VERTICAL AND NONVERTICAL CLASS MOBILITY IN THREE COUNTRIES*

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Classes are held to have specific relations to labor and commodity markets, and these relations are thought to constrain the mobility chances of their members. Classes are also held to be unequal, though not necessarily strictly ordered in a hierarchy of advantage. The theorist of class mobility should distinguish between movement attributable to closeness on a vertical dimension and movement (or lack of it) attributable to specific class relations.

This paper looks at all four combinations of vertical vs class-specific, and distributional vs exchange mobility, for men in three countries. While there is evidence of some inter-societal differences in both aspects of class-specific mobility, differences in vertical mobility are minute. The outstanding result of the analysis, however, is that 88% of all differences must be attributed to differences between occupational distributions.

The analysis employs a "structured" approach to modeling which reflects the traditional concerns of mobility analysis.

PROPOSITIONS ABOUT MOBILITY

Lipset and Zetterberg (1966) advanced the thesis that vertical mobility is constant across societies. No analyst has yet succeeded in testing this thesis because none has found a way of modeling vertical mobility. When Lipset and Zetterberg themselves discussed empirical data they looked at outflow patterns for want of a better way of defining a vertical dimension.

To test their thesis three things are required. First, it is necessary to demonstrate that classes lie, to some significant degree, in a vertical hierarchy. This need not mean, of course, that all relativities between classes lie along such a dimension; on the contrary, the degree to which they do so is a matter of major sociological interest. Common sense assures us, however, that there must be a vertical dimension, and our empirical study must begin by establishing how classes project onto it. It may be noted, in parenthesis, that our investigation of this point shows that Lipset and Zetterberg were wrong when they chose the manual/non-manual split as a criterion of vertical mobility.

Second, it must be shown that frequency of movement between classes is a function of their degree of vertical separation, or rather, since no one doubts this, we must find a way of stating precisely how much movement is to be expected between any two classes as a consequence of the vertical distance which separates them.

Third, we must free ourselves from the analytical dilemma posed by "outflow" and "inflow" modes of analysis. The people in a mobility table have moved once, not twice, and it should be possible to find a form of analysis which captures the salient features of both modes of investigation. It is true that the two margins of a mobility table have different conceptual standings, in that the distribution of fathers does not constitute a picture of the occupational distribution of men at some one point in the past. Duncan (1966) has established, however, that it is possible to treat the two margins as coordinate simply by relabeling them "origins" and "destinations." Once the validity of this change

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of standpoint has been granted, it becomes a relatively simple matter to replace the "origins or destinations" disjunctive approach of traditional mobility theory by the "sums and differences" approach of the diamond model (Hope, 1981a). Simple though this step is, its consequences are far-reaching. For the first time it becomes evident that we ought to disaggregate the usual base model of mobility analysis (i.e., the ordinary model of statistical independence of the rows and columns of a contingency table), and that the true base from which mobility should be measured is one of the constituents into which that model can be broken down. Once we have established the true base, namely the "sums" or "halfway" model (Hope, 1971), then we are in a position to quantify the several definable components of mobility on a common scale of percentage of variance[1] accounted for. Furthermore, the question of how far countries differ in the extent of their mobility can be broken down into a set of questions, one for each component of mobility variance.

The result of these analytical maneuvers is a single, comprehensive, table of mobility variance in which theoretically defined effects are rendered commensurate both within a single country and across countries. Having recounted these theoretical innovations, we turn now to a more technical exposition of the new method of comparative mobility analysis. The essence of the method is that it is "structured" in the sense that the final model is built up, piece by piece, out of sociologically defined components. The interest of the method is not so much in the closeness of the ultimate fit, as in the relative importance of the pieces. Structuring is a general approach to contingency table analysis which is not confined to any one model. So we may further define our technique by saying that the analysis presented here is an instance of the "structured diamond" model of mobility analysis which was first presented in Hope, 1981a. The model is specified by means of a design matrix, and examples of design matrices were given in the earlier paper. The Appendix to the present paper gives the formulae for constructing a design matrix.

THE REPRESENTATION OF VERTICAL MOBILITY

Most of the recent work on mobility analysis has concentrated on the investigation of a single table (Hauser, 1978; Duncan, 1979; Clogg, 1981; Breiger, 1981; Hope, 1981a). The present state of the art of *comparative* mobility analysis was succinctly presented by Goodman (1969) some years ago, and its first applications were to comparisons over time, that is, to a search for trends (Hauser et al., 1975; Hope, 1974, 1980a). Basically, it consists in taking two tables—for example, from England in 1949 and 1972, or from the United States in 1962 and 1973 (Featherman and Hauser, 1978)—and fitting a log-linear model. The overall conclusion of the analyses carried out so far is that there is very little change in mobility pattern over time.

If GM represents the grand mean in the table, I represents inquiries (i.e., years or countries), F represents father's occupation, and S represents son's occupation, then change in mobility is assessed by fitting all terms except the three-way combination IFS. Insofar as this is significant, it is claimed that mobility has changed between the two inquiries. In the English analysis, for example, omitting the factor of cohorts and looking only at mobility tables aggregated across cohorts (Hope, 1974), we have two 7×7 mobility tables, one for 1949 and the other for 1972. The interaction term IFS is not significant, and so we conclude that we have no evidence of change in mobility pattern.

It is important to note that the mobility pattern whose stability (over time, or between countries) is being tested is the pattern of exchange (also known as "fluidity," "pure," or "circulation") mobility. In the analysis of a single table, exchange mobility is defined as the difference between the observed table and the fitted table which represents statistical independence of rows and columns

[1] The term "deviance" is sometimes employed. And it would be legitimate to treat χ^2 as a distance (Bacharach, 1970). "Variance" is used here to bring out the analogy with R^2. More accurately, χ^2 is the analogue of $1 - R^2$.

(commonly called "perfect mobility"). In a single, father × son table, perfect mobility may be written as the log-linear model GM + F + S. Exchange mobility is therefore the residual which is accounted for when we write the "fully-saturated" model[2] GM + F + S + FS, that is, the model which fits the observed frequencies perfectly by the addition of the term FS, which accounts for the pattern of association (or interaction) between fathers and sons.

So when we fit the model,

$$GM + I + F + S + IF + IS + FS$$

to a three-way table in order to test the second-order interaction, IFS, what we are doing is asking whether the pattern of association between fathers and sons is the same in one table as in the other (Kullback, Kupperman and Ku, 1962; Goodman, 1969).[3]

As a statistical test this procedure is unimpeachable, but as a piece of sociological analysis it is imprecise and of uncertain import. If we have two inquiries, and the mobility table has seven rows and columns, then IFS is tested with $1 \times 6 \times 6 = 36$ degrees of freedom, and these are too numerous to constitute an informative test. Treating χ^2 as a measure of distance between two points in a multidimensional space (Bacharach, 1970), what we want to know is whether the observed table (represented by one point) deviates from the fitted table (represented by the other point) in many of the 36 dimensions, or in only a small subset of them. If the deviation is confined to one or two axes, we want to know what those axes stand for sociologically. More precisely still, the existence of a hypothesis such as Lipset and Zetterberg's (1966) thesis of constant vertical mobility impels us to ask whether we can specify what we mean by the sociological terms employed in the formulation of the thesis. Can we, for example, define vertical mobility as a subspace of exchange mobility?

A model of vertical mobility was introduced in Hope (1981a), and it is a slightly modified version of that model which we employ here to investigate constancy of vertical mobility across societies.

THE REPRESENTATION OF STRUCTURAL MOBILITY

So far our discussion has concentrated on that aspect of the structured diamond model which reflects vertical mobility, however, the model incorporates a second innovation which is essential to any useful comparative analysis. This second innovation takes the form of a conceptual and statistical disaggregation, not of exchange mobility, but of perfect mobility.

It is probably not too far off the mark to say that the perfect mobility model was employed by sociologists simply because they had learned how to compute the Pearson chi-square for a two-way contingency table. And the model has been applied to comparisons of two or more tables simply because the iterative proportional scaling algorithm is easy to program.[4] As in the case of vertical mobility, our task is to forget the techniques and to concentrate on the basic theoretical question—how do we isolate structural mobility? We need to find two models: a first model which excludes the postulated structural effect, and a second model which includes it. Of course we must be able to show that the difference between the two models really does comprehend all and only the variance due to structural mobility.

Structural mobility within a single mobility table is ordinarily defined as mobil-

[2] In writing the formula of a model, users of the iterative proportional scaling algorithm (Goodman, 1969) commonly omit any term, or set of terms, which is a component of another term in the model. For example, the model in the text is often written simply as FS. In the regression approach to log-linear analysis, however, every degree of freedom must be represented by a distinct column in a design matrix. This technique thus encourages us to adopt the desirable practice of writing models out in full.

[3] The original generalization of the definition of interaction to a three-way table was carried out by Bartlett (1935). The main line of development of this idea may be summarily traced in Plackett (1962) and Darroch (1962).

[4] A generalized proportional scaling algorithm is rather more difficult to write but I found, when I came to write a program to analyze contingency tables of any dimensionality, that algorithms written for completely crossed analyses of variance can be readily adapted to log-linear analysis.

ity necessitated by differences between the occupational distributions of fathers and sons.[5] It can be shown (a) that structural mobility is entirely subsumed in the perfect mobility model, in the sense that the fit of the perfect mobility model can never be improved by adding to it a model of structural change; and (b) that a model called the "halfway" model (Hope, 1971) has the properties of being entirely subsumed in the perfect mobility model and of abstracting all and only the elements of a mobility table which do not represent structural mobility (Hope, 1981a). The difference between the perfect mobility model and the halfway model is an entirely straightforward and unambiguous measure of structural mobility; the relative size of the chi-square associated with the difference is an index of the importance of structural mobility; and the contingency hierarchy (additive component of the mobility table, Hope, 1972) associated with it reveals the pattern of structural mobility. In comparative analysis, the interaction between inquiry and the halfway model reflects societal (or temporal) differences in occupational structure. Thus interaction between inquiry and the "difference" model (Hope, 1981a; this is the model which complements the halfway model to make up the perfect mobility model) reflects differences in structural mobility.

If we write H for the halfway model, and D for the difference model, then the conventional perfect mobility model for a two-way mobility table, namely GM + F + S (that is, the model which fits the ordinary chi-square expectations) is precisely equivalent to the "structured" model GM + H + D. (The Appendix to Hope, 1971, illustrates how two models which look very different on the surface can actually be formally identical.)

[5] Structural mobility has several distinguishable senses (Hope, 1980b), but all of them which refer to differences between two distributions can be handled by the sort of models which are described here. Theorists who put forward new models have constantly to reiterate that no model is sacrosanct; choice of model depends on the particular conceptual issue under investigation. The contrast between the structured model and models put forward by Goodman and Hauser has been drawn in another paper (Hope, 1981d, see also Hope, 1981b).

The defect of previous work is that it fitted the perfect mobility model because this was felt, in an obscure way, to be an index of structural mobility, but analysts knew of no way of separating out its two constituent parts, i.e., structural constancy and structural change. The structured model solves this problem because the halfway component H accounts for constancy but not change, and the difference component D accounts for change but not constancy.

Nothing we have said so far imposes any order assumption on the categories of our occupational distribution. The analysis of structural mobility applies equally well to the study of class mobility as to the study of vertical mobility. If, however, we are willing to assume that the categories are evenly distributed along a vertical scale, then we can disaggregate structural mobility, D, into two parts; one degree of freedom representing net shift (upward or downward) in the marginal occupational distribution, and the residue representing nonuniform shifts. It can be shown (Hope, 1981a) that a linear term L, representing uniform shift, is entirely subsumed in the difference model, D, and hence, a fortiori, that it is entirely subsumed in the perfect mobility model GM + H + D. L takes the value $i - j$ for cell i, j.

THE ANALYSIS OF MOBILITY

Having dealt with the disaggregation, first of exchange mobility, and then of its complement, perfect mobility, we now put the two disaggregations alongside each other and examine the "structured diamond" method of mobility analysis which they constitute.

Exchange mobility is the difference between observed mobility and perfect mobility. Let us call it E. Provided we are willing to impose a vertical scale on our categories, we can fit a term (again accounting for only a single degree of freedom) which relates frequency of movement to distance traversed. This term, V, is a component of E, and it is defined by specifying a constant for each cell of the mobility table. The constant for cell i, j is $|i - j|$, that is, the absolute value of the number of steps moved.[6] V is subsumed in exchange mobility E, rather as the linear term, L, is subsumed in structural mobility, D. The residue after removal of V may be further analyzed according to a number of conceptual schemes. In a table with four or more categories the degrees of freedom associated with the residue exceed the degrees of freedom fitted by all the models so far described. For example, in a 9×9 table the residue lies in 63 of the 80 dimensions which the data contain. In practice, although the residue is usually significant, it is often difficult to interpret. Indeed, if the analysis has been specifically designed for the study of vertical mobility, that is, if the occupational categories really do represent the vertical hierarchy in a society, then the residue may be negligible in degree (Hope, 1981a).

Our exposition has postulated two effects in a hypothesized vertical dimension: the linear term L representing uniform upward shift in the occupational distribution, and V representing vertical distance traveled. It should be emphasized that these effects are defined a priori, and that they relate to the theoretically defined vertical dimension of stratification. When we turn to the residual elements of structural change, D − L, and to the residual elements of exchange mobility, E − V, we leave the theoretical domain and enter the realms of induction. Writing D for the difference model and E for exchange mobility, we may say that L and V are, respectively, the structural and the exchange elements of vertical class mobility, whereas D − L and E − V are the corresponding structural and exchange elements of specific (or nonvertical) class mobility. The relations among the terms of the model are expressed diagrammatically in Figure 1.

The diamond model separates out the vertical and non-vertical aspects of class mobility, and for each of these it defines a structural and an exchange component. In order to appreciate the virtues of this scheme consider, for example, cells 2, 3 and 2, 7 of a mobility table. If the categories represent classes, but classes ranked in a vertical hierarchy, then the principle of vertical mobility, i.e., that frequency of movement varies with distance traveled, leads us to expect more people in 2, 3 than in 2, 7. Of course our interest in the study of specific relations and disjunctions between classes leads us to ask whether class connections or class barriers produce under- or over-population in these cells. But the question we have to ask is under- or over-population with respect to what? The independence (perfect mobility) model is clearly not an adequate basis against which to measure specific class effects because deviations from it (E) typically include a substantial element of vertical mobility (V). Thus, the base for the investigation of class-specific effects should be, not the perfect mobility model GM + H + D, but the model plus the vertical term V.

The analogous argument for the case of structural change, D, is that uniform upward (or downward) shift in opportunity between fathers and sons, L, should be abstracted before we start attributing effects to differential expansion or contraction of classes.

The theoretical and technical exposition is now complete, and we turn to an examination of the empirical material.

THE CLASSES

In a recent paper Erikson et al. (1979) presented comparative mobility data for men in England and Wales, France and Sweden, and they explicitly claim that the occupational categories which they employ constitute classes. If this is true, then the data should contain a record of the barriers and aids to class mobility, thus presenting a challenge to the theorist to distinguish and isolate the various class effects.

[6] Our term V differs from other terms which are defined in the same way (for example, Goodman, 1972) in that V is fitted with one degree of freedom, and not as a set of contrasts. However, Haberman (1974) has employed V exactly in our sense. We need not, of course, confine ourselves to the assumption that every step moved is equal to every other step. It would be quite possible to supply elements of V from a prior theoretical or empirical analysis such as, for example, the canonical analysis which is given below. The elements of V need not even be derived from a one-dimensional analysis, for example, they could be computed as generalized distances in the space of several canonical variates. They might still then be fitted with one degree of freedom.

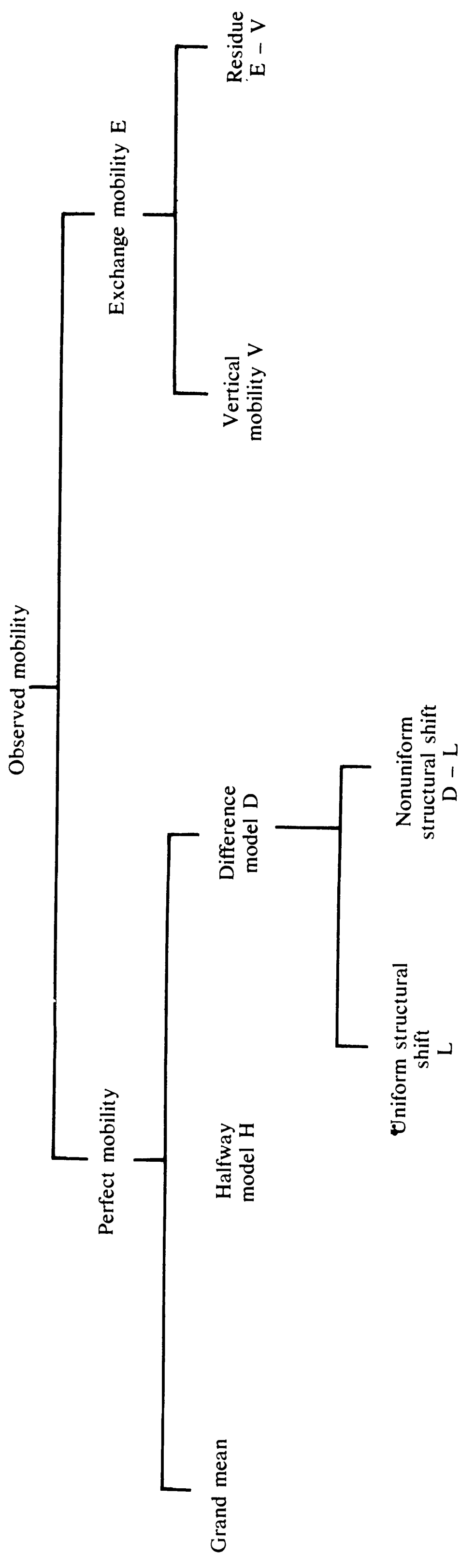

Figure 1. Tree Representation of the Relations among the Components of the Structured Diamond Model.

Our first task is to examine the claim that the occupational categories represent classes. The evidence presented here is of two sorts: that related to the manner of construction, and that derived from projecting the categories onto variables related to class. The nine categories are aggregations of the 124 Hope-Goldthorpe categories (Goldthorpe and Hope, 1974), and we made every effort to ensure that the 124 building blocks are homogeneous with respect to class. Furthermore, the nine categories have some face validity as class groupings (Table 1). Clearly, the ninth ought to be split into semi- and unskilled, and the top class, which we here call "higher controllers," is really more of a status group than a class. By this we mean that members of this group could meet on a position of equality at a football match or in a club, but they are quite various in their market positions, educational background, and relations to the means of production.

While it would be possible to disaggregate the top and bottom categories in the English data, there is no possibility of carrying out the same disaggregation in the French and Swedish data; we have to use the categories as they are supplied.

Table 2 shows how the "classes" project onto three variables in the 1972 Oxford Social Mobility Survey of men aged 20 through 64 in England and Wales. E (which here stands for "Education," not "Exchange mobility") is my scale of Education. It is intended to record the extent to which a particular course of education may be thought to give access to central cultural values. Details of its construction are given in Hope (forthcoming). It has been shown to be more reliable than other basic variables in the Oxford inquiry, the test-retest correlation being 0.84 (Hope et al., 1979). Hope-Goldthorpe value is position on the HG scale, which represents a consensual averaging of the social value and the rewards of an occupation (Hope, 1981c). The analogous table for the seven "Hall-Jones" occupational strata has been reported elsewhere (Hope, 1981a). The overall patterns of the tables are much the same, but the Hall-Jones categories are ranked monotonically on all three variables (and on the canonical variate), while

Table 1. The Nine Categories of the HG9 Classification of Occupations.*

Short Title	%		Inventory	HG124
1 Higher controllers	13	I	Higher-grade professionals administrators and officials; managers in large industrial establishments; large proprietors.	1–22 24 28 30 31 33 37 40 41 51 59 64
2 Lower controllers	11	II	Lower-grade professionals, administrators and officials; higher-grade technicians; managers in small business and industrial establishments; supervisors of nonmanual employees.	23 25–27 29 34–36 38 39 42 43 45 47 52–54 63 72
3 Small proprietors with employees	4	IVa	Small proprietors; artisans etc., with employees.	32 46 48 50 55–57 60–62 89 91
4 Farmers	2	IVc	Farmers and smallholders; self-employed fishermen.	44 100
5 Skilled manual workers	33	V/VI	Lower-grade technicians; supervisors of manual workers; skilled manual workers.	58 65–71 73 74 76 78 80 81 83 84 92 93 96–98 101 103 105 107 111
6 Small proprietors without employees	4	IVb	Small proprietors, artisans, etc., without employees.	49 77 79 82 85 86 88 90 95 106 109 114–116 124
7 Routine non-manual workers	9	III	Routine nonmanual employees in administration and commerce; sales personnel; other rank-and-file service workers.	75 94 99 102 108 112 121 122
8 Agricultural workers	2	VIIb	Agricultural workers.	113
9 Semi and unskilled workers	22	VIIa	Semi- and unskilled manual workers (not in agriculture).	104 110 117–120 123
	100			

* The numbers and short titles on the left are those employed in this report, the Roman numerals and inventories in the middle are those given by Erikson et al (1979), and the column on the right shows how the 124 Hope-Goldthorpe categories map into the HG9 set. % is the percentage of men in the Oxford Social Mobility Inquiry who fall in each class.

the HG9 categories of Table 2 are not. Furthermore the second canonical root for the HG9 categories is 0.05 (corresponding to a canonical correlation of 0.22), and the third is 0.02 (canonical correlation 0.16). The second and third roots for the Hall-Jones categories are 0.03 and 0.00 respectively. In other words, the alleged

Table 2. Means of Respondents to the Oxford Social Mobility Inquiry.*

HG9 Category	n	E	HG Value	Income (£ p.a.)	Canonical variate
1. Higher controllers	1337	8.4	71	3137	4.77
2. Lower controllers	1143	7.2	60	2129	2.74
3. Small proprietors with employees	368	4.5	55	2540	1.88
4. Farmers	154	3.9	49	1851	0.71
5. Skilled manual workers	3313	3.8	41	1713	−0.57
6. Small proprietors without employees	421	3.9	39	1823	−1.02
7. Routine nonmanual workers	923	4.3	37	1627	−1.33
8. Agricultural workers	152	2.4	31	1118	−2.41
9. Semi and unskilled workers	2239	2.3	29	1493	−2.86
Overall mean	10050	4.5	44	1920	0.00
Within-category standard deviation		3.1	6	875	1.00
Ratio of Between-category to Total SS (R^2)		0.30	0.86	0.27	0.86

* Classified by occupation into nine Hope-Goldthorpe categories, on education (E) Hope-Goldthorpe value, income, and the first canonical variate. The canonical variate is that weighted sum of the three variables which maximally distinguishes the seven categories.

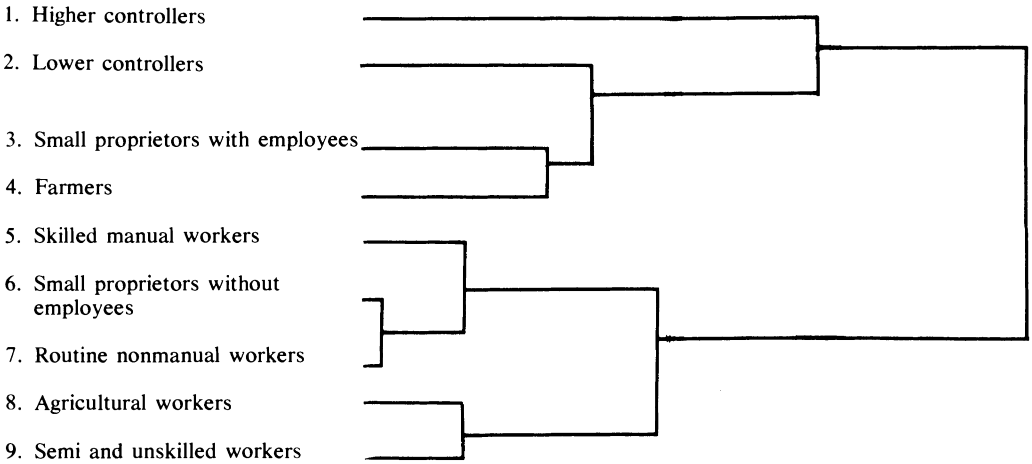

Figure 2. Dendogram Showing the Relations among the Means of the HG9 Occupational Categories in the Cannonical Space.

class categories, while they undoubtedly manifest a hierarchical ordering, do not display the same unidimensional simplicity as the Hall-Jones categories. We shall see that, whereas Hall-Jones exchange mobility is largely attributable to the one-dimensional term for vertical mobility which we call V, the same cannot be said of the class categories, which is as it should be if the latter are picking up the "lumpiness" of a class table in contrast to the smooth hierarchy of a vertical mobility table.

There is another respect in which the HG9 categories display a satisfactory class aspect: Figure 2 contains a dendrogram summarizing the results of a numerical taxonomy carried out in the space of all three canonical axes.[7] Numerical taxonomy is not a determinate method, and no dendrogram can be more than a two-dimensional representation of a multivariate scatter of points (the points in this case being the means of the nine occupational categories). Furthermore any set of branches of a dendrogram may be rotated about its stem without altering the formal properties of the figure as a whole. Nevertheless, having stated the caveats, we may express a cautious satisfaction in the representational tree which has emerged from analysis of the canonical space. The break between the controlling classes (including farmers and small employers) and the rest is exaggerated by the dendrogram; the generalized distance between classes 4 and 5 in the space of all three canonical variates is 1.29 (Table 1 shows that virtually all of this is in the vertical dimension). This is quite a lot less than the minimum distance between any two neighbouring classes (2.16 for classes 1 and 2). Nevertheless there is a tendency for the controllers to cluster in the upper part of the space, and for the other class categories to cluster together in the lower part.

[7] So far as I am aware, the first example of a taxonomy carried out in a canonical space is that in Hope, 1972. The critical problem which has to be solved in order to apply this technique is that of finding an appropriate standardization for the canonical variates. In fact, more than one solution can be envisaged, but the solution which has been favored up to now is that of setting the weighted average mean square within categories to unity for every variate. Distances between category means are then in the metric of Mahalonobis' generalized distance D (Rao, 1948). D is simply the number of within-category standard deviations. Of course, in practice, the categories are not homoscedastic, and this must be borne in mind when the results are being interpreted.

VERTICAL AND SPECIFIC CLASS MOBILITY

We have now established groups of occupations which have some claim to represent rough-and-ready approximations to classes, but just as important we have ordered these groups on a vertical scale of advantage. For our aim is to give analytical representation to both the categorical and the ordered character of classes.

Neglect of this distinction is a standing reproach to empirical sociology in that analyses of mobility tables ordinarily omit the class order from their formal models while engaging in a rhetoric which adverts frequently to inequality. The model most often employed (the perfect mobility model) would be entirely appropriate to the sort of society described by William Morris in *News from Nowhere,* that is, to a society in which each person employs him or herself in a preferred avocation which carries with it no invidious distinctions. Yet the ideological heat which frequently accompanies analysis in terms of class is generated by just those invidious rankings which the usual model ignores.

English usage encourages a bifurcated view of the subject in that class as a concrete noun places the emphasis on what members of a single class have in common, whereas class as an abstract noun alludes primarily to an ordering of society from high to low. "The class of 1821" carries with it no reference to an order other than the temporal; "class and class consciousness," on the other hand, ordinarily refer to objective and subjective aspects of inequality. Sociological usage, starting with the six classes instituted by Servius Tullius, cannot be adequately represented by models which contain no formal element of order. It may be, of course, that intransitivities imply the existence of more than one dimension of ranking. But that is a call for a many-dimensional, rather than for a no-dimensional, analytical model.

The analysis of Table 2 suggests the desirability of fitting more than one class dimension to the HG9 categories, but we shall not take up that challenge here. Rather we shall see how we fare with a very simple model incorporating only a single ordering, to which we fit the simple functional forms of L and V.

The intergenerational table for the HG9 classes is given in Table 3 and analyzed in Table 4. The base model, GM + H, fits a table, symmetric about the principal diagonal, in which a son's class is independent of his father's class. Because it is symmetric, the model has the same marginal distribution for sons as for fathers. H is a model which allows for the fact that some classes are larger than others, while making no allowance for differences in class size between fathers and sons. It is the true base model of mobility analysis. In what follows the importance of a component of mobility is quantified as a percentage of the variance (chi-square) which remains after H has been fitted. This is referred to as the "mobility variance."

Twenty-three percent of mobility variance is accounted for by structural mobility, that is, by mobility associated with differences between the marginal distributions (D). About a fifth of this is due to a simple upward shift in status between fathers and sons (L), the rest being associated with other kinds of change in class size (D − L). Vertical exchange mobility (V) accounts for 27% of mobility variance. This may be contrasted with 75% for the same men organized into Hall-Jones categories.

The terms so far examined account for 92% of the total variance (chi-square for deviations from the grand mean), which contrasts with 98% in the Hall-Jones table.

Table 3. Intergenerational Mobility Table for Men Aged 20 through 64 in England and Wales

	Respondent's occupation									
	1	2	3	4	5	6	7	8	9	sum
Father's occupation										
1. Higher controllers	311	130	24	7	70	22	79	1	44	688
2. Lower controllers	161	128	21	6	112	12	66	1	47	554
3. Small proprietors with employees	86	85	77	4	112	38	44	5	71	522
4. Farmers	43	23	16	99	86	14	25	40	81	427
5. Skilled manual workers	356	375	105	5	1506	143	325	22	839	3676
6. Small proprietors without employees	38	43	27	4	110	45	37	3	73	380
7. Routine nonmanual workers	128	109	24	3	197	27	89	4	113	694
8. Agricultural workers	12	14	5	10	96	18	18	56	114	343
9. Semi and unskilled workers	150	180	48	9	802	74	187	15	685	2150
Sum	1285	1087	347	147	3091	393	870	147	2067	9434

Source: Oxford Social Mobility Inquiry, 1972.

Table 4. Structured Analysis of Vertical and Class Mobility in Table 3.

Terms Fitted	d.f.	χ^2	Effects tested		d.f.	χ^2	% of mobility variance (χ^2 = 3057)
Grand mean	80	16867					
+ Halfway model H	72	3057	base model	H	8	13810	
+ Linear in mobility L	71	2936	structural movement	vertical shift L	1	121	4
+ Residue of difference model D-L	64	2367		class-specific D-L shifts	7	569	19
+ Vertical mobility V	63	1549	exchange movement	vertical mobility V	1	818	27
+ Occupational inheritance of classes 1, 2, 3, 4, 5, 6 and 8 I	56	754		class inheritance I	7	795	26
+ Bilateral exchange of classes 1 and 2, 1 and 3, 1 and 7, 2 and 7, 3 and 6, 4 and 8, 5 and 9 B	49	310		bilateral class B exchange	7	444	15

We have dealt with the vertical and class-specific aspects of structural mobility and with the vertical element of exchange mobility. What we have left is relations which are particular or specific to subsets of classes. We believe that this is the first analysis which has accomplished this task, and it has done so by grounding the preceding models in a theoretical analysis of the various conceptually distinguishable components of a mobility table. Just as in status inconsistency research we have to take the theoretical plunge and define status consistency before we can define status inconsistency (Hope, 1975), so in mobility research we have to be able to define the general factor of vertical mobility in order to isolate nonvertical relations between classes. If we are not willing to do the one, then we cannot do the other.

Unfortunately there is no theory of class mobility to guide us in our disaggregation of the remaining 49% of mobility variance, so we proceed inductively, that is, by examining the deviations from the model H + D + V. The examination suggests the two components listed in Table 4. Seven of the classes manifest more stability than would be expected if vertical mobility alone were at work. A term is fitted to the diagonal cell for each of these, and the seven terms together (I) take out a further 26% of mobility variance. (A comparable analysis (Hope, 1981a), which fits a status inheritance term to each of the seven Hall-Jones categories, accounts for only 2% of the variance). Seven pairs of classes (1 and 2, 1 and 3, 1 and 7, 2 and 7, 3 and 6, 4 and 8, 5 and 9) exchange members in both directions more frequently than the model H + D + V + I would suggest, so we fit seven terms for bilateral exchange, and these remove 15% of mobility variance.

Ten percent of mobility variance remains unexplained. It would of course be possible to fit further effects, but, clearly, we have succeeded in pinning down most of what matters by postulating a structural effect (23%), a vertical effect (27%), and two specific class effects (41%). The analysis has used up 23 of the 72 substantive degrees of freedom and has explained 90% of the mobility variance.

A COMPARATIVE ANALYSIS

Now we turn to an analysis of the data for England and Wales, France and Sweden which have been assembled by Erikson, Goldthorpe and Portocarero (1979). The raw frequencies were computed from their table of outflow percentages (Table IX) by multiplying each percentage by its row sum.

The English data are organized into the HG9 categories, and the French and Swedish data were classified, as nearly as possible, into the same nine categories. Both the categories, and the order in which they have been placed by the present paper (Table 2), are derived from England and are likely, therefore, to be not quite so apposite to the study of French and Swedish mobility.

Table 5 presents the first comparative analysis to isolate structural mobility and to separate out vertical and specific class mobility. In the table the mobility variance is taken to be $\chi^2 = 7207$, though this value clearly incorporates some elements of interaction, that is, terms which reflect *differences* between mobility patterns, rather than components of mobility.

The largest single effect in the table is the chi-square for inter–societal differences in occupational structure ($\chi^2 = 2989$). No doubt, as in the earlier analysis which compared British mobility in 1949 with British mobility in 1972 (Hope, 1974), it must be supposed that some of the discrepancies are artifacts which result from the difficulty of coding occupation in a comparable manner. Nevertheless, differences in occupational structure between countries appear to be an important source of difference in their mobility patterns.

Table 6 shows the marginal expectations for the halfway model before (E_1) and after (E_2) allowing for differences among societies. Because each of these figures is an average of number of fathers and number of respondents, the observed sums, expressed as deviations from E_1, are given separately for fathers and respondents. Looking at the top category, we see that England has 145 (992–847) more higher controllers than international parity would ascribe to it, and the discrepancy between fathers and respondents suggests a rapid intergenerational expan-

Table 5. Structured Comparative Analysis of Male Intergenerational Mobility in England and Wales, France and Sweden. Source: Erikson et al, 1979.

Term fitted	d.f.	χ^2	Effects tested		d.f.	χ^2	% of mobility Variance (χ^2=7207)
Grand mean + Country C	240	25586					
+ Halfway model H	232	10196	base model	H	8	15390	
+ H × C	216	7207		H × C	16	2989	
+ Linear in mobility L	215	7129	structural movement	L	1	78	1
+ L × C*	213	7095	(Vertical shift)	L × C*	(2)	(34)	(0)
+ Residue of difference model D−L	208	5526	structural movement (class-specific shifts)	D−L	7	1603	22
+ D × C	192	5329		D × C	16	197	3
+ Equal step mobility V	191	3938	exchange movement (Vertical constraint)	V	1	1391	20
+ V × C	189	3909		V × C	2	29	0
+ Occupational inheritance of all nine classes I	180	1718		I	9	2191	31
+ I × C	162	1625	exchange movement (Class-specific constraints)	I × C	18	93	1
+ Bilateral exchange of classes 1 and 2, 1 and 3, 1 and 7, 2 and 7, 3 and 6, 4 and 8, 5 and 9 B	155	606		B	7	1019	14
+ B × C	141	531		B × C	14	75	1
							93

* This term is deleted from succeeding models.

Table 6. Marginal Expectations for the Halfway Model before E_1 and after E_2 Allowing for Differences Among Societies.*

HG9 Category	England and Wales E_1	F	R	E_2	France E_1	F	R	E_2	Sweden E_1	F	R	E_2
1. Higher controllers	847	−157	447	992	428	−171	−66	310	188	−85	32	162
2. Lower controllers	887	−333	186	814	448	−126	246	508	197	−76	102	210
3. Small proprietors with employees	428	85	−74	434	216	−5	−27	200	95	45	−25	105
4. Farmers	858	−436	−728	276	434	800	89	879	190	355	−80	328
5. Skilled manual workers	2868	845	212	3397	1450	−571	−336	997	637	−141	−10	562
6. Small proprietors without employees	501	−107	−111	392	253	222	28	378	111	−13	−19	95
7. Routine nonmanual workers	773	−79	114	791	391	2	70	427	172	−101	−8	118
8. Agricultural workers	330	13	−162	256	167	146	−3	239	73	37	−30	77
9. Semi- and unskilled workers	1963	168	115	2105	992	−298	−2	842	436	−21	38	445

* E_1 is a sum of expectations generated by the model Grand mean + H (Table 5), the sum being taken over rows or columns (it makes no difference, because H generates a symmetric table) of each country's mobility table. F and R are the corresponding observed sums, for fathers and respondents respectively, expressed as deviations from E_1. E_2 is the corresponding sum for the model which incorporates the interaction of H with country. $E_2 = \frac{1}{2}(2 E_1 + F + R)$.

sion in this category. It may be surmised that these figures reflect a substantial process of bureaucratization, which has not taken place on anything like the same scale in France, or even Sweden. In contrast, skilled manual workers are underrepresented in England and overrepresented in France, though there appears to be a steep intergenerational decline in France. It must, of course, be borne in mind that our data relate to men only.

France has far more one-man businesses than Britain, though here again the decline is very steep. Britain has relatively more routine non-manual workers than France or Sweden, though (insofar as we can infer distributional change from a comparison between fathers and sons) the category is declining in Britain and expanding in the other two countries. France has relatively more semi- and unskilled workers than England.

As the detailed analysis suggests, most of the intergenerational shift in occupational distribution is nonuniform ($\chi^2 = 1603$), and there is some sign of international differences in the pattern of shift ($\chi^2 = 197$).

Vertical constraints on mobility account for 20% of mobility variance, and the differences between countries are negligible. 31% of mobility variance is associated with class inheritance, and here again international differences are small. 14% of variance is attributable to reciprocal interchange within seven pairs of classes, and the interactions are again small.[8]

At this stage we have explained 93% of the mobility variance, and it is doubtful how much credence could be given to any purported analysis of the residue. It is true that, of the 16,337 men in the table, 799 would have to be moved in order entirely to abolish the residual $\chi^2 = 531$; but we are dealing here with data organized into doubtfully comparable categories and recomputed from percentages, so that any further analysis would run the risk of "detecting" quite adventitious "effects."

The overall results are simple and easily interpreted. The sum of chi-squares for all interaction effects other than H × C is $\chi^2 = 394$, or 6% of variance. Shift in the

[8] In Table 4 the class constraints on exchange movement were identified by examination of standardized deviations, a standardized deviation being computed from the observed frequency 0 and the expected frequency E as $(O - E)/E^{1/2}$. The nature of the occupational inheritance term is obvious. A bilateral exchange term was fitted to classes i and j if the standardized deviation for cell i, j, and that for cell j, i, were both greater than about 1.0. Each such term was fitted by assigning +1 to the two exchanging cells and a −1 to all other cells.

In the case of Table 5, standardized deviations were computed, not for individual cells, but for observed and expected values summed across the first dimension of the table, (i.e. country).

occupational distribution between fathers and sons accounts for 24% of mobility variance (χ^2 = 78 + 1603), the vertical constraint accounts for 20%, and class inheritance accounts for 31%. A pattern of bilateral exchange, inductively established, accounts for 14%. This leaves a residue of 7% of mobility variance (χ^2 = 531) unexplained.

The last word, however, should lie with the halfway model, since interaction H × C (χ^2 = 2989) constitutes 88% of all the variance across societies (i.e., the sum of all the interaction terms).

Employing the symbols which were used earlier in the paper (but substituting C, standing for country, in place of I, which stood for inquiry) we may note that the usual model, CS + CF (which tests FS + CFS), is precisely equivalent to the "structured" model Grand mean + C + H + HxC + D + DxC. Both are a way of fitting the perfect mobility model to each of the countries separately. In other words, the usual model *removes* and *ignores* the most important source of differences among countries, whereas the structured approach *isolates* and *quantifies* it.

SUMMARY OF RESULTS

In spite of all the statistics which have been generated by investigations of mobility, that field of endeavor has up to now lacked two basic desiderata of empirical research, i.e., clear conceptual distinctions and straightforward quantifications of the relative importance of effects on mobility. The "structured" approach to mobility analysis supplies these deficiencies in that (a) it furnishes a base model (GM + H) whose chi-square has a plausible claim to constitute the total mobility variance to be disaggregated, and (b) it defines effects a priori to represent distinguishable aspects of mobility.

In the present paper the "diamond model" of mobility analysis, which was propounded for the isolation of distributional and vertical effects (Hope, 1981a) in a single table, has been extended to cover specific relations between classes, and its applicability to comparative analysis (Hope, 1980b) has been confirmed. We have employed it to isolate effects of vertical and class-specific distributional shift, vertical exchange, and class-specific exchange.

The data indicate that the two most important aspects of class exchange are class inheritance and a pattern of bilateral exchange.

By far the most important source of differences in mobility among the three societies studied is differences in occupational distribution, which account for 88% of all the difference variance. Some part of the distributional effect is, no doubt, an artifact of differences in the coding of occupations, but it is unlikely that this is the whole explanation. The most important reason for variations among the mobility patterns of these three countries is that Britain has many more men in bureaucratic occupations than France, Sweden being somewhere in between.

The traditional (perfect mobility) model of analysis entirely fails to isolate this most important source of differential mobility because in fitting the usual model it implicitly fits the H × C variance, and is not therefore in a position to test it.

Broadly speaking, we have established that mobility is constant across three societies, except insofar as the societies differ in their occupational distributions. Thus we have found strong empirical support for Lipset and Zetterberg's (1966:73) conclusion "that mobility patterns in Western industrialized societies are determined by the occupational structure."

APPENDIX

The Diamond Model

The diamond model is one instance of a class of "structured" models. The outline of its structure is shown in Figure 1, and here we give the rules for formulating the components named in that diagram. The model is fitted by regressing the natural logarithms of the observed cell frequencies on columns of a design matrix by weighted least squares. The following rules specify the design matrix for analysis of a mobility table with k rows and k columns, in which the ith row corresponds (in some sense) to the *i*th column.

We define a dummy variable f_i such that if a cell falls in row *i* of the mobility table then $f_i = 1$, otherwise $f_i = 0$. Dummy variables s_i are similarly defined for the columns of the table. In order to set up column h_i of the halfway model H, we take k − 1 of the row variables and the corresponding k − 1 column variables and add them, pair by pair (Hope, 1971),

$$h_i = f_i + s_i.$$

The elements of the difference model D consist of the analogous differences,

$$d_i = f_i - s_i.$$

Taken together with a column (consisting entirely of ones) which represents the Grand mean, the 2 (k − 1) columns of H and D are formally identical with the ordinary model of statistical independence of rows and columns (the perfect mobility model),

$$GM + H + D = GM + F + S.$$

If we also specify l − 1 contrasts for the l countries, and define interaction terms by multiplying each of these contrasts by each element of the halfway model and of the difference model, then we obtain the model,

$$GM + C + H + D + CxH + CxD,$$

which is formally identical with the loglinear model which is usually written

$$CF + CS.$$

Neither H nor D imposes any ordering on the categories or on the cells of the table. However term L, which is a one-dimensional component of D, does assume an ordering. The elements of L might be empirically derived, or they might be derived from theory, in which case they need not take the simple form specified here. However, for the purpose of the present paper the element of L for cell i, j of the mobility table is given by i − j.

Like L, V is also represented by a single vector, and its elements are given by $|i-j|$. Class inheritance may be represented either by a single contrast between all the diagonal cells and the remaining cells or (as in the present paper) a separate contrast may be defined for each diagonal cell. Bilateral exchange between classes *i* and *j* is represented by putting a one in each of the cells i,j and j,i and a minus one in all the other cells.

Vectors representing interaction with country are formed by multiplication in the usual way.

REFERENCES

Bacharach, Michael
1970 Biproportional Matrices and Input-output Change. Cambridge: Cambridge University Press.

Bartlett, Maurice S.
1935 "Contingency table interactions." Journal of the Royal Statistical Society B 2:248–52.

Breiger, Ronald L.
1981 "The social class structure of occupational mobility." American Journal of Sociology, forthcoming.

Clogg, Christopher C.
1981 "Latent structure models of mobility." American Journal of Sociology 86:836–38.

Darroch, J. N.
1962 "Interactions in multi-factor contingency tables." Journal of the Royal Statistical Society B 24:251–63.

Duncan, Otis D.
1966 "Methodological issues in the analysis of social mobility." Pp. 51–97 in Neil J. Smelser and Seymour M. Lipset (eds.), Social Structure and Mobility in Economic Development. Chicago: Aldine.

Duncan, Otis D.
1979 "How destination depends on origin in the occupational mobility table." American Journal of Sociology 84:793–803.

Erikson, Robert, John H. Goldthorpe and Lucienne Portocarero.
1979 "Intergenerational class mobility in three Western European countries: England, France and Sweden." British Journal of Sociology 30:415–40.

Featherman, David L. and Robert M. Hauser
1978 Opportunity and Change. New York: Academic Press.

Goldthorpe, John H. and Keith Hope
1974 The Social Grading of Occupations: A New Approach and Scale. Oxford: Clarendon Press.

Goodman, Leo A.
1969 "On partitioning χ^2 and detecting partial associations in three way contingency tables." Journal of the Royal Statistical Society B 31:486–98.

Goodman, Leo A.
1972 "Some multiplicative models for the analysis of cross classified data." Pp. 649–96 in Proceedings of the Sixth Berkeley Symposium on Mathematical Statistics and Probability. Berkeley: University of California Press.

Haberman, Shelby J.
1974 The Analysis of Frequency Data. Chicago: University of Chicago Press.

Hauser, Robert M.
1978 "A structural model of the mobility table." Social Forces 56:919–53.

Hauser, Robert M., J. N. Koffel, Harold P. Travis and P. J. Dickinson
1975 "Temporal change in occupational mobility: evidence for men in the United States." American Sociological Review 40:279–97.

Hope, Keith
1971 "Social mobility and fertility." American Sociological Review 36:1019–32.

Hope, Keith
1972 "Quantifying constraints on social mobility: the latent hierarchies of a contingency table." Pp. 121–90 in Keith Hope (ed.), The Analysis of Social Mobility: Methods and Approaches. Oxford: Clarendon Press.

Hope, Keith
1974 "Trends in the openness of British society in the present century." Paper delivered to the Mathematical Social Science Board

Seminar "Measurement and Models in Social Stratification," Toronto, 1974. Partially printed in the proceedings of the Internationale Arbeitstagung "Anwendung mathematischer Verfahren zur Analyse sozialer Ungleichheit und sozialer Mobilität." Bad Homburg, 1974.

Hope, Keith
1975 "Models of status inconsistency and social mobility effects." American Sociological Review 40:322–43.

Hope, Keith
1980a "Trends in the openness of British society in the present century." In Donald J. Treiman and Robert V. Robinson (eds.) Social Stratification and Mobility. Vol. 1. Greenwich, Conn.: JAI Press.

Hope, Keith
1980b "A counterfactual theory of comparative mobility analysis." Nuffield College: mimeograph.

Hope, Keith
1981a "Vertical mobility in Britain: a structured analysis." Sociology 15:14–55.

Hope, Keith
1981b "The new mobility ratio." Social Forces, forthcoming.

Hope, Keith
1981c "A liberal theory of prestige." American Journal of Sociology, forthcoming.

Hope, Keith
1981d "Levels and ladders: a comparison between a structural model of mobility analysis and a structured diamond model." Nuffield College: mimeograph.

Hope, Keith
forthcoming "Constancies in the analysis of social stratification: a replication study." Quality and Quantity.

Hope, Keith, Sara Graham and Joseph E. Schwartz
1979 "Uncovering the pattern of social stratification: a two year test-retest inquiry." Nuffield College: mimeograph.

Kullback, S., M. Kupperman, and H. H. Ku.
1962 "Tests for contingency tables and Markov chains." Technometrics 4:573–608.

Lipset, Seymour M. and Hans L. Zetterberg.
1966 "Social mobility in industrial societies." Pp. 11–76 in Seymour M. Lipset and Reinhard Bendix (eds.), Social Mobility in Industrial Society. Los Angeles: University of California Press.

Morris, William
1891 News from Nowhere. London: Reeves and Turner.

Plackett, R. L.
1962 "A note on interactions in contingency tables." Journal of the Royal Statistical Society 24:162–66.

Rao, C. Radhakrishna
1948 "The utilization of multiple measurements in problems of biological classification." Journal of the Royal Statistical Society B 10:159–93.