THE DYNAMICS OF SPATIAL LABOR
MOBILITY IN THE NETHERLANDS

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FOREWORD

Sharply reduced rates of population and industrial growth
have been projected for many of the developed nations in the
1980s. In economies that rely primarily on market mechanisms
to redirect capital and labor from surplus to deficit areas,
the problems of adjustment may be slow and socially costly. In
the more centralized economies, increasing difficulties in
determining investment allocations and inducing sectoral redis-
tributions of a nearly constant or diminishing labor force may
arise. The socioeconomic problems that flow from such changes
in labor demands and supplies form the contextual background
of the Manpower Analysis Task, which is striving to develop
methods for analyzing and projecting the impacts of interna-
tional, national, and regional population dynamics on labor
supply, demand, and productivity in the more-developed nations.

As part of the subtask that focuses on regional and urban
labor markets, this study investigates spatial and temporal
characteristics of internal labor migration in the Netherlands.
The authors apply a two-stage migration model, that is described
more extensively in a companion paper (Liaw and Bartels 1981),
to recent data on interprovincial flows of labor migrants. This
empirical analysis demonstrates that the conditions of both
national and regional labor markets are among the determinants
of the patterns of aggregate labor migration. Among the non-
economic factors, housing suppy is found to assume a dominant
position.

Publications in the Manpower Analysis Task series are listed
at the end of this paper.

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ABSTRACT

The spatial mobility of labor changes over time. Both the
general propensity to migrate and the spatial allocation of
mobile people over regions of destination are characterized by
important dynamic properties. This paper discusses several
factors that may explain these dynamic properties of internal
labor migration. We focus especially on the influence of labor
market and housing conditions on the mobility of people. A two-
stage, generation-allocation model is proposed, to investigate
the role of different factors in the explanation of aggregate
interregional migration flows. This model is applied to recent
data on interprovincial labor migration in the Netherlands. The
results indicate that housing supply seems to be an important
determinant of temporal developments of spatial mobility, and
also that the conditions of national and regional labor markets
are associated with specific properties of recent migration
patterns.

CONTENTS

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1. INTRODUCTION

In the period 1960-65 approximately 42 out of 1,000 persons
annually changed their municipality (*gemeente*) of residence in
the Netherlands. This number had increased to 52 on the average
in 1970-75. A peak of 53 was reached in 1973, and since then a
continuous decrease has occurred. Now this mobility index is
again equal to its value in the first half of the sixties.

This temporal development occurred in a roughly similar way
in the different provinces. However, the level around which
these fluctuations occurred differed considerably between prov-
inces. Extreme values were registered for Utrecht, with between
50 and 65 migrants per 1,000 inhabitants annually in 1960-75, and
Overijssel, where this number fluctuated between 38 and 44.

At the same time, interprovincial migration probabilities
appeared to change as well. Significant breaks in the direction
of the migration flows seem to have occurred in 1963 and 1973:
since 1963 the interprovincial migration probabilities became
each year more different from those in the fifties, while since
1973 an opposite trend is observed [compare van der Knaap and
Sleegers 1978, and also the various publications of the CBS
(Central Bureau of Statistics) concerning migration].

These observations demonstrate that the aggregate pattern of spatial mobility of people alters substantially over time. It is the objective of this paper to study the factors that contribute to the variations in this spatial mobility over time and in space.

The explanatory analysis will be restricted to the spatial mobility of a certain group of people, the labor force, during a recent period, the seventies. We shall especially investigate the influence of labor market circumstances in the seventies on the level and structure of spatial labor mobility. Their influence will be compared with that of other explanatory factors, like housing supply and living conditions. With an estimation of the relative importance of such factors for the changing pattern of interprovincial migration, we hope to obtain an assessment of possibilities for government intervention in the migration process. Furthermore, the results are useful for a judgement about the possibilities to obtain quantitative forecasts of labor mobility, by means of a simple quantified model.

We shall start our discussion with the presentation of some ideas and observations that form the point of departure for the subsequent analysis. Then we argue for a specific modeling approach that seems to be attractive for the disentanglement of separate influences in a combined time-series/cross-section study. We give detailed information on the specification of the variables that are used for the estimation of the model. The estimation is done for annual labor mobility between the 11 Dutch provinces for the period 1971-78. A discussion of the results of the empirical application concludes the paper.

2. BACKGROUND IDEAS AND OBSERVATIONS

The desirability of studying internal migration in its temporal context has been stressed by previous studies in this field (Hart 1975, Willis 1974). Few of the many empirical and theoretical migration studies have followed this advice. It is therefore difficult to find in the existing literature a useful framework for analyzing aggregate migration flows over time.

Theoretical migration studies have been formulated completely in terms of individual decision making. Indications of how to apply the theoretical concepts to aggregate data are generally missing. Besides, the temporal context in which the migration decision is taken is generally ignored. These characteristics apply to the now popular search theories (Karlqvist and Snickars 1977, Miron 1978, Rogerson and MacKinnon 1980, Schwartz 1976, Sugden 1980).

Empirical studies of aggregate migration data are mostly limited to the analysis of a cross section of migration data for one point in time or for one period. Dynamic influences are then again ignored. This type of study dominates the empirical migration literature. Some typical references are Creedy (1974), Fields (1976), Hart (1972, 1973), Liu (1975), Muth (1971), and Oliver (1964).

A small number of empirical studies have used time-series data, or cross-section data for different points or periods in time. But these studies frequently possess less attractive and less generalizable properties, such as the focus on net migration data instead of gross flows (Liu 1980, Suijker 1980), a one-sided selection of explanatory variables (Bell and Kirwan 1979), a non-parsimonious selection of variables which makes the model inappropriate for use in forecasting experiments (Liu 1980), or a relatively weak investigation of the temporal context of the migration process (Arora and Brown 1978).

Not having available a clear cut framework for analyzing temporal and regional variations in the spatial mobility of people, we shall first develop some ideas that are useful points of departure for the estimation of a macro migration model. The ideas are derived from theoretical reasoning and empirical observations for different types of migration data. Later in this paper we shall apply these ideas specifically to labor migration.

In discussing the dynamics of aggregate internal migration patterns, there are at least three aspects that require explicit attention. The first aspect concerns temporal variations in the

general propensity to migrate. The second aspect is related to the interregional variations in this propensity to migrate, which may exhibit a pattern that changes over time. The third aspect relates to changes in the distribution of people who leave a region over different regions of destination. We shall discuss each of these aspects more extensively. [A more detailed description of these dynamic aspects in Dutch internal migration data can be found in van der Knaap and Sleegers (1978)].

The *general propensity to migrate* may be approximated by the relative number of persons who did change their residence within a given period of time. This general migration propensity changes over time, as we described already in the introduction. Additional evidence for changes in the spatial mobility of people can be found in a long time series for internal population migration in the Netherlands. Using the relative number of persons who moved in a certain year from one municipality to another as a mobility indicator, one can observe values varying between 40 and 69 per 1000 inhabitants for the years in the period 1920-78 (CBS 1978). In more recent years, this mobility index showed a decline for 1953-63, an increase for 1963-73, and a decline again since 1973 (see also van der Knaap and Sleegers 1978).

Several types of explanation are possible for these variations in the general mobility rate. A first explanation is the changing composition of the population. Spatial mobility differs considerably for different groups of people, e.g., subdivided according to age, sex, occupation, and education (Grant and Vanderkamp 1976, Rogers 1979, Willis 1974). A constant propensity to migrate for more homogeneous subgroups of population and a changing composition of the population, could contribute to changes in the overall mobility index.

This explanation makes sense if certain secular trends in mobility exist that are consistent with developments in the population structure. For example, the increase in the average level of schooling of the population would have caused an increase in spatial mobility, because this mobility is generally higher

the higher the level of schooling. Also the shift from manual
to clerical work would be consistent with higher overall mobility,
because white collar workers are more mobile than blue collar
workers. Secular changes in the age composition of the popula-
tion could have contributed to the secular trend in mobility.
The problem with these kinds of explanations is that they would
imply mainly a secular increase in spatial mobility, while in
fact rather a decrease seems to have taken place. Furthermore,
there are also significant short-run fluctations in the mobility
data that cannot easily be attributed to the above arguments.

An alternative, and additional, explanation for temporal
variations in the general-mobility rate is that also the mobility
rates of relatively homegeneous subgroups of the population
change over time for certain reasons. Migration involves a
change in the house one occupies, and in case of labor migration
it may also involve a change in work place. Several micro- and
macrostudies of internal migration have demonstrated that housing
and labor market variables are among the most important deter-
minants of the spatial mobility patterns (Bartel 1979, Bonnar
1979, Greenwood 1980, Rogers and Castro 1979, Simpson 1980). In
a temporal context one would therefore expect that the general
level of spatial mobility is to some extent controlled by the
supply of houses and of jobs. Especially if there exists a
scarcity for one of the two, this will impose a restriction on
the possibilities for spatial mobility. An overall relative
scarcity in job opportunities, as demonstrated, e.g., by high
unemployment rates, would then be consistent with lower spatial
mobility among the working population (Grant and Vanderkamp 1976,
Hart 1975). A relatively limited supply of houses will similarly
affect the mobility of people.

The fluctuations that can be observed in the migration data
for the Netherlands seem at first sight rather consistent with
this latter type of explanation. As we noted before, overall
spatial mobility during the seventies increased until 1973 and
has been decreasing since then. In 1973 also the relative supply
of new houses reached its peak, and since then this supply has
been declining. In 1973-74 the labor market deteriorated

considerably, as is demonstrated by the increase in the unemploy-
ment level. The unemployment rate stands at a high level in the
second half of the seventies.

Still more support for the importance of housing and labor
market conditions is obtained from a crude analysis of the long
time series on internal migration, which we mentioned before. We
estimated a relationship that explains annual relative internal
migration figures as a function of the national unemployment rate
and the relative supply of new houses. Details of this estima-
tion are given in the Appendix. If we take all observations for
the period 1921-77 together (excluding 1940-46 for which period
no unemployment figures exist) rather disappointing results are
obtained. Unemployment does not have the expected negative
association with mobility, and the housing variable has no
significant positive association. If we divide the observations
set into prewar and postwar, however, an interesting result is
obtained. For the prewar data, unemployment has the expected
negative association with mobility, but housing supply still
does not have a significant influence. For the postwar period
the picture has changed. Now the housing supply has become very
significant, with the expected positive sign, and unemployment
does not possess the expected negative association any longer.
Reestimation of this relationship with only one explanatory
variable, i.e., unemployment for the prewar period and housing
supply for postwar years, demonstrated that inclusion of a sec-
ond variable does not add much to the descriptive power of this
simple model (as measured by the coefficient of determination R^2).

From this long time-series analysis it would therefore
appear that an investigation of recent trends in internal migra-
tion has to devote particular attention to the influence of
housing supply, while the role of the labor market would be of
minor relevance. However, such long run observations may conceal
important short run changes. The data for the seventies seem to
suggest that the labor market may again have gained in importance
as a determinant of the mobility process during recent years.
Besides, the previous observations are based on a rough analysis
of total population migration, so that associations for a specific

part of the population, i.e., the labor force, could quite well deviate from this general trend. Hence, there seems enough reason to incorporate both housing supply and labor market conditions in the anlaysis of recent labor migration.

Interregional differences in the propensity to migrate have been mentioned as a second aspect of the dynamic pattern in internal migration data. We demonstrated in the introduction that such differences are rather large between Dutch provinces. Furthermore, it can be observed that although the direction of change in the general provincial mobility levels has been rather similar, the magnitude of change differed between provinces. While for all provinces (Figure 1) mobility increased in the period 1963-73, the largest increase occurred in the provinces of Noord Holland, Zuid Holland, Utrecht, and Groningen (van der Knaap and Sleegers 1978). Hence, this aspect also needs to be taken into account in the analysis of labor migration.

Changes in the destination of outmigration of the different regions is the third dynamic aspect in the migration pattern. Migrants select a certain destination on the basis of comparison of several regional characteristics that contribute to their utility. The relative importance of each of these characteristics for the individual decision-making process may vary over time. Such temporal variations will translate themselves into changes in the weights for different determinants of spatial mobility at an aggregate level.

A typical secular development revealed by micro- and macro-studies of migration, is the declining importance of economic and especially labor market variables for migration decisions in the recent past and the increasing importance of factors associated with living conditions. For the Netherlands, several empirical studies have shown that this structural break in the causal mechanism of spatial mobility occurred at the end of the sixties and the beginning of the seventies (Janknegt 1976, Nijkamp 1974, Suijker 1980). Also for other countries a similar secular change has been identified (e.g., for Belgium in Bulté and Lesthaeghe 1980; and for the United States in Graves 1980, and Liu 1975).

Legend: Provinces

GR = Groningen
FR = Friesland
DR = Drenthe
O = Overijssel
G = Gelderland
U = Utrecht
NH = Noord-Holland
ZH = Zuid-Holland
Z = Zeeland
NB = Noord-Brabant
L = Limburg
ZYP = Zuidelijke
        Ysselmeer
        Polders
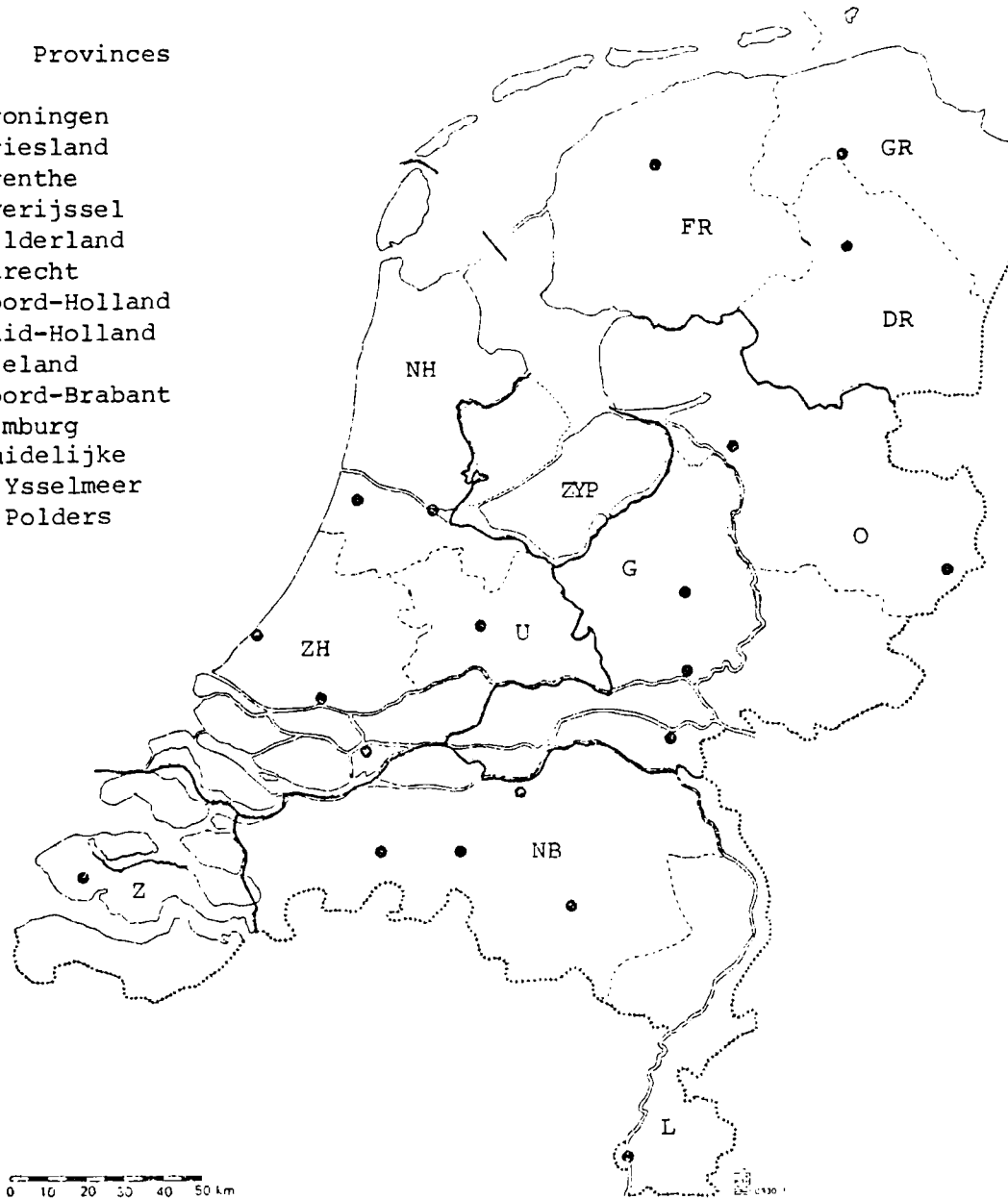
Figure 1. Regional demarcation of the Netherlands according to
           provinces. (The dots represent the location of major
           cities.)

It has to be noted, however, that this structural break has been identified on the basis of migration data for a time period in which the general labor market situation was very favorable. One would expect that a marked deterioration in labor market conditions in the form of very bad employment opportunities would affect the weights that individuals associate with different factors. The decision to move to another region could depend more on the prospects in the regional labor market than in times with a tight labor market. We would then expect that the economic developments during the seventies would have affected the weights of the determinants of migration at an aggregate level. In a preliminary investigation of certain recent data for interregional labor migration in the Netherlands, we did indeed find support for this conjecture: the severe deterioration of labor market conditions since approximately 1974 seems to have contributed to an increase of the relative importance of labor market variables and a slight decrease of the importance of environmental conditions (Bartels and de Jong 1981). Since this conclusion is based on a partial analysis of labor migration in the seventies, it still has to be investigated if the same holds true for a more complete investigation of interprovincial labor migration.

Having discussed a number of possibly important influences on the spatial mobility of people, we shall proceed with a more specific analysis of these factors in the context of internal *labor migration*. The restriction to labor migration is based on the desire to consider the spatial mobility of a more homogeneous category of the population, for which an association with labor market conditions can reasonably be expected. We prefer to investigate aggregate migration *flows*, since we think that flow data are the best point of departure for studying the processes behind temporal variations in internal migration. We intend to develop a *parsimonious model*, that presents a reasonable decription of migration in the recent past, and that could be used for simulation purposes along with a more complete regional labor market model. This prospective use of the migration model has also implications for the selection of explanatory variables: they must be relatively easy to predict and preferably include instrumental variables to account for government intervention in the migration process.

3. A GENERATION-ALLOCATION MODEL FOR MIGRATION

A first look at our data on labor migration, which are available for only a relatively short period, suggests that the description of the dynamics may be facilitated by using a two-level, generation-allocation approach, because it appears that general mobility (generation) is less constant over time than the allocation of moving people over space. Also other studies have shown a preference for such a two-level approach, e.g., Cordey-Hayes and Gleave (1973), Frey (1978), Morrison (1973), Moss (1979), Schuurmans (1975), and van Est (1979).

In this section we shall present the particular specification of the two-level migration model, which has been adopted for the empirical analysis. For a more extensive discussion of the specification, interpretation, and estimation of this model we refer to Liaw and Bartels (1981).

Let m_{ijt} denote the probability that a person will move from region i to region j in year t ($i,j = 1,...,R$; $t = 1,...,T$). We write

$$m_{ijt} = p_{it}\, p_{ijt} \tag{1}$$

where

p_{it} = the probability that a person leaves region i in year t

p_{ijt} = the conditional probability that a person who leaves region i, selects region j as a destination in year t

We further assume that within each region the propensity of every person to migrate to any other region is described by equation (1). This assumption requires that the population being investigated is sufficiently homogeneous.

The probabilities P_{it} and P_{ijt} have to satisfy the following constraints:

$$0 \leq P_{it} \leq 1 \tag{2}$$

$$0 \leq P_{ijt} \leq 1 \tag{3}$$

$$\sum_{\substack{j=1 \\ j \neq i}}^{R} P_{ijt} = 1 \tag{4}$$

They will further depend on certain factors that enter the individual decision-making process. To satisfy the constraints (2)-(4) we express this dependency by means of the following, statistically convenient, logistic functions:

$$P_{it} = \frac{e^{a_0 + a_1 x_{1it} + \ldots + a_K x_{Kit}}}{1 + e^{a_0 + a_1 x_{1it} + \ldots + a_K x_{Kit}}} \tag{5}$$

and

$$P_{ijt} = \frac{e^{b_1 y_{1ijt} + \ldots + b_N y_{Nijt}}}{\sum_{\substack{j=1 \\ j \neq i}}^{R} e^{b_1 y_{1ijt} + \ldots + b_N y_{Nijt}}} \tag{6}$$

where

$x_1, \ldots, x_K$ are observable factors affecting the generation probabilities

$y_1, \ldots, y_N$ are observable factors affecting the allocation probabilities

$a_0, \ldots, a_K; b_1, \ldots, b_N$ are parameters to be estimated

Although we used in (5) the regional index i for all independent variables for convenience, it has to be noted that also non-region specific variables may enter this specification.

The observations we have are for aggregate migration flows. M_{it} then indicates the number of people leaving region i in year t, and M_{ijt} the number of migrants who leave i and select region j as a destination in year t. Assuming that the migrants are random samples from the population under consideration, we can write the likelihood functions of model (5)-(6) for aggregate migration

$$
L_1 = \prod_{t=1}^{T} \prod_{i=1}^{R} \left(\frac{P_{it}}{1 - P_{it}} \right)^{M_{it}} \left(1 - P_{it} \right)^{N_{it}} \frac{N_{it}!}{M_{it}! (N_{it} - M_{it})!} \quad (7)
$$

$$
L_2 = \prod_{t=1}^{T} \prod_{i=1}^{R} \left[\prod_{\substack{j=1 \\ j \neq i}}^{R} \frac{P_{ijt}^{M_{ijt}}}{M_{ijt}!} \right] M_{it}! \quad (8)
$$

where

N_{it} = the size of the population under consideration in region i in year t

Note that these likelihood functions are based on a pooling of time-series and cross-section data. If such pooling is not preferred, modified expressions for the likelihood functions would result.

These likelihood functions can be maximized separately, using an iterative procedure. Under certain conditions, the solution of this procedure is unique, and the estimators of the parameters have an asymptotic normal distribution. The information matrix provides conservative estimates of the standard errors of the parameter estimates. Hence it is possible to obtain rough indicators (t-ratios) to judge the significance of individual parameter estimates. In the definition of these t-ratios we have made a correction for the possibility that the

estimates of the standard errors, derived from the estimated
information matrix, may severely underestimate the true standard
errors. The correction consists of multiplying the asymptotic
standard errors by the square root of the weighted residual mean
square. For more information on all these details we again
refer to Liaw and Bartels (1981).

The particular specification of the migration model adopted
here possesses three properties that seem to require a bit more
defence.

A first property of the model is that it consists in fact
of two single-equation models. For each of these single-equation
models the causal relation is supposed to be unidirectional: the
explanatory variables are themselves not affected by migration.
If this assumption is not valid in reality, one obtains biased
parameter estimates (compare Greenwood 1980 and Muth 1971 for a
discussion). Our defence for ignoring this possibility of simul-
taneous relationships is that an appropriate treatment of this
matter would require the formulation of a rather complicated
multi-equation model, in which explanatory variables such as
employment, unemployment, and housing supply would depend on
current and past migration in a special way (e.g., with each
having its specific lag structure). Attempts that have been made
to account for simultaneity bias can be characterized as partial
approaches, since only part of the possible interrelationships
have been investigated. [A simultaneous relation between migration
and employment is studied in Dahlberg and Holmlund (1978), Miron
(1979) and Muth (1971). In Greenwood (1980) housing supply is
additionally included as dependent on past migration. In Cebula
(1979) welfare benefits appear as a dependent and independent
variable in the model.] We think that such a partial approach will
hardly improve the quality of the results. Besides, the specifi-
cation of a more comprehensive multi-equation model is still beyond
our capacity, so we decided to rely on the single-equations
approach. [For additional arguments for this approach see Hart
(1972) and Oliver (1964)].

A second property is that we neglect the possibility of
lagged relationships between the variables. It can be argued that
especially the uncertainty that enters the decision-making process

requires the incorporation of time lags in the migration model
(Hart 1975). However, operationalization of this idea requires
a number of *ad hoc* assumptions with respect to the typical lag
structure that is used, so that it is again not clear what is
exactly won by this approach.

A third property is the imposed constancy of the parameters,
over time and in space. Because we focus in this paper on the
dynamic aspects of migration, we shall investigate the possibility
of time dependent parameters below. The possibility of region-
specific parameters has not been considered, because this would
result into a too small number of observations especially in the
case of the generation model. [For evidence on region-specific
parameter estimates see Arora and Brown (1978), Bartels and
ter Welle (1979), Hart (1972), Muth (1971), and Oliver (1964).

4. SPECIFICATION OF THE VARIABLES

The two-level model specified above will be used to analyze
labor migration between the 11 Dutch provinces (*provincies*) for
the period 1971-78. Only for this short period are the required
data available in sufficient detail. It will be clear that long-
run, secular changes will not easily be identifiable with such
short time series. For an analysis of dynamic patterns in internal
migration this period is, however, still quite interesting,
because the upward trend in mobility in the beginning of the
seventies changed into a downward trend, while at the same time
housing and labor market conditions deteriorated. In this section
we shall discuss the precise specification of the variables that
will be included in the estimation in the next section.

Labor migration is operationally defined as the number of
heads of households (including independently moving persons) who
have moved to another province in a certain year, and who have a
known occupation in the province of destination. This definition
is rather particular and requires more explanation. (For detailed
information on the particulars of Dutch migration data we refer to
the publications of the Central Bureau of Statistics.)

Information about the position in the labor market is
obtained from a special card (*verhuiskaart*) that heads of house-
holds are requested to fill in when they move to another muni-
cipality and to hand over to the municipality of destination.
This card contains information on the old and new municipality
of residence and on several personal characteristics of the
heads of households, i.e., sex, family relation, civil status,
age, nationality, and occupation. After registration of the
arrival in the municipality of destination, the card is returned
to the municipality of origin and from there it is passed to the
Central Bureau of Statistics. There the cards are used to obtain
different types of tabulations for internal migration, e.g.,
interprovincial flows of heads of households belonging to differ-
ent occupational categories. These tabulations form the basis of
the present analysis. We use the available information on the
occupational position of movers in the municipality of destination
(instead of in the place of origin) because this is the most
actual and therefore reliable registration of a person's occupa-
tion. The available tabulations for internal labor migration do
not allow for the possibility to cross classify the interprovin-
cial flows with respect to age and occupational status. This is
at present only possible for the total in- and outmigration of
provinces. Further processing of the original data could yield
such cross tabulations also for the interprovincial flows.

The fact that only heads of households are registered implies
that spouses and children who also have a job are not counted as
labor migrants. One may therefore expect that the real level of
spatial labor mobility is higher than that revealed by these data.

Restriction to persons with a known occupation implies that
we exclude heads of households with no occupation (students,
disabled persons, pensioners) and with an unknown occupation.
The reason for excluding also this latter group is that we cannot
separate it from the "no occupation" category. However, the
"unknown occupation" category is not very important: according to
information of the Central Bureau of Statistics it amounts to
approximately 5% of the "no occupation" group.

To present an indication of the part of the migration process that is covered by these data, we can mention some figures for 1977. The total number of persons that moved from one municipality to another was 626,719, which is 45 per 1,000 of average population. Of these persons 42% moved to another province, and 63% were heads of households (including independently migrating persons). Of the latter group 250,000 persons had a known occupation, so that 40% of the total number of moves would be considered as labor migration. Approximately 15% of all moves between municipalities is counted as interprovincial labor migration (information based on CBS 1981).

To obtain relative figures for the generation model, we divide labor migration as defined above by the size of the labor force in the province of origin. The variation in the resulting provincial outmigration rates can be illustrated by mentioning some typical figures.

If we pool all data we obtain an average of 55 annual interprovincial moves per 1,000 persons in the labor force. However, the range is rather wide with a minimum value of 39 (Noord Brabant 1978) and a maximum value of 74 (Utrecht 1971). For all 11 provinces the lowest value is observed for 1978 and the highest value in the first half of the period. The provinces with the highest relative outmigration is Utrecht (the most centrally located and also the smallest province), and the lowest levels are found in Overijssel, Noord Brabant, and Zeeland.

The selection of *independent variables* is based on the desire to develop a parsimonious model that describes the observed migration flows reasonably. Four types of influences are expected to be important for the explanation of the aggregate migration pattern. First, the *distance* between provinces, which will affect the allocation of migrants over space. Second, *labor market conditions* that may affect the outmigration rates and the allocation pattern. Third, the *conditions in the housing market* which may have a similar effect. And fourth, regional *living conditions* which may again affect outmigration and spatial allocation.

We shall use rather simple indicators to represent these influences, with the hope that they will nevertheless capture most of the variation in our data. The definition of these indicators will be discussed separately for the generation and the allocation model.

The *generation model* associates the relative outmigration of provinces with two groups of indicators. The first group intends to capture general fluctuations in spatial mobility over time, and the second represents "pushes" in the region of residence.

General fluctuations in spatial mobility are assumed to be related to the change in housing supply and to the job opportunities in the labor market. The annual change in housing supply is measured as the percentage increase in the total housing stock, and the size of job opportunities is approximated by the inverse of the unemployment rate. It is hypothesized that the national observations for these indicators are appropriate to explain the general temporal variations in spatial mobility.

"Push" indicators are defined by taking the regional value of a certain variable, and dividing it by its national value. Three push indicators will be used: for the labor market conditions again the reciprocal of the unemployment rate; for housing the percentage increase in housing stock; and for living conditions an approximation of the attractiveness of the natural environment. This attractiveness is operationalized by taking the relative surface of land that is not occupied by buildings and roads.

Besides these five possible determinants of relative out-migration rates, one could of course postulate other explanatory factors. For example: the size of the region, its specific location with respect to other regions, the composition of the population according to age and occupation, the intraregional settlement pattern, the availability of financial incentives for migrating, etc. We shall return to the possible importance of such additional factors below, when we discuss the results of the estimation.

The *allocation model* explains the distribution of outmi-
grants over space with five independent variables. Interprovin-
cial distance is measured as the distance between the centers
of gravity of the provinces. The other variables express the
attractiveness of conditions in the region of destination com-
pared with those in the region of origin. Indicators for this
relative attractiveness are obtained by taking the ratio of the
observations for a variable in region of destination and origin.
Two indicators are used for the relative labor market conditions:
one based on total regional employment, which represents the size
of the regional labor market and one based on the reciprocal of
the regional unemployment rate, which represents the relative job
opportunities in a region. For housing supply the indicator is
again based on the percentage increase in the regional housing
stock, and for living conditions on the quality of natural
environment, as discussed above.

This selection of indicators seems appropriate for estimating
our two-level migration model. Before proceding with the results
of this estimation, however, it seems desirable to compare this
particular operationalization of explanatory factors with other
possibilities that have been discussed in the literature. [For
informative general discussions of migration models we refer to
Greenwood (1975), Hart (1975), and Willis (1974)].

The most controversial topic in the literature on internal
migration seems to be the measurement of economic conditions.
Part of the controversy concerns the possibility of including
both employment and income opportunities in the model, and
another part of the controversy is related to the exact measure-
ment of employment opportunities.

With respect to the possible role played by regional dif-
ficulties in income opportunities, it can be noted that empirical
research that has been done for other countries has produced
ambiguous results. Several studies did find support for a
positive influence of income differentials on migration (Arora
and Brown 1978, Fields 1976, Gallaway et al. 1967, Ghali et al.
1978), but in other studies the results have been less conclusive.

[In Hart (1974) little support for income effects is found, in Creedy (1974) only a significant effect appears after a given threshold value, in Grave (1980) a negative effect of income differentials on migration flows is reported, in Grant and Vanderkamp (1976) only the income in the region of destination has the expected positive effect, and in Weeden (1973) only the income in the region of departure has a positive association with the migration flows.]

Besides these ambiguous results of previous studies, there are two other reasons for not incorporating income as an explanatory variable in the model. First, wage rates are set by collective bargaining, which does not allow much regional divergence in wage rates for the same job. Second, the information on regional incomes that is available is simply much too crude to test the possible role of regional differentials in real income opportunities.

With respect to the measurement of employment opportunities different approaches have been followed in different studies. These opportunities have been approximated by regional unemployment rates, sometimes relative to the national level (Gallaway et al. 1967, Hart 1972, Somermeijer 1971, Weeden 1973); a transformation of the unemployment rate, such as its inverse and the inverse of the logarithm (Creedy 1974, Hart 1973, Kelley and Schmidt 1979, Oliver 1964); the relative number of open vacancies (Nijkamp 1974); the total number of new job openings (Fields 1976); total regional employment (Drewe and Rodgers 1973); the regional population size (Grant and Vanderkamp 1976); the increase in regional employment (Bell and Kirwan 1979, Greenwood 1980, Hart 1972, Weeden 1973); the expected additional employment from manufacturing completions (Hart 1973); the size of relative net commuting (Bulté and Lesthaeghe 1980); and even the differential between regional and national output growth (Ghali et al. 1978).

We have selected two indicators for regional labor market conditions, one for the size of labor demand, employment, and one for relative employment opportunities, the reciprocal of the

unemployment rate (since this can be interpreted as a measure of
relative job opportunities, and it seems to be a very crucial
variable in the individual perceptions of labor market conditions
in space and over time; compare also Kelley and Schmidt 1979, for
additional arguments). We do not use employment growth as an
indicator for job opportunities, because its measurement at the
regional level seems to be rather unreliable. We do not use open
vacancies or job openings, because the registration of these
variables is again very poor, and because they are difficult to
incorporate in forecasting experiments (most labor market models
have unemployment instead of open vacancies, as a dependent
variable).

Besides the measurement of economic conditions, the living
conditions and the distance variable could also invoke discussion.
For the living conditions we have selected a simple indicator of
the quality of the natural environment, because several empirical
studies for the Netherlands have shown that this environmental
quality has become important in explaining migration at both the
micro- and macrolevel. To keep the model parsimonious in the
parameters, we have not included other dimensions of regional
living conditions, such as the provision of different services,
the quality and prices of the housing stock, and the quality of
the public goods. The particular measurement of the quality of
the natural environment is a bit *ad hoc*, and other indicators
could be equally attractive (e.g., population density).

Interregional distance has been operationalized by using
figures for the physical distance between provinces. This is an
easily operationable variable, which seems to represent quite
well the different types of barriers that result from nonproximity
in space (monetary costs of moving, informational barriers,
cultural differences). Besides, physical distance has proven to
be a successful indicator in several macrostudies of internal
migration in the Netherlands (Bartels and ter Welle 1979, Drewe
and Rodgers 1973, Klaassen and Drewe 1973, Nijkamp 1974).

5. ESTIMATION RESULTS

The generation-allocation model for interprovincial labor mobility is first estimated by pooling all data for the 11 provinces and 8 years. This gives 88 observations for the generation model and 880 observations for the allocation model. These numbers seem sufficiently large to enable us to use asymptotic properties of the maximum likelihood estimates for the interpretation of the quality of the results. We shall also experiment with some subsets of the data, to investigate the possibility of parameter variations over time. For both parts of the model, we start with the inclusion of all variables presented in Section 4; this gives *Specification I* of the model. Unsatisfactory estimation results for this specification will lead to the consideration of alternative specifications. It can be noted that all applications of the estimation program are characterized by a very fast convergence in the calculation of parameter estimates.

The results obtained for the *generation model* are presented in Table 1, where a precise definition of the independent variables is also given. It appears that the results are rather poor: R^2 is low, and the regional variables do not possess the expected sign. Besides, investigation of the residuals revealed that these are particularly large for the provinces Groningen and Utrecht (underprediction of mobility by the model) and Overijssel (overprediction by the model).

To improve the results, we attempted several other speci- fications, including additional variables and other definitions of certain variables. We added the areal size of a province as a possible determinant of its outmigration rate. (Utrecht and Groningen are small provinces, so that a higher outmigration rate could be expected here; the reverse is true for Overijssel.) We tried to take into account the specific location of provinces within the total spatial structure by means of incorporation of "potentials" (defined as the sum of weighted values of a variable in all provinces, where weights depend inversely on the physical distance to the region of origin). We investigated whether

Table 1. Estimation results for the generation model.

Independent variable	Specification I coeff.	t-value	Specification II coeff.	t-value	Specification III coeff.	t-value	Specification III^1 coeff.	t-value	Specification III^2 coeff.	t-value
Constant	-4.03	(-16.2)	-3.76	(-17.5)	-3.23	(-68-7)	9.27	(0.3)	-3.42	(-15.2)
National housing, h_n	0.15	(6.6)	0.14	(8.7)	0.14	(8.3)	-3.00	(-0.4)	0.47	(5.7)
National job opp., j_n	0.10	(0.8)	0.11	(1.6)	0.11	(1.6)	-4.07	(-0.4)	-2.60	(-3.3)
Regional housing, h_{rn}	0.004	(0.1)	-0.06	(-2.1)	-0.05	(-1.8)	-0.07	(1.9)	-0.05	(-1.3)
Regional job opp., j_{rn}	0.22	(5.6)	0.09	(2.2)						
Regional Nat. Environment, n_{rn}	0.51	(2.1)	0.45	(2.2)						
Dummy Groningen			0.12	(2.9)	0.12	(3.4)	0.05	(1.1)	0.17	(3.9)
Dummy Utrecht			0.19	(5.1)	0.25	(9.4)	0.22	(6.3)	0.27	(8.5)
Dummy Overijssel			-0.16	(-4.9)	-0.14	(-4.7)	-0.14	(-3.7)	-0.14	(-3.8)
R^2	0.49		0.77		0.79		0.73		0.83	

NOTES: R^2 is defined as the squared value of the simple correlation coefficient between the observed and the predicted dependent variable; t-values incorporate a correction for possible small sample bias (see Liaw and Bartels 1981); if not otherwise stated, the Zuidelijke Ysselmeerpolders (a part of newly created land) has been included in the observations for the province of Gelderland.

The definition of the variables is as follows:

h_n = the percentage increase in the national housing supply. Source: CBS, Statistiek voor de bouwnijverheid, annual publications, Table 2.2.

j_n = the reciprocal of the natioanl unemployment percentage (number of registered unemployed persons as a percentage of the dependent labor force). Source: SER (1978) for the years 1971-76 and the Ministry of Social Affairs (1980) for 1977 and 1978.

h_{rn} = the percentage increase in regional housing supply divided by the national increase. Source: as for h_n.

j_{rn} = the reciprocal of the regional unemployment percentage divided by the reciprocal of the national unemployment percentage. (The figure for Overijssel includes the Zuidelijke Ysselmeerpolders.) Source: as for j_n.

n_{rn} = the regional share of natural land and land used for agriculture in total surface (exclusive of water) divided by the national share. Source: CBS (1978), figures 1-1-1976.

measurement of the general conditions in the labor and housing market could perhaps be better based on regional observations instead of national ones. None of these trials did yield very satisfactory results, however.

Still other reasonable modifications could be easily suggested; e.g., accounting for typical intraprovincial settlement structures (in Groningen the largest population concentration is close to the provincial boarder with Drenthe, so that short distance suburbanization may be expected to contribute to the high outmigration rate), and for different compositions of the labor force (in Overijssel there are many workers in the manufacturing sector, which could be an explanation for the low outmigration rate). The problem is, however, that such possible influences are not easy to operationalize and that the observed large residuals can be explained in several alternative ways.

Therefore, we do not want to pursue this "trial and error" approach further, and we prefer to introduce a small number of dummy variables that represent significant regional deviations from the general influences. It can be noted that other empirical studies had also to rely on dummy variables to obtain reasonable results, compare, e.g., the Central Planning Bureau's migration model in Suijker (1980).

Three dummy variables will be used. The dummy variable for Groningen may represent the joint effect of the province's small size, its typical intraprovincial settlement structure, and the occupational composition of its labor force. (Since Groningen is a center of higher education, the number of mobile higher educated persons is realatively large.) The one for Utrecht may account for the small size and the typical central location of this province. The dummy variable for Overijssel may represent the large size of this province and the occupational composition of Overijssel's labor force.

Introduction of these three dummy variables gives *Specification II*. See Table 1 for the results. The dummy variables are highly significant and contribute considerably to the value of R^2. But still two of the remaining variables do not

yet possess the expected sign. We delete these variables to obtain *Specification III*.

Deletion of these variables does not affect R^2 negatively (see Table 1; instead a slight increase in R^2 occurs, which can be explained by the nonlinearity of the model and the definition of R^2). The parameter estimates are reasonable, especially if one takes into account that our t-values present a rather conservative picture of the significance of the estimates (see Liaw and Bartels 1981 for more details). *Specification III* will therefore be accepted as a reasonable description of the variations in provincial outmigration rates.

This specification shows that national housing supply and national job opportunities have the expected positive association with outmigration rates. It can also be noted that this association remains very stable for different specifications. On the basis of the t-values housing would seem to be the more important factor, which is in accordance with the results of the long time series on migration we discussed in Section 2. But the results confirm our previous contention that in recent years the influence of labor market conditions on spatial mobility may not be ignored. Of the variables that represent regional "pushes" only housing has the expected negative association in the final specification (a relatively large housing supply in a province is associated with a low outmigration rate); the empirical analysis does not lend support to an important association of regional labor market conditions and natural environment with aggregate outmigration rates for labor. The general conclusion could therefore be that the housing factor has a much more dominant association with the aggregate mobility propensity than the labor market factor.

Now we will investigate the extent to which the results for *Specification III* are time dependent. The time period analyzed here is so short that only tentative conclusions can be derived. We split the data set up in two periods: 1971-73 (*Specification III*[1] in Table 1) and 1974-78 (*Specification III*[2] in Table 1), because evidence cited in Sections 1 and 2 suggests that around 1973-74 important changes in the migration context

have occurred. The first subperiod is so short that an effect of national housing and labor market can not be detected. For the second subperiod this still is problematic, but in any case national housing has the "good" direction of association. For these two national variables the coefficients are very unstable, which is not so strange in view of the previous remarks. For regional housing and the dummy variables this drawback is less important: the parameter estimates appear to be quite stable, except for the dummy for Groningen whose influence increased considerably. The R^2 values indicate that the description is best for the most recent years. This experiment thus shows that the time period is too short to detect time dependent variations in the effect of national variables on mobility; for the regional variables the variation in observations is larger so that rather stable parameter estimates result.

The results for the *allocation model* are presented in Table 2. The first specification again incorporates all variables that were introduced in Section 4. The overall level of explanation is quite good, and especially the employment and distance factor shows a strong association with the interprovincial allocation rates. However, job opportunities and natural environment do not show the expected sign. Besides, the model appears to predict certain allocation rates rather badly, i.e., from Drenthe to Groningen, from Zeeland to Zuid Holland, and from Utrecht and Overijssel to Gelderland. Part of these large residuals can be explained easily. The overprediction for the flow Zeeland to Zuid Holland is possibly caused by the typical geographical structure of Zeeland, that will cause our distance indicator to underestimate the real interprovincial distance to Zuid Holland. The underprediction of the flows from Overijssel and Utrecht to Gelderland is explainable from the typical structure of Gelderland, caused by the inclusion of the newly created land (*Zuidelijke Ysselmeerpolders*) as part of this province. The underprediction of the flow from Drenthe to Groningen is less understandable.

Table 2. Estimation results for the allocation model.

Independent variable	Specification I coeff.	t-value	Specification II coeff.	t-value	Specification III coeff.	t-value
Housing	0.25	(5.1)	0.19	(4.7)		
Employment	0.19	(13.9)	0.23	(17.7)	0.34	(36.7)
Job opportunities	-0.22	(-6.1)	-0.25	(-7.8)		
Natural environment	-3.55	(-11.0)	-3.64	(-12.9)		
Distance	-2.12	(-52.2)	-2.06	(-59.2)	-2.21	(-63.1)
Dummy Ze-ZH			-1.15	(-8.8)	-1.54	(-11.6)
Dummy Dr-Gr			0.94	(9.4)	1.14	(11.0)
Dummy Geld			0.75	(16.2)	0.59	(12.5)
R^2	0.79		0.91		0.88	

NOTES: The value of the variables is defined as the observation in the region of destination divided by the observation in the region of origin. For housing, job opportunities, and natural environment see the remarks for Table 1.

Employment figures for 1971-75 are taken from Nederlands Economisch Instituut (1978), and for 1976-78 an estimate from Bartels (1980:31) has been used. (This is a figure for 1977, which has also been used for 1976 and 1978 since no good data exist for these year.)

Estimate for interprovincial distances in kilometers were obtained from the Central Planning Bureau. (These estimates represent the distance between centers of gravity, the latter being estimated on the basis of population figures for the municipalities.) These have been standardized by dividing each element in the distance matrix by the average value of all the elements.

To capture these typical deviations from the general pattern
we again decided to enter a small number of dummy variables: one
for the flow from Zeeland to Zuid Holland, one for the flow from
Drenthe to Groningen, and one for the flows of Utrecht and
Overijssel to Gelderland. The results are reported in Table 2
under *Specification II*. They are still not satisfactory, because
two of the variables possess the wrong sign. If we delete these
variables, the housing variable appears to obtain a wrong sign.
Hence, the preferred *Specification III* incorporates only the
employment and distance variable and the three dummy variables.

If we compare *Specifications II and III* we note that the
inclusion of housing, job opportunities, and environment does not
alter the overall level of association much. For *Specification
III* all variables are highly significant.

The conclusion that can be derived from these experiments
is that only provincial employment size and interprovincial
distance show the expected type of association with interprovin-
cial allocation rates for labor migration. Together with three
dummy variables, which represent large deviations from the pattern
explained by the previous factors, employment and distance yield
a good description of the variation in the interprovincial allo-
cation rates. The expected role of housing supply, relative job
opportunities, and attractiveness of natural environment finds no
support in these outcomes.

Also for the allocation model we consider the possibility
that the parameter estimates are to some extent time dependent.
Since we have so many observations available for the allocation
rates, we can investigate this in a more detailed way than for
the generation model. For *Specification III* we estimate the
equation for each year separately; see Table 3 for the results.

The results appear to be remarkably stable. The order of
importance of the explanatory variables, as measured by their
t-values, does not change significantly. The R^2 values are of
the same order of magnitude. The parameter estimates show rather
small changes; only the effect of the dummy for Zeeland-Zuid
Holland seems to decline over time. When we compare the results

Table 3. Annual estimation results for the allocation model (Specification III).

Independent variable	1971	1972	1973	1974	1975	1976	1977	1978
Employment	0.35 (12.5)	0.34 (12.0)	0.33 (11.7)	0.34 (12.1)	0.34 (13.1)	0.32 (12.5)	0.32 (12.3)	0.31 (12.5)
Distance	-2.17 (-20.2)	-2.25 (-21.2)	-2.25 (-23.2)	-2.26 (-22.8)	-2.27 (-24.0)	-2.14 (-23.4)	-2.14 (-23.4)	-2.12 (-23.4)
Dummy Ze-Zit	-1.66 (-4.0)	-1.72 (-4.1)	-1.59 (-4.0)	-1.63 (-4.2)	-1.56 (-4.5)	-1.47 (-4.0)	-1.32 (-3.7)	-1.30 (-3.7)
Dummy Dr-Gr	1.22 (3.7)	1.16 (3.6)	1.03 (3.2)	1.07 (3.5)	1.12 (4.0)	1.18 (4.2)	1.15 (4.5)	1.15 (4.3)
Dummy Geld	0.58 (3.9)	0.65 (4.5)	0.64 (4.6)	0.53 (4.2)	0.55 (4.2)	0.54 (4.0)	0.61 (4.6)	0.55 (4.4)
R^2	0.86	0.88	0.88	0.89	0.89	0.89	0.89	0.89

in Table 3 with those in Table 2, we can conclude that estimation
of the allocation model based on cross-section data for a certain
year does not give fundamentally different results than that
based on pooled time-series/cross-section data.

Having obtained empirical specifications of the generation
and allocation model, we finally evaluate to what extent these
satisfy the previously expressed desirable characteristics of a
model for labor migration. The specifications are in any case
parsimonious, including just a small number of variables. They
also seem useful for predictive purposes, because the independent
variables are either national variables (which are easier to
predict than regional variables) or regional variables that do
not change much over time. Instrumental variables also appear in
the model, especially in the form of the national and regional
housing supply in the generation model. But to some extent also
the employment variable in the allocation model could act as an
intermediary value for the calculation of policy impacts, as far
as policy affects regional employment.

The model does not incorporate separate variables represent-
ing the policy with respect to labor migration that existed in
this period. In 1971 financial migration incentives were intro-
duced for unemployed persons who would move to another location,
provided that this was outside the Rimcity *(Randstad)*,* to take a
job. In 1973 incentives were introduced for the move of workers
from the Rimcity to the northern provinces (Groningen, Friesland,
Drenthe). In 1977 these regulations were replaced by a scheme
with more general incentives on spatial mobility which discrimin-
ate much less among regions. If these incentives have been
successful, then we could expect that not incorporating them in
the model would produce a certain systematic pattern in the

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*The Rimcity is the highly urbanized part of the provinces Zuid
 Holland and Noord Holland in the western part of the country.

residuals. The allocation model would generate overpredictions
for the allocation rates towards Noord Holland and Zuid Holland
(where the Rimcity is located) especially in 1971-76 and under-
predictions for the allocation from these two provinces towards
the northern provinces in 1973-76. With respect to the first
possibility we find 52 overpredictions out of 168 cases; for the
second possibility there are 9 underpredictions out of 24 cases.
These figures suggest that at this level of analysis no signifi-
cant impact of migration incentives can be detected.

6. CONCLUSION

The empirical experiements described above allow us to draw
some general conclusions with respect to spatial labor mobility
in the Netherlands over time.

The level of spatial mobility of labor appears to change
considerably over time, and we could explain this from national
developments in the housing and labor market. The allocation of
mobile workers over space shows a more constant pattern, at least
over a relatively short time period. Interregional distance and
the size of regional labor markets seem to account for much of
the variation in the allocation rates. The results do not suggest
a significant impact of financial incentives on spatial labor
mobility.

A refinement of the foregoing analysis could consist of a
similar analysis for the different occupational groups. Data
limitations seem to restrict this possibility considerably, how-
ever.

APPENDIX: A LOGIT MODEL OF MOBILITY
         OVER A LONG PERIOD

To analyze the association between internal population migration, and housing supply and the labor market situation, we estimated the following logit model [for a more extensive discussion of this type of model and its estimation, see Section 3 in the text and Liaw and Bartels (1981)]:

$$m_t = \frac{e^{a + b\,u_t + c\,h_t}}{1 + e^{a + b\,u_t + c\,h_t}}$$

where

m_t = the number of persons who change their municipality of residence in year t, divided by the population size in the same year

u_t = unemployment as a percentage of the total labor force in year t

h_t = the number of newly constructed houses divided by the population size in year t

a, b, c = parameters to be estimated

In CBS (1979) data for the three variables can be found for the period 1921-77, excluding 1940-46.

Results of maximum likelihood estimation of this logit model are reported in Table A1 for three different cases: combination of pre- and postwar data; prewar data; and postwar data.

Table A1. Estimation results for logit model of mobility over a
          long period.

Period	Constant	Unemployment	Housing supply	R^2
1921-77[a]	-3.1 (-41.4)	0.01 (2.5)	0.01 (1.5)	0.08
1921-39	-2.7 (-24.6)	-0.02 (-5.2)	-0.007 (-0.5)	0.76
1947-77	-3.4 (-112.1)	0.02 (2.9)	0.04 (11.2)	0.83

NOTES: Numbers in brackets are corrected asymptotic t-values. See Section 3
        for remarks about the interpretation of the results.

[a]excluding 1940-46.

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