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An econometric model of guest-worker migrations to and from the FRG based on an individual decision theoretical approach

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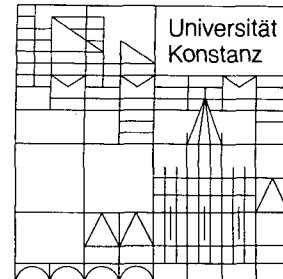
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Sonderforschungsbereich 178
„Internationalisierung der Wirtschaft“

Diskussionsbeiträge



Juristische
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wissenschaften und Statistik

Hans Günther Seifert-Vogt

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**AN ECONOMETRIC MODEL OF GUEST-WORKER MIGRATIONS
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Hans Günther Seifert-Vogt

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AN ECONOMETRIC MODEL OF GUEST-WORKER MIGRATIONS
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INDIVIDUAL DECISION THEORETICAL APPROACH¹⁾

by Hans Günther SEIFERT-VOGT^{2) 3)}

ABSTRACT

Starting from a sequential decision of international migration under incomplete information (see (1)) a Markov process for the number of in- and out-migrants from country j to country o is modeled. The parameters of this process involve the degree of uncertainty of the migrants about the quality of life in the guest-country before migration and indices of their productivity in the j - and o -economy. Using time series of in- and out-migration from and to the main countries sending guest-workers to the FRG these parameters will be estimated.

In the paper the model of the mentioned Markov process is presented, thereby stressing the underlying microeconomic model, and some results of the econometric estimation of the parameters of the model. Finally some hints for the economic implications of the empirical findings will be given.

1) Paper to be presented at the Third Annual Meeting of ESPE (European Society of Population Economics), held at L'Université de l'UAP, Bouray sur Juine (Paris), 8-10 June 1989.

2) University of Konstanz, Sonderforschungsbereich 178 "Internationalization of the Economy".

3) The theoretical part of this paper was discussed with Prof. S. Berninghaus, while I have got much assistance in the empirical part by K. Straus and W. Ernst. Many thanks to them all!

1. INTRODUCTION

Presumably it is undisputed among economists, social scientists and demographers, that a key factor influencing the migration behavior besides the pecuniary aspects is the 'quality of life'. In this latter all factors are subsumed that influence the subjective well-being of an individual, like the cultural climate, the education system, the acceptance by the neighbourhood, the situation on the working place etc. On the other side it must be expected that a potential migrant especially in international migration will be typically only partially or rather vaguely informed about the quality of life in his prospective guest country before migration. Only by living there, i.e. after migration, the individual will be well informed about this.

Starting with McCall (1984) in the last years some progress has been made to give a sound economic description and analysis of this incomplete information aspect in international migration; (compare McCall (1987), Berninghaus/Seifert-Vogt (1987), Meier (1985)). The essential feature of these works is a sequential decision framework and the application of some methods from stochastic dynamic programming yielding a characterization of optimal individual migration behavior which seems well-suited for analytical and econometric purposes.

It is the aim of this paper to contribute to the mentioned stream of research on international migration by

- the presentation of an econometric model explaining aggregate migration and remigration flows from and to countries sending guest-workers to W-Germany, where an important part of the structural parameters of this model can be seen as parameters of the individual sequential decision migration model.
- the report and valuation of a first empirical experiment with this econometric model; data about the migration resp.

remigration from (rsp. to) Greece to (rsp. from) W-Germany from 1970 to 1984 are used for the estimation of the model.

But this paper should also be seen as a step⁴⁾ from the "partial-partial"-equilibrium framework of the works cited above to a general equilibrium framework: It is tried to have regard to the effects on the labour markets in the sending and in the guest country which are caused by migratory movements. This is done here in a very crude fashion by deriving wage functions from Cobb-Douglas production functions using the marginal productivity theory of labour.

From a theoretical point of view, this attempt to capture both sides of the guest-worker markets deserves attention. But in this context it must also be stressed that no equilibrium model of the migratory movements between all sending and receiving European countries is designed - because the relevant data are not yet available and because attention must be paid to the manageability of the econometric estimation.

At best of my knowledge there don't exist comparable theoretical and econometric works; it is claimed that with this paper a new field of research on international migration has been entered.

The rest of the paper will be organized as follows: In section 2 the impact of the migration and remigration flows on the wage rates in a sending country and in a receiving is modeled. The dependence of the migration and remigration probabilities in a fixed time period on the wage differentials for given degrees of uncertainty about the quality of life differences is modeled in section 3; here the sequential decision migration model is presented. In section 4 the two sides of the markets for guest workers are brought together, yielding transition probabilities for the Markov process, a part of which are the migration and remigration flows. Based on this transition probabilities the

4) Another step in this direction is Berninghaus/Seifert-Vogt (1989).

likelihood function of the unknown parameters of the model will be derived in section 5. In section 6 the results of the econometric estimation will be presented and discussed. With concluding remarks in section 7 the paper will be finished.

2. THE MIGRATION AND REMIGRATION FLOWS AND THEIR IMPACT ON THE WAGES

We consider a guest country, indexed by o , to which in each period t guest workers from various sending countries $1, \dots, j, \dots, n$ migrate (temporary or permanent), and from which a portion of these guest workers remigrates in each period to their home countries.

For the migration flows from j to o and back from o to j the following identities hold:

$$(2/1) \quad l_{j,t} = l_{j,t-1} - m_{j,t} + r_{j,t} + g_{j,t}$$

$$(2/2) \quad l_{o,j,t} = l_{o,j,t-1} + m_{j,t} - r_{j,t} + g_{o,j,t}$$

Here we make use of the following symbols:

$l_{j,t} :=$ number of 'active' individuals⁵⁾ in j at the end of period t

$m_{j,t} :=$ number of active migrants from j to o during period t

$r_{j,t} :=$ number of active remigrants from o to j during period t

$l_{o,j,t} :=$ number of active individuals ("guest workers") from j in o at the end of period t

$g_{j,t}$ resp. $g_{o,j,t}$ are the respective residuals. Thus $g_{j,t}$ contains the difference between the number of people becoming active persons and the number of those becoming inactive persons, e.g. by death or retirement, and furthermore the difference between the number of remigrants to j from other countries than o and the number of migrants from j to other countries than o . The residual $g_{o,j,t}$ contains above all the difference between the number of people with nationality of country j , but living in o already for some periods, and becoming active persons in period

5) In the glossary of the "Statistisches Bundesamt" (Wiesbaden, FRG) here 'Erwerbspersonen' are meant.

t and the number of people with nationality of country j becoming inactive persons.

In the empirical part of the paper the sending countries j will be 1 = Greece, 2 = Italy, 3 = Turkey, 4 = Yugoslavia, 5 = Spain and 6 = Portugal, and the guest country o will be the FRG.

The core of the econometric model will be to interpret the vectors

$$(2/3) \quad y_t = (l_{jt}, l_{ojt}, m_{jt}, r_{jt}), \quad t = 1, \dots, T$$

as the realization of a (vector-valued) Markov process (Y_t) with

$$(2/4) \quad Y_t = (L_{jt}, L_{ojt}, M_{jt}, R_{jt}).$$

The link which will bring the realization of Y_{t-1} and Y_t together, and will thus yield the transition probabilities for the Markov process, are the wage profiles

$$w_t = (w_{jt}, w_{ojt})$$

where w_{jt} resp. w_{ojt} is the real wage rate in j resp. for the guest workers from j in o in period t .

In the rest of this section 2 it will now be specified, how these wages depend on the realization of Y_t . Section 3 serves for the micro-foundation of the dependence of the realization probabilities of the Y_t on the wage profile w_t .

Finally in section 4 these two parts are puzzled together for establishing the transition probabilities of the Markov process (Y_t) . - Perhaps the constructions which follow are best understood by keeping in mind that the Markov process (Y_t) could be seen as a generalization of a cobweb type model. Thus, the dynamics of the model will be generated by the idea of a one-period lag between the realizations of (Y_t) and the wages (w_t) . More specifically the following dynamic structure will be modeled:

$$(2/5) \quad y_{t-1} \rightarrow w_t > Y_t$$

where \rightarrow is the symbol for a deterministic while $>$ is the symbol for a stochastic relationship.

For specifying the first part of this relationship, wage functions in countries j and o will be specified by making use of the marginal productivity theory of labour, applied to Cobb-Douglas production functions. I begin by doing this for country o . Assuming a production function

$$Y = \varepsilon_0 l_0^{\varepsilon_1} \dots l_n^{\varepsilon_n} L^{\varepsilon_{n+1}} K^{\varepsilon_{n+2}}$$

where K resp. L denote the stock of capital resp. of domestic labour in country o , and where $0 < \varepsilon_1, \dots, \varepsilon_{n+2} < 1$ are the respective elasticities of substitution, and $\varepsilon_0 > 0$ a scale parameter it can be derived the following equation for the wage $w_{o,j,t}$, paid to the guest workers from j in o in period t .

$$\ln w_{o,j,t} = (\varepsilon_j - 1)\lambda_{o,j,t-1} + \ln \varepsilon_j + \ln \varepsilon_0 + \varepsilon_{n+1} \ln L_{t-1} + \varepsilon_{n+2} \ln K_{t-1} + \sum_{k \neq j} \varepsilon_k \lambda_{o,k,t-1}$$

Here the abbreviations

$$\lambda_{o,k,t} := \ln l_{o,k,t} \quad (k = 1, \dots, j, \dots, n)$$

are used.

If L_t and K_t are assumed to be constant = L resp. K during the considered time periods $t=1, \dots, T$, the wage function for $w_{o,j,t}$ can be written in a more compact form as

$$(2/6) \quad \ln w_{o,j,t} = \alpha_{o,j} + \beta_{o,j} \lambda_{o,j,t-1} + \sum_{k \neq j} \varepsilon_k \lambda_{o,k,t-1}$$

where the meaning of the symbols

$$\alpha_{o,j} := \ln \varepsilon_j + \ln \varepsilon_0 + \varepsilon_{n+1} \ln L + \varepsilon_{n+2} \ln K$$

$$\beta_{o,j} := \varepsilon_j - 1$$

should be kept in mind for later interpretation of the empirical results.

In a similar but more simple way the function determining the wage w_{jt} paid to the workers in j during period t can be derived as

$$(2/7) \quad \ln w_{jt} = \alpha_j + \beta_j \lambda_{jt-1}$$

where $\lambda_{jt-1} = \ln l_{jt-1}$, and $1+\beta_j$ is the elasticity of substitution of labour in country j and α_j is a linear combination of the logarithm of this elasticity, capital stock in j (assumed to be constant too) and of the scale parameter of the production function.

3. THE IMPACT OF THE WAGES ON THE MIGRATION AND REMIGRATION FLOWS

In this section a fixed sending country j is considered, and it is the aim to derive a stochastical dependence of the migration and remigration flows from j to o resp. back from o to j on the wages w_{jt} resp. w_{ot} for a specific time period t . For easiness of notation in this section it is written w_{ot} instead of $w_{o,j,t}$.

The kernel of this stochastic dependence will be a sequential decision model of the individual migration/remigration decisions. This model will be presented in 3.1., whereas the propositions concerning the dependence of the migration resp. remigration probabilities on the wages w_{jt} and w_{ot} will be derived in 3.2.

3.1. THE INDIVIDUAL MIGRATION- AND REMIGRATION-DECISION PROCESS

In this subsection a special version of a migration decision model will be presented which has first been introduced by McCall (1984), and further been elaborated in Berninghaus/Seifert-Vogt (1987). The idea there is to model the migration and remigration decisions in a Multi-Armed-Bandit (= MAB) framework, and to use the method of the 'Gittins indices' for the characterization of the individual migration behavior. I restrict myself here on a Two-Armed-Bandit (= TAB) version of this type of model although it would be desirable to analyze the migratory movements from one sending country to more than one guest country (e.g. from Greece to Switzerland, France, W-Germany etc.) as a MAB-Problem. But at the moment the lack of satisfactory comparable empirical data cause the restriction to the empirical and theoretical analysis of the guest worker migration from one sending country to only one possible guest country (e.g. from Greece to W-Germany).

Now consider a fixed time period t , and define

$I_{j,t} :=$ the set of all workers in j at the beginning of period t

$I_{o,t} :=$ the set of all guest-workers from j in o at the beginning of period t .

The model that will be given now will be designed to capture the migration-remigration decision process (= MRDP) with an infinite planning horizon of an individual $i \in I_t := I_{j,t} \cup I_{o,t}$.

A state in this MRDP is a vector

$$s_{t+n} = (c_{t+n}, w_{t+n}, q_{t+n}), \quad n = 0, 1, 2, \dots$$

collecting the factors which are supposed to be relevant in the MRDP in period $t+n$. Here $c_{t+n} \in \{j, o\}$ denotes the country where i is living (and working) in period $t+n-1$, $w_{t+n} = (w_{j,t+n}, w_{o,t+n})$ denotes the vector of wages i would receive in j resp. in o in period $t+n$; q_{t+n} is a real-valued index measuring the difference in the qualities of life,⁶⁾ the individual i would experience in j resp. in o in period $t+n$; (to simplify considerations, the quality of life in c is supposed to be representable by a real number $q_{c,t+n}$).

The set of states is thus given by

$$S = S_j \cup S_o$$

where $S_c = \{(c, w, q), w \in R^{+2}, q \in R\}$.

The set of decisions of i in each of his planning periods $t, t+1, \dots$ is supposed to be

$$D = \{d_j, d_o\}$$

6) Under the quality of life we want to subsume all factors that influence the subjective well-being of an individual, this may be the cultural climate, the education system, the acceptance by the neighbourhood etc. - The quality of life in o is better (resp. worse) than that in country j , iff $q > 0$ (resp. $q < 0$).

where d_c is interpreted as "decision for living in c in the considered period", $c = j, o$.

The remaining - and most essential - rules of the MRDP are now captured by the transition probability distribution $P : \bar{S} \times S \times D \rightarrow [0,1]$, where \bar{S} denotes a σ -algebra of events in S .⁷⁾ Here any number $P(S' | s, d)$, for $S' \in \bar{S}$, $s \in S$, $d \in D$, describes the (subjective) probability of i that the state in a period $t+n+1$ belongs to the set S' , if the state in period $t+n$ is s and i chooses in this period $t+n$ the decision d . For P the following restrictions (I), ..., (IV) are supposed:

- (I) For each $s \in S_j$ the probability measure $P(\cdot | s, d_j)$ gets all its mass on the singular event $\{s\}$; i.e. if no migration from j takes place in a period, then the situation does not alter in the subjective view of the individual i .
- (II) There is a positive real number η' , such that for any state $s = (j, w, q) \in S_j$ the mass of the probability measure $P(\cdot | s, d_o)$ is concentrated on the event $\{s^+, s^-\}$, where $s^+ = (o, w, +\eta')$ and $s^- = (o, w, -\eta')$, and that is

$$P(s^+ | s, d_o) = P(s^- | s, d_o) = 1/2.$$

(Thus it is assumed: i supposes only two possible differences in the qualities of life in countries o and j , namely that with index $+\eta'$ and that with index $-\eta'$, each with probability $1/2$.)

- (III) For any $s \in S_o$ the probability measure $P(\cdot | s, d_o)$ gets all its mass on the singular event $\{s\}$; i.e. if no remigration

7) The transition probability P is assumed to fulfill the following technical assumptions:

- i) $P(\cdot | s, d) : \bar{S} \rightarrow [0,1]$ is a probability measure on S for each $(s, d) \in S \times D$
ii) $P(S' | \cdot, \cdot) : S \times D \rightarrow [0,1]$ is a measurable mapping for each $S' \in \bar{S}$.

from o to j takes place in a period, then in the subjective view of i the situation will not change.

- (IV) For any $s = (o, w, q) \in S_o$ the probability measure $P(\cdot | s, d_j)$ gets all its mass on the singular event $\{(j, w, q)\}$ i.e. if i remigrates from o to j in a period, then only his country of residence will change while the other factors of the old state s remain constant.

To make the presentation of the MRDP complete the criterion function of the individual i has to be defined: At this a per period utility (return) function $u : S \times D \rightarrow R$ with

$$(3/1) \quad u((c, w, q), d) = \begin{cases} \ln w_j + & \text{for } d = d_j \\ \ln w_o + q & \text{for } d = d_o \end{cases}$$

is assumed; i.e. if the state in a specific period is $s = (c, w, q)$ and if the the decision d is taken, then in that period i gets a return $u((c, w, q), d)$. Furthermore let δ' denote the discounting factor assumed identical for all $i \in I_t$.

Then the objective of i is to choose a decision rule for the MRDP, such that the expected discounted sum of this per period utilities is maximized, starting from an initial state s_t .

Finally it is supposed, that each i is completely informed about the initial state of his MRDP.

Now using a simply dynamic programming argument (or equivalent applying the method of Gittins indices) the following characterizations of an optimal migration resp. remigration decision in the framework of the model of a MRDP as specified above can be given:⁸⁾

Proposition 1: Let an initial state $s_{j,t}^{(1)} = (j, w_t, q_{j,t}^{(1)})$ for the MRDP of $i \in I_{j,t}$ be given such that

8) For a detailed description and derivation of this result see Berninghaus/Seifert-Vogt (1987).

$$(3/2) \quad \ln w_{0t} - \eta' < \ln w_{jt} < \ln w_{0t} + \eta'$$

holds. Then i will migrate from j to o in period t , iff

$$(3/3) \quad q_{jt}^{(1)} > (\ln w_{jt} - \ln w_{0t})\delta - \eta$$

with $\delta := (1-\delta'/2)/(1-\delta')$, $\eta := \eta'\delta'/2(1-\delta')$

Proposition 2: Let an initial state $s_{0t}^{(1)} = (o, w_{0t}, q_{0t}^{(1)})$ for the MRDP of an $i \in I_{0t}$ be given. Then i will remigrate from o to j in period t , iff

$$(3/4) \quad q_{0t}^{(1)} < \ln w_{jt} - \ln w_{0t}$$

The formulas (3/3) and (3/4) will turn out to be one of the crucial relations for the further theoretical and econometrical analysis.

Proposition 2 says: A remigration from o to j will take place if and only if the index for the quality $q_{0t}^{(1)}$ and the wage w_{0t} for i in country o are so unfavorable that the utility for i after remigration to j will be greater than the utility for i , if he stays in o . This simple 'myopic' decision behavior is a consequence of the rule (IV) for the transition probability. - It should be remarked that the index $q_{0t}^{(1)}$ must not be identical with the estimation $\pm \eta'$ for this index from rule (II): $q_{0t}^{(1)}$ is a potential index of quality of life, i may actually be confronted with after migration from j to o .

The interpretation of Proposition 1 is: if i 's estimate $\pm \eta'$ of the index of the quality of life in country o in the future periods $t+1, t+2, \dots$ before migration to o is such that i would foresee his remigration in the case where the negative index $-\eta'$ would prevail - this is the content of formula (3/2) - then a migration of i from j to o will take place if and only if the index of the differences in quality of life $q_{jt}^{(1)}$ in the present period for country o is high enough compared with the present

value of the wage differentials and the future quality of life in country o .

3.2. THE MIGRATION AND REMIGRATION PROBABILITIES

Whereas it was supposed that each worker $i \in I_t$ is completely informed about his relevant initial state $s_{j,t}^{(1)} = (j, w_t, q_{j,t}^{(1)})$ resp. $s_{o,t}^{(1)} = (o, w_t, q_{o,t}^{(1)})$, the empirical analyst of this model will typically not be so well informed. Naturally this "incomplete information" will apply to the indices of the quality of life, more specifically to: $q_{j,t}^{(1)}$ and $q_{o,t}^{(1)}$, and to the subjective estimate η' and the discount factor δ' (resp. to η and δ ; compare Proposition 1).

A possible way out of this informational deficit which will be pursued in this paper consists of the following steps:

(A): It is assumed, that all workers $i \in I_{j,t}$ are homogenous with respect to the subjective factors of the MRDP: η' and δ' ; (and that of course they all have the same utility function (3/1)). Then η' and δ' resp. η and δ are treated as unknown parameters of the econometric model.

(B): a) The workers $i \in I_{j,t}$ may be different with respect to their initial quality of life indices $q_{j,t}^{(1)}$, in the following sense: There is a random variable $Q_{j,t}$ with c.d.f. $F_{j,t}$ such that each $q_{j,t}^{(1)}$, $i \in I_{j,t}$ is a realization of $Q_{j,t}$; and similarly:

b) The (guest)workers $i \in I_{o,t}$ may be different with respect to their initial quality of life indices $q_{o,t}^{(1)}$ in the sense: There is a random variable $Q_{o,t}$ with c.d.f. $F_{o,t}$ such that each $q_{o,t}^{(1)}$, $i \in I_{o,t}$, is a realization of $Q_{o,t}$.

c) The c.d.f.'s $F_{j,t}$ resp. $F_{o,t}$ are identical = F_j resp. F_o for all considered time periods t , and F_j and F_o are known.

These assumptions (A) and (B) seem to be convenient econometric practice and need no further comment here. Accepting them allows the straightforward derivation of the following propositions concerning the migration resp. remigration probabilities:

Proposition 3: Given the wages w_{jt} and w_{ot} , then the probability that any $i \in I_{jt}$ will migrate from j to o in period t is equal to

$$(3/5) \quad \Pi_j(w_{jt}, w_{ot}; \delta, \eta) := 1 - F_j((\ln w_{jt} - \ln w_{ot})\delta - \eta)$$

This follows easily from (A) and (B) combined with Prop. 1.

Proposition 4: Given the wages w_{jt} and w_{ot} , then the probability that any $i \in I_{ot}$ will remigrate from o to j in period t is equal to

$$(3/6) \quad \Pi_o(w_{jt}, w_{ot}) := F_o(\ln w_{jt} - \ln w_{ot})$$

Again this is obvious, by (A), (B) and Prop. 2.

4. THE MARKOV TRANSITION PROBABILITIES FOR THE PROCESS (Y_t) WITH REALIZATIONS $y_t = (l_{jt}, l_{ojt}, m_{jt}, r_{jt})$

It is the aim of this section to specify in complete detail the transition probabilities

$$\text{Prob} [L_{jt} \leq l_{jt}, L_{ojt} \leq l_{ojt}, M_{jt} = m_{jt}, R_{jt} = r_{jt} | Y_{t-1} = y_{t-1}]$$

with $y_{t-1} = (l_{j,t-1}, l_{oj,t-1}, m_{j,t-1}, r_{j,t-1})$ for the stochastic process (Y_t) . This specification will be based on the wage functions (2/6) and (2/7), on the individual migration probabilities given in (3/5) and (3/6), and on the following assumptions:

(C.1) Each individual $i \in I_{jt}$ has the equal probability $\Pi_j(w_{jt}, w_{ot}; \delta, \eta)$ of being a migrant from j to o in period t , and for different individuals these probabilities are independent.

(C.2) Each individual $i \in I_{ot}$ has the equal probability $\Pi_o(w_{jt}, w_{ot})$ of being a remigrant from o to j in period t , and for different individuals these probabilities are independent.

(C.3) There are real numbers \bar{g}_{jt} and \bar{g}_{ot} ($t=1, \dots, T$), such that the residuals g_{jt} resp. g_{ojt} can be written as

$$(4/1) \quad g_{jt} = \bar{g}_{jt} + e_{jt} \quad \text{resp.} \quad g_{ojt} = \bar{g}_{ot} + e_{ot}$$

where the e_{jt} and e_{ot} are mutually and serially independent random variables with c.d.f. Φ_{jt} resp. Φ_{ot} .

The idea leading to (C.1) resp. (C.2) is to consider the sets I_{jt} resp. I_{ot} of workers in j at the beginning of period t resp. of guest-workers from j in o at the beginning of t as a sample out of the population of all workers in j at all periods resp. of all guest-workers from j at o at all periods and then to look for the individuals with characteristic "migrant from j to o " resp. "remigrant from o to j ". Then it is supposed in (C.1) resp.

(C.2), that this samples are $l_{j,t-1} = |I_{jt}|$ resp. $l_{o,j,t-1} = |I_{ot}|$ independent Bernoulli trials with success probability $\Pi_j(w_{jt}, w_{o,j,t}; \delta, \eta)$ resp. $\Pi_o(w_{jt}, w_{ot})$.

In (C.3) it is assumed that the residuals $g_{jt} = l_{jt} - l_{j,t-1} + m_{jt} - r_{jt}$ resp. $g_{o,j,t} = l_{o,j,t} - l_{o,j,t-1} - m_{jt} + r_{jt}$ may be decomposed into a deterministic part \bar{g}_{jt} resp. \bar{g}_{ot} (whose estimation will be tried in sections 5 resp. 6) and an unpredictable stochastic part with known probabilistic law.

Since $l_{j,t-1} = |I_{jt}|$ resp. $l_{o,j,t-1} = |I_{ot}|$ we get from (C.1) resp. (C.2)

Proposition 5: With w_{jt} resp. $w_{o,j,t}$ given by the wage equations

$$(2/6) \quad \ln w_{o,j,t} = \alpha_{oj} + \beta_{oj} \lambda_{o,j,t-1} + \sum_{k \neq j} \epsilon_k \lambda_{ok,t-1}$$

$$(2/7) \quad \ln w_{jt} = \alpha_j + \beta_j \lambda_{jt-1}$$

the conditional probability that the (discrete) random variable M_{jt} takes the value m_{jt} , given $Y_{t-1} = y_{t-1}$, is:

$$(4/2) \quad \text{Prob} [M_{jt} = m_{jt} | Y_{t-1} = y_{t-1}] = \begin{bmatrix} l_{j,t-1} \\ m_{jt} \end{bmatrix} [\Pi_j(w_{jt}, w_{o,j,t}; \delta, \eta)]^{m_{jt}} [1 - \Pi_j(w_{jt}, w_{o,j,t}; \delta, \eta)]^{l_{j,t-1} - m_{jt}}$$

Proposition 6: Again with w_{jt} resp. w_{ot} given by (2/6) by (2/7) the conditional probability that the (discrete) random variable R_{jt} takes the value r_{jt} , given $Y_{t-1} = y_{t-1}$, is:

$$(4/3) \quad \text{Prob} [R_{jt} = r_{jt} | Y_{t-1} = y_{t-1}] = \begin{bmatrix} l_{o,j,t-1} \\ r_{jt} \end{bmatrix} [\Pi_o(w_{jt}, w_{o,j,t})]^{r_{jt}} [1 - \Pi_o(w_{jt}, w_{o,j,t})]^{l_{o,j,t-1} - r_{jt}}$$

As an obvious implication from (C.3) the following relation may be established

Proposition 7: Given $M_{jt} = m_{jt}$ and $R_{jt} = r_{jt}$, the conditional probabilities that the random variable L_{jt} resp. $L_{o,j,t}$ takes values $\leq l_{jt}$ resp. $l_{o,j,t}$, given $Y_{t-1} = y_{t-1}$, are:

$$(4/4) \quad \text{Prob} [L_{jt} \leq l_{jt} | M_{jt} = m_{jt}, R_{jt} = r_{jt}, Y_{t-1} = y_{t-1}] \\ = \Phi_{jt}(l_{jt} - l_{jt-1} + m_{jt} - r_{jt} - \bar{g}_{jt}), \quad \text{resp.}$$

$$(4/5) \quad \text{Prob} [L_{o,j,t} \leq l_{o,j,t} | M_{jt} = m_{jt}, R_{jt} = r_{jt}, Y_{t-1} = y_{t-1}] \\ = \Phi_{ot}(l_{o,j,t} - l_{o,j,t-1} - m_{jt} + r_{jt} - \bar{g}_{ot})$$

If now the results of Propositions 5, 6 and 7 are combined, this yields:

Proposition 8: The stochastic process (Y_t) is indeed a Markov process under the assumptions made so far, where the transition probabilities are given by

$$(4/6) \quad \text{Prob}[L_{jt} \leq l_{jt}, L_{o,j,t} \leq l_{o,j,t}, M_{jt} = m_{jt}, R_{jt} = r_{jt} | Y_{t-1} = y_{t-1}] \\ = \text{Prob}[L_{jt} \leq l_{jt} | M_{jt} = m_{jt}, R_{jt} = r_{jt}, Y_{t-1} = y_{t-1}] \cdot \\ \cdot \text{Prob}[L_{o,j,t} \leq l_{o,j,t} | M_{jt} = m_{jt}, R_{jt} = r_{jt}, Y_{t-1} = y_{t-1}] \cdot \\ \cdot \text{Prob}[M_{jt} = m_{jt} | Y_{t-1} = y_{t-1}] \cdot \text{Prob}[R_{jt} = r_{jt} | Y_{t-1} = y_{t-1}]$$

where the probabilities in the product of the right-hand side are given by (4/4), (4/5), (4/2) and (4/3).

This formula (4/6) will consist the starting point for the specification of the likelihood function which will be used for the econometric estimation.

5. THE ECONOMETRIC SPECIFICATIONS AND THE LIKELIHOOD FUNCTION

In order to obtain a form of the model which can be estimated by usual econometric methods some further specifying restrictions must be introduced.

(D.1) In the wage equation (2/6) for $w_{j,t}$ the term $\sum_{k \neq j} \varepsilon_k \lambda_{o,k,t-1}$ can be approximated in a sufficient way by $\beta'_{o,j} \lambda'_{o,j,t-1}$ with $\lambda'_{o,j,t} := \sum_{k \neq j} \lambda_{o,k,t}$

(D.2) The random variable $K_{j,t} := (-1)Q_{j,t}$ with $Q_{j,t}$ as introduced in (B)a), is exponentially distributed with hazard rate 1; i.e.

$$(5/1) \quad \Pi_j(w_{j,t}, w_{o,j,t}; \delta, \eta) = 1 - \exp[(\ln w_{j,t} - \ln w_{o,j,t})\delta - \eta]$$

(D.3) The random variable $Q_{o,t}$ as introduced in (B)b) is logistically distributed with location parameter 0 and scale parameter 1, i.e.

$$(5/2) \quad \Pi_o(w_{j,t}, w_{o,j,t}) = \{1 + \exp[\ln w_{o,j,t} - \ln w_{j,t}]\}^{-1} \\ = 1 - \{1 + \exp[\ln w_{j,t} - \ln w_{o,j,t}]\}^{-1}$$

(D.4) The random variables $\lambda_{j,t}$ resp. $\lambda_{o,t}$ as introduced in (C.3) are all identically standard normally distributed, i.e.

$$\Phi_{j,t} = \Phi_{o,t} =: \Phi$$

where Φ is c.d.f. of the standard normal distribution.

(D.5) There are real numbers $x_{j,t}$ resp. $x_{o,t}$ ($t=1, \dots, T$) and (unknown) parameters $a_{j,1}, a_{j,2}, a_{o,1}, a_{o,2}$ such that

$$((5/3) \quad \bar{g}_{k,t} = a_{k,1} + a_{k,2} x_{k,t} \quad (k = j, o),$$

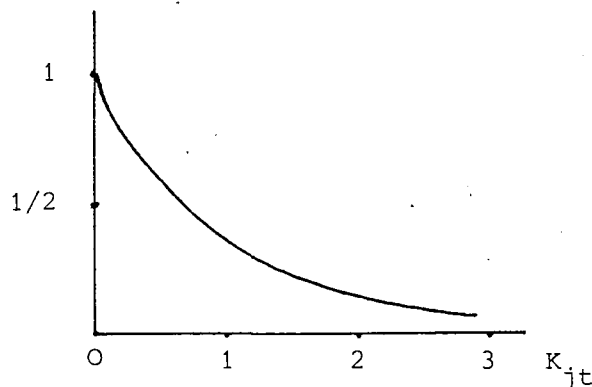
i.e. such that the residuals $g_{j,t}$ resp. $g_{o,j,t}$ can be linearly approximated by $x_{j,t}$ resp. $x_{o,t}$.

Remarks

1. The simplification (D.1) is admittedly not entirely consistent with the derivation of the wage function from the marginal productivity approach, applied to the Cobb-Douglas

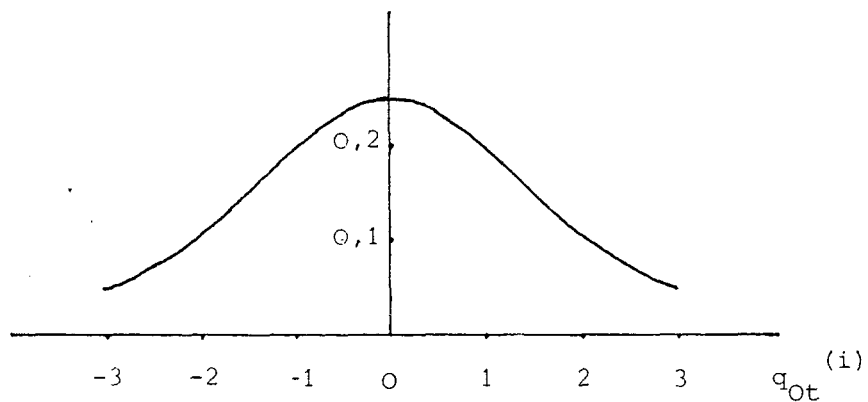
production function, except for the case, where all elasticities of substitution ϵ_k , for $k \neq j$, would be identical. But this simplifying assumption must be made in order to restrict the number of parameters which must be estimated - and it is claimed that this assumption is justifiable as a first approach.

2. Remembering the meaning of Q_{jt} as that random variable whose realizations are the indices $q_{jt}^{(1)}$ of the quality of life for the individuals $i \in I_{jt}$ they are confronted with in the first period in the case they migrate from j to o it seems natural to interpret the realizations of K_{jt} as the (nonpecuniary) costs of migration. Then in (D.2) it is asserted, that these costs are nonnegative with probability one, and that their density function is of the shape



The standardization of the hazard rate is an identifying assumption, i.e. if the hazard rate would be an unknown parameter, the model would not be identifiable in general.

3. Assuming that the random variable Q_{ot} whose realizations are the indices $q_{ot}^{(1)}$ of the quality of life which the individuals $i \in I_{ot}$ experience as guest workers in o , amounts to suppose the following approximately normal shape of the density of Q_{ot} :



Again the (0,1)-standardization is made for reasons of identification.

A brief look on the probabilities Π_j resp. Π_0 shows that the parameters α_j and α_0 , from the wage functions cannot be identified separately but only the difference

$$(5.4) \quad \alpha := \alpha_j - \alpha_0$$

Thus the unknown parameters of the model which must be estimated are the components of the parameter vectors

$$(5/5) \quad \mu := (\beta_{0j}, \beta'_{0j}, \beta_j, \alpha, \delta, \eta)$$

and

$$(5/6) \quad \nu := (a_{01}, a_{02}, a_{j1}, a_{j2})$$

The data which are used for the estimation are $(y_t)_{t=0, \dots, T}$ with $y_t := (l_{jt}, l_{0j,t}, m_{jt}, r_{jt})$, $(x_{0t})_{t=1, \dots, T}$ and $(x_{jt})_{t=1, \dots, T}$. Here the vectors y_t ($t=1, \dots, T$) are endogenous, while the x_{0t} , x_{jt} and y_0 are exogenous.

Then the log-likelihood function L can be written as:

$$\begin{aligned}
 L(\mu, \bar{n}; y_1, \dots, y_T) & \stackrel{9)}{=} \sum_{t=1}^T \left\{ \ln \begin{bmatrix} l_{j,t-1} \\ m_{j,t} \end{bmatrix} + \right. \\
 & + m_{j,t} \ln(1 - \exp[(\alpha + \beta_j \lambda_{j,t-1} - \beta_{0j} \lambda_{0j,t-1} - \beta'_{0j} \lambda'_{0j,t-1}) \delta - \eta]) \\
 & + (l_{j,t-1} - m_{j,t}) [(\alpha + \beta_j \lambda_{j,t-1} - \beta_{0j} \lambda_{0j,t-1} - \beta'_{0j} \lambda'_{0j,t-1}) \delta - \eta] \} \\
 & + \sum_{t=1}^T \left\{ \ln \begin{bmatrix} l_{0j,t-1} \\ r_{j,t} \end{bmatrix} - r_{j,t} \ln(1 + \exp[-\alpha - \beta_j \lambda_{j,t-1} + \right. \\
 & \quad + \beta_{0j} \lambda_{0j,t-1} + \beta'_{0j} \lambda'_{0j,t-1}]) - (l_{0j,t-1} - r_{j,t}) \cdot \\
 & \quad \cdot \ln(1 + \exp[\alpha + \beta_j \lambda_{j,t-1} - \beta_{0j} \lambda_{0j,t-1} - \beta'_{0j} \lambda'_{0j,t-1}]) \} \\
 & + \sum_{t=1}^T \left\{ -\ln(2\pi) - \frac{1}{2} (l_{j,t} - l_{j,t-1} + m_{j,t} - r_{j,t} - a_{j1} - a_{j2} x_{j,t})^2 - \right. \\
 & \quad \left. - \frac{1}{2} (l_{0j,t} - l_{0j,t-1} - m_{j,t} + r_{j,t} - a_{01} - a_{02} x_{0,t})^2 \right\}
 \end{aligned}$$

The parameter vector (μ, \bar{n}) will be estimated as the maximizer of $L(\cdot; y_1, \dots, y_T)$. Since L is additively separable in μ and \bar{n} , this estimation may be carried through by two independent steps. - The results of this estimation procedure will be reported in section 6 and its economic implications will be discussed in section 7.

9) The likelihood function L' with $L = \ln L'$ is of a mixed continuous/discrete type, i.e.

$$\begin{aligned}
 L'(\mu, \bar{v}; y_1, \dots, y_T) & = \prod_{t=1}^T \text{Prob}[M_{j,t} = m_{j,t} | y_{t-1}] \cdot \text{Prob}[R_{j,t} = r_{j,t} | y_{t-1}] \cdot \\
 & \quad \cdot \varphi(g_{j,t} - g_{j,t}) \cdot \varphi(g_{0j,t} - g_{0,t})
 \end{aligned}$$

where φ is the standard normal density function

$$\varphi(l) = (2\pi)^{-\frac{1}{2}} \exp(-\frac{1}{2} l^2)$$

6. THE ECONOMETRIC ESTIMATION: THE GREEK CASE¹⁰⁾

The estimation is based on the following data for the years 1970

(t = 0), to 1984 (t = 14)

Erwerbspersonen eines Landes in der BRD:

Land: 1	Jahr: 0	Anzahl: 229891
Land: 1	Jahr: 1	Anzahl: 263170
Land: 1	Jahr: 2	Anzahl: 272036
Land: 1	Jahr: 3	Anzahl: 252214
Land: 1	Jahr: 4	Anzahl: 242874
Land: 1	Jahr: 5	Anzahl: 221478
Land: 1	Jahr: 6	Anzahl: 189830
Land: 1	Jahr: 7	Anzahl: 170224
Land: 1	Jahr: 8	Anzahl: 153881
Land: 1	Jahr: 9	Anzahl: 146367
Land: 1	Jahr: 10	Anzahl: 138841
Land: 1	Jahr: 11	Anzahl: 132632
Land: 1	Jahr: 12	Anzahl: 128380
Land: 1	Jahr: 13	Anzahl: 122410
Land: 1	Jahr: 14	Anzahl: 112463
<hr/>		
Land: 2	Jahr: 0	Anzahl: 328856
Land: 2	Jahr: 1	Anzahl: 427321
Land: 2	Jahr: 2	Anzahl: 501828
Land: 2	Jahr: 3	Anzahl: 610420
Land: 2	Jahr: 4	Anzahl: 638676
Land: 2	Jahr: 5	Anzahl: 600011
Land: 2	Jahr: 6	Anzahl: 556425
Land: 2	Jahr: 7	Anzahl: 543723
Land: 2	Jahr: 8	Anzahl: 544359
Land: 2	Jahr: 9	Anzahl: 568778
Land: 2	Jahr: 10	Anzahl: 628020
Land: 2	Jahr: 11	Anzahl: 644366
Land: 2	Jahr: 12	Anzahl: 648999
Land: 2	Jahr: 13	Anzahl: 626440
Land: 2	Jahr: 14	Anzahl: 603882
<hr/>		
Land: 3	Jahr: 0	Anzahl: 376167
Land: 3	Jahr: 1	Anzahl: 407761
Land: 3	Jahr: 2	Anzahl: 425826
Land: 3	Jahr: 3	Anzahl: 454009
Land: 3	Jahr: 4	Anzahl: 355184
Land: 3	Jahr: 5	Anzahl: 325697
Land: 3	Jahr: 6	Anzahl: 297417
Land: 3	Jahr: 7	Anzahl: 299356
Land: 3	Jahr: 8	Anzahl: 306980
Land: 3	Jahr: 9	Anzahl: 316987
Land: 3	Jahr: 10	Anzahl: 326603
Land: 3	Jahr: 11	Anzahl: 318593
Land: 3	Jahr: 12	Anzahl: 296200
Land: 3	Jahr: 13	Anzahl: 273504
Land: 3	Jahr: 14	Anzahl: 250808

Source: Stat. Bundesamt: Jahrbuch

L_{01t}

1 = Greece

L_{02t}

2 = Turkey

L_{03t}

3 = Italy

10) Since at the moment I've not yet got satisfactory data for all relevant countries sending guest workers to W-Germany, the estimation is only carried through for Greece in this first version of the paper I hope to get the necessary data for Italy, Turkey, Yugoslavia, Spain and Portugal within the next weeks, so that the estimation for these countries can be established too. Only then the desired comparisons may be carried through and discussed.

Land: 4	Jahr: 0	Anzahl: 389531
Land: 4	Jahr: 1	Anzahl: 470761
Land: 4	Jahr: 2	Anzahl: 474092
Land: 4	Jahr: 3	Anzahl: 537679
Land: 4	Jahr: 4	Anzahl: 483909
Land: 4	Jahr: 5	Anzahl: 446187
Land: 4	Jahr: 6	Anzahl: 406304
Land: 4	Jahr: 7	Anzahl: 389978
Land: 4	Jahr: 8	Anzahl: 382335
Land: 4	Jahr: 9	Anzahl: 378688
Land: 4	Jahr: 10	Anzahl: 368985
Land: 4	Jahr: 11	Anzahl: 360468
Land: 4	Jahr: 12	Anzahl: 345127
Land: 4	Jahr: 13	Anzahl: 334032
Land: 4	Jahr: 14	Anzahl: 322937

lost

4 = Yugoslavia

Land: 5	Jahr: 0	Anzahl: 166102
Land: 5	Jahr: 1	Anzahl: 184333
Land: 5	Jahr: 2	Anzahl: 185044
Land: 5	Jahr: 3	Anzahl: 191072
Land: 5	Jahr: 4	Anzahl: 162374
Land: 5	Jahr: 5	Anzahl: 136994
Land: 5	Jahr: 6	Anzahl: 116020
Land: 5	Jahr: 7	Anzahl: 104032
Land: 5	Jahr: 8	Anzahl: 96058
Land: 5	Jahr: 9	Anzahl: 93247
Land: 5	Jahr: 10	Anzahl: 89539
Land: 5	Jahr: 11	Anzahl: 86147
Land: 5	Jahr: 12	Anzahl: 81938
Land: 5	Jahr: 13	Anzahl: 78200
Land: 5	Jahr: 14	Anzahl: 74418

lost

5 = Spain

Land: 6	Jahr: 0	Anzahl: 40265
Land: 6	Jahr: 1	Anzahl: 55315
Land: 6	Jahr: 2	Anzahl: 63287
Land: 6	Jahr: 3	Anzahl: 85219
Land: 6	Jahr: 4	Anzahl: 83234
Land: 6	Jahr: 5	Anzahl: 72807
Land: 6	Jahr: 6	Anzahl: 65156
Land: 6	Jahr: 7	Anzahl: 61383
Land: 6	Jahr: 8	Anzahl: 60051
Land: 6	Jahr: 9	Anzahl: 60359
Land: 6	Jahr: 10	Anzahl: 60085
Land: 6	Jahr: 11	Anzahl: 57282
Land: 6	Jahr: 12	Anzahl: 54403
Land: 6	Jahr: 13	Anzahl: 49204
Land: 6	Jahr: 14	Anzahl: 44006

lost

6 = Portugal

Erwerbspersonen im Heimatland: (Greece)

Jahr: 0	Anzahl: 3223000
Jahr: 1	Anzahl: 3235000
Jahr: 2	Anzahl: 3248000
Jahr: 3	Anzahl: 3216000
Jahr: 4	Anzahl: 3274000
Jahr: 5	Anzahl: 3288000
Jahr: 6	Anzahl: 3302000
Jahr: 7	Anzahl: 3318000
Jahr: 8	Anzahl: 3337000
Jahr: 9	Anzahl: 3375000
Jahr: 10	Anzahl: 3451000
Jahr: 11	Anzahl: 3678000
Jahr: 12	Anzahl: 3718000
Jahr: 13	Anzahl: 3841000
Jahr: 14	Anzahl: 3868000

lit

Source: Stat. Bundesamt, jährl. Länderberichte

Migranten und Remigranten:

Jahr:	Anzahl:	Anzahl:	Anzahl:
Jahr: 1	Anzahl: 41943	Anzahl: 25499	
Jahr: 2	Anzahl: 26715	Anzahl: 27982	
Jahr: 3	Anzahl: 14309	Anzahl: 27014	
Jahr: 4	Anzahl: 6838	Anzahl: 26375	
Jahr: 5	Anzahl: 4052	Anzahl: 33193	
Jahr: 6	Anzahl: 4410	Anzahl: 27675	
Jahr: 7	Anzahl: 4458	Anzahl: 21470	
Jahr: 8	Anzahl: 4863	Anzahl: 15685	
Jahr: 9	Anzahl: 4833	Anzahl: 12011	
Jahr: 10	Anzahl: 5575	Anzahl: 8938	
Jahr: 11	Anzahl: 6995	Anzahl: 5075	
Jahr: 12	Anzahl: 4618	Anzahl: 6759	
Jahr: 13	Anzahl: 3372	Anzahl: 6007	
Jahr: 14	Anzahl: 2600	Anzahl: 4280	

Source: Stat. Bundesamt, Fachserie
"Ausgewählte Strukturdaten
für Ausländer"

m_{jt} , r_{jt}

Unconstrained (!) maximization of the log-likelihood function L from section 5 yields the following results:

a) For $\mu := (\beta_{01}, \beta'_{01}, \beta_1, \alpha, \delta, \eta)$

Index: 1	Wert:	-1.63113640797553261000
Index: 2	Wert:	0.22538309653707717900
Index: 3	Wert:	-1.89725632458697868000
Index: 4	Wert:	20.19082812036988980000
Index: 5	Wert:	-0.00362500841970298042
Index: 6	Wert:	0.01178239079406102640

b) For $\nu := (a_{01}, a_{02}, a_{11}, a_{12})$

a_{01}	9462.7
a_{02}	-1309.8
a_{11}	-24574.5
a_{12}	8349.2

Here the 'exogenous' variables $x_{0t} \equiv t$ resp. $x_{1t} \equiv t$ have been used. The corresponding Durbin-Watson statistics are

$$d_0 = 2.52 \quad \text{and} \quad d_1 = 2.23$$

The estimation for ν is only an instrument to test the assumption in (C.3), that the residuals $g_{jt} = l_{jt} - l_{j,t-1} + m_{jt} - r_{jt}$ resp. $g_{0jt} = l_{0jt} - l_{0j,t-1} - m_{jt} + r_{jt}$ can be written as $g_{jt} = a_{j1}t + a_{j2}t + e_{jt}$ resp. $g_{0jt} = a_{01} + a_{02}t + e_{0jt}$ where the e_{jt} resp. e_{0jt} are serially uncorrelated. As seen from the Durbin-Watson statistics d_0 and d_1 this hypothesis cannot be rejected by the data for $j = 1$, i.e. for the Greek case.

The first four components of μ refer to the parameters of the wage functions

$$(2/6)^* \quad \ln w_{0,t} = \alpha_{0,1} + \beta_{0,1} \ln l_{0,1,t-1} + \beta'_{0,1} \sum_{k=2}^6 l_{0,k,t-1}$$

$$(2/7) \quad \ln w_{1,t} = \alpha_1 + \beta_1 \ln l_{1,t-1}$$

where $\alpha = \alpha_1 - \alpha_{0,1}$.

The results under a) show that the slope parameters $\beta_{0,1}$, $\beta'_{0,1}$ and β_1 all have an economically meaningful sign, but that neither $\beta_{0,1}$ nor β_1 allow an interpretation as an elasticity of substitution minus one with such an elasticity lying between 0 and 1, nor even greater 0. If the estimations for δ and η are transformed - according to Proposition 1 - into the discount rate

$$\delta' = (\delta - 1) / (\delta - \frac{1}{2})$$

and the Greek migrant's estimation of the quality of life in W-Germany

$$\eta' = 2\eta(1 - \delta') / \delta'$$

the following results are obtained: $\delta' \approx 2$, $\eta' \approx 0.0118$. The obvious problem with this estimation for δ' is two-fold: it seems highly implausible and - a fortiori - it is not in accordance with the theoretical model where $0 < \delta' < 1$ is a crucial assumption for the derivation of the results in Proposition 1. I guess that this poor result may be explained by the application of an unconstrained maximization procedure; (neither the restrictions $0 < \delta' < 1$ resp. $1 < \delta' < \infty$ nor the inequality (3/12): $\ln w_{0,t} - \eta' < \ln w_{1,t} + \eta'$ resp. $\eta / (\delta - 1) > \ln w_{0,t} - \ln w_{1,t}$ have been taken into consideration). Unfortunately I have not yet been able to try out whether with an appropriate constrained maximization procedure better results could be obtained, (but this gap will hopefully soon be filled!).

7. CONCLUDING REMARKS

In this paper an attempt has been made to construct an econometric model of guest worker migrations and remigrations from various sending countries to W-Germany. This model has its foundation in a work of J. McCall (1984) to capture the important aspect of incomplete information in international migration by a sequential decision making approach under uncertainty. Building on an elaborated version of this approach in Berninghaus/Seifert-Vogt (1987) individual migration and remigration probabilities depending on the wages in the home country and the guest country and an subjective estimation of the quality of life difference between both countries have been derived. Assuming that each migrant resp. remigrant can be seen as a "success" in a Bernoulli trial with those respective probabilities, the probabilities for specific numbers of migrants and remigrants are implied. Combining this with some simple wage theory a vector-valued Markov process can be modeled with the numbers of migrants and remigrants as two of its components. The likelihood function of the econometric model is then derived from the transition probabilities of this Markov process. Finally an estimation of the relevant model parameters is carried through, for the present only for the guest worker migration between Greece and W-Germany.

There are two urgent open problems: First, the estimation by maximization of the log-likelihood function must be improved in order to get more plausible results than at the moment, especially (and above all) for the parameters which are closely related to the sequential decision making model. Second, if dates about the "Erwerbsspersonen im Heimatland" l_{jt} , for $j = 2, \dots, 6$ are available,¹¹⁾ the estimation for the guest worker migrations between these remaining countries $j = 2, \dots, 6$ should be done.

11) The respective numbers m_{jt} and r_{jt} of migrants and remigrants are available.

The practical purpose of the work begun with this paper is an attempt to find out whether there are significant differences in those parameters which may be seen as crucial for the migration and remigration decisions, especially the discount rate δ' and the subjective estimation of the difference in the quality of life between home and guest country, η' .

As is argued in McCall (1984) and Berninghaus/Seifert-Vogt (1987), higher values of η' may be interpreted as more uncertainty resp. less information about the guest country. Thus the estimations of η' , if they will turn out to be 'good', will yield insights into the variation of the degrees of this uncertainty resp. of this information between different countries.

Finally it should be remarked, that it seems a very challenging task for future research to generalize the model of this paper to a "general equilibrium" model, where - at least principally - the interdependencies between the labour markets of all sending countries and the guest country could be regarded.

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