The Dynamics of Migration in the Presence of Chains

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Abstract

The paper focuses on the structural analysis of migration flows. The assumption that migrants are a homogenous entity is replaced by a distinction between single migrants and chain migrants. The theoretical analysis is based on the solution of a differential equation describing the dynamic process of migration. The results of several simulations are depicted graphically. The results are crucially depending on the labor demand elasticity in the destination country, the intensity of the push and the pull factors and the different levels of the subsistence minimum for single and chain migrants. The results may be useful for policy makers for predicting and steering the migration flows between countries.

Zusammenfassung

Im Mittelpunkt des Papiers steht eine Strukturanalyse internationaler Wanderungsströme. Die verbreitete Annahme, daß Migranten eine homogene Einheit darstellen, wird zugunsten einer Kategorisierung der Migranten in solche mit und solche ohne transnationale Verbindungen zum Zielland aufgegeben. Die theoretische Analyse basiert auf der Lösung einer Differentialgleichung, die den dynamischen Prozeß internationaler Wanderungen beschreibt. Graphische Abbildungen veranschaulichen die Simulationsergebnisse. Es zeigt sich, daß das zeitliche Einwanderungsprofil wesentlich von der Lohnelastizität der Arbeitsnachfrage im Einwanderungsland geprägt wird. Von Bedeutung ist darüberhinaus die Intensität der Push- und Pull-Faktoren sowie die unterschiedliche Höhe der Subsistenzminima beider Kategorien von Migranten. Die Resultate legen eine Reihe wirtschaftspolitischer Schlußfolgerungen nahe, die der Vorhersage und der Steuerung internationaler Wanderungen förderlich sein können.

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Contents

2 Basic Assumptions

a. We consider migration flows between two countries and abstract from interactions with all migratory movements connected with any third country.

b. There are two categories of migrants: *chain-migrants* and *single-migrants*. One can think of several significant differences between these two categories. The chain-migrants have the advantage of receiving economically advantageous information by their network. The network may also provide assistance in obtaining a better job abroad. However, these considerations lie out of the scope of this paper. For this paper, the crucial distinction between chain migrants and single migrants is that the expenditures necessary in order to maintain the minimum existence level or to reach a certain utility level are lower for chain migrants.

In Western Europe, the rent for a flat usually requires a major part of the migrant´s income. A chain migrant can significantly reduce these expenditures by sharing a flat with one or several members of his network. Because of this the minimal wage which is necessary for survival can occasionally be substantially lower.

Reductions of expenditures may also occur if several single-migrants decide to share a flat. If this is the case the single migrant shifts to the category 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. Hence, for the first period after immigration such shifts in a migrant's categorization are ruled out subsequently.

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

d. Upon entry, a migrant faces a set of different labor markets in which he can offer his work. 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 in every labor market where he supplies his labor. However, at any point of time, a migrant offers his labor on merely one labor market. There the migrant is confronted with a given wage distribution over the vacancies. A migrant also faces a non-zero probability to receive a wage that exceeds the minimum existence level. As a migrant's calculus is intended to maximize his income, from the vacancies offered he chooses that one which offers the best income opportunity. The wage distribution of higher skilled workers dominates the wage distribution of lower skilled workers, i.e. for any given wage the probability to receive this wage is higher for a skilled worker than for an unskilled worker.

3 The Dynamic Process of Migration

3.1 Formulation of the Problem

The population in the home country is denoted by N_H and assumed to be constant over time which implies 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

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

w_L denotes dw/dL. 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 shows the slope of the labor demand curve in the destination country,

$$w_L = -\theta. \qquad (2)$$

Furthermore, θ can be interpreted as an elasticity in the pre-migration labor market equilibrium of two countries of equal population size. 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.

w_i is the lower border of the wage distribution of vacancies and it represents the equilibrium wage for the lowest paid vacancy. Thus, the possibility that a skilled worker might assume a low paid job is not ruled out by definition.

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

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

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 get jobs with wages $w > C_i$ (i = h, s) stay, while the others return immediately to their home country.

Three cases of the wage distribution for vacancies relative to the survival minimum abroad can be distinguished (see Fig. I-III).

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:

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

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

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

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

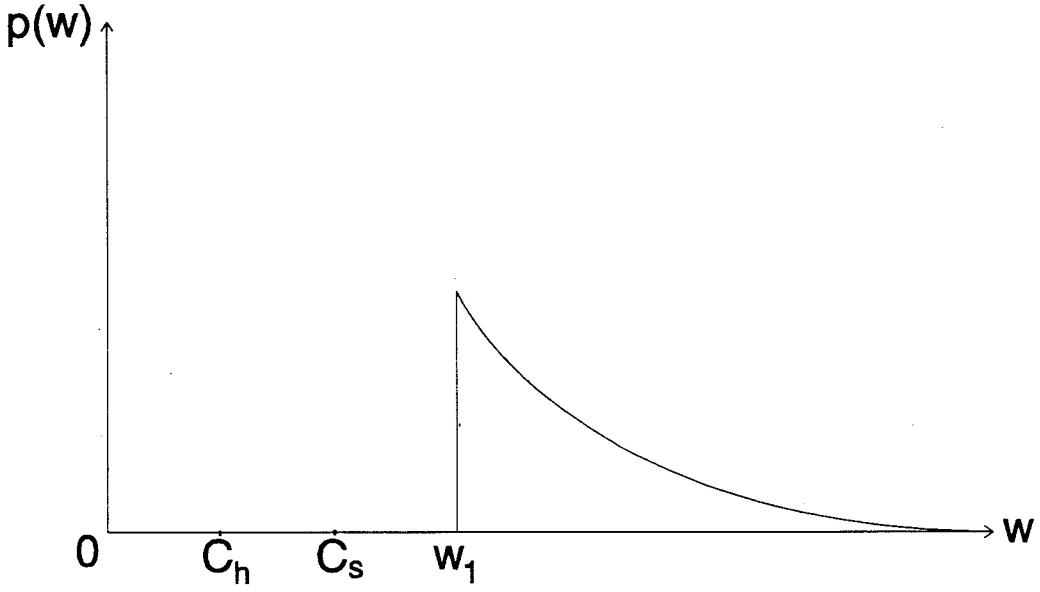

Fig. I: Wage distribution of vacancies available for migrants (case a).

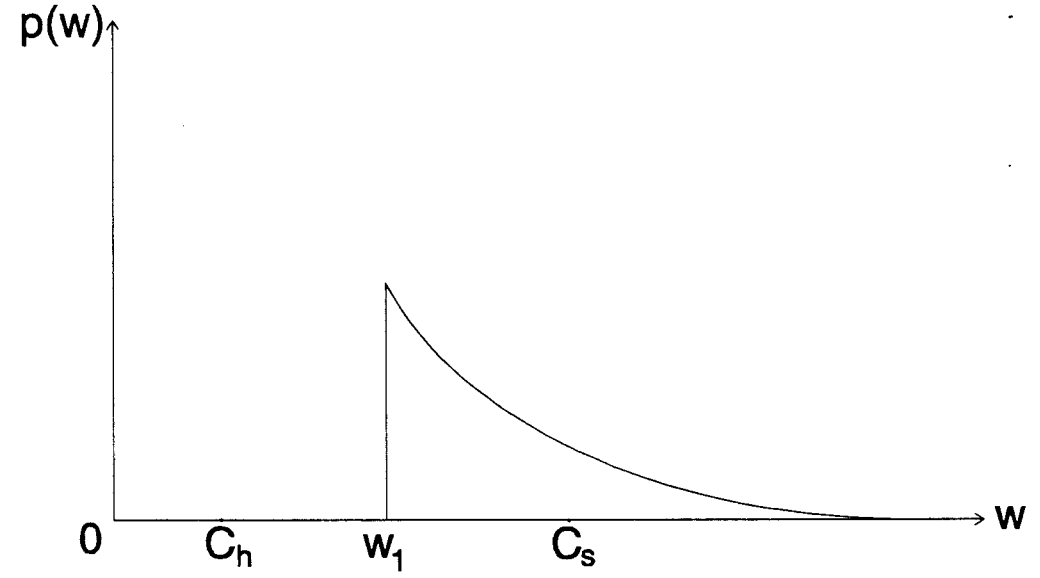

Fig. II: Wage distribution of vacancies available for migrants (case b).

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 the case with a certain probability.

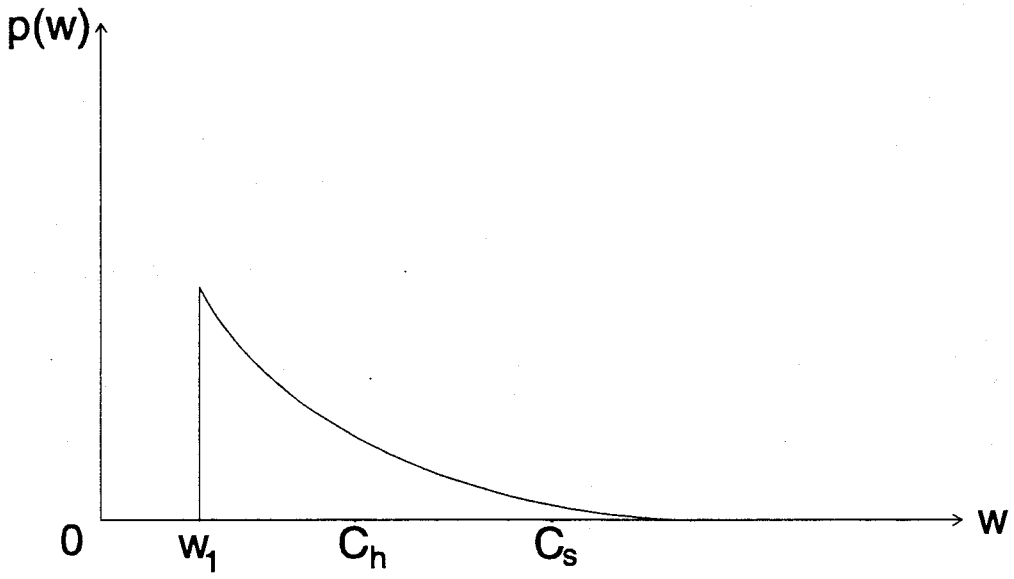

Fig. III: Wage distribution of vacancies available for migrants (case c).

In case c) for both categories there is no guarantee to find a job with an income necessary to reach the survival minimum.

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

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

where λ is a parameter of order 1. The distribution

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

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, the probability to find a job for a single migrant 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% (≙ 40% of 75%) of single migrants are able to find a job. Implicitly, it is assumed that the skills of both categories of migrants are equally distributed. Hence, some relatively skilled single migrants may not find a job because these positions are occupied by relatively unskilled chain migrants.

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

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

where

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

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.

Let

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

These flows of potential migrants are a result of exogenously given push and pull factors which will be outlined subsequently.

Formula (10),

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

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, i.e. 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 the next formula,

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

α is the share of potential migrants among the people without a network abroad, i.e. 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,

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

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) the following formula which describes the dynamics of the inflow of migrants can be obtained,
In the case of a constant slope of labor demand the wage decreases according to the

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

following formula:

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

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

$$N_{F,k+1} = N_{F,k} + n_{k+1}. \qquad (20)$$

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

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

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 constant.

In continuous time the dynamic process of migration is described by the following differential equation,

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

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.

3.2 The Analytical Solution

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. Subsequently, some calculations will be provided. The solution gives the relationship between time and the stock of immigrants.

Various numerical experiments depict the effects of different 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, a, b) requires to set 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 (e.g. within one year) due to economic reasons. These migrants are assumed to have no links abroad.

Parameter β represents the strength of the pull mechanism, i.e. 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.

4 Numerical Experiments Varying Several Parameters

The main results of the numerical experiments are depicted in Fig. 4-Fig. 13. For Fig. 4-Fig. 6 the following set of parameters was selected:

$C_h = 1$, $C_s = 1.5$, $\lambda = 1$, $N_H = 1$, $\alpha = 0.05$, $\beta = 0.5$.

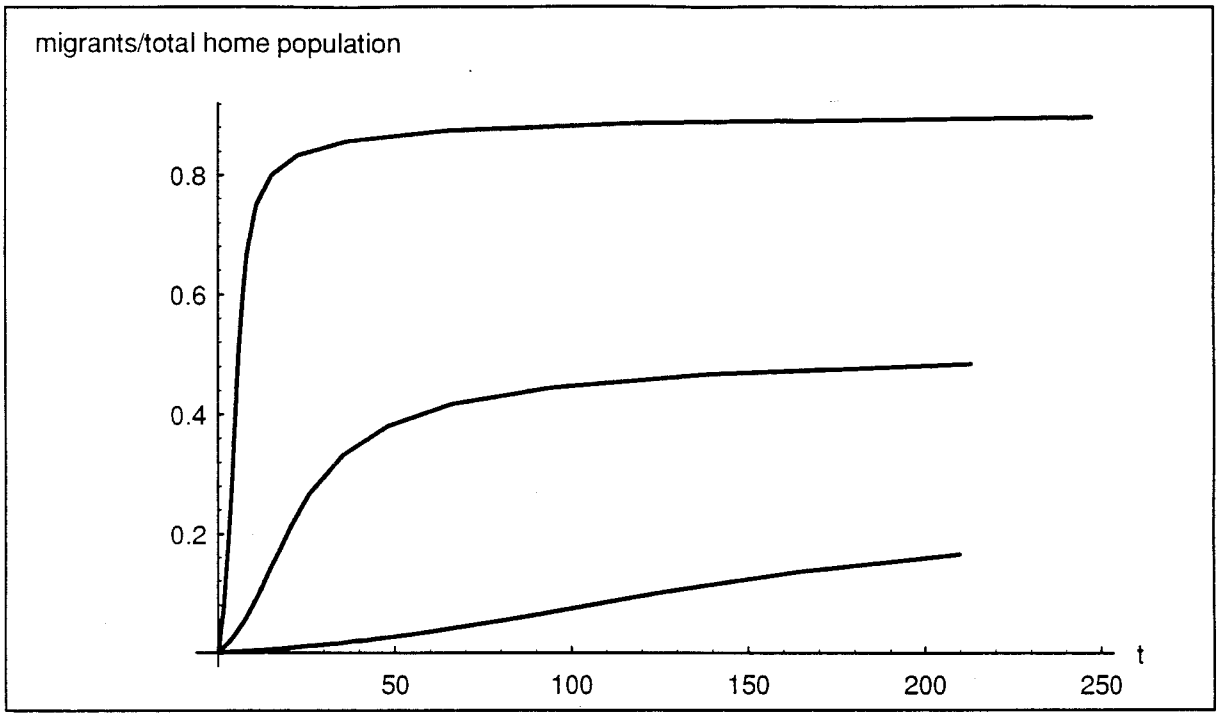

Fig. 4: Dynamics of migration for different θ. Upper curve corresponds to $\theta = 1$, middle to $\theta = 1.5$, lower to $\theta = 2$.

For Fig. 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 initially becomes more difficult for a migrant. Second, a smaller number of chains emerges, the total pull capacity of chain migrants is reduced and, thus, the total migration flow shrinks significantly.

Fig. 5 shows the wage dynamics for different values of θ. The more inelastic labor demand is the smaller the drop in the wage level due to migration is. This effect occurs because with inelastic labor demand it is more difficult to find a job covering the costs of living. This implies that a newly arriving immigrant may find himself unemployed with the consequence of immediate return as no immigrant accepts a wage below minimal living costs. In this model rather inelastic labor demand acts as an effective regulator for immigration.

In the destination country there might be vacancies with wages below the survival minimum. However, natives might accept such low paid jobs because their income is supplemented by other sources (e.g. by monetary transfers as well as by transfers in kind from parents, other relatives etc.).

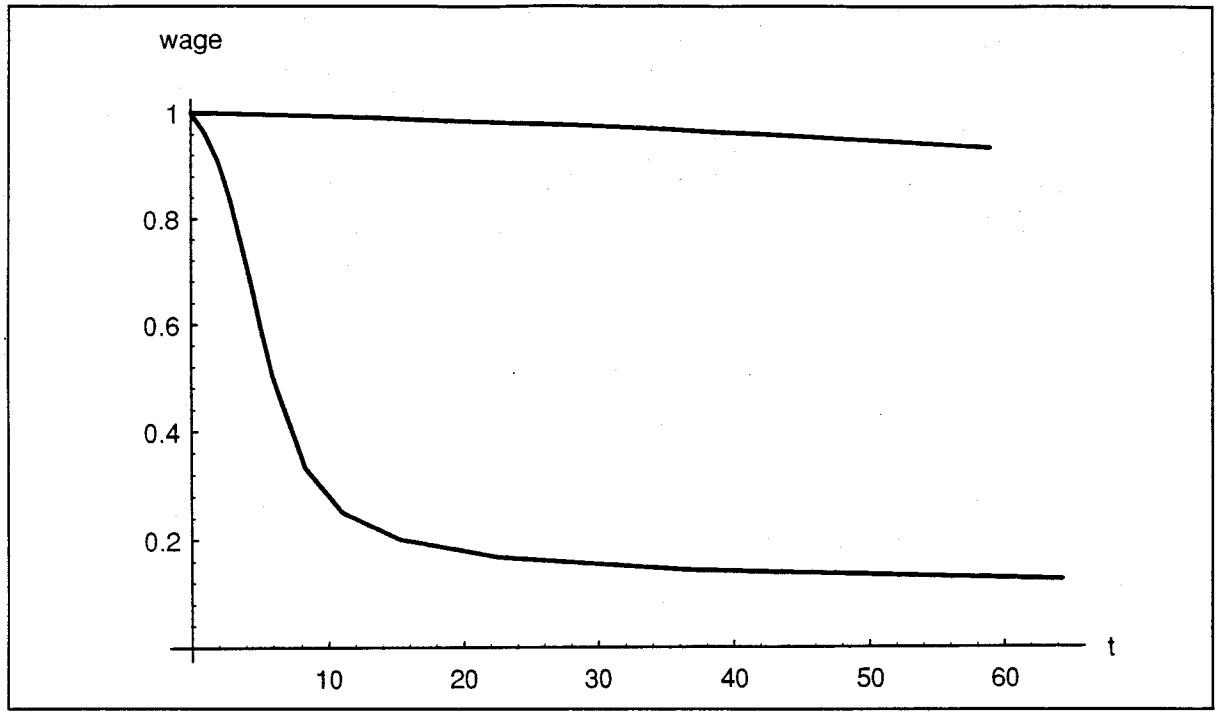

Fig. 5: Wage dynamics for different θ. Upper curve for $\theta = 2$, lower curve for $\theta = 1$.

For Fig. 6-Fig. 9 parameters α, β, λ, C_h, N_H are as before but θ and C_s are changed. Fig. 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 high skills.

Fig. 7-Fig. 9 show how the change of living costs of single migrants affects the inflow of new migrants, thereby influencing the equilibrium wages over time and by this also changing the share of single migrants in the total inflow of migrants. Migrants from a country opening its borders for emigration are single migrants in the first period by definition. Migrants from such a country face a disadvantage in comparison to migrants from countries with an emigration history.

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

Fig. 11-Fig. 13 reveal the influence of simultaneous changes of the parameters θ and λ on the inflow of migrants, the wage dynamics and the share of single migrants.

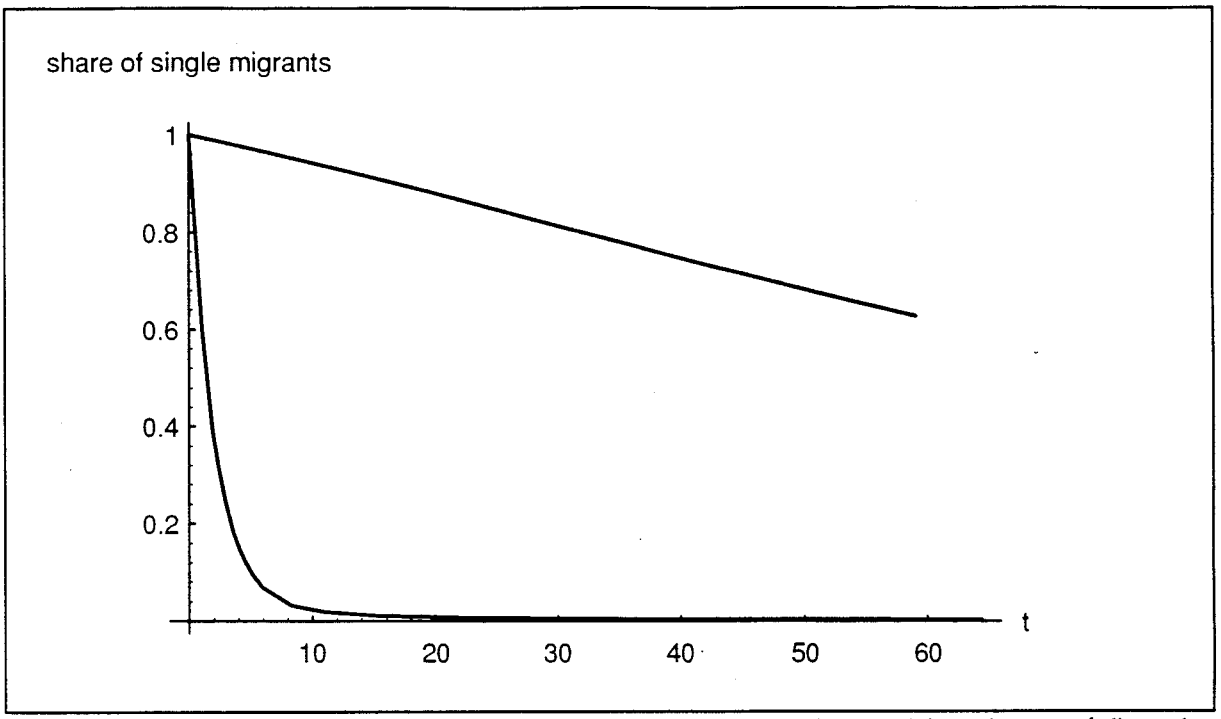

Fig. 6: Dynamics of the share of single migrants in total immigrants´ flow for different θ: upper curve for $\theta = 2$, lower curve for $\theta = 1$.

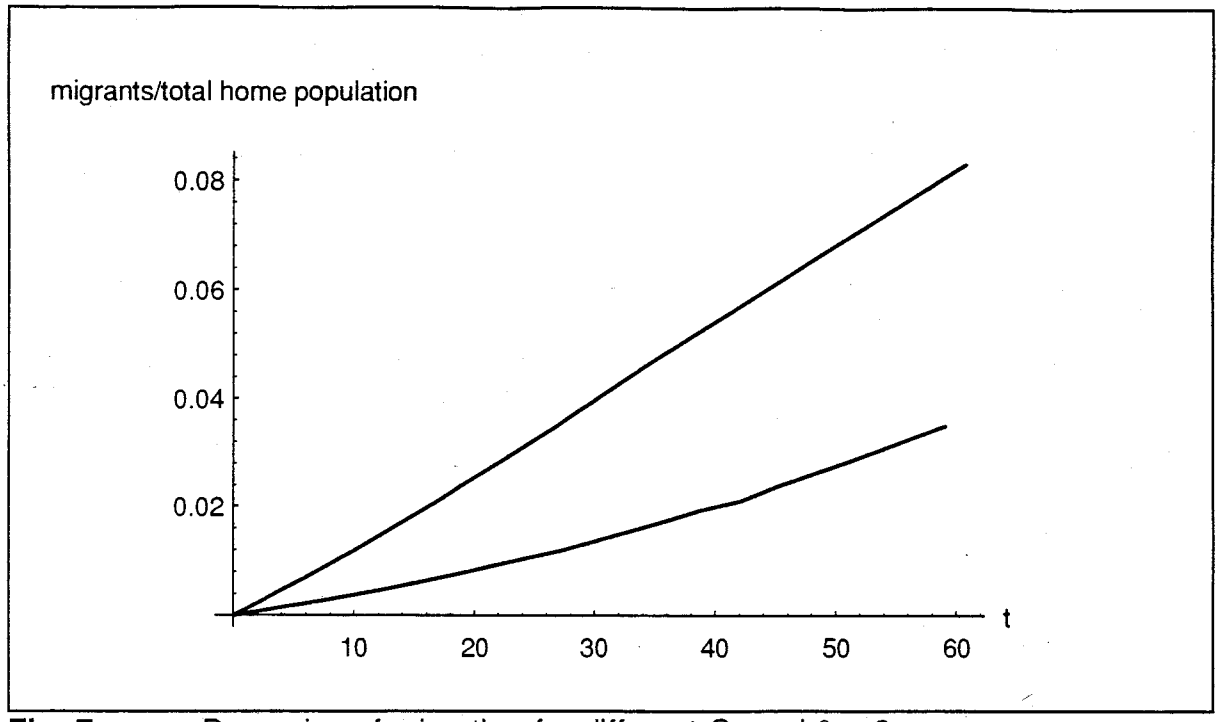

Fig. 7: Dynamics of migration for different C_s and $\theta = 2$.
Upper curve for: $C_s = 1.2$, lower curve for: $C_s = 1.5$.
Other parameters as before.

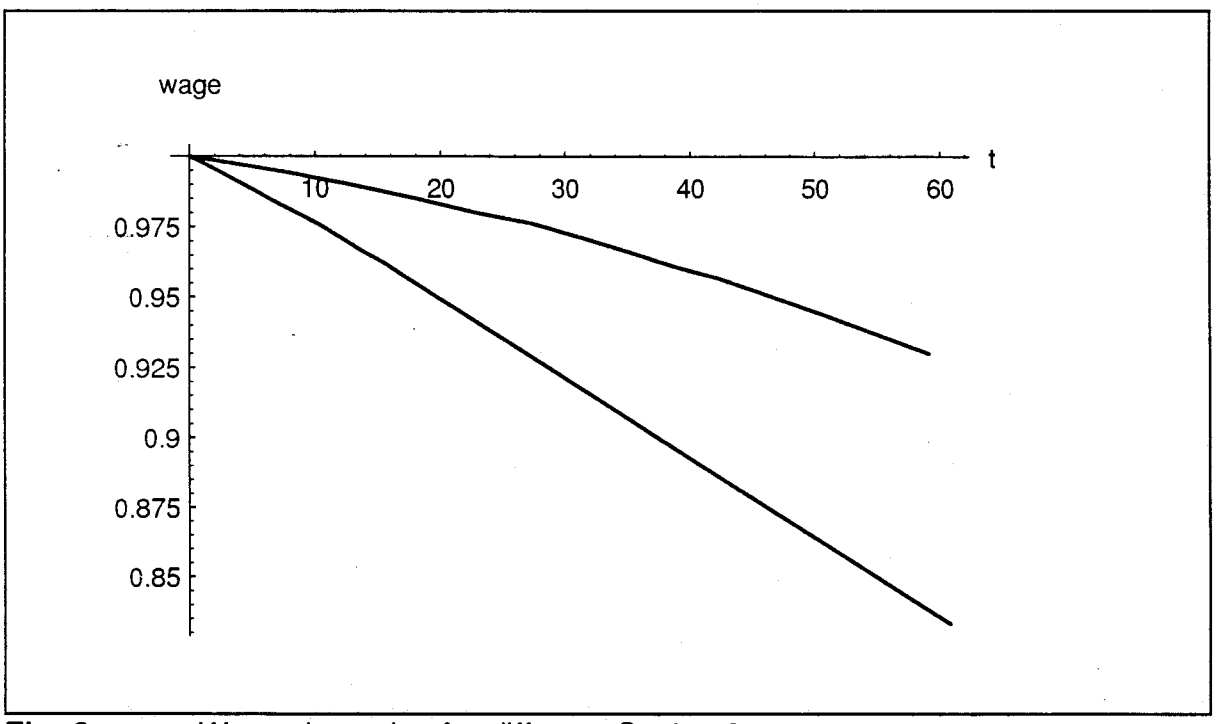

Fig. 8: Wage dynamics for different C_s, $\theta = 2$.
Upper curve for $C_s = 1.5$, lower curve for $C_s = 1.2$.

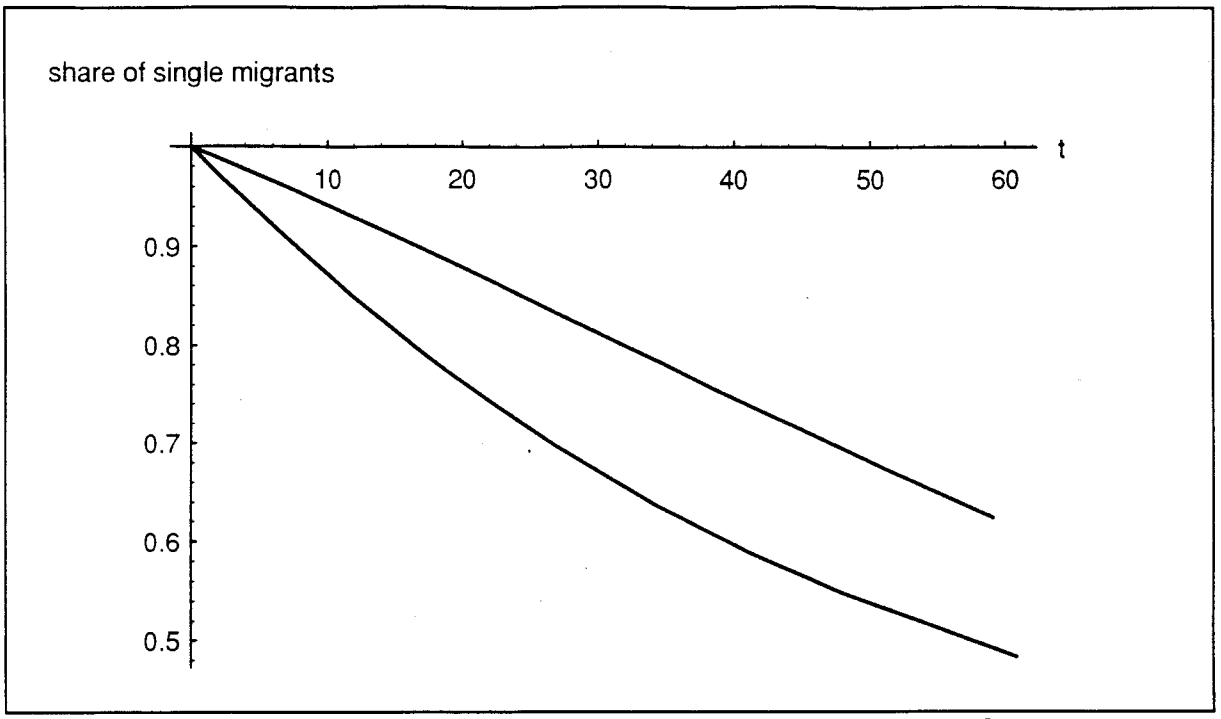

Fig. 9: Dynamics of the share of single migrants for different C_s, $\theta = 2$. Upper curve for $C_s = 1.5$, lower curve for $C_s = 1.2$.

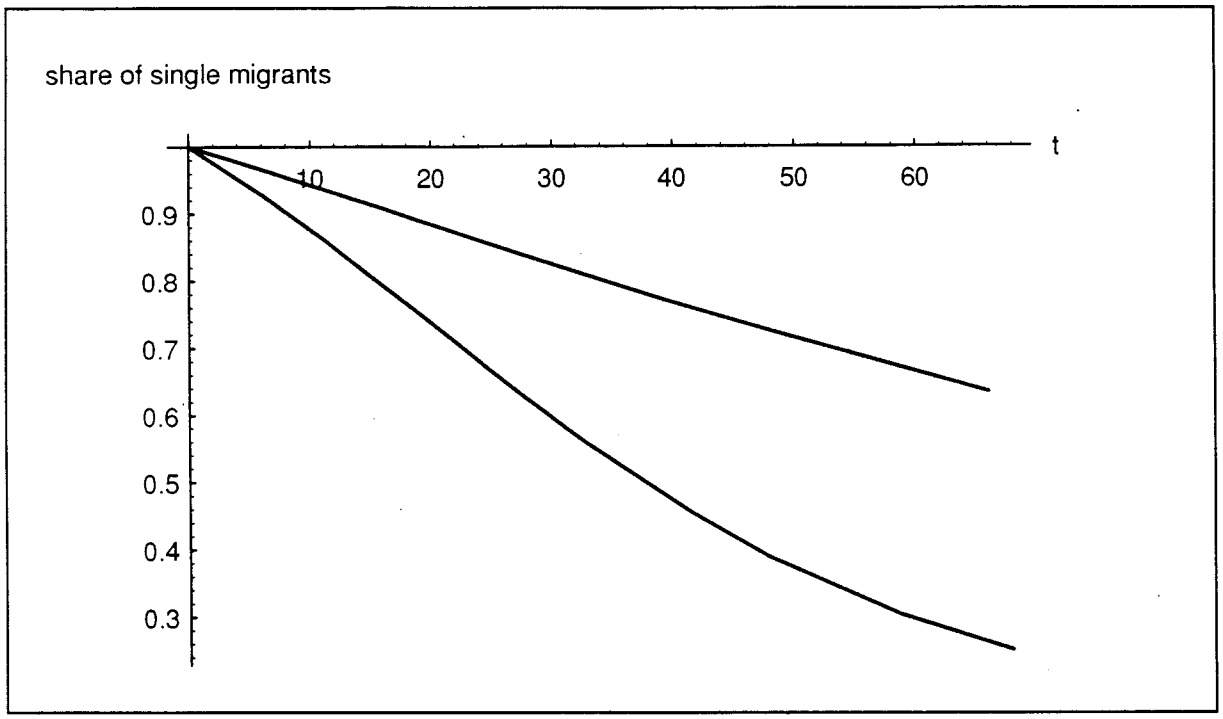

Fig. 10: Share of single migrants as a function of time. Upper curve for $\alpha = 0.1$, $\beta = 0.5$, lower curve for $\alpha = 0.05$, $\beta = 1$. Other parameters are: $C_s = 1.5$, $\theta = 2$, $\lambda = 1$.

In the case of Fig. 10 we have $C_s = 1.5$ and $\theta = 2$. In order to study the influence of the push and pull mechanisms, parameters α and β are varied.

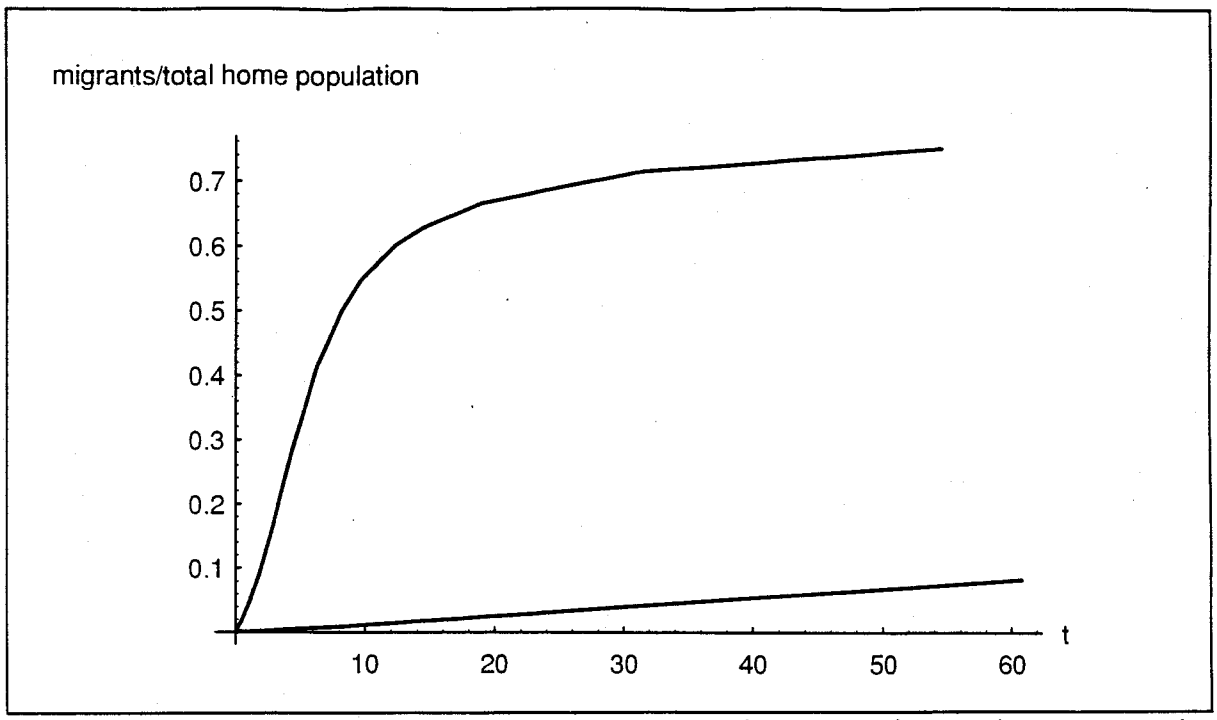

Fig. 11: Dynamics of migration. Upper curve for $\theta = 1$, $\lambda = 2$, lower curve for $\theta = 2$, $\lambda = 1$. Other parameters are: $\alpha = 0.1$, $\beta = 0.5$, $w_0 = 1$, $C_s = 1.2$, $C_h = 1$.

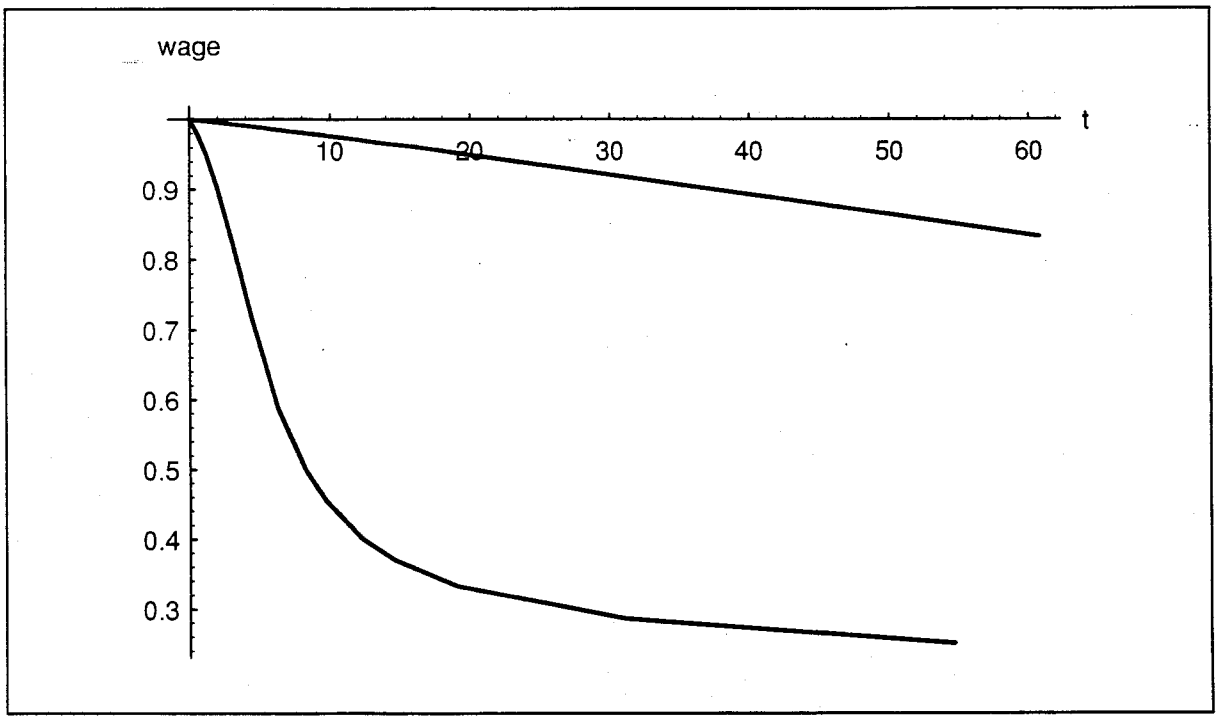

Fig. 12: Wage dynamics, upper curve for $\theta = 2$, $\lambda = 1$, lower curve for $\theta = 1$, $\lambda = 2$. Other parameters as before.

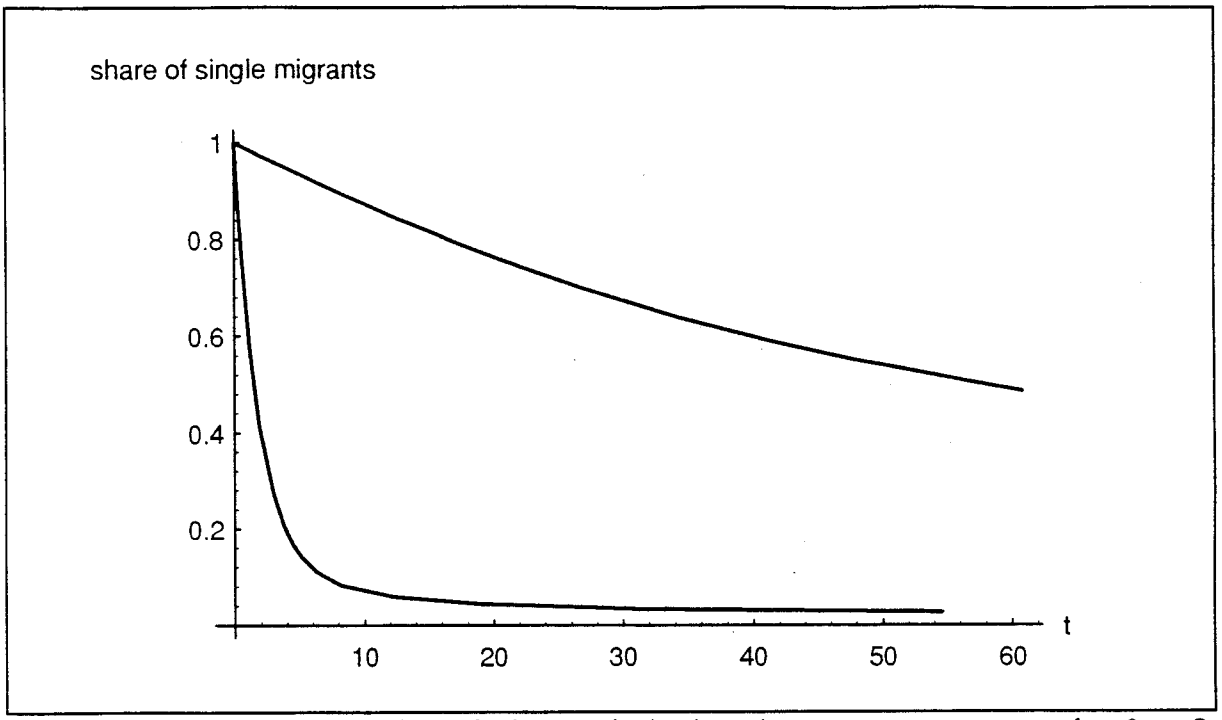

Fig. 13: Dynamics of share of single migrants, upper curve for $\theta = 2$, $\lambda = 1$, lower curve for $\theta = 1$, $\lambda = 2$. Other parameters as before.

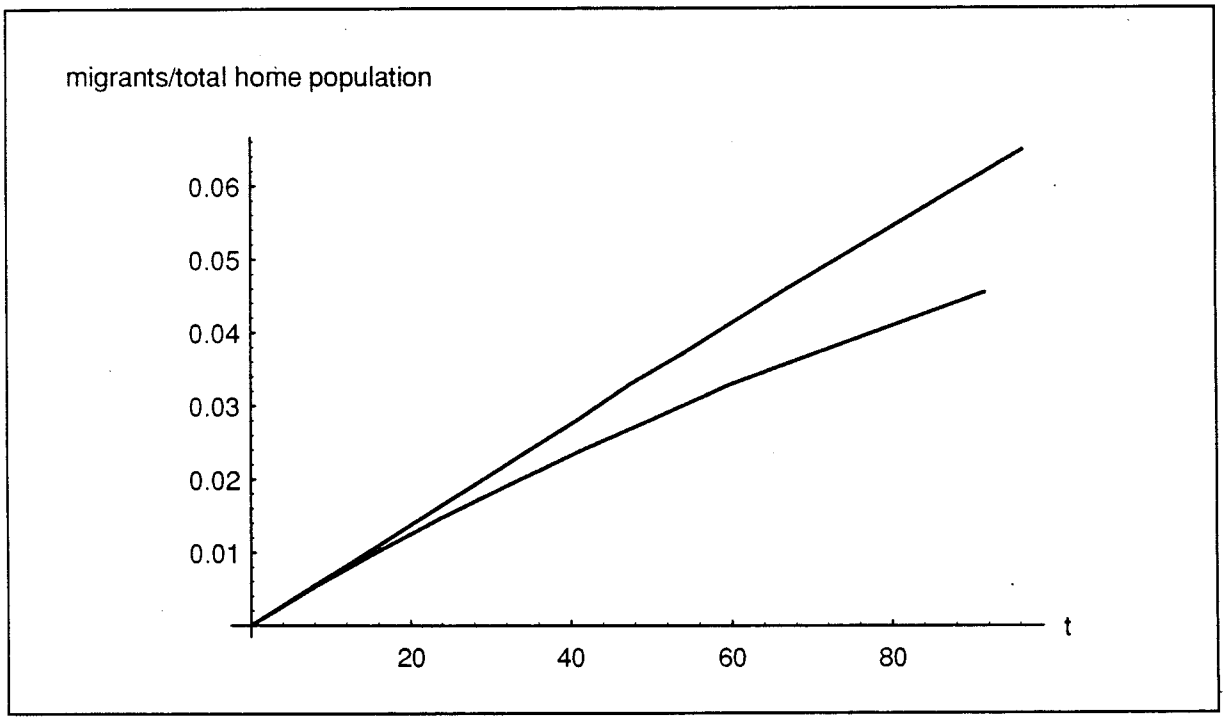

Fig. 14: Comparison of two cases:
Single migration vs. single combined with chain migration.
Upper curve: $\beta = 0.2$, lower curve: $\beta = 0$.

Fig. 14 shows a specific evolution of immigration 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, i.e. all migration is single

migration. Even for single migration the dynamics is non-linear because the equilibrium wage diminishes. As time passes, the difference between both paths becomes more and more pronounced.

5 Policy Implications

(1) Chain migrants can afford to accept vacancies with relatively low wages. Hence, comparatively skilled single migrants can be driven out of the labor market by comparatively unskilled chain migrants. In order to prevent this effect, immigration legislation might provide efficient mechanisms to guarantee that immigrants are selected according to their skills (MARKUSEN, J.R. (1988), BECKER, G.S. (1990), STRAUBHAAR, T./ZIMMERMANN, K.F. (1991)).

(2) Persons originating from a certain country or a specific ethnical group have comparative advantages over persons from other countries or ethnical groups migrating to the same destination country because they can rely on their networks abroad. This conclusion suggests that the legislative latitude with respect to family reunification, i.e whether to employ a narrow or a broad definition of ´family´, might have considerable influence on the pull capacity of each migrant.[2]

(3) The existence of chains towards a certain destination country reinforces the attraction of this country compared to other potential destination countries. This comparative advantage might overcompensate other, disadvantageous factors in that specific destination country. This effect may well explain the observation of relatively extensive migration to countries with comparatively smaller wage differentials. It might be concluded that the population size of the country of origin might also belong to the criteria of selection as the potential number of chain-links is positively correlated with the population size of the country of origin.

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[2] For immigration to Germany due to family reunification compare VELLING, J. (1993).

6 Conclusions

The model outlined above combines several dispersed ideas to form a consistent model theoretic approach towards the issue of chain migration. First, in the neoclassical model it is usually assumed that there is a single wage clearing the labor market for a given skill level. The more realistic case that a job-searching individual faces a probability distribution of getting a certain job allows new insights. Taking a macro perspective the distribution of accepted wages repeats the probability distribution for an average individual to occupy a vacancy with a certain wage. On the micro level, however, a single job-searching individual is confronted with a take-it-or-leave-it decision.

The idea 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 it is better to employ two discrete states instead of an infinite number of intermediate states though in reality the latter is the typical case.

The dynamics of migration depends significantly on the following factors: the wage elasticity of labor demand, the intensity of the pull capacity and the push mechanism which are both assumed to be exogenous, the wage distribution of vacancies and differences in the level of the subsistence minimum for single and chain migrants. The results are outstandingly sensitive to changes in the labor demand elasticity. This effect is illustrated by figures 4-6. The relative importance of the wage elasticity is stronger in this model than in a model with a homogenous group of migrants. This is because the quantity of single migrants belonging to the first wave which can be absorbed by the host country is determined by this figure. Moreover, as the second and all subsequent waves are almost proportional to the number of immigrants in the first wave, the strength of this multiplicator effect is crucially depending on the labor demand elasticity.

7 References

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