between immigration flows due to their labor market effects and the existence of chains. While the ratio of the intensities of the pull factors is only four, the final share of the immigrants from country B exceeds that of the immigrants from country A eight times. Now assume that there is a *temporary* occurence of a comparative advantage in the pull capacity of migrants from a certain country. This will lead to a *persistently* higher inflow of migrants from that country, even after the higher pull capacity has been removed again. Thus, our model demonstrates that the innocuous assumption of the existence of chains gives rise to the complex phenomenon of hysteresis in migration flows.

Also note that the existence of some stock of migrants abroad gives individuals from certain countries of origin or a specific ethnical group a comparative advantage relative to individuals from other countries or ethnical groups in migrating as they can rely on their network abroad (cf.

figure 12). Moreover, recall that the difference in the pull capacities for countries A and B for the same initial stock of immigrants abroad ($N_F^A = N_F^B$) strongly influences the dynamics of migration (figure 16). Thus, it becomes apparent that migration policy is not an apt area for a policy based on the trial and error principle. This calls for the formulation of a thoroughly and comprehensively designed immigration policy. If applied to the legislation on family unification, these findings suggest that the room for legislative manoeuvring, that is whether to employ a narrow or a broad definition of 'family', plays a crucial role in influencing the pull capacity of each migrant and therefore shapes the dynamic pattern of immigration accordingly (for family unification in the case of Germany compare VELLING (1993)).

b. Immigration taxes

For the purpose of imposing a tax on immigrants, a variety of tax bases might be employed. We will confine our analysis to the introduction of a lump sum tax which has to be repeatedly paid for all periods after immigration. Assume that the lump sum tax increases the baseline consumption expenditures of chain migrants only. Therefore the cost advantage of chain migrants relative to single migrants is less than in the case without taxes. To operationalize this notion, one might think of raising the minimum requirements for per-capita living-space in flats.

Two effects of the introduction of a lump sum tax deserve special attention. First, an increase of 20% in the minimum consumption expenditures of chain migrants as in case 2 (figure 13) entails a 52.9% decrease of the share of immigrants in the total population after 20 periods. Second, despite of being non-discriminating between different countries of origin, imposing an immigration tax of this kind leads to a relatively more homogenous immigrant population with respect to its nationality and/or ethnicity. This outcome is due to the fact that the initial comparative advantage because of a high stock of immigrants already residing abroad decreases as the evolution of chains is inhibited by the tax.

c. Improving the living conditions in the countries of origin

Policy measures to improve the living conditions in the source countries of immigration have gained considerable attention during the past years. Their attraction stems from the prospect to have a powerful policy measure at hand that tackles a bundle of issues at once, such as creating an export market for domestic goods and curbing the flow of emigrants.

In our models an improvement of the living conditions in the countries of origin relative to the country of destination is reflected in a lower α. We define two cases. In the benchmark case the intensity of the push factor is identical for both countries of origin, that is $\alpha_A = \alpha_B = 0.01$, while the pull capacity of migrants from country B is assumed to exceed the pull capacity of migrants from country A four times, that is $\beta_A = 0.1$ and $\beta_B = 0.4$. The respective dynamics of migration is depicted in table 1.

In the second case we implement the improvement of the living conditions in one of the source countries by halving the intensity of the push factor for country B, that is $\alpha_B = 0.005$, while α_A remains unchanged. This reduction of the intensity of the push factor by 50% leads to a decrease of the share of immigrants from country B of only 19.6% in our example as the pull mechanism remains unaffected by an improvement of the living conditions in the source country.

Table 1

The effect of improved living conditions in a source country on the dynamics of migration

Period	Share of A-immigrants in total population		Share of B-immigrants in total population		Overall share of immigrants in total population	
	α = 0.01 benchmark	α = 0.01 improved conditions	α = 0.01 benchmark	α = 0.005 improved conditions	benchmark	improved conditions
1	0.00	0.00	0.00	0.00	0.00	0.00
5	0.0035	0.0036	0.0053	0.0027	0.0088	0.0063
10	0.0078	0.0086	0.0230	0.0134	0.0308	0.0220
15	0.0108	0.0128	0.0504	0.0354	0.0612	0.0482
20	0.0123	0.0153	0.0749	0.0602	0.0872	0.0755

However, even this relatively small reduction is partly offset yet by an increase in the immigrant flow from country A. Note that this increase occurs despite of the fact that the intensity of the push and pull mechanisms related to country A remain unchanged. This outcome is due to the non-linear interaction of the migration flows on the labor market. Compared to the benchmark case, wages are depressed by three percentage points less in the improved conditions case. Hence, more migrants from country A will be able to find a job that generates an income sufficient to maintain the baseline consumption level.

Our analysis leads to a pessimistic conclusion about the effectiveness of attempts to improve the living conditions in the countries of origin in curbing migration flows relative to other policy measures. There might still be strong arguments for engaging in improving the living conditions in the source countries of migration. However, for reasons of influencing migration flows international transfers do not appear to be a means of outstanding effectiveness, but if the improvement of living conditions turns out to be a success, one can expect some contribution to the reduction of migration flows.

5 Conclusions

The model outlined above combines several dispersed ideas to form a consistent theoretical approach towards the issue of chain migration. The standard neoclassical model employed in migration theory is based on the assumption that there is a single wage that clears the labor market for a given skill level. The more realistic case that a job-searching individual faces a probability distribution of getting a job with a certain payment allows new insights. Taking a macroeconomic perspective, the wage distribution of accepted vacancies repeats the probability distribution for an average individual to occupy a vacancy with a certain wage. On the microeconomic level, however, a single job-searching individual is confronted with a take-it-or-leave-it decision.

The concept of classifying migrants into single and chain migrants takes into consideration that both categories of migrants are endowed with a substantially different vector of characteristics. This results in a different individual decision problem implying a different market behavior. For purposes of clear theoretical reasoning we employ two discrete states of the survival cost function instead of an infinite number of intermediate states though in reality the latter is the typical case.

In the framework of our models, the dynamics of migration depends on the wage elasticity of the demand for labor, the intensities of the pull capacity and the push mechanism, the wage distribution of vacancies, and the differences in the baseline consumption levels for single and chain migrants. The results are outstandingly sensitive to changes in the labor demand elasticity. The relative importance of the wage elasticity is stronger in our models than in a model with a homogenous group of migrants. This is due to the fact that the number of single migrants belonging to the first wave who are absorbed by the host country is determined by this elasticity. As the second and higher order waves are nearly proportional to the number of migrants in the first wave, the strength of this multiplier effect is crucially influenced by the labor demand elasticity.

The existence of chains towards a certain destination country reinforces the attraction of this country compared to other potential destination countries. The resulting comparative advantage might overcompensate other, disadvantageous factors in that specific destination country. This effect might well explain the observation of relatively extensive migration to countries with comparatively small wage differentials. The effect is still more pronounced the more the living costs of single and chain migrants differ.

When emigration from two countries into a third country starts at the same time, higher country-specific push factors lead to a higher immigration only in the initial periods. The further dynamics eminently depends on the distinct strength of the country-specific pull factors. With respect to the transition process in Eastern Europe a sudden opening up of the borders together with a contractive economic shock provides a possibility as well as an incentive to migrate. Our results indicate that during the first periods the migration flows will be dominated by the push mechanism. However, in the course of time the relative importance of the push mechanism on the migration flow diminishes more and more in favor of a growing significance of the pull mechanism.

Based on the assumption that differences in the intensities of the pull mechanisms across countries arise from distinct cultural and social traditions, the model reveals that the importance of family unification in the narrow sense is less than inter-family links as well as links between distant relatives and friends. This is because the number of possible immigrants to be attracted from families in the narrow sense is limited while chains can evolve in a nearly unlimited way. Thus, the ratio of a country's population living abroad to the population residing in the source country indicates the scale of potential chain migration and might therefore also belong to the criteria of selection. However, choosing the proper means out of the ample variety of policy options to influence migration flows deserves particular attention. While a measure itself might be abolished after some time, its consequences will continue to be effective in shaping the dynamics of migration.

6 References

BECKER, G.S. (1990): *Opening the Golden Door Wider - To Newcomers with Knowhow*, Business Week, June 11th, p. 10.

DE NEW, J.P.; ZIMMERMANN, K.F. (1993): *Native Wage Impacts of Foreign Labor: A Random Effects Panel Analysis*, Working Paper, SELAPO-University of Munich.

ELMESKOV, J. (1993): High and Persistent Unemployment: Assessment of the Problems and its Causes, OECD Department of Economics Working Papers, no. 132.

ETHIER, W.J. (1983): *Modern International Economics*, Norton: New York.

GRUBEL, H. ; SCOTT, A. (1966): The International Flow of Human Capital, American Economic Review, vol. 56, pp. 268-274.

GURAK, D.T.; CACES, F. (1992): *Migration Networks and the Shaping of Migration Systems*, in: KRITZ, M.M.; LIM, L.L.; ZLOTNIK, H. (eds.): *International Migration Systems - A Global Approach*, Clarendon Press: Oxford.

HAMERMESH, D.S. (1986): The Demand for Labour in the Long Run, in: O.C. ASHENFELTER and R. LAYARD (eds.): The Handbook of Labour Economics, North-Holland.

JOHNSON, G.; LAYARD, P.R.G. (1986): The Natural Rate of Unemployment: Explanation and Policy, in: O.C. ASHENFELTER and R. LAYARD (eds.): The Handbook of Labour Economics, North-Holland.

KALTER, F. (1994): *Sequentielle Wanderungsentscheidungen - Die Bedeutung und Erklärung von Wanderungserwägungen*, paper presented at the 28. conference of the Deutsche Gesellschaft für Bevölkerungswissenschaft, Bochum.

KEMP, M.C. (1969): *The Pure Theory of International Trade and Investment*, Prentice-Hall: Englewood Cliffs (NJ.).

LEE, E. (1966): *A Theory of Migration*, Demography, vol. 3, pp. 47-57.

LITWAK, E.; MESSERI, P. (1989): *Organizational Theory, Social Supports, and Mortality Rates: A Theoretical Convergence*, American Sociological Review, vol. 54, pp. 49-66.

MACDONALD, J.S.; MACDONALD, B.D. (1964): *Chain Migration, Ethnic Neighborhood Formation and Social Networks*, Milbank Memorial Fund Quarterly, vol. 42, pp. 82-97.

MARKUSEN, J.R. (1988): *Production, Trade and Migration with Differentiated, Skilled Workers*, Canadian Journal of Economics, vol. 21, pp. 492-508.

MASSEY, D.S. (1990a): *The Social and Economic Origins of Immigration*, Annals of the American Academy of Political and Social Science, vol. 510, pp. 60-72.

MASSEY, D.S. (1990b): *Social Structure, Household Strategies, and the Cumulative Causation of Migration*, Population Index, vol. 56, pp. 3-26.

MASSEY, D.S.; ARANGO, J.; HUGO, G.; KOUAOUCI, A.; PELLEGRINO, A.; TAYLOR, J.E. (1993): *Theories of International Migration: A Review and Appraisal*, Population and Development Review, vol. 19, pp. 431-466.

MASSEY, D.S.; García España, F. (1987): *The Social Process of International Migration*, Science, vol. 237, pp. 733-738.

MOLHO, I. (1986): *Theories of Migration: A Review*, Scottish Journal of Political Economy, vol. 33, pp. 396-419.

RIKER, W.H.; ORDESHOOK, P. C. (1973): *An Introduction to Positive Political Theory*, Prentice-Hall: Englewood Cliffs/New Jersey.

RITCHEY, N.P. (1976): *Explanations of Migration*, in: INKELES, A; COLEMAN, J., and SMELSER, N. (eds.): Annual Review of Sociology, vol. II, pp. 363-404.

RIVERA-BATIZ, F. (1982): *International Migration, Non-Traded Goods and Economic Welfare in the Source Country*, Journal of Development Economics, vol. 11, pp. 81-90.

SIMON, H.A. (1957): *Models of Man*, John Wiley: New York.

SNESSENS, H. (1993): The Skill Composition of Labour Demand and Supply, Appendix to J.H. DRÈZE and E. MALINVAUD: Growth and Unemployment: The Scope for a European initiative, paper presented at the European Economic Society meeting, Helsinki.

SPEARE, A.; GOLDSTEIN, S.; FREY, W. (1975): *Residential Mobility, Migration, and Metropolitan Change*, Ballinger Publishing: Cambridge (MA.).

STARK, O. (1991): *The Migration of Labor*, Basil Blackwell: Cambridge (MA.) and Oxford.

STRAUBHAAR, T.; ZIMMERMANN, K.F. (1991): *Migration and the European Community*, paper presented at the CEPR workshop on the economics of migration, November 1991, London.

TILLY, C. and BROWN, C.H. (1967): *On Uprooting, Kinship, and the Auspices of Migration*, Journal of Comparative Sociology, vol. 8, pp. 141-164.

VELLING, J. (1993): *Immigration to Germany in the Seventies and Eighties - The Role of Family Reunification*, paper presented at the VII. annual meeting of the European Society for Population Economics, Budapest.

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