INTERGENERATIONAL OCCUPATIONAL MOBILITY IN THE NETHERLANDS IN 1954 AND 1977; A LOGLINEAR ANALYSIS *

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Van Tulder's classical investigation of intergenerational occupational mobility in the Netherlands in 1954 is replicated with 1977 data. The two tables are analysed following Hope's suggestions (a) to construct a "halfway"-model and to use it as a baseline, (b) to model structural mobility with a uniform vertical shift parameter and parameters for non-uniform structural mobility, and (c) to model circulation mobility with linear distance, quadratic distance, and general inheritance parameters. The results are simple: (a) Most of the structural mobility can be modelled by the uniform vertical shift parameter, (b) nearly all of the circulation mobility can be modelled by either a linear or a quadratic distance parameter in combination with a general inheritance parameter, (c) structural mobility is considerably larger in 1977 than in 1954; its uniform part is somewhat larger in 1977 than in 1954, (d) circulation mobility has also grown over the years, which contrasts with the well-known result from the investigation of Hauser et al. for the United States.

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1. INTRODUCTION

In this paper we take up a few of the original problems of mobility research. Mobility can be subdivided in structural and circulation mobility. Structural mobility has been defined as category shifts that are produced by differences between occupational distributions of fathers and sons. Whenever these distributions are unequal, there has to be mobility in a society. Circulation mobility is defined as category shifts that exist independently of structural differences between occupational distributions of fathers and sons. Circulation mobility can be assumed to reflect the intrinsic mobility regime or 'openness' of a society. Assuming that there is no association between family background and resources for status attainment, it is hypothesised that in modern societies there will be more circulation mobility than in traditional ones. The rather surprising result of the study of Featherman & Hauser (1978) was that circulation mobility had not changed very much between 1962 and 1973 in the U.S.A. Our analysis replicates this result for the Netherlands in 1954 and 1977. We will make use of loglinear models for scaled variables, as brought forward by Hope (1980, 1982). These techniques model the association in one or a few parameters. At the same time the give a detailed description of the association structure and simplify the comparison of the implied mobility regimes.

Duncan (1966) has convincingly argued that treating the differences between marginal distribution of fathers and sons in the classical mobility table as if they are equivalent to differences between occupational distributions on two moments in time is a demografic fallacy. Therefore, in recent mobility analysis, particularly when performed by way of loglinear analysis, researchers have shyed away from the concept of structural mobility and concentrated on circulation mobility. However, Duncan's criticism does not imply that differences between occupational distributions do not influence occupational mobility as such. Structural mobility can still be looked upon as 'forced', in as far as occupational distributions can be seen as a result of external (e.g. technological, economic, demografic) factors and can be regarded as a phenomenon with its own importance. It is interesting in macrosociological research both as a dependent variable and as an independent variable. It indicates a major form of social opportunity for the members of a society.

In this paper, alos following Hope (1980), we will study the extent of regular and irregular structural shifts in the mobility table, that are indicative of these kinds of social change. Structural shifts can consist of a gradual decline of the lower occupational groups and growth of the higher ones, most probably reflecting the increasing complexity of a society's technological level. Other influences may change occupational structures as well, but in a more irregular way. The questions at issue are: Is the pattern of structural mobility regular or irregular and has it changed over the years?

Our analysis is paralelled by a companion paper of Sixma & Ultee (1983; also in this volume), who analyse with the same methods partner selection in marriages, another measure for openness of a society, the same way.

2. THE DATA

Van Tulder (1962) is the classical study on intergenerational occupational mobility in the Netherlands. He collected his data in 1954. The interviewees consisted of a national sample of nearly 2400 males of 18 years or older, who were active in the labour force at that time. The occupations were coded on a 6-point prestige scale with the following categories:

VI. Upper upper class, including scientists, managers of larger firms, higher civil servants, university and high school teachers.
V. Lower upper class, including higher employees, managers of smaller firms, farmers with a large farm.
IV. Upper middle class, including big storekeepers, higher employees, farmers with a middle-size farm.
III. Lower middle class, including small dealers and middle employees, farmers with a small farm, craftsmen.
II. Upper lower class, including skilled labour and lower employees.
I. Lower lower class, unskilled and farm labour.

Unfortunately, Van Tulder's data are lost. However, his book contains an Appendix with the titles of 217 occupations with their categorisation. This information makes it possible to replicate his categorisation in other datasets, in which occupations have been coded with sufficient detail. Adequate data were collected in 1977 by the Central Bureau of Statistics in a multi-purpose sample Quality of Life Survey of the Dutch population (total effective sample size 4100, simple random sampling, 35% non-response) and by the General Election Survey 1977.

For this study the four-digit Census Occupation Code (CBS, 1971) has been matched with the list of Van Tulder (see Appendix). The matching was done by three judges. They did not experience many difficulties, except for one point: Van Tulder's categorisation of farmers was based on farm size and this variable was not included in the surveys. Therefore, categorisation of farmers was approximated as best as possible from information on respondent's education and income, and on his father's education, respectively, combined with known marginal frequencies for farm sizes in 1954 and 1977. We think that this matching procedure resulted in a fairly good approximation of Van Tulder's codebook, though there may be some slight differences.

Table-1 gives the two-dimensional distributions in 1954 and 1977. The counts can be summarized as follows:

	1954	1977
immobile	41.1%	34.3%
mobile	58.9%	65.7%
upward	32.7%	42.3%
1 step	20.4%	22.3%
2 steps	9.6%	12.0%
3,4,5 steps	2.7%	8.0%

downward	26.3%	23.4%
1 step	18.4%	14.8%
2 steps	6.5%	6.4%
3,4,5 steps	1.4%	2.2%

The percentage of actually mobile persons has grown considerably over the years: from 59% to 66%. In both years there was more upward mobility than downward mobility.

Table-1: Mobility from Father's (Last) Occupation to Son's Current Occupation: Men Active in the Labour Force, Aged 18-64, The Netherlands, 1954 and 1977

1954	SONS								1977	SONS							
		I	II	III	IV	V	VI				I	II	III	IV	V	VI	
F	I	52	106	73	20	7	0	258	F	I	8	23	39	7	3	6	86
A	II	60	288	182	72	17	3	622	A	II	27	153	228	47	55	23	533
T	III	44	165	353	125	66	16	769	T	III	36	147	398	126	128	69	904
H	IV	20	76	168	211	48	14	537	H	IV	7	41	71	39	30	31	219
E	V	1	10	28	33	49	20	141	E	V	8	13	43	22	65	49	200
R	VI	0	0	2	5	7	14	28	R	VI	2	1	13	11	36	37	100
S									S								
		177	645	806	466	194	67	2355			88	378	792	252	317	215	2042

3. LOGLINEAR ANALYSIS

Frequency counts (cf. Fienberg, 1977) can be modelled as:

$$F_{ij} = GM * R_i * K_j * C_{ij} \qquad (A)$$

Expected frequencies F_{ij} in an I*J-table are modelled as the result of an overall effect GM, a row-effect R_i, a column-effect K_j and a cell- or association-effect C_{ij}. Equations of type A are not identified, but can be solved by introducing restrictions like:

$$PROD_i(R_i) = PROD_j(K_j) = PROD_i(C_{ij}) = PROD_j(C_{ij}) = 1 \qquad (A.a)$$

These restrictions are widely used (for example in ECTA) and result in parameter estimates that have a strong analogy to that of analysis of variance models. An alternative set of restrictions is:

$$R_1 = K_1 = C_{1j} = C_{i1} = 1 \qquad (A.b)$$

This set is applied in the GLIM computer program we used, and results in parameter estimates that have a strong analogy to that given by regression models with dummy variables. Like in dummy regression, the analist has to choose an arbitrary category (row, column, cell) that acts as a reference category.

Models with restrictions A.a and A.b are equivalent: the expected frequencies are the same. In fact they can be reparametrized in each other. The restriction sets A.a or A.b are necessary to identify the equation systems and to produce saturated models. More restrictions can be made, and should be made to construct more informative models.

For estimation it is necessary to take logs of A and estimate parameters in an additive form. In this paper we will discuss primarily multiplicative parameters, which can be interpreted more easily. Because the additive (loglinear) paramaters are accompagnied by standard errors and multiplicative parameter are not, we will need the forme for statistitical testing. We have used the computer program GLIM (Baker & Nelder, 1978), which has a very flexible structure and can incorporate nearly every kind of restriction on parameters, including metric restrictions. The use of GLIM for modelling mobility tables is treated extensively in Dessens, Jansen & Verbeek (1983).

3.1. HOPE AND HAUSER

The following type of models for mobility tables has been used by Featherman and Hauser (Featherman & Hauser, 1978; Hauser, 1979):

$$F_{ij} = GM * O_i * D_j * H_k \qquad [k \text{ E } i,j;\ PROD_k(H_k)=1] \qquad (2)$$

(F_{ij} refers to expected frequencies, GM to 'Grand Mean', O to origins, D to destinations, H to (Hauser-)levels). Hout (1983) labels this type of models "topological". The association parameters H_k are grouped in so-called "levels". By way of some trial-and-error procedure the original set of C_{ij}-parameters are organized in K categories. These models have the advantage of symplifying the interpretation of the association structure. However, this procedure has been criticised on several occasions (Hope, 1980, 1982; MacDonald, 1982). We think that Hope's (1980) criticism is most important among these. His criticism consists of three points:

a. In the Hauser-type models structural mobility is neglected. Hope argues that structural mobility is a sociologically relevant component of the mobility process and deserves attention and modelling on its own account.

b. The procedure is overconcerned with fitting the data and testing the goodness of fit. The procedure is - like all stepwise and atheoretical search methods - explorative and it suffers from dangers as capitalising on chance and overinterpretation.

c. From a prestige perspective it can be argued that the measurement level of occupations is always at least ordinal. By using methods for analysis of nominal data, interesting information about mobility is lost. As Hope admits, it is not entirely true that the ordinal character of occupational codes is neglected. For example, Hauser (1981: 577) states: "... models can be developed from such simple ideas as the clustering of observations on or near the main diagonal, (and) the randomness of destinations in long distance mobility." Hope stresses that the ordinal information has been used in the interpretation of the models only, but that this information can better be used in building the model and restricting its parameters.

Hope (1980) suggests several modifications of this procedure:

a. He proposes to choose a different model as a starting point of the analysis. Instead of statistical independence as a baseline, a "halfway"-model is constructed, in which there is no structural mobility and circulation mobility is perfect. The halfway model is defined by equal marginal distributions (marginal homogeneity) and statistical independence. Structural mobility can be incorporated in the model by adding parameters that estimate the difference between the halfway model and the actual marginal frequencies.
b. Hope stresses the point that it is not a very interesting problem to test whether some trial-and-error model with sometimes hardly understandable features 'fits' the data, but that it is more interesting to estimate sociologically interesting mobility components, by way of assessing their contributions in G^2-statistics (explained deviance).
c. Hope proposes to incorporate ordinal information about occupational categories by treating them as points with equal intervals on a metric dimension. Association parameters for instance can be modelled by restricting them proportional to the number of steps (distance) between origin and destination categories.

We think that Hope's proposals are in some respects a progression on Hauser's work. In other respects, however, we disagree with Hope, and try to work out his suggestions a little further. In our opinion, it is not correct to regard G^2-contributions as sociologically relevant mobility components. We think that Featherman and Hauser (1978) were correct in stressing the importance of the estimated parameters in their models. As percentages explained variance are not lawlike relations in regression models (but regression coefficients are), G^2-components inform only about how well a certain model fits the data. The information about the structure of the mobility regime is to be found in the estimated parameters. Our data contain interesting examples in which interpreting G^2-components leads to obviously false conclusions.

4. THREE GLOBAL MODELS

Table-2 sums up deviances and numbers of degrees of freedom for all models to be discussed, in a stepwise procedure. The first three models (1,2 and 3) contain global information on the pattern of counts: statistical independence (perfect mobility), equal association and symmetrical association. These three will be discussed before the specific models with restrictions on parameters (4 to 21). Model (14) will be selected as the best fitting and parsimonious account of the data.

Table 2 Log-linear models for intergenerational occupational mobility in the Netherlands 1954/1977 (N=2355/2042)

Years together					Years apart					
						1954		1977	
No.	Model	ndf	dev.	%	ndf	dev.	%	dev.	%
(1)	IND * Y	50	1016		25	686	6%	331	
(2)	EQ	25	90						
(3)	QSYM	20	37		10	11		26	
(4)	H	66	1685	0%					
(5)	H * Y	60	1169	31%	30	732	0%	437	0%
(6)	+ L	59	1082	36%					
(7)	+ L * Y	58	1066	37%	29	718	2%	348	20%
(8)	H * Y + D	55	1055	37%					
(9)	+ D * Y	50	1016	40%	25	686	6%	331	24%
(10)	+ V	47	156	91%					
(11)	+ V * Y	48	119	93%	24	59	92%	60	86%
(12)	+ Q	49	246	85%					
(13)	+ Q * Y	48	193	89%	24	128	83%	65	85%
(14)	(11) + I	47	113	93%					
(15)	+ I * Y	46	111	93%	23	59	92%	52	88%
(16)	(11) + DIA	42	96	94%					
(17)	+ DIA * Y	36	88	95%	18	39	95%	49	89%
(18)	(13) + I	47	107	94%					
(19)	+ I * Y	46	96	94%	23	45	94%	52	88%
(20)	(13) + DIA	42	91	95%					
(21)	+ DIA * Y	36	75	96%	18	26	96%	49	89%

IND=Independence, Y=Year, EQ=Equal association, QSYM=Quasi Symmetrical association, H=Halfway, L=Linear shift, D=Difference, V=Vertical, Q=Quadratic, INH=Inheritance, DIA=Diagonal blocked out

4.1. STATISTICAL INDEPENCE PER YEAR

Model (1) assumes statistical independence between origins and destinations per year:

$$F_{ij} = GM * O_i * D_j \qquad (1)$$

This model is used in most mobility analyses as a baseline: statistical independence of origins and destinations means "perfect mobility" and can be conceptualized as a theoretical vanishing point for mobility analysis. Take note that this model does not give any information on structural mobility. It can be reconciled with nearly every amount of the G^2-measures that it fits somewhat ... 1954.

4.2. EQUAL ASSOCIATION IN 1954 AND 1977

Model (2) takes up the question of the openness of Dutch society in exactly the same way as Featherman & Hauser (1978) did for the U.S.A.: is there, between 1954 and 1977, any difference in association between origins and destinations, given the differences between the marginal distributions of origins and destinations? That is: can any difference in circulation mobility be observed? This question can be answered on a global level (on which the pattern of association is not modelled in a very parsimoneous and intelligible way) by fitting the marginal distributions exactly and restrict the association parameters only by:

$$F_{ij} = GM * O_i * D_j * C_{ij} \qquad [C_{ij.54} = C_{ij.77}] \qquad (2)$$

The residual G^2 of model (2) is as high as 90, which is very significant with 25 degrees of freedom. Moreover, the residual G^2 is 8.9% of the original G^2 for the independence model (1). This can be compared with 0.7% in the analogue case of Featherman & Hauser (1978: 135) for the U.S.A. Our conclusion is that circulation mobility in the Netherlands has changed over the years.

4.3. QUASI-SYMMETRIC ASSOCIATION

A third model (3) tests a further global feature of the circulation mobility pattern, namely its symmetric character. A model is defined to be symmetric, if its parameters C_{ij} and C_{ji} are equal. Since we do not have a similar restriction on the marginal effects (which would result in equal distributions for fathers and sons), the model is labelled "quasi-symmetry":

$$F_{ij} = GM * O_i * D_j * C_{ij} \qquad [C_{ij} = C_{ji}] \qquad (3)$$

Quasi-symmetry simplifies the interpretation of the models and can be combined with many other more specified structures. In addition, it takes up an interesting theoretical question. In a symmetrical pattern, the probability of going from origin i to a destination j is equal to the probability of going from j to i, given the distribution of persons in categories i and j. If the global model of quasi-symmetry is refuted, it follows that some categories have "semi-permeable" walls (Blau & Duncan, 1967: 59), through which it is easier to leave than to come in, or the other way round. The fit of model (3) shows that in the data show that there is no semi-permeability for 1954 and a small semi-permeability for 1977. In the sequel we will not look for asymmetric models. All the following more specified models will be quasi-symmetric.

4. SPECIFIC MODELS

Specific models for our mobility tables can be described with the general formula:

$$F_{ij} = GM * H^{h}{}_{k} * L^{(j-i)} * D^{d}{}_{k} * V^{|i-j|} * Q^{(i-j)**2} * DIA_{k} * INH \qquad (C)$$

GM: Normalizing constant

H_k: Halfway-parameters,
for k=1..I=1..J:
$h_k = 0$ if $i \neq k$ and $j \neq k$
$h_k = 1$ if $i=k$ or $j=k$ and $i \neq j$
$h_k = 2$ if $i=j=k$

L : Parameter for uniform structural mobility

D_k: Parameters for non-uniform structural mobility,
for k=1..I=1..J:
$m_k = 0$ if $i \neq k$ or if $j \neq k$ or if $i=j=k$
$m_k = -1$ if $i=k$ and $j \neq k$
$m_k = 1$ if $j=k$ and $i \neq k$

V : parameter for linear circulation mobility.

Q : parameter for quadratic circulation mobility.

DIA_k : parameters to fit the main diagonal cells,

INH : parameter to fit one contrast for the main diagonal versus the other cells.

Formula (C) models the frequencies in mobility tables by several (sets of) mobility components and a normalizing constant. The components can be looked upon as restrictions on the expected frequencies pattern. Model 4 is general in the sense that by removing (or setting equal to 1) one or more of the parameters more simple models can be generated. Next we will discuss the nature of each of the components in the general model.

5.1. NORMALIZING CONSTANT GM

The normalizing constant GM just serves to garantee $SUM_{ij}(F_{ij})=1$. It is directly related to the sample size and does not have any interesting interpretations.

5.2. EQUAL MARGINAL DISTRIBUTIONS AND STATISTICAL INDEPENDENCE

According to Hope (1980, 1982) the baseline of mobility analysis should be a model with equal marginal distributions (marginal labels this model the 'halfway-model' since the modelled marginals are equal for fathers and sons and are in fact equal to the mean distribution of fathers and sons. Expected marginal frequencies F_{ij} can be computed from the observed frequencies f_{ij} as:

$F_{i+}=F_{+j}=((f_{i+})+(f_{+j}))/2$ for $i=j$

The expected frequencies under the assumption of statistical independence and the G^2-value can be computed easily. However, for using the halfway model as a baseline it is more interesting to estimate this component via parameters which produce the same expected frequencies. In this way other parameters can be added to the halfway model. Using GLIM this is easily accomplished by constructing a set of variables as defined. For our 6*6-tables these h_k look like:

$$h_1 = \begin{matrix} 2&1&1&1&1&1\\ 1&0&0&0&0&0\\ 1&0&0&0&0&0\\ 1&0&0&0&0&0\\ 1&0&0&0&0&0\\ 1&0&0&0&0&0 \end{matrix} \quad \ldots \quad h_3 = \begin{matrix} 0&0&1&0&0&0\\ 0&0&1&0&0&0\\ 1&1&2&1&1&1\\ 0&0&1&0&0&0\\ 0&0&1&0&0&0\\ 0&0&1&0&0&0 \end{matrix} \quad \ldots \quad h_6 = \begin{matrix} 0&0&0&0&0&1\\ 0&0&0&0&0&1\\ 0&0&0&0&0&1\\ 0&0&0&0&0&1\\ 0&0&0&0&0&1\\ 1&1&1&1&1&2 \end{matrix}$$

There are I-1=J-1 non-redundant H_k-parameters. Therefore, one restriction has to be introduced to remove redundancy in the total set of I=J H_k parameters and to make it possible to identify the parameters. In GLIM this is done by a dummy-type restriction (A.b), for which we chose H_1. By adding a proper constant to the estimated values, one can reparametrize this to anova-type restrictions (A.a)

As can be seen from the display of h_k, each treats the corresponding columns and rows in the same way and estimates a contrast between the frequencies in that row and column versus the rest of the table. In the crossing of row and column (i=j=k) the effect is taken twice. If the H_k's are the only parameters in the model this results in the same marginal frequencies for rows (fathers) and columns (sons). The expected marginal frequencies are equal to the mean (halfway) of the observed distributions of fathers and sons.

The H_k-parameters can be interpreted as the mean occupational distribution. For our analysis this is not a very interesting issue, but when comparing countries cross-sectionally, these parameters may have interesting values in themselves. In this analysis their only function is to form a baseline on which more interesting mobility components are modelled.

5.3. UNIFORM (UPWARD) STRUCTURAL MOBILITY

The component $L^{(j-i)}$ estimates structural mobility as far as it can be treated as a uniform vertical (upward or downward) shift of the

marginal ...
modern societies, the occupational distributions of sons have a higher mean than that of their fathers. This forces an upward shift of sons. The magnitude of this shift can be modelled by incorporating a variable (j-i) which has the following display for our tables:

0	1	2	3	4	5
-1	0	1	2	3	4
-2	-1	0	1	2	3
-3	-2	-1	0	1	2
-4	-3	-2	-1	0	1
-5	-4	-3	-2	-1	0

In tables with upward structural mobility (an average increase of occupational positions) the estimated parameter L will be greater than 1. The expected frequencies are proportional to the value of (j-i). The expected frequencies on the first subdiagonals will be 1.05^{+1} higher and 1.05^{-1}=.95 lower than the expected frequencies on the main diagonal. A general shift of persons in the direction of the higher occupational categories can be observed. This uniform shift results in a better fit for the marginal distributions: the higher categories show a regular positive difference between fathers and sons, and the lower categories show a regular negative difference between father and sons.

5.4. NON-UNIFORM STRUCTURAL MOBILITY

Not every structural shift in the mobility table acts in a uniform way. Occupational categories may grow or diminish in other ways than the general trend. These non-uniform changes can be modelled for each occupational category separately by introducing an restricting variable d_k per category and by estimating a contrast parameter D_k between rows and columns i=j=k. The d_k-variables look like this:

$$\underline{d_1} \quad \cdots \quad \underline{d_3} \quad \cdots \quad \underline{d_6}$$

$$\begin{matrix} 0 & 1 & 1 & 1 & 1 & 1 \\ -1 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 \end{matrix} \quad \cdots \quad \begin{matrix} 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 \end{matrix} \quad \cdots \quad \begin{matrix} 0 & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & -1 \\ 1 & 1 & 1 & 1 & 1 & 0 \end{matrix}$$

By taking the D_k's into the model marginal frequencies are perfectly fitted. In general, there will be I-1=J-1 non-redundant D_k parameters. However, when there is a L-parameter for uniform structural mobility in the model (which is in the same 'parameter space'), there will be only I-2=J-2 non-redundant D_k-parameters. A second reference category has to be chosen or the L-parameter has to be taken out again. If all parameters H_k, L, and D_k are present in the model, expected frequencies will be equal to those of statistical independence or perfect mobility. Structural mobility is partitioned in a baseline (constant + halfway

parameters) and in two forms of [illegible]
that acts uniformly throughout the table, and (2) non-uniform ones, that represent irregular shifts from or to certain occupational categories.

5.6. LINEAR DISTANCE CIRCULATION MOBILITY

Circulation mobility can be modelled by introducing a linear distance variable $V^{|i-j|}$ in the model. The variable $|i-j|$ scales occupational categories on an equal interval scale. Its structure is:

0	1	2	3	4	5
1	0	1	2	3	4
2	1	0	1	2	3
3	2	1	0	1	2
4	3	2	1	0	1
5	4	3	2	1	0

The effect of the V-parameter can be explained as follows. In most mobility tables, where there is a positive association between origins and destinations, the parameter will take a value lower than 1. If, for example, V equals .60, this will result in expected frequencies on the first subdiagonals of 60% of the expected frequencies on the main diagonal, net of the effect of the other parameters in the model. By the same value of V expected frequencies for maximal circulation mobility (rise from category I to VI or descend from VI to I) are $(.60)^5 = .08$ times the expected frequencies on the main diagonal.

5.7. QUADRATIC DISTANCE CIRCULATION MOBILITY

The variable $|i-j|$ is just one of many ways to make use of the ordinal information that is offered by an occupational prestige scale. The assumption of equal intervals between the occupational categories may be criticized as being arbitrary, since all monotonous transformations will do.

One obvious alternative for linear mobility is quadratic mobility: expected frequencies are modelled to vary linearly with the square of i-j:

0	1	4	9	16	25
1	0	1	4	9	16
4	1	0	1	4	9
9	4	1	0	1	4
16	9	4	1	0	1
25	16	9	4	1	0

This model gives a decreasing probability of mobility with distance: expected frequencies are relatively higher in the neighbourhood of the main diagonal and lower in the far-off diagonal cells. This model is very popular in mobility analysis under the name 'constant association'. It can be proved (Goodman, 1979b) that it has the characteristic of constant odds-ratio's.

5.8. OCCUPATIONAL INHERITANCE

Several authors (e.g. Goodman, 1979a) have suggested that a main characteristic of social mobility is occupational inheritance. Sons tend to have an occupation in the same category as their fathers, and if not, there is not much association between origins and destinations. It should be stressed that the V-parameter for circulation mobility results in probabilities for occupational inheritance that are higher than any of the probabilities to 'travel' to one of the other categories. However, there may be an extra effect of occupational inheritance in our data, e.g. because of the direct transfer of properties. Two variables are constructed to deal with this phenomena. The DIA_k fit for every cell on the main diagonal its own contrast versus the non-diagonal cells, and so fit the main diagonal perfectly. INH fits only one contrast of the main diagonal cells versus the non-diagonal cells. Therefore, INH is more parsimoneous than DIA.

6. RESULTS

6.1. THE FORWARD INTRODUCTION OF COMPONENTS INTO THE MODEL

In table 2 the above mentioned mobility components are introduced, in a step-wise way. The halfway model (4) results in a baseline G^2-deviance of 1016 for both years together. When the halfway-model is specified for each year apart (model 5), the fit drops to 1169, with ndf=60. This indicates that the mean occupational occupational categories are significantly different occupied in the two years. The introduction of the uniform shift L (model 6) reduces the deviance to 1082. A distinct shift-parameter for each year (model 7) gives a further drop to 1066; which means a difference of 16 for one degree of freedom. Apparently there are different linear uniform shift parameters for both years. The deviances drop to 98% (1954) and 80% (1977). The introduction of the non-uniform shifts (model 8) reduces the residual G^2 to 1055, with 55 degrees of freedom. The deviance of model (9), 1016 with 50 degrees of freedom, shows that non-uniform changes in marginal distributions are significantly different in both years. By introducing the non-uniform shift parameters we have reached the model of independency of origins and destinations. For 1954 this model explains 6% of the baseline G^2, and for 1977 is explains 24% of the baseline G^2, if introduced before the circulation mobility components.

The addition of the V-parameter in model (10) reduces the residual G^2 to 156, with 47 degrees of freedom. When distinct V-parameters are introduced for both years (model 11), the deviance drops to 119 with 46 degrees of freedom. The difference between models (10) and (11), a deviance of 47 with one degree of freedom, shows that there are significantly different V-parameters. The residual G^2's have thus been reduced to 8% for 1954 and 14% for 1977.

The addition of the Q-parameter to the independence-model (model parameters (model 13) for each year give drop with 53, for one degree of freedom.

Introducing V- or Q-parameters does not give totally satisfactory fits for our mobility tables. Therefore we add the occupational inheritance variables to our models. First, we add the inheritance-variables to model (11). Adopting a general inheritance-parameter (model 14) gives a drop with a deviance of 6, for one degree of freedom. Different INH-parameters for both years give a further, insignificant, drop with 2 points for one degree of freedom. Fitting the main diagonal perfectly gives better results. The deviance of model (16) with equal DIA-parameters for both years is 96, with 42 degrees of freedom, which means a drop with 23 for 6 degrees of freedom. Fitting different DIA-parameters for the two tables (model 17) does not give a further significant drop. Comparison of models (15) and (17) learns, that when a V-parameter is in the model, the diagonal cells do not have precisely a constant density. The difference is 23 for 10 degrees of freedom.

Secondly, we adopt the occupational inheritance variables to the quadratic distance model (13). The general inheritance-parameter causes a drop wich 86 points G^2, for one degree of freedom (model 18). Fitting different INH-parameters (model 19) gives a further drop with 11 points for one degree of freedom. Fitting the main diagonal perfectly (model 20) gives a deviance of 91, with 42 degrees of freedom. Model (21) shows that adopting different densities for the diagonal cells for both years gives a further significant drop of the fit. Comparison of models (19) and (21) learns again, that when a Q-parameter is adopted in the model, the diagonal cells have not precisely a constant density. The difference is 21 for 10 degrees of freedom.

Models (15), (17), (19) and (21) all give acceptable fits for our mobility tables. Although knowing that models (15) and (17), and models (19) and (21) show (hardly) significant differences, for sake of simplicity in demonstrating the parameter estimates we choose models (17) and (21) for presentation. Models (19) and (21) give five parameter more to discuss than models (15) and (17). Model (15) explains for 1954 92% and for 1977 88% of the baseline deviance, and model (19) explains for 1954 94% and for 1977 88%.

6.2. THE PARAMETERS OF THE MODEL

The parameter estimates of models (15) and (19) can be found in table 4. Structural mobility is modelled by the non-uniform shift parameters D, and alternatively by the uniform shift parameter L. Uniform structural mobility was in 1977 higher than in 1954 (multiplicative parameters of 1.13 vs. 1.05), and this difference is significant ($p<.05$). For the observed differences (j-i) in our tables the L-parameter can be recomputed multiplicatively as:

i-j	-5	-4	-3	-2	-1	0	1	2	3	4	5
1954	.79	.83	.87	.91	.95	1	1.05	1.10	1.15	1.21	1.26
1977	.56	.63	.70	.79	.89	1	1.12	1.26	1.42	1.60	1.79

Table-3: Parameters of selected models from table-2

Panel A Structural Mobility Parameters

	dummy-restrictions(s.e.) (Model 9) 1954	1977	anova-restrictions (reparametrized) 1954	1977
H_1	1.596 (.123)	-.522 (.097)	-.232	-1.082
H_2	2.683 (.116)	1.119 (.069)	.855	.559
H_3	2.900 (.115)	1.753 (.065)	1.072	1.193
H_4	2.447 (.117)	.471 (.076)	.619	-.089
H_5	1.340 (.125)	.541 (.076)	-.488	-.020
H_6	0	0	-1.828	-.560
D_1	.625 (.123)	.371 (.097)	-.251	-.065
D_2	.418 (.116)	.555 (.069)	-.045	-.248
D_3	.413 (.115)	.449 (.065)	-.040	-.142
D_4	.507 (.117)	.313 (.076)	-.134	-.006
D_5	.277 (.125)	.152 (.076)	.097	.154
D_6	0	0	.373	.307
GM	-.227 (.224)	2.354 (.119)	3.428*	3.474*

	GLIM-estimates (Model 7) 1954	1977
L	.047 (.013)	.117 (.013)

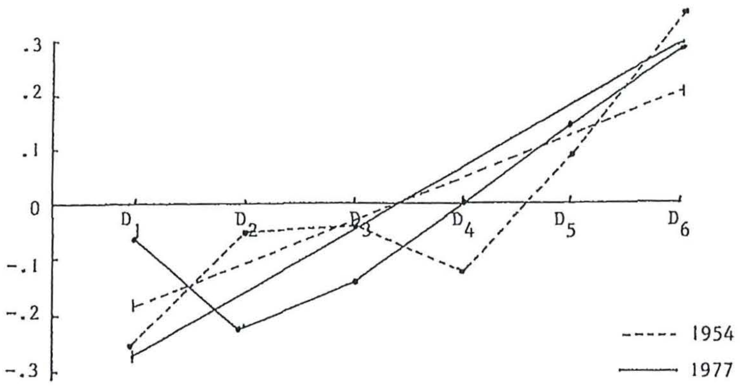
Panel B Circulation Mobility Parameters

	GLIM-estimates (Model 15) 1954	1977	GLIM-estimates (Model 19) 1954	1977
Vertical	-.644 (.042)	-.476 (.040)		
Quadratic			-.167 (.011)	-.109 (.009)
Inheritance	-.051 (.071)	-.123 (.008)	.455 (.050)	.208 (.056)

(*) computed with substitution

The estimated values for the L-parameter and the D_k-parameters are plotted simultaneously in figure 1. The D-parameters show a somewhat irregular, but on the average ascending pattern with a somewhat steeper slope in 1977. This pattern, i.e. the general increase of higher prestige categories and decrease of the lower prestige categories, is modelled with the L-parameter.

Figure 1: Simultaneous plot of D-parameters and L-parameters for structural mobility



The V- and Q- parameters of models (15) and (19) suggest that there was a considerable difference in circulation mobility between both years. The V-parameter of model (15) is (multiplicative) .53 for 1954 and .62 for 1977. The Q-parameter of model (19) is (multiplicative) .85 for 1954 and .90 for 1977. As seen before, this difference are very significant ($p<.001$). This confirms our conclusion from model (2) that there was a difference in openness of the Dutch society between both years. The values show that there was more openness in 1977 than in 1954. For the observed differences (i-j) in our tables the values of the $V^{|i-j|}$- and $Q^{(i-j)**2}$-components can be computed as:

i-j		-5	-4	-3	-2	-1	0	1	2	3	4	5
1954	V	.04	.08	.14	.28	.53	1	.53	.28	.14	.08	.04
	Q	.02	.07	.22	.51	.85	1	.85	.51	.22	.07	.02
1977	V	.09	.15	.24	.39	.62	1	.62	.39	.24	.15	.09
	Q	.07	.17	.37	.65	.90	1	.90	.65	.37	.17	.07

These values can be interpreted as relative frequencies. Given the expected frequencies from the other components of the model, the probability of maximal mobility (upward from I to VI or downward from VI to I) is 2 or 4% in 1954 and 7 or 9% in 1977 compared to the probability of immobility. The difference for models in which V or Q is adopted lies in the subdiagonals next to the main diagonal. In the sub-diagonals farther away from the main diagonal the effects are much the same. It is interesting to look at the values of the inheritance parameter INH. Combined with the vertical exchange parameter V this parameter has a negative value. For 1954 this value is not significantly different from zero, but for 1977 it is. This means, that, when V is adopted in the model, the relative chance to find a case on the main diagonal is .95 in the 1954 table and .88 in the 1977 table. However, combined with the quadratic exchange parameter Q the inheritance parameter has a positive sign for both years. The multiplicative parameters are 1.58 for 1954 and 1.23 for 1977. This means, that, after adding Q in the model, relative chances for the main diagonal have dropped from 1.58 to 1.23.

7. INTERPRETATION OF PARAMETERS VERSUS INTERPRETATION OF G^2-RESIDUALS

In loglinear analyses of mobility tables it has become common practice to draw conclusions on the basis of residual G^2 differences between them. Magnitudes of mobility components are computed from G^2 differences. This practice should be discarded in favour of the interpretation of the parameters of the model. Interpreting G^2 as such confuses measures for the fit of a model with the model itself. This problem is in perfect analogy with the better known problem of confusing correlations or percentages explained variance with the regression coefficients in causal modelling or other regression techniques. Interpreting G^2 differences as mobility components comes down to the same thing as interpreting percentages explained variance as structural coefficients. This may lead to serious mistakes. Percentages explained variance and explained deviance depend on the order of the introduction of parameters, which is to some extent arbitrary.

In addition, and also in analogy with regression techniques, it should be stressed that parameters can only be assessed in a reasonably fitting and acceptable model. There is a mutual dependence of parameters: introduction of additional parameters may change the estimates of parameters that are already present in the model.

Our analysis shows two examples of possible pitfalls. First, an important example may be drawn from the comparison of models (15) for both years and of model (19) for both years. If only percentages explained deviance were compared, both comparisons would lead to the conclusion that circulation mobility was greater in 1954 than in 1977. However, just the opposite is true. The parameter estimates for the V-, Q- and INH-parameters show clearly that there was much more circulation mobility in 1977. A second example has already been mentioned: the significant reduction of G^2 from model (11) to (14) for the 1977 table (à drop in residual G^2 of 8 for one degree of freedom) does not indicate any "occupational inheritance". The estimated parameter shows this added effect to be an indication for status disinheritance, given the effects on the other parameters in the model.

8. CONCLUSIONS AND DISCUSSION

The conclusions from our analysis of intergenerational occupational mobility in the Netherlands are:

a. With a structured approach to loglinear analysis the mobility tables can be partitioned in effects of structural mobility and circulation

mobility. Structural mobility can be ...
uniform shifts.

b. The non-uniform structural mobility shows a somewhat irregular pattern, with a somewhat different structure between the two tables. However, in both cases there is a upward trend: the lower status groups have diminished and the higher status groups have grown. Uniform structural shifts, designed to model this status inflation, differ significantly between both years. In 1977 the growth of higher status categories and the decline of lower ones, as far as uniform shifts are concerned, was larger than in 1954.
c. The regimes for circulation mobility can be shown to have the same pattern in both years: that of linear or quadratic distance parameter in combination with a general inheritance parameter for the main diagonal. The probability of going up or down in a certain category is proportional to the (quadratic) distance between that category and the category of the father, when an exception has been made for the main diagonal.
d. The regimes of circulation mobility in the two years, notwithstanding their same structure, have a different severity: Dutch society has become more open between 1954 and 1977, at least in as far as intergenerational mobility is concerned. Both the V- or Q-parameters, and the INH-parameter have decreased.

We have not posed any explanatory questions in this paper: why was Dutch society more open in 1977 than in 1954 and why is this not true for the US? We suggest that mobility analists take up an old lead of Lipset & Bendix (1959): the comparison of mobility regimes of several societies. In analysing and comparing mobility tables from different societies two conditions (among others) have to be fulfilled. First, these societies should be scaled along relevant cultural, political, economic and technological dimensions. Secondly, mobility regimes should be modelled with simple (few parameters) models, in which parameters are restricted according to levels of explanatory factors. Our research group (cf. Ultee, 1982) is working on this program.

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APPENDIX: RECODING THE CENSUS OCCUPATIONAL CODE INTO VAN TULDER'S PRESTIGE CATEGORIES

(0100-0133, 0211-0259, 0260, 0270, 0510, 0520, 0612-0634, 0650-0670, 797, 0810-0842, 0901-1329, 1412-1499, 1911-1929, 1952-1999, 2010, 2100, 2110, 4010, 4110=6)
(0142-0149, 0281-0329, 0412-0439, 0532-0544, 0640, 0680-0719, 0762-0796, 0798, 0843-0849, 0852, 0853, 1330-1399, 1510-1803, 1931-1944, 2020, 2120-2199, 3001-3009, 3101-3109, 3510, 3597, 4020, 4120, 4220, 4712-4714, 5010=5)
(0331-0390, 0732-0741, 0752, 0753, 0797, 1803, 1946, 3212, 3312, 3392-3399, 3520, 3591-3596, 3599, 3803, 3978, 4210, 4430-4467, 4510-4620, 4732-4739, 4910, 5020-5199, 5202-5209, 5821, 5823, 5893, 6010-6130, 9830, X211=4)
(0722-0724, 0729, 0742, 0743, 3213-3215, 3220, 3313-3317, 3410-3423, 3600, 3802, 3912-3936, 3938-3999, 4300, 4310-4320, 4390-4420, 4490-4499, 4722-4729, 4900, 5311, 5312, 5601, 5702-5704, 5811, 5812, 5822, 5892, 5894-5934, 7011-7029, 7731, 7735, 7761-7769, 8011, 8012, 8030, 8120-8199, 8311, 8312, 8400-8590, 8602-8609, 8712-8990, 9211-9294, 9410, 9511-9599, 9612-9699, 9732-9749, X212=3)
(3700-3709, 4812-4819, 5319-5329, 5412-5414, 5416-5419, 5422-5429, 5513-5529, 5705-5709, 6212-6494, 7112-7720, 7732, 7733, 7734, 7739, 7742-7759, 7770-7992, 8000, 8022-8029, 8110, 8202, 8209, 8319, 8321-8390, 9012-9109, 9312-9396, 9422-9425, 9430-9490, 9722, 9723, 9792-9820, 9842-9899, 9912-9916, 9939, 9980=2)
(4822-4829, 5415, 5512, 5602-5609, 5992, 5999, 9711-9719, 9919, 9922-9929, 9990, X213=1)
IF (FATHER=FARMER AND FATHER'S EDUCATION=1) PRESTIGE=3, ELSE 4
IF (FARMER AND INCOME LOWER THAN FL.21.000) PRESTIGE=3, ELSE 4

1984