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The Frequency of Geographic Mobility in the Population of Canada

by Leroy O. Stone

Census Analytical Study

The Frequency of Geographic Mobility in the Population of Canada

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with the assistance of
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FOREWORD

The Canadian censuses constitute a rich source of information about the condition of groups and communities of Canadians, extending over many years. It has proved to be worthwhile in Canada, as in some other countries, to supplement census statistical reports with analytical monographs on a number of selected topics. The 1931 Census was the basis of several valuable monographs but, for various reasons, it was impossible to follow this precedent with a similar program until 1961. The 1961 Census monographs received good public reception, and have been cited repeatedly in numerous documents that deal with policy problems in diverse fields such as manpower, urbanization, income, the status of women, and marketing. They were also of vital importance in the evaluation and improvement of the quality and relevance of Statistics Canada social and economic data. This successful experience led to the decision to continue the program of census analytical studies. The present series of analyses is focused largely on the results of the 1971 Census.

The purpose of these studies is to provide a broad analysis of social and economic phenomena in Canada. Although the studies concentrate on the results of the 1971 Census, they are supplemented by data from several other sources. These reports are written in such a way that their main conclusions and supporting discussion can be understood by a general audience of concerned citizens and officials, who often lack the resources needed to interpret and digest the rows of numbers that appear in census statistical bulletins. For these persons, interpretive texts that bring the dry statistics to life are a vital dimension of the dissemination of data from a census. Such texts are often the only means that concerned citizens and officials have to personally perceive benefits from the national investment in the census. This particular report is one of a series planned to be published concerning a variety of aspects of Canadian life, including income, language use, farming, family composition, migration, adjustment of immigrants, human fertility, labour force participation, housing, commuting and population distribution.

I should like to express my appreciation to the universities that have made it possible for members of their staff to contribute to this program, to authors within Statistics Canada who have freely put forth extra effort outside office hours in preparing their studies, and to a number of other members of Statistics Canada staff who have given assistance. The Social Science Federation of Canada has been particularly helpful in the selection of authors for some of the studies, and in arranging for review of several manuscripts. In addition, thanks are extended to the various readers, experts in their fields, whose comments were of considerable assistance to the authors.

Although the monographs have been prepared at the request of and published by Statistics Canada, responsibility for the analyses and conclusions is that of the individual authors.

PETER G. KIRKHAM,

Chief Statistician of Canada.

PREFACE

This report is the partial result of one of a series of 1971 Census Analytical Studies. These studies, as well as the 1971 Census Profiles that have already been published, are intended to place into the public domain synthesized and interpreted census information. Although most Canadians benefit only indirectly from these studies (through digests of the information prepared for mass communication and through the improvement of the work by public and private policy analysts), they are an important aspect of census data dissemination.

The majority of Canadians make direct use only of synthesized and/or digested information derived from a census. Only well-equipped agencies have the resources to take the raw data from Census of Canada tabulations and conduct their own syntheses. None of these agencies is engaged in disseminating a broad range of synthesized Census of Canada information as public goods on behalf of the general public upon whose co-operation Census of Canada depends. Without the benefits of an active program of disseminating synthesized and interpreted census information, most Canadians would cease to obtain from the census direct tangible improvements in their ability to function as well-informed citizens of a democracy.

This study is a demographic analysis of an important aspect of the behaviour of Canadians in their geographic mobility. It concentrates upon variations in mobility pattern among different groups within the population rather than on the spatial pattern of residence change. In so doing it is addressed to at least four kinds of audience.

Firstly, public officials and citizens who are concerned with policies and program in which the mobility of Canadians is an important factor should be able to obtain some insight from reading this chapter, the short concluding chapter, and the summaries of research findings that are reported in Chapters 2 and 3. The intended area of interest to them pertains to the levels of geographic mobility shown by important subgroups within the population of Canada, the manner in which these levels are related to characteristics of such subgroups, and the relative importance of such characteristics. Hopefully, this study will help such officials to base their assumptions and policies about the geographic mobility of Canadians on a firmer foundation than formerly. Citizens concerned with the impact and evaluation of such policies should have an enhanced ability to assess the work of government, a matter of some significance in a democratic state. Some aspects of relevant government policies are cited briefly in the concluding chapter.

Secondly, specialists and students who require intensive knowledge about the mobility of Canadians should be able to gain concrete information about the association of mobility **frequency** with important population characteristics from the detailed statistical estimates and interpretations in Chapters 2 and 3, and from the summarizing sections of this text. In the process of reviewing this information, some of the specialists and students will likely be stimulated to further explore questions that come to mind, or important analytical "loose ends" that remain at the end of this necessarily brief and exploratory work.

Thirdly, researchers who wish to adapt the cross-tabulation type of statistics that a census normally produces to analytical ends that require multivariate analysis, where higher-order interactions of variables need to be handled should benefit from studying this text. It includes a concrete and extended illustration of the application of recently developed techniques for the multivariate analysis of contingency tables to large census data files. Census data are almost always available in the form of cross-tabulations or contingency tables, and traditional multivariate analysis techniques are not designed to handle contingency tables. Therefore, this demonstration of the **applicability** of the new techniques to census data, and the supplementary technical information (including computer programs) that the author is ready to provide to interested analysts, should substantially expand the potential field of applicability of Canadian census data. In this way the opportunity for Canadians to benefit from public investment in the Census of Canada should be materially enhanced.

Fourthly, in a number of ways this study contributes to the evaluation of the usefulness of 1971 Census data and to the planning of future censuses. In particular, certain limitations of the census data, for the purposes of analysing the frequency of mobility in Canada, are clearly stated. Through this study Statistics Canada is better able to help those who wish to use the 1971 data on migration. Also redundancies between the inter-group mobility differentials revealed from studying data on mobility frequency and those shown in the analysis of the more traditional census data on area-to-area migration patterns are mentioned. Already the experience gained from analysing the 1971 Census data on the frequency of inter-municipal mobility has been used in planning migration questions for the 1981 Census of Canada.

Three factors have seriously delayed the publication of this report. Firstly, the achievement of a "clear" 1971 Census master file with respect to migration data occurred only near mid-1974. Secondly, the properties of the census data prompted the author to opt for the adaptation and further development of a recently introduced methodology for multivariate analysis. The explication of this development and the preparation of the related computer programs were very time-consuming, although the resulting methodological advance is of major significance for the potential uses of Census of Canada data. Thirdly, more urgent duties continually interfered with the author's attention to this study, and as a result the first draft (which was ready in late 1975) required serious and extensive revision in the latter half of 1976. Despite the late publication, however, the study provides information of enduring interest because it emphasizes stable patterns in the geographic mobility of Canadians.

Many persons have made vital contributions to the completion of this report. The staff members of the Senior Advisor on Population Studies Division have been extremely supportive, especially Andrew Siggner (now with the Department of Indian and Northern Affairs) in the conception of the study problem and in polishing the final draft, Susan Fletcher in helping to develop and implement programming and statistical concepts that expanded the applicability of the general methodology and in drawing up data processing specifications, Frances Aubry in programming census tabulation runs and in supervising the clerical staff, and the clerical staff itself in conducting the statistical work. Extremely valuable professional consultation was received from Stephen Fienberg (University of Minnesota), Leo Goodman (University of Chicago), Marvin McInnis (Queen's University), and James Simmons (University of Toronto). The work and inspiration of Fienberg and Goodman form a major basis for the new and important methodology that is only partially exposited in this study. Finally, the preparation of reasonably readable texts in English and French are due in no small part of copy-editing support provided by Eva-Maria McLean on behalf of Statistics Canada Information Division. However, the author remains solely and personally responsible for the opinions and any errors that the text may contain, particularly since good advice may not always have been fully followed.

Leroy Stone,
Senior Advisor on Population Studies,
December 1976.

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CHAPTER 1

PURPOSE AND MAIN FINDINGS

1.1. Main Questions and Some Basic Concepts

Canadians are a highly mobile people. Both the 1961 and 1971 Censuses of Canada have indicated that nearly one half of the adult population changes place of residence over a five-year period. A number of studies published since the 1960's (see Stone, 1974) have substantially improved knowledge about the kinds of people who tend to be geographically mobile and the spatial pattern of this mobility. However, there are several areas of useful knowledge about migration in Canada that need expansion. This study is addressed to one of these areas: the phenomenon of multiple changes of municipality of residence between 1966 and 1971. Using a unique body of data first yielded by the 1971 Census of Canada, this study will attempt to contribute to existing knowledge about the frequency of inter-municipal mobility in Canada, and the personal attributes that meaningfully distinguish those people who tend to be exceptionally mobile from those who are largely immobile.

This study is one of a series of projects aimed at providing Canadians with interpretive syntheses of data from the 1971 Census of Canada. The materials presented are organized about two sets of questions. Before stating these questions, it is worthwhile to clarify some technical concepts that will be used.

Migration is generally considered to be the act of uprooting one's household and moving it from one location (an origin) to another (a destination). Many studies and bodies of data limit the application of term "migration" to someone who actually crosses some defined boundary (e.g., a municipal boundary) in moving his/her household. (For further discussion of this concept see Stone, 1969, pp. 6 - 8.) In the Canadian census statistics, for example, a move that fails to cross a municipal boundary is treated as an instance of geographic mobility; but it is not classified for statistical purposes as an instance of migration. This distinction is somewhat arbitrary. Generally, its usefulness rests on the assumption that moves which cross municipal boundaries are likely to be more consequential for the local communities as well as for the movers' households than ones that fail to do so.

The composition of a population with respect to a given attribute (e.g., educational attainment) means here the proportional distribution of the population among categories of the pertinent variable; for example, the proportional distribution of population among levels of educational attainment. The phrase, **socioeconomic composition**, is sometimes used as a short-hand reference to composition with regard to one or more socioeconomic attributes (e.g., educational attainment and occupation).

In terms of these concepts, two central questions may be stated. Measuring the level of geographic mobility in terms of the frequency of inter-municipal mobility, what was the level of inter-municipal mobility in Canada over the 1966-71 period, and how much did the mobility level vary according to sex, age, marital status, mother tongue, educational attainment, and occupation? What are the relative contributions of these six attributes in accounting statistically for the distribution of the Canadian population by frequency of inter-municipal mobility?

A question about the number of changes of residence involving move to another municipality, was first used in the 1971 Census. Data provided in response to this question should add significantly to public understanding of the frequency and patterns of mobility in Canada. Since these data are completely new, a basic study must be made of differences in socioeconomic composition among groups that show varying frequencies of inter-municipal mobility. This study explores the extent to which the mobility level for a population group, as indicated by the frequency of inter-municipal mobility, is associated with the group's demographic and socioeconomic composition. This exploration gives insight into the value of including the question about "number of changes of residence" in the census.

Users of census data for analytical purposes may note that "new" techniques for the multivariate analysis of contingency tables have been specially adapted for this study. The effect of this adaptation is to illustrate the applicability of the new techniques to large masses of census data which pose logistical problems that are more demanding than those typically involved in the illustrative analysis of contingency tables (cf. Goodman, 1972; Davis, 1974; Bishop, Fienberg, and Holland, 1974). With the use of these techniques, the census data are readily applicable in answering certain questions of explanatory analysis where a variety of higher-order interactive effects of several variables need to be considered. The potential field of application of census data is thus considerably broadened. It should be noted however, that an effort has been made to keep intensive and detailed technical discussions out of this document. The primary emphasis has been placed on a reasonably non-technical discussion of the results of the multivariate analysis.

1.2. Data Sources and Quality

The data base for this study is comprised almost entirely by the 1971 Census of Canada. Occasionally comparisons are made that involve data from earlier censuses. The most relevant portion of the 1971 Census data base pertains to geographic mobility, and two questions are involved. Both were put to a one-third systematic sample of the population aged 15 and older as of 1 June 1971. From the sample responses, estimates of the relevant totals for the whole population were developed (see Appendix A). (In this text, the population aged five and older on 1 June 1971 will be called the reporting population.) The first of the two census questions, commonly called the "five-year migration question", asked about the respondent's place of residence on 1 June 1966. The second question asked about the number of times respondents had changed their municipality of residence between 1 June 1966 and 1 June 1971 (see Appendix A).

The second question was asked for the first time in Canada during the 1971 Census. The first question had been asked in the 1961 Census, and was the basis of two census monographs (Stone, 1969; George, 1970). Estimates of annual inter-provincial mobility based on family allowance data have clearly shown for some time that the five-year migration question by itself yields substantial underestimates of the frequency of mobility in Canada (see Stone, 1969, Appendix B); but these estimates contained two major limitations for analysing migration in Canada. Firstly, they pertained to provincial areas only. Secondly, they could not be broken down to yield migration data for a great variety of demographic and socioeconomic groups in Canada. Neither limitation exists in the 1971 Census data base for the number of inter-municipal moves between 1966 and 1971, although this data source is not without its own deficiencies (see Appendix A). In short, the analysis that is presented here and in the 1971 Census Profile Study on migration of the data on number of inter-municipal moves should provide some insight into a major dimension of Canadian mobility that was hidden in every preceding migration study.

The 1971 Census has also been used to provide data on a variety of characteristics of both migrants and non-migrants. These characteristics include data drawn from the 100% count of the reporting population at the 1971 Census date (e.g., sex, age, marital status, and mother tongue), as well as information gleaned from the one- third sample mentioned above (e.g., educational attainment and occupation). For reasons of economy no discussion on the quality of these data can be presented here.

Some discussion of the quality of the migration data is given in Appendix A. In general, the amount of data quality evaluation that has been done suggests that the data are reasonably reliable for the type of use to which they are put in this study. The statistics are faulty; but informed and judicious use of them permits the derivation of useful information about certain broad features of Canadian mobility. The reader should emphasize the general magnitudes of aggregates, differences, or ratios and look for broad systematic patterns of variation among the numbers in any table. By emphasizing these aspects of the data, rather than the exact values of numbers shown below, the reader will concentrate on information in which distortions due to data errors are minimized.

1.3. Summary of the Main Findings

It may be helpful at this point to draw together some of the research findings of this study. Although the following section recapitulates summarizing commentaries that are sprinkled in the text, it gives the reader an overall view of the principal "message" of this report about some important aspects of the geographic mobility of Canada's population. Additional general summary remarks are provided within each chapter. The reader who wishes only to get the broad flavour of the report without ploughing through the procedures used to develop the contents and the detailed substantive commentaries, should read this chapter, Chapter 4, and the introductory and summary sections of Chapters 2 and 3.

1.3.1. The Volume and Pattern of Internal Mobility

Nearly one half of the residents of Canada in 1966, changed the locations of their homes between 1966 and 1971. A very similar level of geographic mobility was observed a decade earlier with respect to migration during the 1956 - 61 period. Roughly comparable data for the United States show that a similar level of geographic mobility is attained by the two national populations. In both countries young adults in the peak ages of family formation and labour force entry, approximately ages 20 - 34, show mobility rates far above the national average. For example, nearly two out of every three Canadians aged 20 - 34 in 1971 changed place of residence between 1966 and 1971.

The incidence of multiple changes of residence of individuals between 1966 and 1971 was substantial. About four and one-half million persons who resided in Canada in 1966 changed their municipality between 1966 and 1971. This number represents 24% of the 1971 population aged five and older who resided in Canada in both 1966 and 1971. As many as 11% of the population just mentioned had changed municipality of residence at least twice between 1966 and 1971. Three per cent changed municipality of residence at least four times. Much of the total volume of geographic mobility was being generated by a relatively small proportion of the movers. Persons who changed municipality of residence did so an average of two times between 1966 and 1971.

It was young adults aged 20 - 34, who most frequently engaged in repetitive change of residence, although some hypermobility was shown in all age groups. The tendency toward hypermobility was heightened substantially if these young adults were of English mother tongue, had post-secondary education, or were in certain professional occupation groups. Some interpretive comments concerning these findings are offered in Chapter 2.

An intricate association of family formation with geographic mobility is revealed by the 1971 Census data. Persons who were married after 1 June 1966, and who thus changed their marital status during the migration period, had by far the highest inter-municipal mobility rates among marital status groups. For example, the inter-municipal mobility rate for those who changed marital status after 1 June 1966 was more than twice as high as that of the whole population. This differential is especially sharp among those who were living with a spouse in 1971. In contrast those who were living with a spouse in 1971 but were married before June 1966 had lower than average inter-municipal mobility rates, even after age composition differences are taken into account.

Among the ages where most geographic mobility takes place, persons who were once married but were no longer living with their spouses on the 1971 Census date had consistently higher than average mobility rates. The rates for single (never married) persons were generally lower than those for ever-married persons who were not living with their spouses. Thus the popular stereotype of the footloose bachelor or spinster is not confirmed by the 1971 data. In the peak ages of family formation, for example, persons who were single on both 1 June 1966 and 1 June 1971, had by far the lowest inter-municipal mobility rates among marital status groups. Interpretive comments and hypotheses on the association of marital status with mobility are provided in Chapter 2.

It appears that as the level of schooling increases so does the degree of inter-municipal mobility. For both males and females aged 15 and older, the inter-municipal mobility ratio rises steadily as the level of schooling rises from less than Grade 9 to a university degree. The level of inter-municipal mobility among the college graduates is generally much higher than that among persons with less than Grade 9 education. Basically the same pattern is shown separately in each of the two key age groups of 20 - 29 and 30 - 44. An unusually high inter-municipal mobility ratio is shown by persons aged 20 - 29 and holding university degrees. However, a substantial part of the mobility of these college-trained persons was probably connected with residence changes between locations of family home, university, and workplace.

Among occupation groups, the Armed Forces and two of the predominantly professional occupation groups generally had the highest levels of inter-municipal mobility in 1966 - 71. The two predominantly professional occupation groups are: 1. teaching and related occupations, and 2. technological, social, religious, artistic, and related occupations. Unusually low levels of inter-municipal mobility were shown by persons in generally low-skilled occupations. Comments concerning the explanation of the educational and occupational pattern of geographic mobility are presented in Chapter 2.

1.3.2. The Mobility of Immigrants

The first impression that immigrants are substantially more mobile than non-immigrants can be seriously misleading. For example, if one deals with the 1966 residents of Canada, native-born Canadians had a higher inter-municipal mobility rate than foreign-born Canadians even after age composition differences are taken into account. A similar comparison that includes immigrants who were residing outside Canada on 1 June 1966, is difficult to make partly because of the varying length of residence in Canada of these persons. An adjustment of the data may be made to take into account this variation of length of residence in Canada, as well as the fact that the immigrants come from the "mobile segments" of populations in the countries from which they emigrated. After this adjustment is made, the estimated inter-municipal mobility rates of the immigrants are slightly below those of the 1966 Canadian migrants.

Recent immigrants (all persons residing outside Canada on 1 June 1966), regardless of their country of birth were a very distinctive portion of the Canadian population in terms of their composition. They, like the internal migrants who were 1966 residents of Canada, were predominantly young adults, much higher than average percentage having university training and professional occupations. The recent immigrants also had slightly higher than average percentages in the service and machine fabricating occupations. Much more, in proportional terms, than the population that resided in Canada on 1 June 1966, they were of a mother tongue that was neither English nor French. Among the recent immigrants, hypermobility within Canada was also predominantly a phenomenon of young adults, and it tended to increase with level of education excepting the actual possession of a university degree. Recent immigrants holding a university degree were less mobile within Canada than those with post-secondary education, but without a degree.

1.3.3. Multivariate Analysis of Mobility Frequency

There is a strong multivariate association between the distribution of the Canadian population by number of inter-municipal moves and several explanatory attributes taken together – age, marital status, mother tongue, schooling, and occupation. By far the most important explanatory attribute is age. However, even when age is held constant there remains a systematic tendency for the distribution of population by number of inter-municipal moves to be associated with education and mother tongue. The effect of marital status depends critically on the value assumed by age. It appears that the strong influence of age may be caused by the tendency of changes in individual social and economic status to be concentrated in particular age groups. The reader is invited to review the more detailed summary remarks that appear at the start and the end of Chapter 3.

1.4. Organization of the Discussion

The contents of the following chapters may be introduced as follows. Chapter 2 reviews major differences among various "mobility groups" in regard to relevant demographic and socioeconomic attributes. The "mobility groups" in question are non-movers (persons who resided in the same dwelling in both 1966 and 1971), intra-municipal movers, immigrants (persons who were residing outside of Canada in 1966), and subgroups of internal migrants differentiated according to their frequency of inter-municipal mobility. The compositions of these "mobility groups" with respect to sex, age, marital status, mother tongue, educational attainment, and occupation will be compared to highlight some principal ways in which the groups differ.

Chapter 3 turns to an analysis of the distribution of the reporting population by number of inter-municipal moves. The relative contributions of six attributes to statistical explanation of the number-of-moves composition of the reporting population of Canada are studied. (The attributes in question are those reviewed in Chapter 2.) In the process a method for anticipating differences in the pattern of mobility frequency shown by two populations, as a result of their distinctive compositions, is exposited and concretely applied. Chapter 4 presents brief concluding remarks.

Several appendices are provided. To keep the size of this volume small, detailed technical discussion is avoided even in these appendices. In some cases further relevant detailed discussion is contained in working papers prepared by the author. These papers are cited in the pertinent appendices and are available by writing to the author.

CHAPTER 2

THE DEGREE OF CANADIAN MOBILITY, INTER-GROUP DIFFERENCES, AND INTERNATIONAL COMPARISON

2.1. Questions Addressed and Two Basic Concepts

This chapter presents an overview of 1971 Census data on the level of geographic mobility in Canada. Emphasis is placed on significant differences in mobility pattern among important subgroups of the population. The following questions are asked: What was the level of geographic mobility in Canada during the 1966 - 71 period, and how does it compare with other countries and with the level during the 1956 - 61 period? How much do key population subgroups, defined in terms of sex, age, mother tongue, marital status, education, and occupation vary in their levels of geographic mobility? What are the main patterns of this inter-group variation in mobility? Classifying the population into groups according to their type of mobility (non-movers, intra-municipal movers, internal migrants, and immigrants from abroad), what are some of the salient differences among these groups in regard to their demographic and socioeconomic composition?

To deal with these questions it is necessary to make a choice among alternative ways of measuring the level of population mobility. The alternatives arise because there are differences in the properties of varying data sources and, in addition, no single measure clearly reflects all aspects of the phenomenon of geographic mobility. For example, mobility data based on recording residence changes as they occur, present different possibilities for measuring degree of mobility than data based on comparing addresses at different times. As another example, the concept of degree of mobility may be defined in such a way as to pertain at least partly to the distances moved, or it may be defined so as to ignore distances and concentrate only on the number of times residence is changed.

Taking into account the properties of the 1971 Census data, two measures of degree of mobility have been selected. The first is a traditional mobility rate, in this case the proportion of the reporting population that changed place of residence at least once over the migration interval 1 June 1966 - 1 June 1971. The second measure is a new ratio whose numerator is the actual number of inter-municipal moves and whose denominator is a rough approximation of the maximum that could take place. The following discussion will begin with consideration of the traditional mobility rate.

2.2. International Comparison of Five-year Mobility

Nearly one half (45%) of reporting Canadians, excluding immigrants from abroad, changed their places of residence at least once between 1966 and 1971 (see Table 2.1). The urban population was slightly more mobile, 48% having moved at least once in the five-year period, than the total population; but the rural farm population was considerably less mobile (18%). In terms of this crude measure of level of mobility, the national rate for the 1961 reporting population in the 1956 - 61 period was only one percentage point below that shown in Table 2.1 for 1966 - 71. Also, the 1961 and 1971 Censuses show similar patterns of urban-rural difference in overall level of mobility. The slight difference in level of mobility between 1956 - 61 and 1966 - 71 is partly because the 1971 Census migration question was addressed to a sample that included permanent residents of collective households (probably a highly mobile group), whereas in the 1961 Census, the corresponding population sample was confined to the residents of private households.

TABLE 2.1. Five-year Internal Mobility Ratios,[1] Persons Aged Five Years and Over in 1971, by Age and Sex, for Urban, Rural Non-farm and Rural Farm, Canada, 1966 - 71

(Excludes Persons Residing Outside Canada on 1 June 1966)

Age and sex	Total	Urban	Rural non-farm	Rural farm
	per cent			
5 years and over	45.1	48.4	41.8	18.0
Male	45.0	48.5	41.9	17.3
Female	45.2	48.2	41.6	18.7
20 - 24 years	65.9	68.7	62.2	30.0
Male	58.3	61.9	54.2	20.7
Female	73.5	75.3	71.0	44.8
25 - 29 years	78.0	81.2	71.7	42.5
Male	79.1	82.4	73.8	38.8
Female	77.0	80.1	69.4	46.6
30 - 34 years	63.6	67.2	57.4	31.0
Male	68.1	72.0	61.7	32.6
Female	59.0	62.4	52.8	29.3

[1] The internal mobility ratio is 100 x (all movers excluding migrants from abroad/ reporting population excluding migrants from abroad).

The reporting population is the estimated total residents of Canada who were aged five years and over as of the census date.

Migrants from abroad are persons who resided in Canada on 1 June 1971, but resided outside Canada on 1 June 1966.

Source: 1971 Census, Statistics Canada, Catalogue 92-719, Table 31.

The age group, 20 - 34, in which geographic mobility is largely concentrated, had mobility rates far above the averages mentioned in the preceding paragraph. For example, Table 2.1 shows that in the 20 - 24 age group, more than 60% of the reporting population had moved at least once between 1966 and 1971. In the 25 - 29 age group more than three quarters of the reporting population had changed residence at least once. Much of this very high mobility is associated with marriage, labour force entry, and education. The higher rate shown for females in the 20 - 24 age group is probably associated with marriage. A large proportion of the females marrying in the 20 - 24 age group had spouses who were in the 25 - 29 age group. Similar patterns were evident in the data from the 1961 Census of Canada (cf. Stone, 1969, pp. 73 - 80).

Through data that became available in the early 1960's it is possible to compare rates of residential mobility among selected countries. Using these data, Long (1970) compared statistics from the 1961 Census of Canada, the 1961 Census of Great Britain, and the 1960 Census of the United States. Although the data are not strictly comparable, it was evident (Long, 1970) that these countries varied in their rates of geographic mobility. Mobility rates seemed to be highest in the United States, but they were not much higher than in Canada. The rates for Great Britain were clearly much lower than those of either Canada or the United States (see Chart 2.1). The marked difference between the rates for the United States and Canada in the two youngest age groups (Chart 2.1) probably arises because the Canadian reporting population included only persons residing in private households, whereas the United States figures included persons living in group quarters.

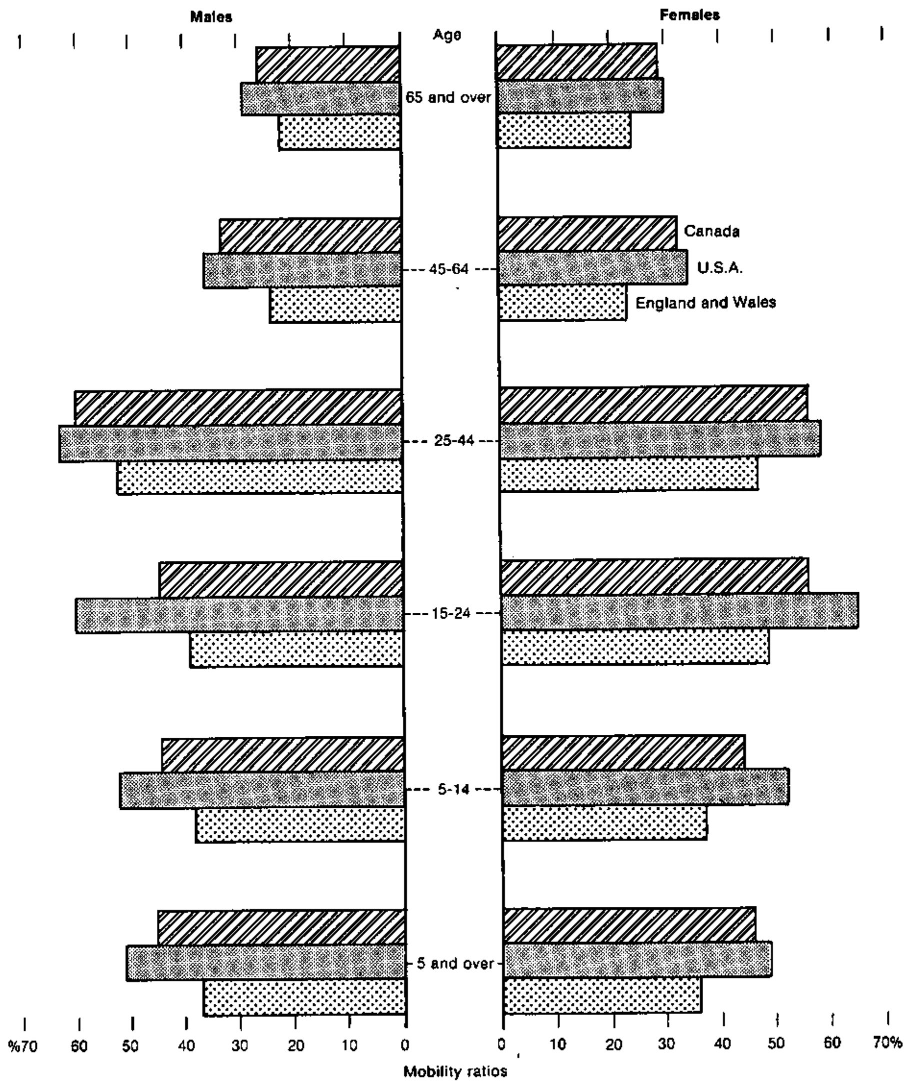
In obtaining his figures, Long included migrants from abroad (Chart 2.1). When these migrants are removed from the figures (in order to get a more accurate picture of internal mobility) for Canada and the United States, the mobility rates in each country decrease by one or two percentage points across the board. The pattern of distribution of the rates over age groups remains the same, as is to be expected since the number of migrants from abroad is very small relative to the number of movers within each country.

Chart 2.2 presents the Canadian and American mobility rates from the 1971 and 1970 Censuses after removing migrants from abroad from the data.[1] In both the United States and Canada, there has been relatively little change in the level of five-year mobility between the two recent censuses (see Charts 2.1 and 2.2). In both the late 1950's and the late 1960's, the Canadian and American levels of internal mobility were similar. However, in the latter period the Canadian level is higher than that for the United States in the 25 - 34 age group (Chart 2.2), an observation that may partly be due to the inclusion, for the first time, of collective households in the Canadian population sample in 1971.

See footnote(s) on page 53.

Chart — 2.1

Five-year Mobility Ratios(1), by Sex and Age, Canada 1956-61, United States, 1955-60, England and Wales, 1956-61



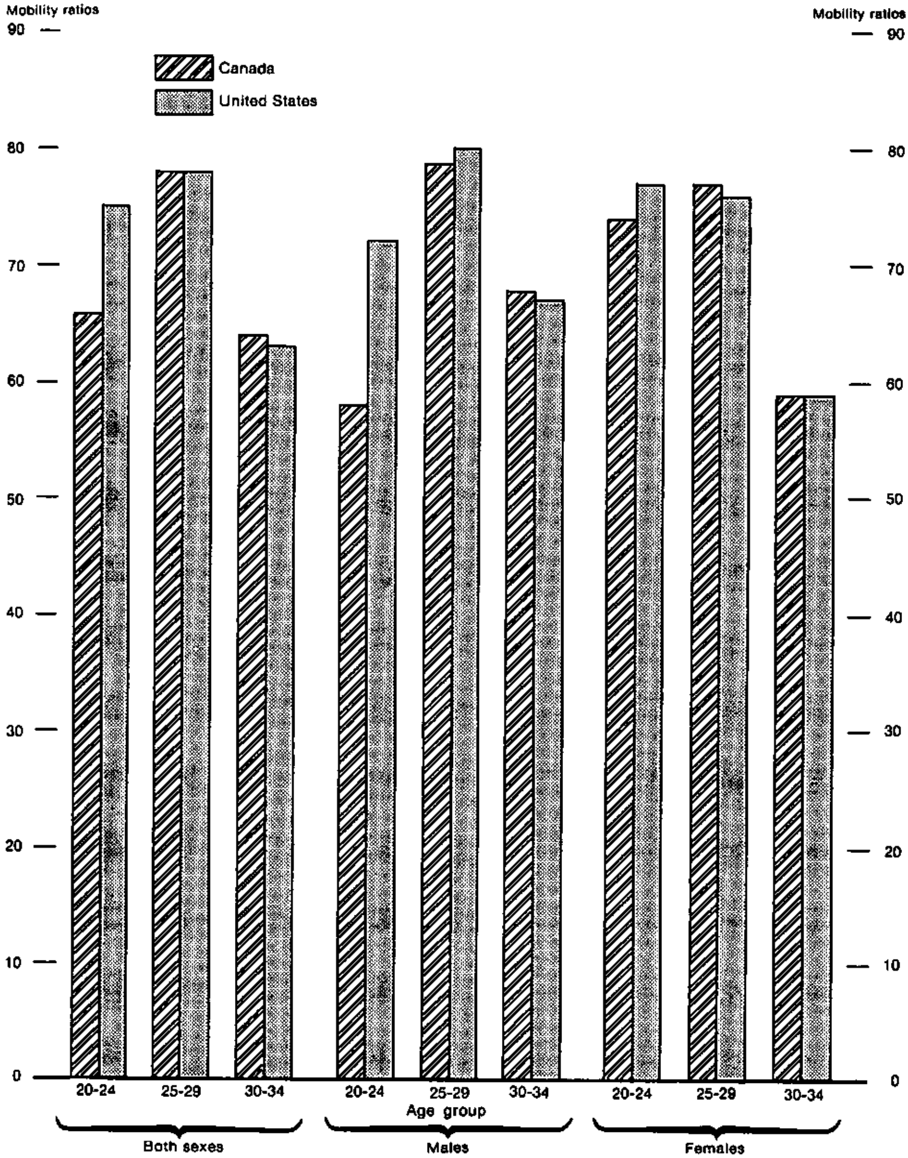
(1) The mobility ratio is 100 X (all movers including migrants from abroad/reporting population). The U.S. and Canadian data represent replies to a census question on usual residence five years prior to census date — 1 April 1960 in U.S. and 1 June 1961 in Canada. Data for England and Wales represent all persons reporting residence at their 23 April 1961 address less than five years. In Canada and Great Britian in 1961, the private household is the basic unit of enumeration in the census. In Great Britain the definition of private household is extended to include in some instances persons residing in group quarters and institutions. In the United States in 1960, all residents of private households, group quarters and institutions are included in the reporting population.

Source: Long (1970), Table 1.

Chart — 2.2

Five-year Internal Mobility Ratios(1), by Sex and Age, Canada, 1966-71, United States, 1965-70

(Excludes migrants from abroad)



(1) U.S. and Canadian data represent replies to a census question on usual residence five years prior to census date — 1 April 1970 in U.S. and 1 June 1971 in Canada. For the definitions of internal mobility ratio and the reporting population of Canada, see table 2.1, footnote (1). For the definition of the reporting population of the United States, see chart 2.1, footnote (1)

Sources: *1971 Census, SCC 92-719, Table 31; 1970 Census of the U.S., Subject Report PC(2)-2B, Table 2.*

2.3. The Rate of Inter-municipal Mobility

About four and one half million persons who resided in Canada in 1966 changed their municipality of residence between 1966 and 1971.[2] This number represents 24% of the 1971 population aged five and older who resided in Canada in both 1966 and 1971. As many as 11% had changed their municipality of residence at least twice between 1966 and 1971. Three per cent of the 1971 population had changed their municipality of residence at least four times.

In all, the four and one half million inter-municipal movers generated a total of nearly nine million inter-municipal moves. However, persons who moved more than once made a disproportionately high contribution to this total. These persons comprised slightly less than one half of all inter-municipal movers (48%); but they were responsible for nearly three quarters (74%) of the moves. Thus a great deal of the geographic mobility in Canada was being generated by a relatively small proportion of the movers. The multiple-movers were a distinctive group within the Canadian population, in terms of their socioeconomic composition.

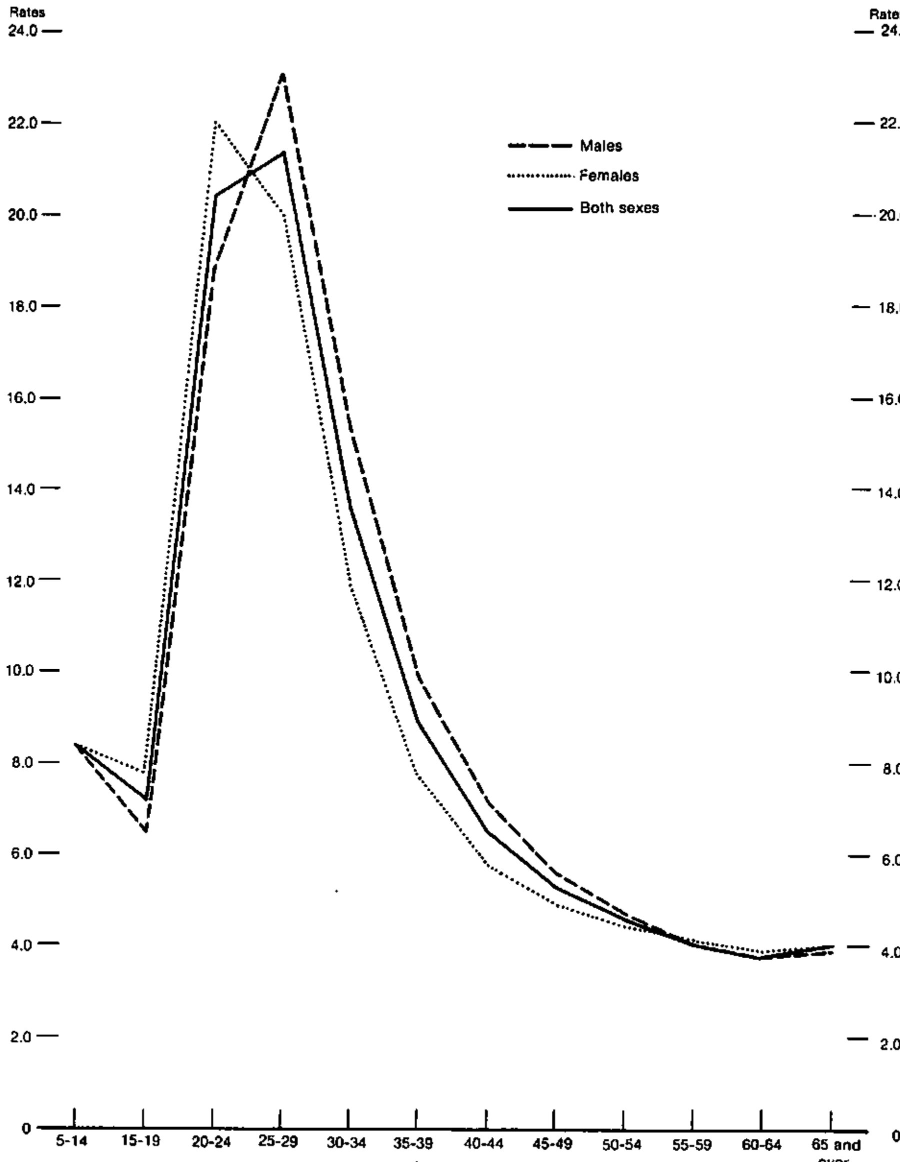
A special mobility rate has been defined to measure the degree of inter-municipal mobility in terms of the number of inter-municipal moves. This rate involves the notion that a person who lived in Canada throughout the 1966 - 71 period was "exposed" to inter-municipal mobility for five person-years. Assuming that this person would typically move at most once per year, he/she could have contributed as many as five moves to the total number of inter-municipal moves. A very rough approximation to the maximum number of moves reportable, under the foregoing assumption, is given by multiplying the 1971 reporting population by five. The product of this multiplication serves as the denominator of the defined inter-municipal mobility rate. The numerator of the rate is the actual number of inter-municipal moves. The rate is then multiplied by 100, allowing the numbers to be referred to in percentage terms. Thus the inter-municipal mobility rate is a very rough approximation to the ratio, in percentage terms, that the actual amount of mobility bears to the maximum possible amount.

In terms of this mobility rate, the observed inter-municipal mobility of the population residing in Canada on 1 June 1966, was about 9% of the approximate maximum amount. However, this approximate maximum amount is an arbitrary yardstick, since it is not realistic to assume that everyone could feasibly move once each year. The arbitrary yardstick helps us to partially compare the degrees of mobility manifested by two or more different population groups; and it is this comparison that should be emphasized.

See footnote(s) on page 53.

Chart — 2.3

Inter-Municipal Mobility Rates(1), Persons Aged 5 Years and Over in 1971, by Sex and Age, Canada, 1966-71



(1) The inter-municipal mobility rate is 100 X [number of inter-municipal moves excluding moves by migrants from abroad/(5 X 1971 reporting population excluding migrants from abroad)]. This ratio is a rough approximation to the ratio that the actual number of inter-municipal moves bears to the maximum possible number.

Source: 1971 Census, unpublished tabulation.

Existing research and theory on geographic mobility have emphasized the relevance of a small set of individual attributes (e.g., age, schooling, occupation) to the explanation of mobility. Strong selectivity of mobility with respect to these and other variables has been shown repeatedly in studies (Stone, 1974a). However, in most cases mobility is measured in terms of the difference between the places of residence of a respondent at the start and end of the pertinent migration time interval (see Shryock, 1964; Stone, 1969; George, 1970; Long, 1970). The discussion that follows will show that the broad pattern of mobility selectivity that was exhibited by 1961 Census data (Stone, 1969, Chapter 3) is repeated in the new data on number of inter-municipal moves.

2.3.1. Sex-age Variation

Males do not differ substantially from females in the 1966 - 71 inter-municipal mobility rate. That for males was 10% while for females it was 9%. However, there is marked variation in the rate according to age groups, and the pattern of variation is that which one would expect from other types of mobility data. The rates reach a peak in the young adult ages, and decline both above and below those ages. For example, the rates for males and females peak in the 25 - 29 and 20 - 24 age groups, respectively. The peak values are more than double those for the entire groups of males and females. Below age 20 the rates are slightly lower than the average for the total population, and above age 54 the rates are less than one-half this average (see Chart 2.3).

So persistent and well known is this pattern of differences among age groups that it barely needs further comment here. It may be noted that the influence of age on mobility is strongly evident even after one takes into account statistically other key factors such as current education and occupation (see Chapter 3). However, it can be argued that this strong apparent "age effect" on mobility is really a reflection of the operation of a set of factors that are not measured in census data but whose influence tends to be concentrated in the young adult ages.

At this age there is a relatively heavy concentration of important changes in life cycle stage for individuals. These include leaving home and establishing a separate household, forming a family, entering the work force, and seeking higher education. Often associated with them is the progressive implementation of steps designed to help the individual actualize aspirations for improvements in his or her perceived social status. Many of these changes require or are facilitated by geographic mobility, and the concentration of such changes in the young adult years produces the strong apparent "age effect" on mobility.

The 1971 Census question on number of inter-municipal moves gave some new information on the degree of mobility exhibited by **migrants**, i.e., persons who moved at least once from one municipality to another, during the 1966 - 71 period. As a group the internal migrants who resided in Canada on 1 June 1966, moved an average of twice during the 1966 - 71 period. The variation by age in the average number of moves per migrant is not substantial. However, an average of nearly three inter-municipal moves is shown by males in the 20 - 29 age group. Twenty-four per cent of the male internal migrants made three or more inter-municipal moves in 1966 - 71. The corresponding figure for females is 22%. More than 38% of the internal migrant males aged 20 - 29, and more than 32% of internal migrant females aged 20 - 29, made at least three inter-municipal moves in the 1966 - 71 period. Almost 16% of the internal migrant males aged 20 - 29 made five or more inter-municipal moves.

Immigrants who resided outside Canada on 1 June 1966, were similar to internal migrants in the average number of inter-municipal moves per person. Their average was slightly below that for the remainder of the population. Rounded to the nearest whole number, both groups had an average of two inter-municipal moves per person. Also both groups showed only a slight peak of the age-specific among average young adults (especially 20 - 29).

2.3.2. Marital Status and Mother Tongue Differences

The 1971 Census data are consistent with the hypothesis that changes of marital status tend to be markedly associated with inter-municipal mobility.[3] Table 2.2 shows that among the specified five marital-status-by-date-of-marriage groups in the population aged 15 and older, those who were married after 1 June 1966, and thus changed their marital status during the migration period, had by far the highest inter-municipal mobility rates. Among those persons aged 15 and older, the inter-municipal mobility ratio for the subgroup that changed marital status after the start of the migration interval was more than twice as high as that of the whole population. This differential is especially sharp among those who were married and living with their spouses in 1971, where the inter-municipal mobility rate for the subgroup of those first married after 1 June 1966, is more than three times as high as that for those who were first married before 1 June 1966.

A portion of this sharp differential is a result of differences in age distribution between those married before 1 June 1966 and those married later. Within the age group 20 - 29, for example, the inter-municipal mobility rate of those who were married after 1 June 1966, and were living with their spouses on 1 June 1971, was substantially less than twice as high as that for the corresponding subgroup married before 1 June 1966.

Among the ages where most geographic mobility takes place, persons who were once married but were no longer living with their spouses at the time of the 1971 Census had consistently higher than average mobility rates. Only persons married after 1 June 1966, and living with their spouses show similarly high rates of mobility (see Table 2.2). The rates for single persons are generally lower than

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See footnote(s) on page 53.

those for ever-married persons who were not living with their spouses. Thus the popular stereotype of the footloose bachelor or spinster is not confirmed by the 1971 data. In the peak ages of family formation, for example, persons who were single on both 1 June 1966 and 1 June 1971 had by far the lowest inter-municipal mobility rates. Among somewhat older persons (age 30 - 44) single individuals showed an inter-municipal mobility rate that was only slightly above that of those who were living with their spouses and who had married before 1 June 1966. Both of these groups had only average or lower than average inter-municipal mobility ratios.

TABLE 2.2. Inter-municipal Mobility Rates,[1] Persons Aged 15 Years and Over in 1971, by Marital Status, Sex and Age, Canada, 1966 - 71

(Excludes Persons Residing Outside Canada on 1 June 1966)

Age	Marital status					
	Total	Single	Married, spouse present		Other[2]	
			First married before 1 June 1966	First married after 1 June 1966	First married before 1 June 1966	First married after 1 June 1966
	per cent					
	Male					
15 years and over	10	10	7	26	10	24
20 - 29 years	21	15	21	29	30	26
30 - 44 years	11	11	9	19	18	23
	Female					
15 years and over	9	9	7	26	7	25
20 - 29 years	21	15	17	27	28	29
30 - 44 years	8	10	7	19	13	20

[1] See Chart 2.3, footnote (1).
[2] Includes married, spouse absent, separated, divorced and widowed.

Source: 1971 Census, unpublished tabulation.

In sum, it may be hypothesized that the marital status of an individual at a specific time does not substantially affect his psychological propensity to be geographically mobile. However, changes in marital status often entail or are otherwise associated with geographic mobility. Marriage will be positively associated with geographic mobility at the ages of the family head where family size tends to be changing substantially, e.g., through the addition of children. Thus the relation between marital status and geographic mobility is complex, depending on status changes and on the presence of certain auxiliary factors.

Mother tongue, like marital status, should generally not affect a person's psychological propensity to be mobile. However, the objective availability and the perception of opportunities to enhance one's social status may vary significantly among mother tongue groups. Because of the common use of geographic mobility as a means of access to status-enhancing opportunities, there may be a tendency for some mother tongue groups to show unusually high or low rates of inter-municipal mobility. Also the geographic distribution of communities with substantial numbers of inhabitants with a given mother tongue group influences the potential migrant's perception of the number of alternative regional locations that would seem to be congenial in terms of the presence of other persons with similar background. In the light of these considerations it is not surprising that in Canada the English mother tongue group is the most mobile inter-municipally.

Among five selected mother tongue groups, persons with English mother tongue showed the highest levels of 1966 - 71 inter-municipal mobility (Table 2.3). In the age group of peak migration rates, 20 - 34, the inter-municipal mobility rate for the group with English mother tongue was at least five percentage points higher than that of the other mother tongue groups. Among these other groups, the inter-municipal mobility rate does not vary much.

TABLE 2.3. Inter-municipal Mobility Rates,[1] Persons Aged Five Years and Over in 1971, by Mother Tongue, Sex and Age, Canada, 1966 - 71

(Excludes Persons Residing Outside Canada on 1 June 1966)

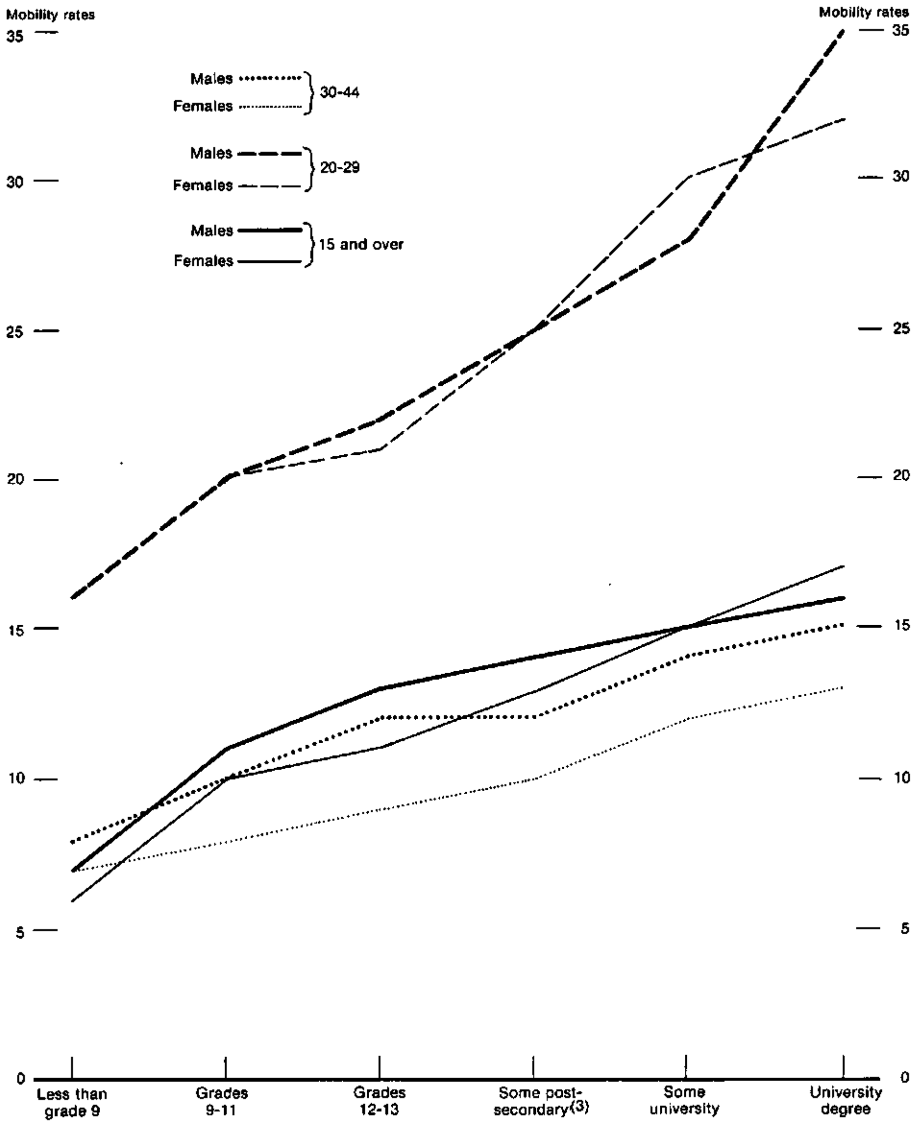
Age	Mother tongue					
	Total	English	French	Selected European[2]	Native Indian and Eskimo	All other
	per cent					
	Male					
5 years and over	10	11	8	7	8	7
20 - 34 years	19	22	15	15	13	15
35 - 44 years	9	9	8	7	9	9
	Female					
5 years and over	9	10	8	6	9	6
20 - 34 years	18	21	15	13	15	12
35 - 44 years	7	7	6	5	8	6

[1] See Chart 2.3, footnote (1).
[2] Includes German, Italian, Netherlands, Ukrainian and Polish mother tongue.

Source: 1971 Census, unpublished tabulation.

Chart – 2.4

Inter-Municipal Mobility Rates[1], Persons Aged 15 Years and Over in 1971 and Not Attending School in 1971[2], by Level of Schooling, Sex and Age, Canada, 1966-71
(Excludes persons residing outside Canada on 1 June 1966)



(1) See chart 2.3, footnote 1.
(2) Refers to persons not attending school at anytime during the 70/71 school term. This remark pertains to all tables and charts that use the phrase "not attending school in 1971".
(3) Non-university.

Source: 1971 Census, unpublished tabulation.

2.3.3. Mobility Rate Differentials by Schooling and Occupation

Using the educational attainment categories shown in Chart 2.4 it appears that as the level of schooling increases so does the degree of inter-municipal mobility. For both males and females aged 15 and older, the inter-municipal mobility ratio rises steadily from those with less than Grade 9 schooling to those with university degrees. The level of inter-municipal mobility among college graduates is generally much higher than that among persons with less than Grade 9 education. Basically the same pattern is shown in the two key age groups of 20 - 29 and 30 - 44. An unusually high inter-municipal mobility ratio is shown by persons aged 20 - 29 and holding university degrees (35% for males and 32% for females). However, a substantial part of the mobility of these college-trained persons was probably connected with residence changes between family homes, university, and workplace.

Among occupation groups, the Armed Forces and two of the predominantly professional groups generally showed the highest levels of inter-municipal mobility in 1966 - 71 (see Table 2.4). For males the two professional occupation groups are: 1. teaching and related occupations; and 2. technological, social, religious, artistic, and related occupations. Among females the corresponding predomi nantly professional occupation groups are: 1. teaching and related occupations; and 2. medicine and health. The occupation groups showing the lowest levels of inter-municipal mobility include among others: 1. farming, horticulture and animal husbandry; 2. processing; 3. machining and product fabricating, assembling, and repairing; 4. clerical and related work; and 5. transport equipment operating.

The data presented in Chart 2.4 and Table 2.4 are consistent with the hypothesis that education and occupation are significant factors in explaining geographic mobility. A person's educational attainment may directly affect his/her psychological propensity to be mobile by influencing the taste for and the adaptability to a variety of social and cultural milieux. As the level of educational attainment goes up there is a tendency for an increase in the taste for and the tolerance of variation in one's social and cultural surroundings. Also educational attainment should be directly related to the aspiration for improvement in one's perceived social status, and the stronger this aspiration becomes the greater will be the search for new opportunities – a search that often involves geographic mobility.

The geographic distribution of economic opportunities varies markedly among educational and occupational groups. The labour market for some occupations is virtually national, whereas that for others is a small local area. The practitioners of some occupations tend to be "tied" to specific locations by virtue of their dependence on the slow establishment of a loyal local clientele or because of norms laid down by their colleagues (e.g., union regulations). In other occupations mobility is normal and is often an important key to career advancement. Thus, a pattern of systematic differences in inter-municipal mobility rates among education and occupation groups is consistent with general hypotheses about mobility that may be put forward on the basis of existing migration theory and research.

TABLE 2.4. Inter-municipal Mobility Rates,[1] Persons Aged 15 Years and Over in 1971 and Who Worked in 1970, by Sex, Age and Occupation, Canada, 1966-71

(Excludes Persons Residing Outside Canada on 1 June 1966)

Occupation	Male			Female		
	15 years and over	20-34 years	35-44 years	15 years and over	20-34 years	35-44 years
	per cent					
All occupations	11	20	8	11	19	7
Managerial, administrative and related occupations	12	25	10	10	18	7
Teaching and related occupations	20	26	13	17	24	9
Occupations in medicine and health	12	23	9	17	25	9
Technological, social, religious, artistic and related occupations	17	26	11	15	24	9
Clerical and related occupations	10	17	7	12	18	6
Selected sales occupations[2]	12	21	9	12	20	7
Other sales occupations	10	19	8	8	17	7
Armed Forces	29	39	23	34	41	20
Other service occupations	10	20	9	11	21	8
Farming, horticultural and animal husbandry occupations	5	11	4	4	11	3
Other primary occupations[3]	13	21	9	11	17	5
Processing occupations	9	16	6	8	14	5
Machining and product fabricating, assembling and repairing occupations	10	18	7	8	13	6
Construction trades occupations	11	20	8	12	18	8
Transport equipment operating occupations	11	20	8	10	18	5
Occupations not elsewhere specified	10	18	8	10	16	6

1 See Chart 2.3, footnote (1).
2 Includes technical salesmen and related advisers, commercial travellers, street vendors and door-to-door salesmen, newsboys, insurance salesmen and agents, and driver-salesmen.
3 Includes fishing, hunting, trapping and related occupations, forestry and logging occupations, mining and quarrying including oil and gas field occupations.

Source: 1971 Census, unpublished tabulation.

In attempting to interpret the pattern of variation in level of mobility among education and occupation groups, it must be remembered that census respondents' education and occupation are identified only as of the end of the five-year migration interval. From these data it is very difficult to draw firm inferences about the effect of occupation or education upon the tendency to be mobile. For example, a substantial portion of the geographic mobility indicated in the census may have been connected with occupational mobility, and the occupation reported by some respondents in 1971 was not the one they held at the time of their migration. However, when looking at a variety of age groups which show quite different levels of occupational mobility, we still see a basically similar pattern of differences in mobility rates among particular occupation groups. This similarity is consistent with the hypothesis of some influence of occupation upon geographic mobility.

A similar situation exists with regard to educational groups. Persons in the peak ages of entering and leaving post-secondary education have exceptionally high rates of inter-municipal mobility. Yet, persons well above those ages who had very low rates of educational status mobility between 1966 and 1971, also tended to show the same pattern of educational differences in geographic mobility. Both Table 2.4 and Chart 2.4 present a selection of pertinent data for different age groups. (See Stone, 1969, Chapter 3, for related discussion based on 1961 Census data.)

In summary, for the whole reporting population the measured degree of inter-municipal mobility was about one tenth of the appropriate maximum possible degree. A number of important subgroups showed much higher or much lower levels of inter-municipal mobility. For example, young adults as a group had levels twice as high as the average. Even higher levels were shown by young adults who were married and living with their spouses, by young adults with English mother tongue, and by those in certain professional occupation groups. Exceptionally high levels of inter-municipal mobility are shown for university-educated young adults who were out of school by the time of the 1971 Census. However, these highly typical rates may have been connected with university attendance in a municipality different from the one of usual residence during the 1966 - 71 period.

2.3.4. The Inter-municipal Mobility of Recent Immigrants

It is advisable to devote a separate discussion to the inter-municipal mobility rates for persons who immigrated to Canada between 1966 and 1971, because the figures shown for this group are comparable to those for persons who resided in Canada on 1 June 1966. The latter group includes a substantial proportion of non-migrants (persons who did not change municipality of residence even once between 1966 and 1971), who are included in the data of Sections 2.3.1 - 2.3.3. The group of recent immigrants is comprised entirely by persons who made an inter-municipal migration when they entered Canada between 1 June 1966 and 1 June 1971.

Also important is that many of these recent immigrants did not have five years of exposure to inter-municipal mobility within Canada;[4] so that the inter-municipal mobility rate for this group must be calculated in a somewhat different way than that used for persons who resided in Canada on 1 June 1966. In short, the fact that the ratios presented in this section are generally higher than those in Sections 2.3.1 - 2.3.3 does not imply an inherently higher psychological propensity toward mobility on the part of the recent immigrants. In this section, we shall also briefly consider demographic and socioeconomic differences in inter-municipal mobility level within the group of these recent immigrants.

See footnote(s) on page 53.

The 1971 Census data do not permit the calculation of an appropriate inter-municipal mobility rate for the whole subpopulation that immigrated to Canada between 1 June 1966 and 1 June 1971. The year of immigration to Canada must be taken into account, to allow for length of time of exposure of an immigrant to inter-municipal mobility within Canada. Data on the year of immigration to Canada were not collected for all those who had previously emigrated from Canada before 1 June 1966. These persons, many of whom were born in Canada, comprised 22% of the total estimated number of 1966 - 71 immigrants. Data on the year of immigration to Canada were collected only for foreign-born persons. The tables showing inter-municipal mobility rates for immigrants **pertain only to foreign-born persons who first immigrated to Canada between 1 June 1966 and 1 June 1971.** For the sake of convenience these persons will be called "recent foreign-born immigrants".

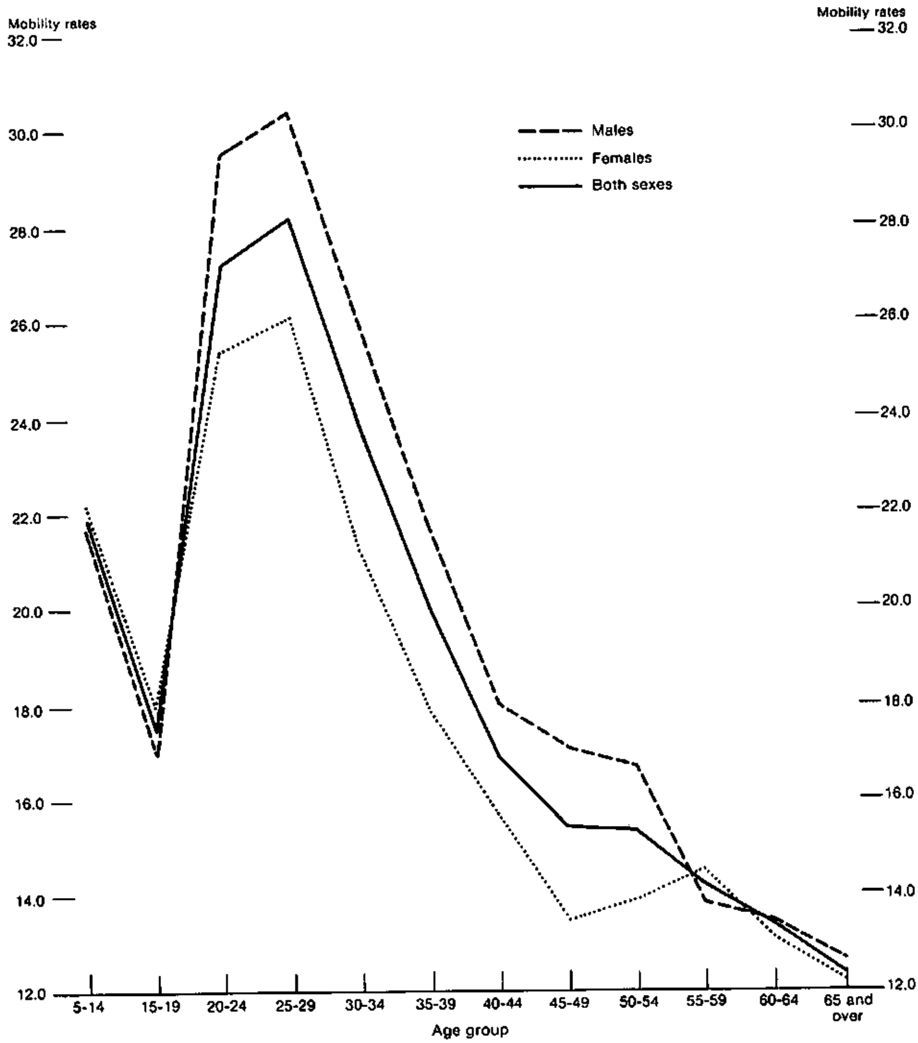
Over the 1966 - 71 period the observed inter-municipal mobility rate for the recent foreign-born immigrants was above 23% of the approximate maximum amount. Although there is a tendency for the rate to rise as one approaches the young adult ages as shown in Chart 2.5, this tendency is not nearly as marked as it is for the remainder of the Canadian population. In general the amount of variation in the inter-municipal mobility rate among the age groups of recent foreign-born immigrant population is less than that shown for the remainder of the Canadian population. The highest rate is observed for males aged 25 - 29 (30%) and the lowest is shown for those aged 65 and older (12%).

To emphasize that the rates shown in Chart 2.5 are comparable with those shown in Chart 2.3 for the residents of Canada, as of 1 June 1966, a few comments about the relative mobility of immigrants and non-immigrants may be made. As noted above, the population base that is used to calculate the rates in Chart 2.3 includes non-migrants; whereas the population base used to compute the rates in Chart 2.5 consists entirely of migrants. All the immigrants were 1966 - 71 inter-municipal migrants by virtue of their entry into Canada between 1 June 1966 and 1 June 1971. To put the immigrant and non-immigrant internal mobility rates on a comparable footing, it is helpful (but not entirely adequate) to remove the non-migrants from the denominator of the rates computed for persons who resided in Canada in 1966. Table 2.5 shows the results of this removal.

Each country's population has a geographically mobile segment and one that is virtually immobile. In technical literature these two groups are called "movers" and "stayers". Immigrants are members of the mobile segment of the national populations that they left when they entered Canada. When we compare the mobility of 1966 - 71 immigrants with that of all persons who resided in Canada on 1 June 1966, we are comparing a part of the mobile segment of one population (that of the countries that the immigrants left) with the whole (mobile and immobile segments) of another population. The result of such a comparison is a foregone conclusion, and tells us nothing about whether the stock of people from which immigrants are drawn are more mobile than Canadians. A

Chart — 2.5

Inter-Municipal Mobility Rates(1), Foreign-born Persons Aged 5 Years and Over in 1971, Who First Immigrated to Canada Between 1 June 1966 and 1 June 1971, by Sex and Age, Canada, 1966-71



(1) The numerator of the rate for these immigrants is the same as that used in table 2.5 — the total number of inter-municipal moves. However, the denominator must allow for the differing lengths of time spent in Canada according to the year of immigration to Canada. In this study, a rough approximate allowance is made. For all persons who reported arrival in a given time period, it was assumed that the average date of arrival was the middle of that time period. In defining the denominator for the ratio, the total number of such persons is multiphied by the number of years from the middle of that time period to 1 June 1971. Thus, if "I_t" means the total of immigrants reporting arrival in period t (usually a calendar year), the denominator was defined as: $\left[(4.75 \times I_{66}) + (3.50 \times I_{67\text{-}68}) + (2 \times I_{69}) + (I_{70}) + (0.25 \times I_{71})\right]$

Source: 1971 Census, unpublished tabulation.

more useful assessment is made by comparing the internal migrants (a portion of the mobile segment of Canada's 1966 population) with the immigrants. In order to improve the basis for comparison the number of inter-municipal moves used for immigrants should include the move into Canada from abroad, and only the immigrants arriving during 1966, after 1 June, are considered. This is the approach used to compute the last three columns of Table 2.5. In Chart 2.5 the move into Canada was counted.

TABLE 2.5. Inter-municipal Mobility Rates, Migrants Who Resided in Canada in 1966 and Foreign-born Persons Who First Arrived in Canada in 1966, by Sex and Age, Canada, 1966-71

Age	Migrants residing in Canada on 1 June 1966[1]			Foreign-born persons who first arrived in Canada in 1966[2]		
	Both sexes	Male	Female	Both sexes	Male	Female
	per cent					
5 years and over	39	40	38	38	39	38
5-14 years	36	36	36	39	38	39
15-19 "	37	36	37	34	34	34
20-24 "	50	53	47	40	40	39
25-29 "	47	50	44	44	46	42
30-34 "	39	41	37	41	42	39
35-39 "	36	37	34	37	38	36
40-44 "	34	35	33	35	35	34
45-49 "	33	34	32	33	35	31
50-54 "	33	34	32	33	34	31
55-59 "	32	33	32	30	31	30
60-64 "	32	32	31	30	29	31
65 years and over	31	31	31	30	28	30

[1] The inter-municipal mobility rate for this group is 100 x [number of inter-municipal moves / (5 x number of inter-municipal migrants)], where all the data refer to persons who resided in Canada on 1 June 1966.

[2] The data in these columns are confined to foreign-born persons who first arrived in Canada in the year 1966 after 1 June. The inter-municipal mobility rate for this group is 100 x [number of inter-municipal moves/ (5 x number of immigrants first arriving in Canada in 1966)]. The move to Canada was counted in "number of inter-municipal moves", in contrast to Table 2.9 where such moves are excluded.

Source: 1971 Census, unpublished tabulation.

In terms of the selected population subgroups and the defined inter-municipal mobility rate, there is little difference between the mobility rates for the 1 June 1966 residents of Canada (internal migrants) and for the foreign-born immigrants, who arrived during 1966 (after 1 June). Table 2.5 shows that for the whole population aged five and older the rates for the former group are approximately one percentage point higher than those for the selected immigrants. Within the age groups 20 - 29 where the vast majority of the mobility took place, the rates for the internal migrants are markedly higher than for the immigrants.

The foregoing comparison shows that the popular conception that foreign-born persons are more mobile than native Canadians, needs considerable qualification. This statement often ignores the need to identify the appropriate base populations before comparing the mobility rates between foreigners and native Canadians. For a further elaboration on this point, Table 2.6 should be studied. It refers entirely to the population that was residing in Canada on 1 June 1966, and separates Canadian-born persons from foreign-born persons. Generally, the inter-municipal mobility rates of the Canadian-born population are higher than those of foreign-born persons. This pattern is distinctly shown in the age group 20 - 34, where the vast majority of mobility takes place. However, in the teen and younger ages the rates for the foreign-born are slightly above those for the native-born.

TABLE 2.6. Inter-municipal Mobility Rates,[1] Persons Aged 15 Years and Over in 1971 and Who Resided in Canada on 1 June 1966, by Place of Birth, Sex and Age, Canada, 1966 - 71

Age	Born in Canada			Born outside Canada		
	Both sexes	Male	Female	Both sexes	Male	Female
	per cent					
5 years and over	10	10	10	7	8	7
5 - 14 years	8	8	8	12	12	12
15 - 19 "	7	6	8	8	8	9
20 - 24 "	21	19	22	16	16	17
25 - 29 "	22	23	20	19	22	17
30 - 34 "	14	15	12	12	14	10
35 - 39 "	9	10	8	9	10	8
40 - 44 "	6	7	6	7	7	6
45 - 49 "	5	6	5	5	6	5
50 - 54 "	4	5	4	5	5	5
55 - 59 "	4	4	4	4	4	4
60 - 64 "	4	4	4	4	4	4
65 years and over	4	4	4	4	4	4

[1] See Chart 2.3, footnote (1).

Source: 1971 Census, unpublished tabulation.

To make a meaningful comparison of the mobility of foreign-born immigrants since 1 June 1966, and that of the remaining 1971 population of Canada, we should consider only persons who migrated at least once between 1966 and 1971. When this is done, the recent immigrants show the lower rates of inter-municipal mobility. Also, considering the population that was resident in Canada on 1 June 1966, a comparison may be made between the Canadian-born and the foreign-born populations with respect to their inter-municipal mobility rates. Again, the rates for the foreign-born are lower than those for the Canadian-born.

2.4. The Hypermobile Population

Special interest attaches to persons who move a great deal across municipal boundaries. In the discussion that follows those who changed municipality of residence at least three times between 1966 and 1971 (roughly speaking they moved to another community about once every 18 months or so) are called "hypermobile". Changing municipality of residence about once every 18 months is an exceptionally high rate of geographic mobility, as anyone with a substantial collection of household effects knows. In the discussion that follows we shall see that the people who engage in this sort of mobility are substantially young adults, although all age groups show some measure of hypermobility.

2.4.1. Young Adult Hypermobility

Table 2.7 reveals the peaking of hypermobility among young adults in the early years of family formation and working life. The distributions for the age

TABLE 2.7. Percentage Distributions, Persons Aged Five Years and Over in 1971, by 1966 Place of Residence, Number of Inter-municipal Moves, and Age, Canada, 1966-71

Age	Persons residing in Canada on 1 June 1966						
	Number of inter-municipal moves in past five years						
	Total	None	One	Two	Three	Four	Five or more
	per cent						
	Distributions by number of inter-municipal moves						
5 years and over	100[1]	76	12	6	3	1	2
5-14 years	100	77	13	6	2	1	1
15-19 "	100	81	11	4	2	1	1
20-24 "	100	59	16	10	6	3	6
25-29 "	100	54	18	13	7	3	5
30-34 "	100	66	17	9	4	2	2
35-39 "	100	75	14	6	3	1	1
40-44 "	100	81	12	5	2	1	1
45-49 "	100	84	10	4	1	--	1
50-54 "	100	86	9	3	1	--	--
55-59 "	100	87	8	3	1	--	--
60-64 "	100	88	8	2	1	--	--
65 years and over	100	87	9	2	1	--	--
	Distributions by age						
5 years and over	100	100	100	100	100	100	100
5-14 years	23	23	24	23	21	19	15
15-19 "	11	11	10	8	8	7	7
20-24 "	9	7	12	16	20	25	33
25-29 "	8	5	11	16	19	22	22
30-34 "	6	5	9	10	10	9	8
35-39 "	6	6	7	7	6	5	4
40-44 "	6	7	6	5	4	3	3
45-49 "	6	7	5	4	3	3	2
50-54 "	5	6	4	3	2	2	2
55-59 "	5	6	3	2	2	1	1
60-64 "	4	5	3	2	1	1	1
65 years and over	9	10	6	4	3	2	2

See footnote(s) at end of table.

TABLE 2.7. Percentage Distributions, Persons Aged Five Years and Over in 1971, by 1966 Place of Residence, Number of Inter-municipal Moves, and Age, Canada, 1966 - 71 – Concluded

Age	Persons residing outside Canada on 1 June 1966						
	Number of inter-municipal moves in past five years						
	Total	None	One	Two	Three	Four	Five or more
	per cent						
	Distributions by number of inter-municipal moves						
5 years and over	100[1]	61	20	9	5	2	2
5 - 14 years	100	58	22	10	6	2	2
15 - 19 "	100	67	18	8	4	1	2
20 - 24 "	100	64	17	8	5	2	4
25 - 29 "	100	57	20	10	6	3	4
30 - 34 "	100	58	21	11	6	2	3
35 - 39 "	100	60	22	10	5	2	2
40 - 44 "	100	62	21	9	4	2	1
45 - 49 "	100	65	21	8	4	1	1
50 - 54 "	100	66	19	9	4	1	2
55 - 59 "	100	69	19	7	3	1	1
60 - 64 "	100	72	18	6	2	1	1
65 years and over	100	73	17	5	2	1	1
	Distributions by age						
5 years and over	100	100	100	100	100	100	100
5 - 14 years	19	18	21	21	21	18	14
15 - 19 "	7	8	6	6	5	5	5
20 - 24 "	14	15	12	13	14	15	21
25 - 29 "	19	18	19	21	23	27	30
30 - 34 "	14	13	14	15	15	16	14
35 - 39 "	9	8	9	9	9	7	6
40 - 44 "	6	6	6	6	5	5	3
45 - 49 "	4	4	4	3	3	3	2
50 - 54 "	2	3	2	2	2	2	2
55 - 59 "	2	2	2	1	1	1	1
60 - 64 "	2	2	1	1	1	1	1
65 years and over	3	4	3	2	1	1	2

[1] Figures may not add to the total due to rounding error.
- - Means less than 0.5.

Source: 1971 Census, unpublished tabulation.

groups 20 - 24, 25 - 29, and 30 - 34 show substantial weights for the categories that represent two or more moves. For example, the percentage moving inter-municipally at least twice over the 1966 - 71 period is 28% for age group 25 - 29, 25% for the age group 20 - 24, and 17% for the age group 30 - 34. In contrast, only 12% of the total reporting population moved inter-municipally at least twice. Whereas about three quarters of this population made no inter-municipal moves during the five-year period, only slightly more than one half of those aged 25 - 29 failed to move from one municipality to another.

Table 2.7 shows that hypermobile persons had unusually high concentrations in the young adult age group of 20 - 29. Seventeen per cent of the reporting population was aged 20 - 29. Of those who moved four and three times respectively, the corresponding percentages aged 20 - 29 were 47% and 39%. In sharp contrast, only 12% of those who made no inter-municipal moves were aged 20 - 29. Clearly, as research from the 1961 Census had suggested, the highly mobile are unusually heavily concentrated in the early years of working life and family formation (see Stone, 1969, Chapter 3).

The immigrant population that resided outside Canada on 1 June 1966 is also a rather mobile segment of the Canadian population (see Table 2.7). About 39% moved inter-municipally one or more times after they arrived in Canada. In attempting to explain the relatively high proportion of these immigrants who showed at least one inter-municipal move after arrival in Canada, it should be borne in mind that this entire group is comprised by migrants. In contrast, a significant proportion of the group that resided in Canada in 1966 were non-migrants.

2.4.2. Marital Status and Hypermobility

Among the five broad marital-status-by-date-of-marriage groups who resided in Canada in 1966 (Table 2.8), the tendency toward hypermobility is strongest for the group of ever-married persons who were first married after 1 June 1966. Whereas, for example, only 6% of the male population aged 15 and older was hypermobile, nearly 20% were hypermobile among those who were first married after 1 June 1966 and were still living with their spouses. About 19% of those males who were married after 1 June 1966, but who were not living with their spouses as of 1 June 1971, were hypermobile. The former group underwent at least one change of marital status after the start of the migration interval, while the latter group underwent at least two such changes. The population that was single in both 1966 and 1971 shows no higher than average tendency toward hypermobility.

There is a distinct tendency toward higher than average levels of hypermobility among persons who were once married but were not living with their spouses as of 1 June 1971. This tendency appears to be lacking in the whole 15 and older age groups of persons married before 1 June 1966; but this appearance is largely a function of the somewhat "older" age structure of the group. The data (Table 2.8) for the 20 - 29 and 30 - 44 age groups show clearly the higher than average hypermobility of those who were married before 1 June 1966, but were no longer living with their spouses on 1 June 1971. As noted above, the corresponding group of ever-married persons who were married since 1 June 1966, showed unusually high levels of hypermobility.

TABLE 2.8. Percentage Distributions, Persons Aged 15 Years and Over in 1971, by Number of Inter-municipal Moves, Sex, Age and Marital Status, Canada, 1966 - 71

(Excludes Persons Residing Outside Canada on 1 June 1966)

Sex, age and marital status	Number of inter-municipal moves in past five years						
	Total	None	One	Two	Three	Four	Five or more
	per cent — Distributions by number of inter-municipal moves						
Male							
15 years and over	100[1]	76	12	6	3	1	2
Single, never married	100	78	10	5	3	1	3
First married before 1 June 1966, MSP[2]	100	81	11	5	2	1	1
First married after 1 June 1966, MSP[3]	100	48	19	14	8	4	8
First married before 1 June 1966, other[4]	100	75	12	6	3	1	2
First married after 1 June 1966, other[5]	100	58	13	10	6	3	9
20 - 29 years	100	59	15	10	6	3	6
Single, never married	100	72	11	6	4	2	5
First married before 1 June 1966, MSP[2]	100	54	18	13	7	3	4
First married after 1 June 1966, MSP[3]	100	45	19	15	8	5	9
First married before 1 June 1966, other[4]	100	48	15	14	8	5	10
First married after 1 June 1966, other[5]	100	55	13	10	7	4	10
30 - 44 years	100	72	15	7	3	1	2
Single, never married	100	76	10	6	3	1	3
First married before 1 June 1966, MSP[2]	100	74	15	7	3	1	1
First married after 1 June 1966, MSP[3]	100	56	19	12	6	3	4
First married before 1 June 1966, other[4]	100	62	15	10	5	3	5
First married after 1 June 1966, other[5]	100	56	16	11	7	3	7
Female							
15 years and over	100[1]	76	13	6	3	1	2
Single, never married	100	77	12	5	3	1	2
First married before 1 June 1966, MSP[2]	100	81	11	5	2	1	1
First married after 1 June 1966, MSP[3]	100	43	23	16	9	4	6
First married before 1 June 1966, other[4]	100	81	11	5	2	1	1
First married after 1 June 1966, other[5]	100	56	13	11	7	5	9
20 - 29 years	100	54	19	12	7	3	5
Single, never married	100	66	16	8	5	2	4
First married before 1 June 1966, MSP[2]	100	59	18	12	6	3	3
First married after 1 June 1966, MSP[3]	100	41	23	16	9	4	6
First married before 1 June 1966, other[4]	100	49	15	14	9	5	9
First married after 1 June 1966, other[5]	100	52	13	11	8	5	11
30 - 44 years	100	76	14	6	3	1	1
Single, never married	100	76	12	7	3	1	1
First married before 1 June 1966, MSP[2]	100	78	13	6	2	1	1
First married after 1 June 1966, MSP[3]	100	52	24	13	6	3	3
First married before 1 June 1966, other[4]	100	68	14	9	4	2	2
First married after 1 June 1966, other[5]	100	58	13	14	5	4	4

See footnote(s) at end of table.

TABLE 2.8. Percentage Distributions, Persons Aged 15 Years and Over in 1971, by Number of Inter-municipal Moves, Sex, Age and Marital Status, Canada, 1966 - 71 – Concluded

(Excludes Persons Residing Outside Canada on 1 June 1966) – Concluded

Sex, age and marital status	Number of inter-municipal moves in past five years						
	Total	None	One	Two	Three	Four	Five or more
	per cent						
	Distributions by marital status						
Male							
15 years and over	100[1]	100	100	100	100	100	100
Single, never married	31	32	28	26	29	29	37
First married before 1 June 1966, MSP[2]	51	54	49	41	35	28	17
First married after 1 June 1966, MSP[3]	10	6	16	24	28	33	35
First married before 1 June 1966, other[4]	7	7	7	7	7	7	7
First married after 1 June 1966, other[5]	1	1	1	1	2	2	3
Female							
15 years and over	100	100	100	100	100	100	100
Single, never married	25	25	24	22	23	23	26
First married before 1 June 1966, MSP[2]	50	53	45	40	35	30	23
First married after 1 June 1966, MSP[3]	10	6	18	26	30	34	36
First married before 1 June 1966, other[4]	14	15	12	12	11	11	11
First married after 1 June 1966, other[5]	1	1	1	1	2	3	4

[1] Figures may not add to the total due to rounding error.
[2] Married, spouse present, date of first marriage before 1 June 1966.
[3] Married, spouse present, date of first marriage after 1 June 1966.
[4] Married, spouse absent, separated, widowed or divorced, date of first marriage before 1 June 1966.
[5] Married, spouse absent, separated, widowed or divorced, date of first marriage after 1 June 1966.

Source: 1971 Census, unpublished tabulation.

2.4.3. Schooling, Occupation and Hypermobility

Among the different educational attainment groups that resided in Canada in 1966 the tendency toward hypermobility is greatest for persons with university education (see Table 2.9). In contrast, the percentage with no inter-municipal moves is greatest for those with less than Grade 9 education. In the key 20 - 29 age group, 26% of the males with university degrees had moved at least three times over the 1966 - 71 period. Relatively high percentages of hypermobile persons are also shown, in the 20 - 29 age group, for males with other post-secondary training. Among females aged 20 - 29, hypermobility is especially marked for those with post-secondary education, particularly those with university degrees, 24% of whom had moved at least three times over the 1966 - 71 period.

The association of schooling with inter-municipal mobility is also evident among the recent immigrants, persons who immigrated to Canada between 1 June 1966 and 1 June 1971. Table 2.9 shows a definite tendency for the level of

TABLE 2.9. Percentage Distributions of the Number of Inter-municipal Moves, Persons Aged 15 Years and Over in 1971 and Not Attending School in 1971, by 1966 Place of Residence, Sex, Age and Level of Schooling, Canada, 1966-71

Sex, age and level of schooling	Persons residing in Canada on 1 June 1966						
	Number of inter-municipal moves in past five years						
	Total	None	One	Two	Three	Four	Five or more
	per cent						
Male							
15 years and over	100[1]	76	12	6	3	1	2
Less than Grade 9	100	83	9	4	2	1	1
Grades 9-11	100	75	12	6	3	1	2
Grades 12 and 13	100	71	14	7	4	2	3
Some post-secondary[2]	100	68	15	8	4	2	3
Some university	100	66	15	8	4	2	4
University degree	100	61	19	10	5	2	3
20-29 years	100	58	15	11	6	3	7
Less than Grade 9	100	67	13	9	5	2	5
Grades 9-11	100	60	15	10	6	3	6
Grades 12 and 13	100	57	16	10	6	4	7
Some post-secondary[2]	100	52	18	12	7	4	7
Some university	100	49	16	12	8	4	10
University degree	100	35	22	16	10	5	11
30-44 years	100	73	14	7	3	1	2
Less than Grade 9	100	79	10	6	2	1	2
Grades 9-11	100	73	14	7	3	1	2
Grades 12 and 13	100	69	17	8	3	1	2
Some post-secondary[2]	100	68	17	8	4	1	2
Some university	100	63	19	10	4	2	2
University degree	100	58	22	12	5	2	2
Female							
15 years and over	100	76	13	6	3	1	2
Less than Grade 9	100	83	9	4	2	1	1
Grades 9-11	100	75	13	6	3	1	2
Grades 12 and 13	100	71	15	7	3	1	2
Some post-secondary[2]	100	67	17	8	4	2	2
Some university	100	65	16	9	5	2	3
University degree	100	60	18	10	5	2	4
20-29 years	100	53	19	13	7	3	5
Less than Grade 9	100	65	15	10	5	2	3
Grades 9-11	100	56	18	12	6	3	5
Grades 12 and 13	100	53	20	12	7	3	4
Some post-secondary[2]	100	44	22	15	9	4	5
Some university	100	41	20	15	10	5	8
University degree	100	37	23	16	10	5	9
30-44 years	100	76	14	6	2	1	1
Less than Grade 9	100	81	10	5	2	1	1
Grades 9-11	100	76	14	6	2	1	1
Grades 12 and 13	100	74	15	7	3	1	1
Some post-secondary[2]	100	70	17	8	3	1	1
Some university	100	68	18	8	4	1	1
University degree	100	63	20	10	4	1	1

See footnote(s) at end of table.

TABLE 2.9. Percentage Distributions of the Number of Inter-municipal Moves, Persons Aged 15 Years and Over in 1971 and Not Attending School in 1971, by 1966 Place of Residence, Sex, Age and Level of Schooling, Canada, 1966-71 – Concluded

Sex, age and level of schooling	Persons residing outside Canada on 1 June 1966						
	Number of inter-municipal moves in past five years						
	Total	None	One	Two	Three	Four	Five or more
	per cent						
Male							
15 years and over	100[1]	60	20	10	5	2	3
Less than Grade 9	100	69	17	7	3	1	2
Grades 9-11	100	58	20	10	6	2	4
Grades 12 and 13	100	59	19	10	6	3	4
Some post-secondary[2]	100	54	21	11	7	3	4
Some university	100	55	20	11	6	3	5
University degree	100	56	23	11	5	2	3
20-29 years	100	58	19	10	6	3	5
Less than Grade 9	100	69	17	7	4	1	2
Grades 9-11	100	58	18	10	6	3	5
Grades 12 and 13	100	57	18	11	6	3	6
Some post-secondary[2]	100	53	19	11	7	3	6
Some university	100	52	20	11	7	4	7
University degree	100	53	22	11	7	3	4
30-44 years	100	58	21	10	5	2	3
Less than Grade 9	100	68	18	7	4	2	2
Grades 9-11	100	56	21	12	6	2	3
Grades 12 and 13	100	58	21	9	6	3	3
Some post-secondary[2]	100	52	24	12	7	3	3
Some university	100	56	21	11	6	3	3
University degree	100	55	25	11	5	2	2
Female							
15 years and over	100	63	20	9	5	2	2
Less than Grade 9	100	72	17	6	3	1	1
Grades 9-11	100	61	21	10	5	2	2
Grades 12 and 13	100	60	20	10	5	2	2
Some post-secondary[2]	100	57	23	10	6	2	2
Some university	100	59	21	11	5	2	3
University degree	100	61	21	10	4	2	2
20-29 years	100	61	20	9	5	2	3
Less than Grade 9	100	71	17	6	3	1	1
Grades 9-11	100	60	19	10	6	3	2
Grades 12 and 13	100	58	20	10	6	3	3
Some post-secondary[2]	100	57	22	9	7	3	3
Some university	100	57	21	11	6	3	3
University degree	100	59	20	11	5	2	3
30-44 years	100	61	21	10	5	2	1
Less than Grade 9	100	71	17	7	4	1	1
Grades 9-11	100	58	23	11	5	2	2
Grades 12 and 13	100	59	22	10	5	2	1
Some post-secondary[2]	100	55	26	11	6	2	2
Some university	100	58	22	11	5	2	2
University degree	100	61	21	10	4	2	2

[1] Figures may not add to the total due to rounding error.
[2] Non-university.

Source: 1971 Census, unpublished tabulation.

inter-municipal mobility within Canada (after arrival in Canada) to vary directly with level of educational attainment, even though the tendency is not quite as systematic as it is for persons who resided in Canada on 1 June 1966. For example, whereas 69% of males aged 15 and older with less than Grade 9 education made no inter-municipal moves within Canada after immigration to Canada, the corresponding figure for those with university training is about 55%. Also, the percentages making two or more moves are much higher among the recent immigrants with post-secondary education than among those who failed to graduate from high school.

Hypermobility is especially marked among the professional and managerial occupations (Table 2.10). Among all males aged 20 - 34 and who worked in 1970, 14% had moved inter-municipally at least three times between 1966 and 1971. The corresponding percentages for the three selected professional groups and for the managerial, administrative, and related occupations range from 17% - 19%. Among females as well, the professional occupations tend to show higher than average percentages of hypermobile persons.

In sum, hypermobility tends to be concentrated mainly among young adults. Within this group the tendency is especially marked for those married after 1 June 1966 for relatively highly educated persons, and for those in certain administrative and professional occupation groups of the civilian labour force.

2.5. Summary

The author's analysis of the more limited 1961 Census data (Stone, 1969, Chapter 3) indicated that "migrants form a distinctive segment of the Canadian population in regard to their social and economic characteristics" (1969, p. 100). This generalization is now partly supported by the unique 1971 data on the degree of inter-municipal mobility over the 1966 - 71 period. The general pattern of variation of repeated inter-municipal mobility with regard to variables such as age, mother tongue, marital status, education and occupation is similar to that previously observed in the study of the more limited 1961 five-year migration data.

Important aspects of this pattern of selectivity may be summarized for focusing on the hypermobile and the relatively immobile groups. The tendency toward hypermobility is most marked among young adult men and women in the early years of working life, and is especially notable among persons of English mother tongue in certain of the professional occupation groups or with post-secondary education. However, significant degrees of hypermobility are evident among all young adults aged 20 - 34. The relatively immobile population, defined here as persons who did not change municipality of residence even once over the five-year period, also tends to be a distinctive subgroup of the Canadian population. Notably higher than average tendencies toward relative immobility are evident among the population of middle and later ages who have had no post-secondary education and who are of non-English mother tongue.

The data are consistent with the notion that changes in socioeconomic attributes are often associated with geographic mobility (cf. Stone, 1975). Exceptionally high rates of mobility are evident among those involved in entering and leaving university, as well as those involved in marital status changes. For example, in the ages where the formation of new families is at a peak (mainly 20 - 34), married persons with spouse present show the highest rates of mobility among marital status groups (cf. Kasahara, 1965); but in the later ages past peak family formation these persons have the lowest rates of mobility unless they were married after 1 June 1966. Young men with a university degree in 1971 had an unusually high level of inter-municipal mobility.

TABLE 2.10. Percentage Distributions of the Number of Inter-municipal Moves, Persons Aged 15 Years and Over in 1971 and Who Worked in 1970, by Sex, Age and Occupation, Canada, 1966-71

(Excludes Persons Residing Outside Canada on 1 June 1966)

Sex, age and occupation	Number of inter-municipal moves in past five years						
	Total	None	One	Two	Three	Four	Five or more
	per cent						
Male							
15 years and over	100[1]	74	12	6	3	1	2
Managerial, administrative and related occupations	100	69	17	8	3	2	2
Teaching and related occupations	100	55	20	12	6	3	4
Occupations in medicine and health	100	70	14	8	4	2	3
Technological, social, religious, artistic and related occupations	100	63	18	9	4	2	4
Clerical and related occupations	100	76	12	6	3	1	2
Selected sales occupations[2]	100	70	15	8	4	2	2
Other sales occupations	100	74	13	6	3	1	2
Armed Forces	100	39	23	17	10	5	7
Other service occupations	100	76	12	6	3	1	2
Farming, horticultural and animal husbandry occupations	100	89	6	2	1	1	1
Other primary occupations[3]	100	74	11	6	3	2	4
Processing occupations	100	78	11	5	3	1	2
Machining and product fabricating, assembling and repairing occupations	100	75	12	6	3	1	2
Construction trades occupations	100	76	11	6	3	1	3
Transport equipment operating occupations	100	75	11	6	3	2	3
Occupations not elsewhere specified	100	76	12	6	3	1	2
20-34 years	100	59	16	10	6	3	5
Managerial, administrative and related occupations	100	47	21	15	8	4	5
Teaching and related occupations	100	44	22	15	9	4	6
Occupations in medicine and health	100	50	20	13	7	4	6
Technological, social, religious, artistic and related occupations	100	49	20	13	7	4	8
Clerical and related occupations	100	63	16	9	5	2	4
Selected sales occupations[2]	100	53	19	13	7	3	4
Other sales occupations	100	59	17	11	6	3	5
Armed Forces	100	29	22	18	13	7	12
Other service occupations	100	60	15	10	6	3	6
Farming, horticultural and animal husbandry occupations	100	78	8	5	3	2	4
Other primary occupations[3]	100	62	13	9	5	3	8
Processing occupations	100	66	14	9	5	2	4
Machining and product fabricating, assembling and repairing occupations	100	62	16	10	5	3	4
Construction trades occupations	100	61	15	10	5	3	6
Transport equipment operating occupations	100	61	14	10	6	3	6
Occupations not elsewhere specified	100	62	15	9	5	3	5
35-44 years	100[1]	76	13	6	2	1	1
Managerial, administrative and related occupations	100	69	20	8	3	1	1
Teaching and related occupations	100	64	20	10	4	1	1
Occupations in medicine and health	100	75	14	7	2	1	1
Technological, social, religious, artistic and related occupations	100	68	19	8	3	1	1
Clerical and related occupations	100	78	13	5	2	1	1
Selected sales occupations[2]	100	73	16	7	2	1	1
Other sales occupations	100	74	15	6	2	1	1
Armed Forces	100	39	29	19	9	3	2
Other service occupations	100	76	13	6	3	1	1
Farming, horticultural and animal husbandry occupations	100	89	6	2	1	..	1
Other primary occupations[3]	100	77	11	5	3	1	2
Processing occupations	100	82	10	4	2	1	1
Machining and product fabricating, assembling and repairing occupations	100	79	12	5	2	1	1
Construction trades occupations	100	79	11	5	2	1	1
Transport equipment operating occupations	100	78	12	6	2	1	1
Occupations not elsewhere specified	100	79	12	5	2	1	1

See footnote(s) at end of table.

TABLE 2.10. Percentage Distributions of the Number of Inter-municipal Moves, Persons Aged 15 Years and Over in 1971 and Who Worked in 1970, by Sex, Age and Occupation, Canada, 1966-71 – Concluded

(Excludes Persons Residing Outside Canada on 1 June 1966) – Concluded

Sex, age and occupation	Number of inter-municipal moves in past five years						
	Total	None	One	Two	Three	Four	Five or more
	per cent						
Female							
15 years and over	100	72	14	7	3	2	2
Managerial, administrative and related occupations	100	75	13	6	3	1	1
Teaching and related occupations	100	61	18	10	5	2	3
Occupations in medicine and health	100	60	19	10	6	3	3
Technological, social, religious, artistic and related occupations	100	66	16	8	4	2	4
Clerical and related occupations	100	71	15	7	4	2	2
Selected sales occupations[2]	100	71	15	7	4	2	2
Other sales occupations	100	79	12	5	2	1	1
Armed Forces	100	39	15	17	15	6	8
Other service occupations	100	73	13	7	3	2	2
Farming, horticultural and animal husbandry occupations	100	88	7	2	1	--	1
Other primary occupations[3]	100	76	11	5	4	1	3
Processing occupations	100	79	11	5	2	1	1
Machining and product fabricating, assembling and repairing occupations	100	78	11	6	3	1	1
Construction trades occupations	100	73	12	7	3	1	3
Transport equipment operating occupations	100	77	11	5	3	2	2
Occupations not elsewhere specified	100	76	12	6	3	1	2
20-34 years	100[1]	57	18	11	6	3	4
Managerial, administrative and related occupations	100	57	19	11	6	3	3
Teaching and related occupations	100	48	21	14	8	4	5
Occupations in medicine and health	100	45	23	14	9	4	5
Technological, social, religious, artistic and related occupations	100	51	19	12	7	4	7
Clerical and related occupations	100	59	18	11	6	3	3
Selected sales occupations[2]	100	55	20	11	7	3	4
Other sales occupations	100	62	17	10	5	3	4
Armed Forces	100	30	14	19	18	8	12
Other service occupations	100	57	17	11	6	3	6
Farming, horticultural and animal husbandry occupations	100	73	14	6	3	1	2
Other primary occupations[3]	100	64	16	7	6	3	5
Processing occupations	100	68	14	8	5	2	3
Machining and product fabricating, assembling and repairing occupations	100	67	15	9	4	2	2
Construction trades occupations	100	63	14	11	6	1	5
Transport equipment operating occupations	100	64	15	9	4	3	5
Occupations not elsewhere specified	100	64	16	9	5	3	3
35-44 years	100	79	12	5	2	1	1
Managerial, administrative and related occupations	100	78	13	5	2	1	1
Teaching and related occupations	100	74	15	6	3	1	1
Occupations in medicine and health	100	74	15	7	3	1	1
Technological, social, religious, artistic and related occupations	100	75	15	6	2	1	1
Clerical and related occupations	100	80	12	5	2	1	--
Selected sales occupations[2]	100	78	14	5	1	--	1
Other sales occupations	100	80	13	5	2	1	--
Armed Forces	100	41	30	19	11	--	--
Other service occupations	100	77	13	6	3	1	1
Farming, horticultural and animal husbandry occupations	100	91	6	2	1	--	--
Other primary occupations[3]	100	86	8	2	1	--	1
Processing occupations	100	84	9	4	1	--	1
Machining and product fabricating, assembling and repairing occupations	100	84	9	4	2	1	--
Construction trades occupations	100	77	13	6	2	1	2
Transport equipment operating occupations	100	83	10	4	1	--	1
Occupations not elsewhere specified	100	83	10	4	2	1	1

[1] Figures may not add to the total due to rounding error.
[2] See Table 2.4, footnote 2.
[3] See Table 2.4, footnote 3.
-- Means less than 0.5.

Source: 1971 Census, unpublished tabulation.

FOOTNOTES

[1] Although a census was taken in 1971, data for mobility in Great Britain are not yet available.

[2] This figure includes persons who left their 1966 municipality of residence but returned to it by 1 June 1971.

[3] It is important to recall that in the census data, marital status is assessed as at the end of the migration interval. Many of the moves reported by ever-married persons were probably related to marital status change.

[4] A relative few of the persons who were residents of Canada on both 1 June 1966 and 1 June 1971, may have established a residence abroad for some time during the 1966 - 71 period.

CHAPTER 3

MULTIVARIATE ANALYSIS OF THE FREQUENCY OF INTER-MUNICIPAL MOBILITY

3.1. The Problem, and Summary of the Principal Findings

The number of times that an individual changed residence from one municipality to another between 1966 and 1971 depends upon several attributes such as age, marital status, education, and occupation. Individuals with certain characteristics can be expected to be much more mobile than those with others. Thus, if two population groups have substantially divergent compositions with respect to such characteristics we can hypothesize that they will differ markedly in the percentage of highly mobile persons that they contain, other things being equal.

It could be said that each of the pertinent attributes helps to form the shape of the percentage distribution of a population group according to their numbers of inter-municipal moves. A central purpose of this chapter is to measure statistical contributions of several population characteristics to the shape of the above-mentioned distribution. Using a form of multivariate analysis, the selected population attributes are treated simultaneously. In this way the "effect" attributed to one characteristic is determined while the others are being held constant statistically.

To achieve this we shall formulate a model that "predicts"[1] a particular distribution of population by number of inter-municipal moves for each unique combination of the values with regard to six "explanatory" attributes. The model hypothesizes a specific pattern of multivariate association between the distribution of population by number of inter-municipal moves and aspects of population composition with respect to the six "explanatory" attributes: sex, age, marital status, mother tongue, schooling, and occupation.[2] By applying several variants[3] of the model to the available data it is possible to measure the pattern and strengths (within the context of the model) of the contribution[4] made by each population characteristic or attribute to the shape of the number-of-moves distribution shown by the population.

It is hoped that this work will help to advance understanding of determinants of the patterns of mobility that are evidenced by different population groups in Canada. This objective would be achieved if two research results are indicated. The first is to significantly improve the accuracy of prediction of the degree of mobility that a particular population group will show when we know specific things about its composition with respect to age, marital status, mother tongue, schooling, occupation and so on. The second is to

See footnote(s) on page 90.

demonstrate a specific formula and algorithm for conducting such prediction, which can, in the context of historical data, be used to help analyse the "roles" played by selected determinants of the pattern of mobility frequency in a given population.

However, the measures of determinants of mobility that are available from census data are seriously limited. Various authors have argued (Stone, 1975) that actual or prospective changes of individual attributes or statuses are more significantly related, in a substantive sense, to geographic mobility than is the possession of particular attributes at a specific time. Yet, for the most part, the 1971 Census data largely restrict the analyst to the latter kind of measure. As a result, a relatively simple model using census data will not be as accurate or as meaningful in its detailed results as one that employs a more appropriate set of variables.

The following paragraphs will review and discuss the principal research findings. It is hoped that the reader who simply wants to digest the main findings and look at the related tables and charts will find this section useful.

There is a substantial multivariate association between the distribution of the Canadian population by number of inter-municipal moves and several explanatory attributes taken together. These attributes are age, marital status, mother tongue, schooling, and occupation. However, the number-of-moves distribution has a characteristic shape which does not vary greatly among different subgroups of the population aged 20 - 64; and as a result the accuracy of our prediction of this shape cannot be vastly improved by taking into account the composition of the group with respect to these attributes. Nevertheless, it seems clear that worthwhile gains can be achieved in understanding and predicting a population's pattern of mobility frequency by taking into account those attributes in roles of explanatory factors.

In analysing the observed differences among groups with respect to their frequency of inter-municipal mobility, age is by far the most important explanatory attribute examined. It is difficult to comment reasonably on the comparative importance of the other explanatory attributes, partly because of a relatively large influence that they jointly share. When age is held constant there remains a systematic tendency for the distribution of population by number of inter-municipal moves (e.g., the percentage that is hypermobile) to be associated with education and mother tongue. The effect of marital status depends critically on the value assumed by age, but recent change in marital status is significantly and directly re'ated to mobility frequency.

The general pattern of the effect of age may be summarized briefly by referring to the average number of inter-municipal moves (see Chart 3.5 below). In the remainder of this text, the average just mentioned will be expressed in terms of the **inter-municipal mobility ratio** which was defined in Chapter 2 (see Table

2.1). This ratio may be loosely interpreted as the number of inter-municipal moves per 100 persons per year – the number of inter-municipal moves that 100 persons made in a typical year during the 1966 - 71 period.

The young adult segment of the population tends to substantially raise this average, while older adults tend to lower it. In other words, the higher the proportion of young adults in a population, the greater is the average number of moves in that population. When age is completely excluded from the explanatory model that is used in the analysis, the "predicted" inter-municipal mobility rate was 10.5 (roughly 10 moves per 100 persons in a typical year between 1966 and 1971). Introducing the "independent effect" of age (i.e., after holding constant statistically the effects of the other measured attributes) into the model produces an average that is 15% higher within the 20 - 34 age group, but 22% lower in the 50 - 64 age group.

The patterns of the "independent" effects of other measured attributes may be briefly summarized. In reading the following comments it should be remembered that the effects of a given attribute are measured while the others (that are included in the model) are being held constant statistically. The university-educated group in the sample population tended to raise the overall mean number of inter-municipal moves by 12%, other factors being equal (e.g., an even distribution of population by educational attainment). In contrast, the subgroup with only elementary education tended to lower this average, other factors being equal. Similarly a slight increase in the average number of moves is achieved in the predominantly professional, technical, and administrative occupation groups. The English mother tongue group raises that average very slightly, while the French mother tongue group lowers it slightly and the "other mother tongue" group (neither English nor French) lowers it still more.

It can be said that this analysis has set age in competition with schooling, occupation, mother tongue, marital status, and sex with regard to their relative contributions to the pattern of mobility frequency in the sample population. (This population is comprised generally of persons aged 20 - 64 in 1971, who were out of school and worked in 1970.) The other attributes seem to be far less significant than age in the statistical explanation of that pattern. In terms of the statistics and the chosen model of analysis, it would seem warranted to conclude that there are influences reflected in the age attribute that are operating independently of education and occupation (measured at the census date) and which are cumulatively much more weighty, statistically, than those connected with occupation and education.

However, three important qualifying remarks must be made. Firstly, the categorization of educational attainment and occupation is rather crude. Perhaps a more refined breakdown of these attributes would substantially change the picture. Based upon the thrust of previous related literature and the author's own work particularly with more detailed categorizations of occupation, this speculation is to be strongly doubted. (Note also that the categorization of age is very crude.) It would be easy in principle to repeat the analysis with much more detailed groupings; but computer core storage restrictions prohibited this approach using the chosen technique. Another type of evaluation could be made using the Public Use Sample Tape and individual-level data; but shortage of time and resources eliminates the prospect of doing such a test in this study.

Secondly, the fact that occupation and education are measured at the end of the migration period rather than at the time of migration causes serious methodological problems. The data undoubtedly reflect a significant confounding of cause and effect with respect to the number-of-moves distribution and population composition by schooling and occupation. The especially high mobility of young adults with university education is a reflection of this problem. However, as is expected from the author's previous work on occupational and educational differentials in geographic mobility (Stone, 1969, Chapter 3), the confounding of cause and effect is probably not a serious source of distortion of the relative statistical influence of age upon the pattern of inter-municipal mobility.

To test this speculation, the explanatory model was reapplied to the data after excluding all data points that pertain to the highly mobile 20 - 34 age group. In this modified set of data, age continues to be by far the most weighty of the measured explanatory attributes.

In yet another attempt to prevent age from unduly masking the effect of schooling, the model was again applied within the 20 - 34 and 35 - 49 age groups. Within the latter age group geographic mobility associated with entering and leaving post-secondary educational institutions cannot be a major element in explaining the pattern of mobility frequency. Yet for each of these two age groups the relative contributions of schooling to that pattern are broadly similar, and only a minor portion of the overall "fit" of the model can be statistically attributed to the "unique" effects of the schooling variable. It seems that even after schooling and occupation (as measured at a point of time) are taken into account, much of the pattern of mobility frequency remains to be explained. The cumulative effects of factors like age, marital status, and mother tongue must also be considered.

Nevertheless, the hypothesis of a strong interaction of actual and prospective status changes with geographic mobility (Stone, 1975) implies that we could still in reality have a serious misrepresentation of the functions of schooling and occupation in these data. The problem could rest largely in the fact that the data do not permit us to measure changes in schooling level and occupation around the time of the migration; and that age (especially the unusually high mobility of the 20 - 34 age group) is capturing much of the unmeasured influence of actual and prospective changes of educational level and occupation. Yet, after we theoretically remove the part of the "age effect" that reflects status changes, there may still be other important unmeasured factors that the age variable is capturing. For example, movement intended to contribute to the increase of lifetime income (which could in fact be included in the concept of prospective status change) is perhaps best undertaken in the early phases of one's working life (i.e., in the young adult ages), and certainly the costs of such movement are usually more readily recovered by young adults than by the middle-aged and the elderly.

The 1971 Census data do permit a superficial probe into the dimensions of status change, using data on the timing of first marriage and the province of birth. For this study the data have been re-analysed, replacing marital status with the compound attribute, "marital-status-by-date-of-marriage", which was used in Chapter 2, to partially identify a group that had marital status change after 1 June 1966. Furthermore, a proxy for past mobility has been introduced in a new variable that distinguishes between persons who resided in their provinces of birth on 1 June 1966, and those who resided elsewhere. These attributes produce a substantial statistical contribution to the shape of the mobility frequency distribution. However, this contribution is largely independent of the measured effect of age, and thus does little to cast light on the hypothesis that the latter is reflecting status changes that are correlated with age.

In short, this analysis strongly hints at a major influence of age upon mobility, independent of and stronger than the influences of occupation and education measured at a single point of time. We believe that age is standing in this analysis as a proxy for several important factors that cannot be measured from existing census data, particularly changes of social and economic status that tend to be concentrated in particular age groups (Stone, 1969, p. 80). More research is needed to help disentangle the factors that are represented in the age variable as it relates to geographic mobility. Non-census data are probably needed to carry on this type of work.

3.2. The Data Base and the Method of Analysis

The census data used for this study refer to those persons aged 20 - 64 in 1971 who were not attending school in the 1970 - 71 school year, who worked in 1970, and who resided in Canada on 1 June 1966. This particular subpopulation, the "sample population", contributed more than one-half the total volume of the inter-municipal mobility in the 1966 - 71 period. By excluding persons attending school we aim to minimize the effects on the data of those whose mobility was largely influenced by that of their parents. Since occupation is included as an explanatory attribute, it is also advisable to ensure that the sample population had substantial working experience prior to the census. Persons who resided outside Canada on 1 June 1966, are excluded because they had varying lengths of time of exposure to inter-municipal mobility within Canada between 1966 and 1971, depending on their year of immigration.

Several attributes were selected for the sample population, to develop a statistical analysis of its distribution by number of inter-municipal moves. These included sex, age, marital status, mother tongue, education, occupation, and number of inter-municipal moves. The categories specified for each of these characteristics are listed in Appendix B.

The concept of the **distribution of a population by number of inter-municipal moves** is central to this analysis, and an attempt should be made to explain its meaning. For the purposes of this study, the term "distribution" means a collection of proportions whose total is 1.00 (or a collection of percentages that add up to 100). The total (1.00 or 100%) represents a certain whole or aggregate, and the proportions (or percentages) show the sizes of selected parts relative to the whole. In this study, each "part" is a specific range of the number of inter-municipal moves (e.g., one move) and the distribution is a collection of percentages that shows the relative quantities of people who made specific numbers of moves between 1966 and 1971. Thus the second line of Table 2.7 shows one distribution of a specific population subgroup by number of inter-municipal moves.

It is apparent that the statistical explanation or "prediction" of a distribution takes as the explanandum (the thing to be explained) a whole collection of numbers (the proportions mentioned above), rather than just one. However, to help keep the discussion reasonably concrete, the text below will often refer to one number that characterizes a whole distribution, such as the mean or average number of **moves** per person within a particular population group. Also important "parts" or categories of certain distributions will be highlighted (e.g., the part of the out-of-school population that is university-educated).

The attributes that are treated as being "explanatory" of the number-of-moves distribution in the context of the statistical analysis are those discussed in Chapter 2. However, in several cases the specification of categories for these attributes is not as detailed in this chapter as it was in Chapter 2. This is due to computer limitations. The basic source of difficulty lies in the requirement for a table in which all the attributes are simultaneously cross-classified. The change in the selection of categories may be summarized as follows. Due to the number of explanatory attributes included in the analysis, it is not feasible to use as many as the 15 occupation groups used in Chapter 2, even though it is very unsatisfying to go to the much cruder five-category grouping used for this chapter. Also, all persons with university education are treated together. In addition, four number-of-moves categories are used (no moves, one move, two moves, and three or more moves), instead of the six used in Chapter 2. The broad patterns emphasized below should not be seriously affected by meaningful variations in the assignment of categories to the attributes.

It may be recalled from the foregoing discussion that the selected "explanatory" attributes are to be treated simultaneously in the statistical analysis. The technique that will be used is designed to deal with the problem of explaining statistically the overall pattern of the distribution shown by a population group with respect to a given attribute (e.g., the distribution of the group by number of municipal moves). Several features of the technique were developed specifically for this study.

Central to the application that is made here is a statistical model that is represented concretely in one or more equations. This model is the formal expression of a series of hypotheses about the ways in which particular aspects of the composition of the population contribute to the shape of its distribution among categories of the number of inter-municipal moves. In the text below the model will be called "the asserted explanatory model".[5] Through a variety of statistical applications of the asserted explanatory model and selected variants of it, one can attribute a certain strength and pattern of simultaneous (i.e., multivariate) association of the selected explanatory attributes with the "dependent" one, and also measure the strength and pattern of the statistical contributions of different elements within the model.

Appendix C develops these concepts in some detail, and the reader can consult it for further technical discussion. However, an attempt should be made at this point to explain some basic aspects of the statistical procedure. A simple example may be considered.

The clarification may be facilitated if we first consider the familiar notion of the "dependency" of a single variable, such as the Canadian birth rate, upon others. We speak of explaining the level of the birth rate when (a) we adopt a theory as to how (and often why) the birth rate attains a given level; (b) we formulate and apply (to suitably chosen sample data) a statistical model through which a systematic pattern of association is shown between the level of birth rate and selected explanatory variables; and (c) we relate the statistical findings to the theory. Such statistical association is crudely cited when we say that "changes in the values of the explanatory variables are associated with systematic changes in the level of the birth rate".

In explaining an aspect of population distribution such as the distribution of the Canadian population by number of inter-municipal moves, one refers not to one number such as the birth rate but to a whole collection of percentages that show how the population is allocated among different number-of-moves categories.

In one type of demographic analysis, the "dependency" of a population distribution is statistically measured by observing the extent to which it varies

See footnote(s) on page 90.

systematically among different population groups that have divergent compositions with respect to selected explanatory attributes. For example, the association of the distribution by number of moves (the mobility frequency distribution) with the attribute, age, is measured by observing the extent to which the distribution varies systematically among different age groups within the population. Thus, two populations with very different age compositions may be expected to have markedly divergent mobility frequency distributions. This type of demographic analysis proceeds through the study of association among population distributions, rather than through a study of association among the values of variables for individuals (or sample observations).

Suppose that it is hypothesized that the distribution of a population group by number of inter-municipal moves depends upon selected aspects of the joint composition of the population with respect to age and schooling. The selected aspects were specified in the model mentioned above. If such a dependency exists, then statistics gathered through a random sampling procedure should show that populations which vary markedly in their compositions with respect to age and schooling, also tend systematically to differ in their distributions with respect to the number of inter-municipal moves. As an oversimplified example, young adults with university education should show a much higher percentage of persons that have moved inter-municipally three or more times, between 1966 and 1971, than elderly persons who have only elementary schooling.

It is possible to represent the pattern of such systematic association by a statistical model, i.e., one or more equations whose variables must be estimated and which incorporate error terms. The elements of the model are specified in accordance with certain hypotheses we elect to assert. For example, we might hypothesize that the distribution of a population group by number of inter-municipal moves depends on its composition by schooling level and age, and that we can "predict" that distribution by considering only the separate associations of the distribution of number of inter-municipal moves with schooling alone, and with age alone. One possible expression of such a hypothesis can be given in terms of the following notation. If "y_i" is the **ith** category of number of moves, "S_j" is the **jth** category of schooling, "T_k" is the **kth** category of age, and "Pr(X|Z)" means the conditional proportion of X **given** Z then:

$$\Pr(Y_i|S_jT_k) \cong \Pr(Y_i) \cdot \left[\frac{\Pr(Y_i|S_j)}{\Pr(Y_i)} \cdot \frac{\Pr(Y_i|T_k)}{\Pr(Y_i)}\right]^{1/2} \cdot \lambda_{jk} \qquad (1)$$

In this particular formulation, the **compositional effect** of attribute S_j is measured by $\Pr(Y_i|S_j)/\Pr(Y_i)$; and this is called the zero-order effect of S_j. The model might also have specified higher-order or "interactive" effects, one of which could be $\Pr(Y_i|S_jT_k)/\Pr(Y_i|T_k)$. Appendix C contains related expository detail.

The foregoing general remarks are intended to partially clarify the distinction between (a) the attributes, and (b) the manner in which they are interrelated in the type of demographic model being used here (called "demometric analysis"). The technique presupposes that the data are available for population groups, and that the associations among attributes are reflected in the interdependence of different aspects of population composition. When we speak of the "elements" of the statistical model, we shall refer to these compositional aspects (e.g., $Pr(Y_i|S_j)/Pr(Y_i)$), and not to the attributes *per se.* Terms such as $Pr(Y_i|S_j)/Pr(Y_i)$ shall be called "compositional variables" or "compositional effects".

3.3. The Substantive Hypotheses

The central hypothesis of this analysis is that the distribution of the population among categories of the called "number of inter-municipal moves" attribute is dependent upon aspects of the joint composition of the population with respect to age, marital status, mother tongue, schooling, and occupation. Some reasons why these attributes would be associated with the distribution by number of inter-municipal moves were mentioned in Chapter 2. This is not an appropriate place to try to develop at length the underlying body of theoretical concepts and propositions. However, some additional theoretical rationale for selecting the above-mentioned explanatory attributes will be considered. This discussion will assert the hypotheses that are later represented in a statistical model.

A major aim of the process of specifying the hypotheses mentioned above is to restrict the statistical model to only those compositional effects that are deemed to be substantively significant (see Appendix C). Ideally, the simplest adequate explanatory model (i.e., the one using the least number of the possible compositional effects) is desirable. Therefore, the problem of the analysis is not merely to achieve the highest possible degree of simultaneous association between the explanatory attributes and the dependent one.

The example that was briefly outlined in Section 3.2 may be used to illustrate the process of specifying the hypotheses that lead to a stated model. In Section 3.2, the model was first expressed verbally in terms of separate associations of mobility frequency with schooling and age. Then followed a possible statistical expression. One way of arriving at that particular model involves the following set of four hypotheses:

H 1. Due to the dependence of mobility upon age and schooling, the distribution of number of moves varies systematically among population with different age and schooling compositions.

H 2. Age has a substantial direct effect[6] upon the number of moves, and this is adequately represented by the zero-order relation between age and number of moves (which is measured statistically by $Pr(Y_i|S_j)/Pr(Y_i)$).

See footnote(s) on page 90.

H 3. Schooling also has a direct effect on the number of moves. This is adequately represented by the zero-order relation between schooling and number of moves (which is measured statistically by $Pr(Y_i | T_k)/Pr(Y_i)$).

H 4. The higher-order effects of age and schooling are substantively insignificant.

Using these four hypotheses[7] and the model derivation procedure outlined in Appendix C, we will arrive at expression (1). The process starts with a general assertion concerning the multivariate statistical association between the distribution of number of moves and population composition with respect to the explanatory attributes. Then follows an enumeration of hypotheses concerning those compositional effects of the explanatory attributes that are deemed to be substantively significant. Ideally, this enumeration of hypotheses is rationalized by a theory of the processes by which the attributes are interrelated.

With respect to the research problem in hand, the general hypothesis of multivariate association (analogous to the illustrative hypothesis H 1 above) has already been enumerated. It remains only to state the subsidiary hypotheses concerning the significant compositional effects. A general theory that integrates all of the enumerated hypotheses into one coherent framework of concepts, assumptions, and propositions does not exist. Some steps in the direction of a general rationale for the network of hypotheses enumerated below are possible; but this text is an inappropriate place for that kind of highly academic discussion. In the following paragraphs the additional substantive hypotheses that lead to the formal expression of the model will be enumerated.

Sex is hypothesized as having no substantively important effect on the number of moves distribution in the specified population. A substantial proportion of the female migrants in the sample population were probably wives migrating together with their husbands. Another significant portion of females were never-married persons, and for these persons no basis is perceived for hypothesizing a substantial relation between sex and inter-municipal mobility. Sex, therefore, will not play a role as an explanatory attribute in the model. Using other attributes the model will attempt to predict number-of-moves distribution for each sex group.

Age is viewed as having a substantial direct effect on the propensity for inter-municipal mobility. There is a concentration of actual or prospective socioeconomic changes in the main ages of family formation and labour force participation that would tend to markedly heighten the propensity to change residence in those ages (see Stone, 1969, Chapter 3; McInnis, 1970; Stone, 1975; and Section 2.3.1 above). The incidence of such prospective or actual socioeconomic changes declines progressively as age declines toward the teen years or rises

See footnote(s) on page 90.

toward the retirement ages. Age is also involved with other attributes in some higher-order effects, because the effects of other attributes on mobility depend on age.

There is a "direct effect" of mother tongue on inter-municipal mobility as a result of the patterns of geographic concentration of the different mother tongue groups. The fewer the number of municipalities containing substantial numbers of the members of a given mother tongue group the lower the inter-municipal mobility of that group will tend to be. Also mother tongue will have some higher-order effects on mobility because the value of the mother tongue attribute will markedly influence the relation between certain other variables and mobility.

The effect of marital status on mobility will depend on the values assumed by other variables in the model, especially age and mother tongue. For example, being a young adult and married tends to promote family size changes that prompt mobility; while being at middle age and married tends to inhibit such changes.

Educational attainment has a direct effect on inter-municipal mobility propensity. The greater the level of schooling attained, the more mobility tends to be perceived as being desirable. There is also a higher-order effect in the sense that the relation between schooling and mobility may be significantly mediated by age.

Occupation has a direct effect on mobility propensity. Some occupations tend to generate immobility as a partial condition of career success, while others tend to generate mobility. The relation between occupation and inter-municipal mobility is also markedly mediated by age and schooling level in some occupations.

The foregoing sketch of hypotheses and related theoretical speculations set forth the particular effects that are expected to be substantively significant in the model that analyses the distribution of the population over the categories of number of inter-municipal moves. Using those hypotheses and the model derivation procedure outlined in Appendix C, we arrive at the following expression for the explanatory model that predicts the pattern of multivariate association between number of inter-municipal moves and six explanatory attributes. The notation is introduced formally in Appendix C:

$$\hat{P}r(M_k | S_v A_q N_p X_g W_b E_u) = Pr(M_k) \cdot \left[\frac{Pr(M_k | A_q)}{Pr(M_k)} \cdot \frac{Pr(M_k | X_g)}{Pr(M_k)} \cdot \frac{Pr(M_k | E_u)}{Pr(M_k)} \cdot \frac{Pr(M_k | W_b)}{Pr(M_k)} \right]^{1/4} \cdot \left[\frac{Pr(M_k | A_q X_g)}{Pr(M_k | A_q)} \cdot \frac{Pr(M_k | W_b A_q X_g)}{Pr(M_k | A_q X_g)} \cdot \frac{Pr(M_k | N_p A_q E_u)}{Pr(M_k | A_q E_u)} \right]^{1/4} \cdot \lambda_{vqpgbu} \tag{2}$$

The four ratios within the first bracket in (2) measure the zero-order effects of age, schooling level, mother tongue, and occupation, respectively. The remaining three ratios measure the following higher-order effects, respectively: schooling with age; occupation with schooling and age; and marital status with age and mother tongue. These seven ratios measure the effects that were postulated as being substantively important in the foregoing series of theoretical speculations concerning the explanation of the frequency distribution of inter-municipal mobility. The symbol "λ" is an adjustment factor explained in Appendix C.

Equation (2) uses seven compositional effects to "predict" statistically the distribution of the population by number of inter-municipal moves. If there was an interest in obtaining the largest possible degree of "prediction accuracy" the model would have listed all of the 63 possible compositional effects; instead only 11% of the possible compositional effects were used. The model is thus relatively simple, and it will now be the task to examine how well it "predicts" the distribution of the population by number of inter-municipal moves for given combinations of the explanatory attributes. (The procedures for estimating the measures of compositional effects mentioned in expresssion (2) are outlined in Appendix C.) We will also examine the patterns and the relative strengths (within the context of the stated model) of the contributions **attributable** to the explanatory variables and their compositional effects.

3.4. General Performance of the Model

There are various ways to measure statistically the success with which a given model can be used to "predict" which distribution by number of inter-municipal moves is associated with a particular population composition in regard to the chosen explanatory attributes. A direct comparison of the observed and the predicted distributions by number of inter-municipal moves is not in itself the crucial test in this type of work, since the essential concept expressed in the model is that of a dependence of the distribution upon the composition of population regarding the selected explanatory attributes. A more appropriate test is that of comparing the "prediction accuracy" of the asserted model with that of a "null" model which specifically denies such dependence. The "null" model expresses the concept that the number of moves distribution is the same regardless of the population composition. Symbolically, the "null" model is:

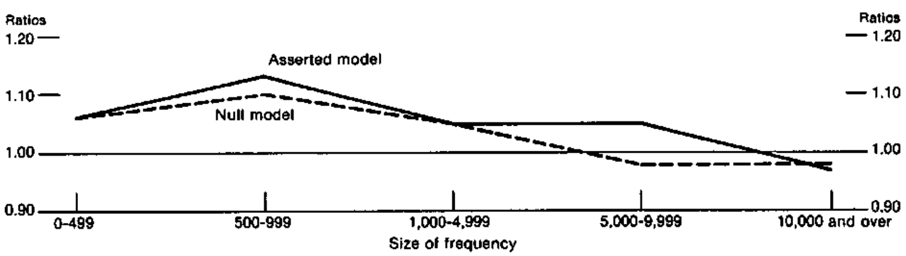
$$\hat{P}r(M_k | S_v A_q N_p X_g W_b E_u) = Pr(M_k) \cdot \lambda_{vqpgbu} \quad (3)$$

Table 3.1 shows that the asserted model, expression (2) "fits" the observed distribution of the population by number of inter-municipal moves substantially better than does the "null" model. Using only 11% of the possible compositional effects, the asserted model produces a 50% reduction in the chi-square of the "null" model. However, on another measure of improvement in "prediction accuracy" (comparing the accuracy of the asserted model to that of the "null" model), the performance of the asserted model is not nearly as impressive. This measure is the weighted average of the **absolute** deviations of the observed from the "predicted" frequencies in cells of the full contingency table. The sum of the absolute deviations is divided by the total size of the sample. The result will be called the **coefficient of prediction error** below. A coefficient cited in this text is adjusted to take into account a rough proxy for the degrees of freedom associated with the model in question. The "null" model, expression (3), yields an adjusted coefficient of prediction error of 26%, while the asserted model, expression (2), yields a coefficient of 20%. By this measure, only about one fourth of the prediction error of the null model is eliminated by the asserted explanatory model.

Chart 3.1 partly reflects this situation. To construct this chart, the contingency table frequencies were classified into five arbitrary size groups. The chart shows similar levels of prediction error, with respect to these arbitrary size-groups, for the "null" and the asserted models. Both models tend to systematically overestimate low frequencies, and underestimate the highest ones. The similarity between the two models that this chart reflects is largely the result of the low variation in the basic shape of the number-of-moves distribution among the identified subgroups of the sample population. In the vast majority of the subgroups this distribution had the same basic shape.

Chart — 3.1

Ratios of Expected to Observed Frequencies for Contingency Table Cells Classified According to Size(1)



(1) The contingency table in question is that which contains the joint distribution of the sample population among all seven measured attributes. The counts in the cells of the table are grouped according to their levels (from low counts to high counts). The ratio measures the tendency of a model to systematically "over-estimate" or "under-estimate" counts of certain sizes. A ratio higher than 1.0 indicates "over-estimation", while a ratio below 1.0 indicates "under-estimation".

Source: 1971 Census, unpublished tabulation.

Another aspect of the overall performance of the model may be examined by inspecting the average level and the pattern of the values of the adjustment factor "λ" (lambda) which appears in expression (2). This factor "forces" the "predicted" sum of the observations over all values of the number of moves, for a specific combination of values on the explanatory attributes, to be equal to the observed sum. The table of lambda values can be used to study variation in the predictive accuracy of the model among different values of the explanatory attributes. Chart 3.2 shows average lambda values associated with particular levels of the explanatory attributes. Generally, the lambda values lie between 0% and 2% (indicating that in most cases a correction of less than 2% was needed in the above-mentioned sum). Chart 3.2 shows that the prediction errors, as measured crudely by lambda values, tend to be most severe among young adults, persons with university education and professional occupations, and those who were married with spouse present.

Chart 3.3 provides yet another vehicle for testing the performance of the asserted model at specific values of the explanatory attributes. At each such value averages were computed of the observed and the expected (if the asserted model is correct) conditional mean number of moves.[8] Chart 3.3 shows clearly that the sharpest discrepancies between the expected and the observed means occur with respect to age. In the young adult age group 20 - 34 the model substantially under-estimates the mean number of inter-municipal moves, whereas similar overestimation occurs among the much more elderly population aged 50 - 64. Much lower levels of underestimation are evident with regard to the categories of university education, and professional occupations.

In sum, among the highly mobile segments of the population the asserted model tends to underestimate the proportions that were hypermobile. Overestimation of the proportions that were hypermobile is typical in the population groups that are marked by lower than average levels of mobility.

Two important points should be remembered when considering the performance of the asserted model, relative to the "null" model. Firstly, it is believed that the census data being used do not adequtely tap the dimensions of status change that are thought to be primary determinants of geographic mobility. Secondly, 63 possible compositional effects could have been included as significant within the asserted model (see Appendix C to understand how the number of possible compositional effects is determined); but only seven were actually specified in the model.[9] Bearing these observations in mind, it would seem that the asserted model fits well enough, relative to the null model, to warrant further interpretation of the detailed results in Table 3.1, as well as commentary on the patterns of the contributions of individual compositional effects.

3.5. The Predominance of the Age Effects

In terms of the given data and the chosen model, age is the selected explanatory attribute that largely accounts for the "performance" of the model. Roughly speaking, nearly 70% of the improvement in prediction accuracy that is achieved by the asserted model, relative to the accuracy of the "null" model, can be attributed statistically to the zero-order effect of age alone. Bearing in mind that the contribution of this effect is assessed only after other measured

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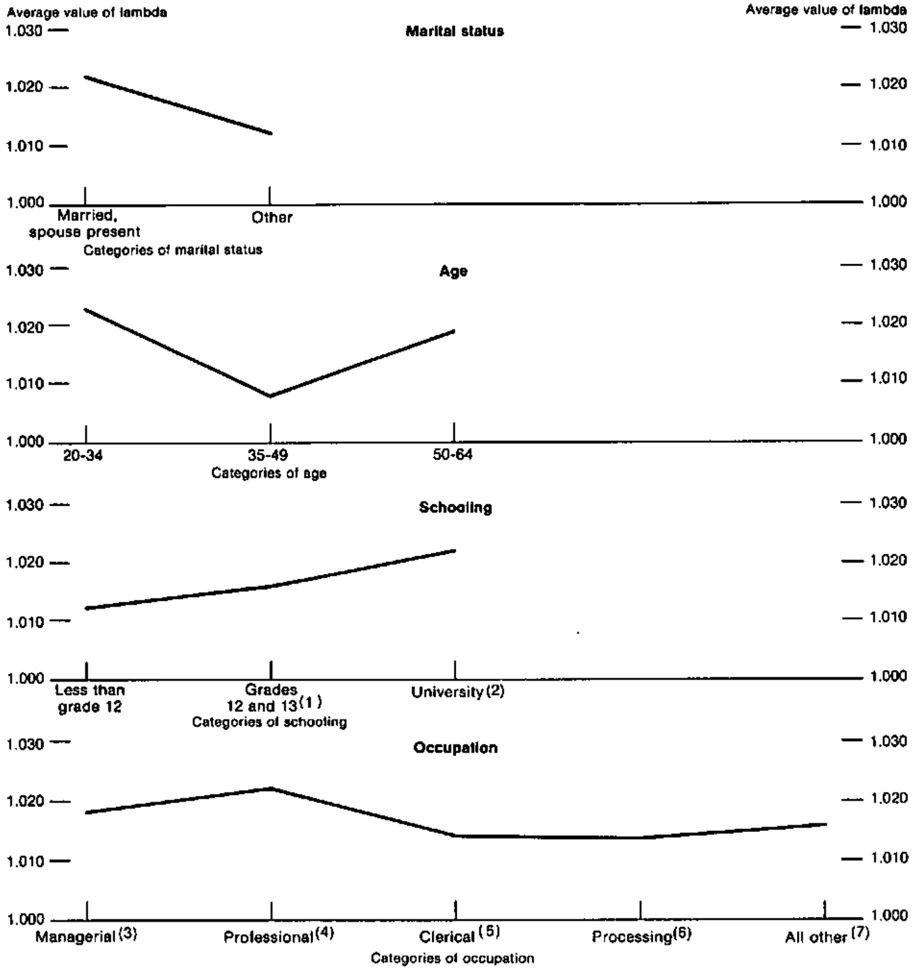
See footnote(s) on page 90.

Chart — 3.2

Average Values of the Model Adjustment Factors for Specific Categories of the Explanatory Attributes, in Prediction of the Number-of-Moves Distribution

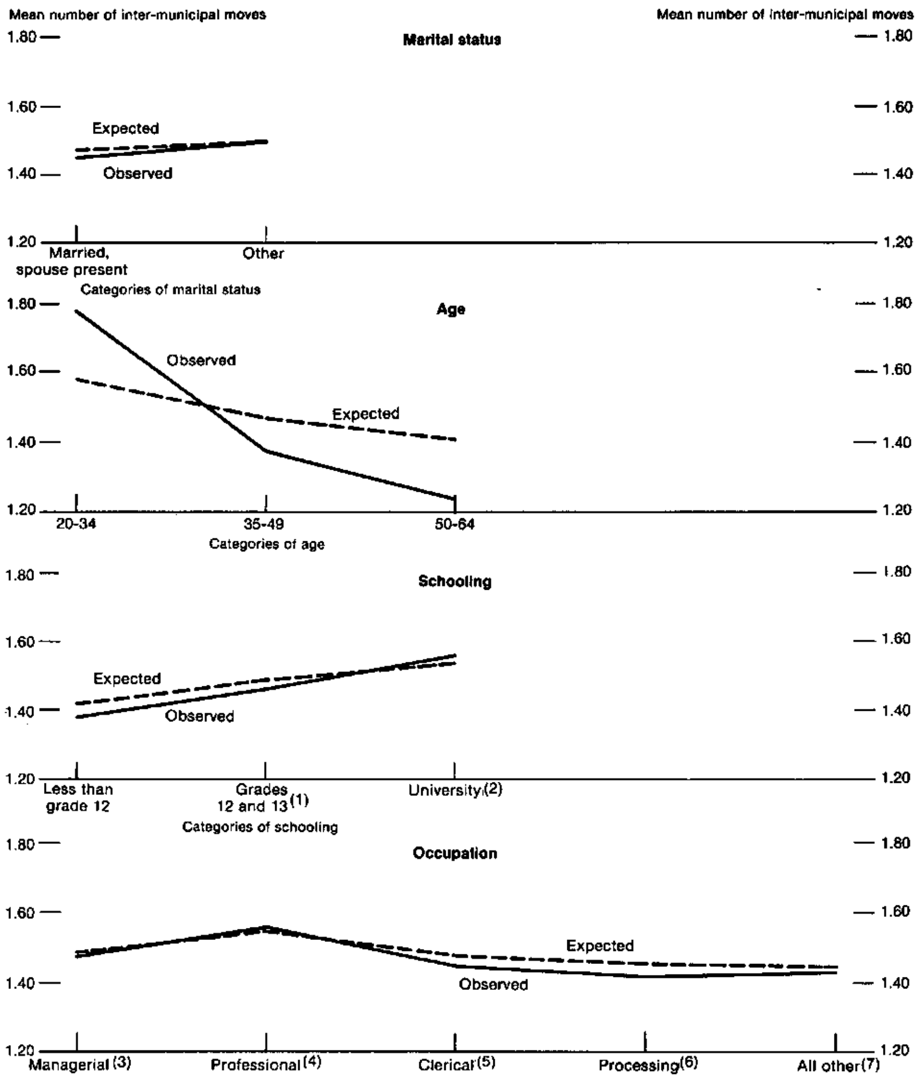


(1) Non-university.
(2) Refers to persons who have attended a university whether or not they received a degree.
(3) Includes managerial, administrative and related occupations.
(4) Includes teaching and related occupations; occupations in medicine and health; occupations in natural sciences, engineering and mathematics; occupations in social sciences and related fields; occupations in religion, artistic literary, recreational and related occupations.
(5) Includes clerical and related occupations; sales occupations; and service occupations excluding armed forces.
(6) Includes processing occupations; machining and product fabricating, assembling and repairing occupations; construction trades occupations; and transport equipment operating occupations.
(7) Includes armed forces; farming, horticultural and animal husbandry occupations; fishing, hunting, trapping and related occupations; forestry and logging occupations; mining and quarrying including oil and gas fields occupations; materials handling and related occupations not elsewhere classified; other crafts and equipment operating occupations; and occupations not elsewhere classified.

Source: 1971 Census, unpublished tabulation.

Chart — 3.3

Observed and Expected Averages of the Conditional Mean Number of Inter-Municipal Moves for Specific Categories of the Explanatory Attributes



(1) See chart 3.2, footnote 1.
(2) See chart 3.2, footnote 2.
(3) See chart 3.2, footnote 3.
(4) See chart 3.2, footnote 4.
(5) See chart 3.2, footnote 5.
(6) See chart 3.2, footnote 6.
(7) See chart 3.2, footnote 7.

Source: 1971 Census, unpublished tabulation.

TABLE 3.1. Multivariate Analysis[1] of the Inter-municipal Mobility Distribution of the Population Aged 20 - 64, Canada, 1966 - 71

Effect	Contribution to reduction in chi-square[2]	Coefficient of association[3]
Model asserted.	100.0	0.51
Zero-order effects:		
Age	64.1	0.73
Mother tongue.	3.9	0.04
Schooling	9.4	0.10
Occupation	5.6	0.06
Higher-order effects:		
Schooling given age.	3.7	0.04
Occupation given age and schooling	1.7	0.02
Marital status given age and mother tongue	6.8	0.07

1 See Appendix B for a specification of the sample universe and the categorization of the variables.

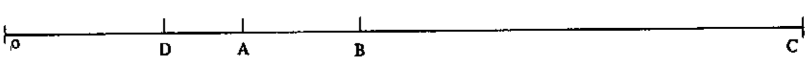
2 The null model which denies any dependence between the "dependent" attribute and the "explanatory" ones generates the chi-square value with respect to which reduction is assessed. (This chi-square is roughly analogous to the variance to be explained in regression analysis (cf. Goodman, 1970 and 1972)). The asserted model which does claim a particular pattern of dependence between the "dependent" attribute and the "explanatory" ones, normally generates a lower chi-square than the null model – thus the asserted model reduces or improves the chi-square of the null model. The reduction in chi-square attributable to the asserted model is the base on which we calculate the percentage contributions of the effects to the overall reduction in chi-square.

The 100% figure in the first row of the first column reminds the reader that the reduction in chi-square achieved by the asserted model is the total contribution. The remainder of the figures in that first column are the percentages of that total reduction in chi-square that are attributable to the particular effects listed in the stub.

The percentage contributions of the effects are not necessarily additive. Additivity depends upon the precise definition of each effect and upon the existence of intercorrelations among the explanatory attributes.

3 The coefficient of association is a measure of the strength of the relationship between a specified set of explanatory variables (effects in this case) and the designated dependent variable (the conditional distribution of the population over categories of the dependent attribute – distribution of migrants by number of inter-municipal moves in this case) within the context of a specified model. The first number in the column pertains to the overall relationship between all the specified effects, within the context of the asserted model, and the dependent variable. This measure is roughly analogous to R^2 in multiple regression analysis. The remaining numbers in this column are measures of partial association between a particular effect and the dependent variable, given that the other specified effects are "held constant" statistically. This measure is roughly analogous to partial r^2.

In assessing the partial coefficient of association for a single effect, we first generate the chi-square of a "modified asserted model". This modification is achieved by deleting from the asserted model the effect in question plus all effects that are intrinsically related to the one in question (due to the nesting phenomenon described in Appendix C, Section C.4). We then compute the chi-square that is implied if we add to the modified asserted model only the effect in question. The difference between this latter chi-square and the one of the modified asserted model is the defined absolute reduction in chi-square attributable to the effect in question. This reduction is then divided by the difference between the chi-square of the null model and that of the modified asserted model (the latter measures the reduction in the chi-square of the null model that the modified asserted model achieves). The following diagram and symbols will illustrate the procedure:



Let A, B and C be chi-square values.

$A < B < C$

C is the chi-square of the null model

B is the chi-square of the modified asserted model

A is the chi-square that is obtained when the effect in question is added back into the modified asserted model

C – A is the reduction in chi-square achieved by the modified asserted model after it has been augmented by the effect in question

B – A is the measured contribution of the effect in question to C – A

$(B - A)/(C - A) = \gamma$ is the defined coefficient of partial association for the effect in question.

The diagram above can also be used to illustrate the coefficient of association for the overall relationship between all the specified effects.

Let D be the chi-square of the asserted model.

C – D is the reduction in chi-square achieved by the asserted model

$(C - D)/C = \eta$ is the improvement in chi-square that the asserted model achieves, and is the defined coefficient of association for the whole asserted model.

Source: 1971 Census, unpublished tabulation.

compositional effects that exclude age are held constant statistically, we may treat it as a largely "independent" statistical effect of age on the inter-municipal mobility distribution of the population. However, the independence is only relative to the other effects (that exclude age) asserted as being relevant by the model.

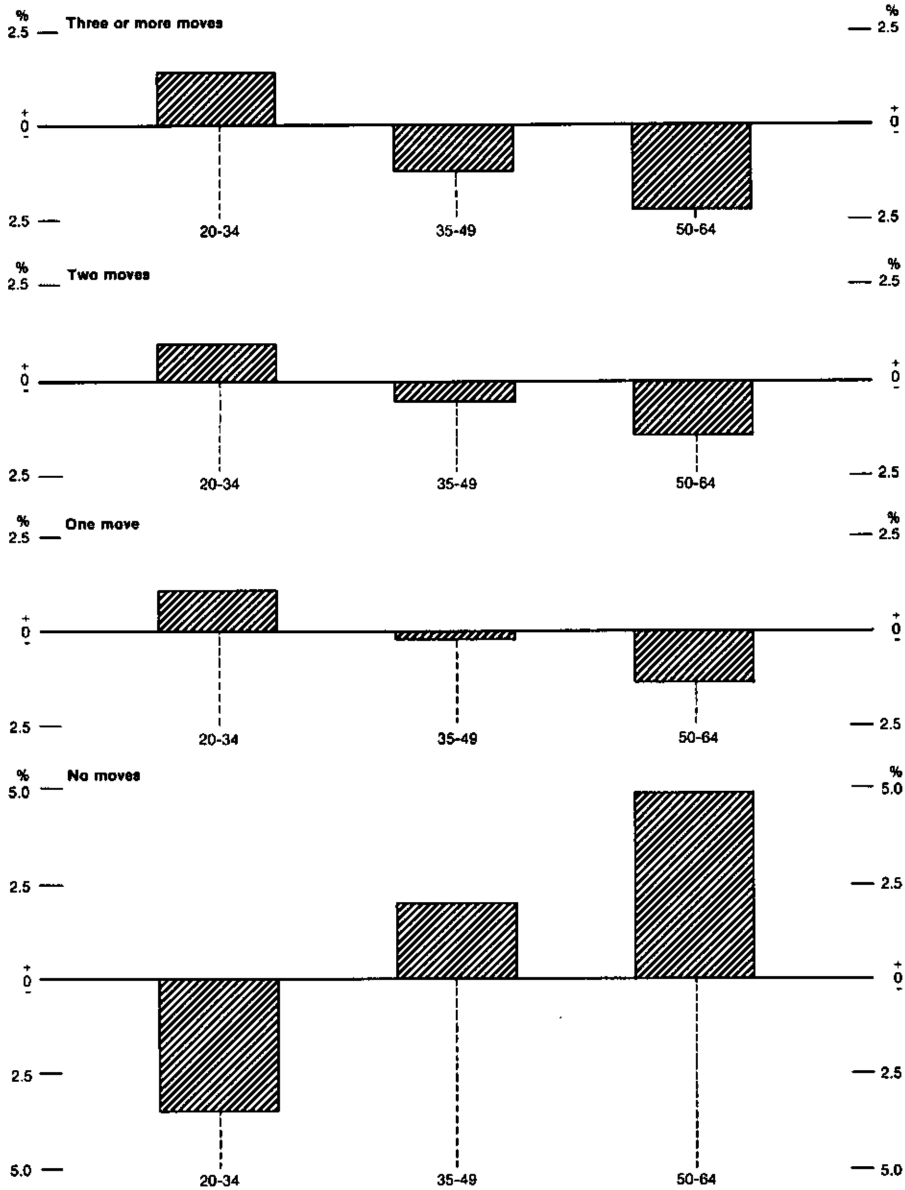
In terms of the partial coefficients of association shown in Table 3.1, only the zero-order effect of age is substantial. The rank order of the remaining effects, going from highest to lowest in terms of the contribution to the performance of the model, is led by the zero-order effect of schooling. However, the large shared contribution needs to be borne in mind in attempting to interpret this ranking. (A **rough** approximation to the shared contribution is the difference between (a) the reduction in the chi-square of the null model that is attributable to the asserted model and (b) the sum of the contributions allocated to the individual effects.) A reasonable allocation of this shared contribution to the individual attributes could significantly change the above-mentioned rank ordering of the measured "independent" contribution of schooling, occupation, and mother tongue. Thus all we can say is that age is clearly of major importance, and the total contributions of schooling and occupation may be substantially greater than those indicated by the measures of their "independent" contributions.

Although the text that follows will repeat some of the information already given in Chapter 2, it is worthwhile to look more closely at the contribution of age. One reason for this is because other explanatory attributes will be partially held constant (statistically) before assessing the "age effects", a procedure that was not pursued in Chapter 2. Through this procedure statistical contributions that are jointly shared by age and other measured attributes are generally reflected in the measured "independent" effect of age. It turns out, however, that for age, as well as for most of the other selected explanatory attributes, the patterns shown in the bivariate analysis of Chapter 2 are again seen in the present multivariate analysis.

Relative to the information provided in Chapter 2, Chart 3.4 provides a "new" perspective on the measurement of the contribution of age. Two variants of the asserted model were applied to arrive at the data reflected in Chart 3.4. In the first variant, all compositional effects that involve age are excluded from the model. In the other variant (of the asserted model) the zero-order compositional effect of age is put back into the model while the other compositional effects that involve age continue to be excluded. By considering these two variants of the asserted model, it is possible to arrive at measurements of the average absolute contribution of the zero-order compositional effect of age to the percentage of a population subgroup that made a particular number of inter-municipal moves (this concept is illustrated below). The overall percentage of the population that made a specific number of inter-municipal moves (e.g., two moves) is the weighted sum of the contribution attributable to the different compositional effects.

Chart — 3.4

Measures of the Contribution of Each Age Category to the Percentage of the Sample Population in Each Number-of-Moves Category



Source: 1971 Census, unpublished tabulation.

For a specific age group, each of the two variants of the asserted model "predicts" an average distribution of the population by number of inter-municipal moves. The model variant that completely excludes the age attribute will "predict" the same distribution obtained for every age group. By comparing the two average predicted distributions obtained for a particular age group, we can show graphically the statistical effect of that particular "value" of age.[10] For example, in the 20 - 34 age group the average "predicted" percentage of the population with zero moves is 72 using the variant model that entirely excludes the age attribute, but it is 69% for that model variant which includes the zero-order compositional effect of age. We could say that in the 20 - 34 age group the statistical contribution of the zero-order effect of age is to lower the proportion of the population with zero inter-municipal moves. At the high end of the scale of inter-municipal mobility "young age" (20 - 34) adds one percentage point to the per cent of the population that is hypermobile, while the "older age" (50 - 64) deducts two percentage points from the relative weight of the hypermobile persons in the population. These comparisons and others are represented graphically in Chart 3.4.

A "predicted" inter-municipal mobility rate can be associated with the "predicted" distribution mentioned in the preceding paragraph.[11] With regard to the "predicted" inter-municipal mobility rate, Chart 3.5 shows the general pattern of the effect of age, after other attributes are held constant statistically. In the younger age group the effect of age is to raise the rate, while among the older ages, the effect is to lower the rate. What the chart shows, in addition, is an actual measurement of how much on the average each age category tends to add to or subtract from the "predicted" mean number of inter-municipal moves. If age is completely excluded from the model then an inter-municipal mobility rate of 10.5% is predicted. The younger age group (20 - 34) tends to raise that value by 1.60 points (an increase of 15%); while the older age group (50 - 64) tends to lower it by 2.3 points (a decline of 22%).

All of the foregoing discussion refers to the zero-order contribution of age, the compositional effect represented by $Pr(M_k|A_q)/Pr(M_k)$ in expression (2). Although this effect "averages" the higher-order effects, the contribution of age could have been shown even more sharply by also considering the higher-order effects that involve age.

3.6. The Patterns of the Effects of Other Attributes

The patterns of the zero-order contributions of schooling, occupation, and mother tongue to the mean number of inter-municipal moves in the population are shown in Charts 3.6 - 3.8. In each case the contribution of a given effect is assessed only after measured compositional effects that exclude that attribute are

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See footnote(s) on page 90.

allowed to "take out" their respective contributions (including those which are shared with the effect in question). Thus these charts, unlike the corresponding data in Chapter 2, reflect "independent" statistical effects.

The university-educated group tended to raise the predicted mean number of moves per person by 12%. In contrast, the group that did not graduate from high school tended to lower the mean number of moves predicted by 4.5%.[12] In short, the zero-order "independent" effect of schooling that is not shared with other measured attributes is in the expected direction but it is of low relative magnitude.

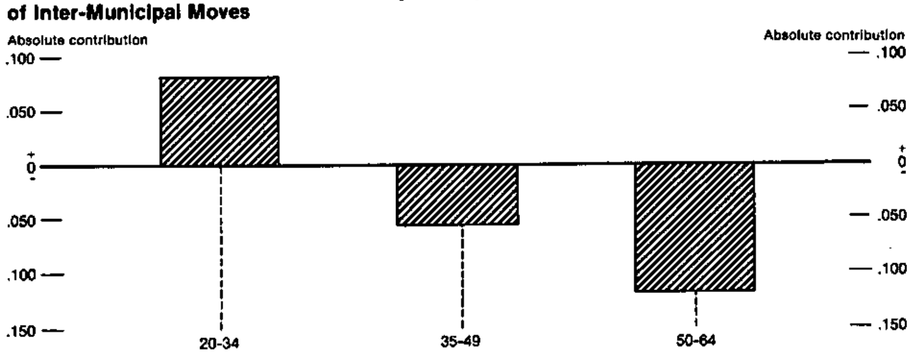
Among the five broad occupational groups chosen, two tend to raise the predicted mean level of the number of moves attribute. When occupation is entirely excluded from the model, the predicted inter-municipal mobility rate is 10.3%. The group of predominantly professional and technical workers tended to raise the mean to 1.53, an increase of 3.3%; but the mean was raised only negligibly by the managerial and administrative group. The other occupation groups tended to lower the mean.

The population with English mother tongue tended to raise the "predicted" inter-municipal mobility rate by 0.28 over the reference value of 10.5%. This reference value is that predicted by the model when mother tongue is completely excluded. The other two selected mother tongue groups tended to lower the predicted mean rate (relative to the reference value) very slightly.

See footnote(s) on page 90.

Chart — 3.5

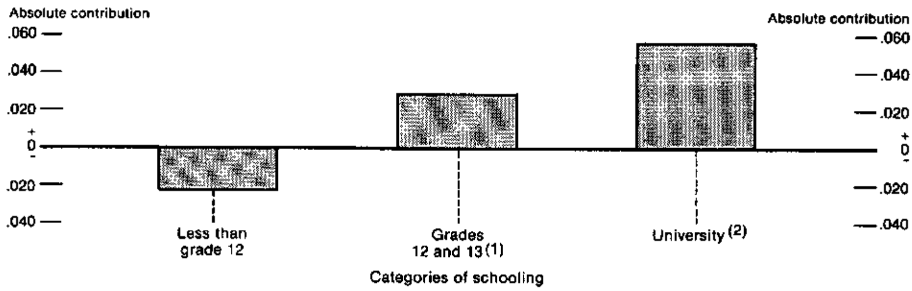
Measures of the Contribution of Each Age Category to the Mean Number of Inter-Municipal Moves



Source: 1971 Census, unpublished tabulation.

Chart — 3.6

Measures of the Contribution of Each Schooling Category to the Mean Number of Inter-Municipal Moves

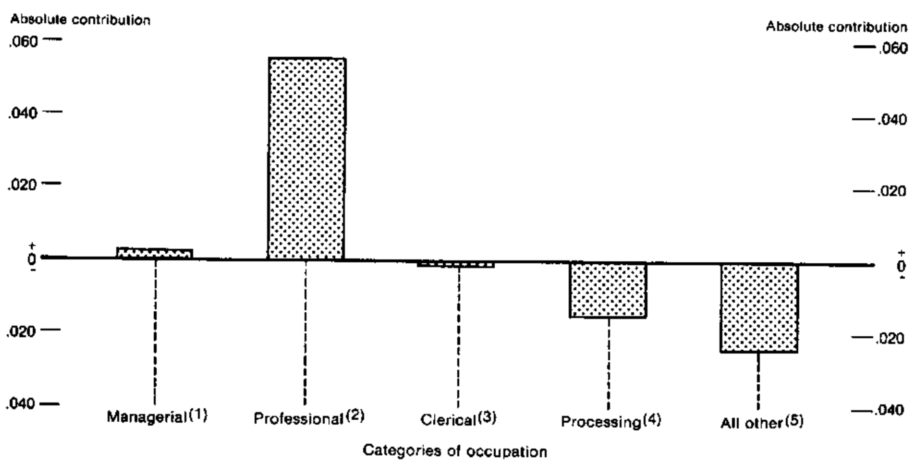


(1) See chart 3.2, footnote 1.
(2) See chart 3.2, footnote 2.

Source: 1971 Census, unpublished tabulation.

Chart — 3.7

Measures of the Contribution of Each Occupation Category to the Mean Number of Inter-Municipal Moves



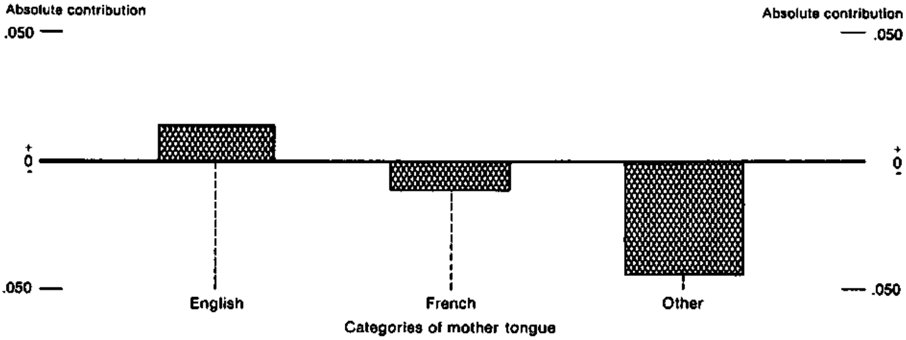
(1) See chart 3.2, footnote 3.
(2) See chart 3.2, footnote 4.
(3) See chart 3.2, footnote 5.
(4) See chart 3.2, footnote 6.
(5) See chart 3.2, footnote 7.

Source: 1971 Census, unpublished tabulation.

Chart 3.9 shows the measured contribution attributed to the second-order effect of marital status, the contribution of marital status after the attributes of age and mother tongue as well as all other compositional effects have already "taken out" their contributions. When the second-order effect of marital status is excluded from the model and because this is the only specified compositional effect which includes marital status, the predicted inter-municipal mobility rate is 10.5% for each of the two marital status categories. This mean tends to be lowered very slightly, by 0.4, for persons married with spouse present, and is similarly raised by 0.1 for persons of other marital status.

Chart — 3.8

Measures of the Contribution of Each Mother-Tongue Category to the Mean Number of Inter-Municipal Moves



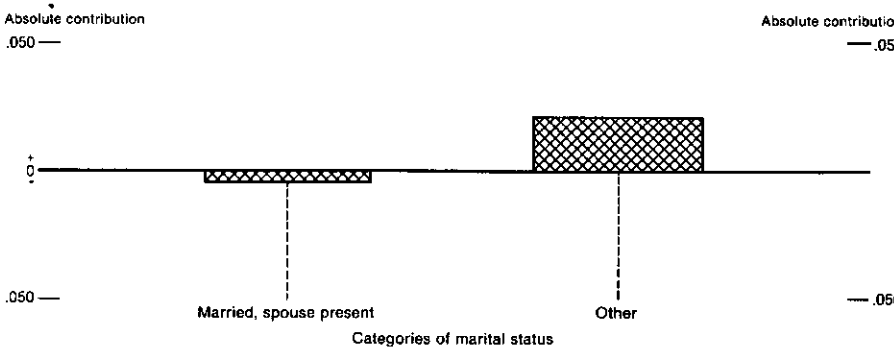
Source: 1971 Census, unpublished tabulation.

In sum, the patterns of the "independent" statistical contributions of the explanatory attributes to the shape of the distribution of the population by number of inter-municipal moves are in the directions suggested by the bivariate associations examined in Chapter 2. Mostly the zero-order compositional effects of the explanatory attributes have been examined above (these are roughly analogous to first-degree variables in regression models) since the higher-order "interaction" effects are generally of much smaller magnitudes than the zero-order ones.

The "cumulative" effects of the explanatory attributes are partially indicated in sharp profile by Chart 3.10. The chart shows how the predicted distribution of the number of moves changes between one extreme population subgroup and another. The proportion with zero inter-municipal moves, is 0.81 among older females of neither English nor French mother tongue, who were in clerical, sales, and service occupations and had less than high school education. A full 23 points lower (0.58) is the corresponding proportion for males aged 20 - 34, who were in the predominantly professional and technical occupations, with English mother tongue, and university education. The percentage that was hypermobile in the latter group is 13%, a full nine percentage points higher than that of the former population subgroup.

Chart — 3.9

Measures of the Contribution of Each Marital-Status Category to the Mean Number of Inter-Municipal Moves



Source: 1971 Census, unpublished tabulation.

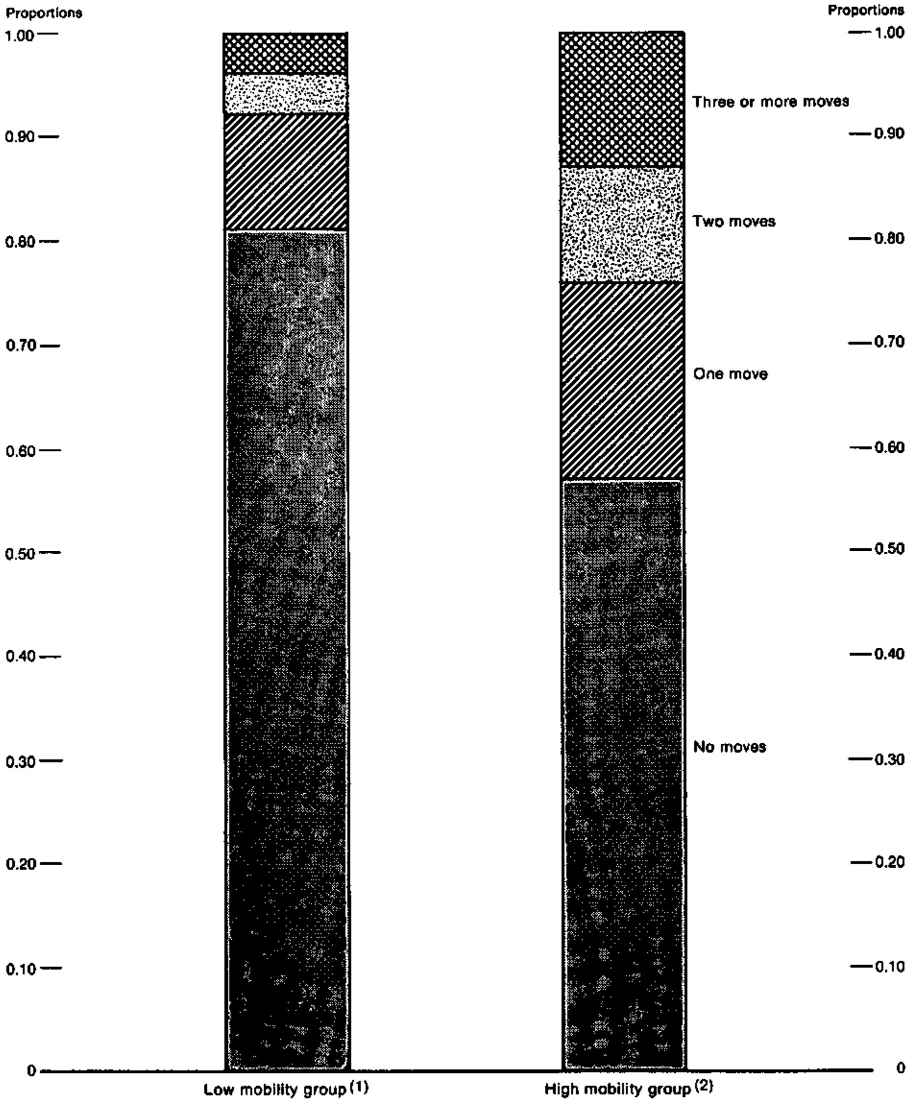
3.7. Supplementary Analyses

The asserted model and its variants have been reapplied to several modifications of the raw data to help deal with some significant methodological issues. Firstly, alternative ways of "controlling" the effect of age have been pursued, because of the suspicion that a heavy "peaking" of mobility associated with entry and exit from post-secondary institutions is dominating the results of the analysis presented above. Secondly, census data that more clearly tap dimensions of status change related to 1966 - 71 levels of mobility have been introduced to test the hypothesis that they will significantly reduce the relative contribution of age; a result that might tend to support the hypothesis that age is partly a proxy variable for aspects of recent or prospective status changes that are important determinants of mobility.

The dominance of the zero-order compositional effect of age is not the result of the high peak of mobility that occurs among young adults. This conclusion stems from the results of a re-analysis of the data in which only two age categories are used, 35 - 49 and 50 - 64. Table 3.2 provides the chi-square analyses of this rerun of the model. It is quite clear from these results that the independent effect of age (i.e., the effect measured after occupation and education are allowed to make their contributions) continues to be dominant. However, as expected the relative statistical importance of the contributions of occupation and schooling rise; since we have, for this table, excluded all data for the age group in which mobility rates reach a substantial peak.

Chart — 3.10

Distributions by Number of Inter-Municipal Moves for Two Subgroups with Sharply Different Combinations of Relevant Attributes



(1) Females 50-64, who resided in Canada on 1 June 1966, and worked in 1970, were married with spouse present, had a mother tongue that was neither English nor French, had less than grade 12 education and were in the clerical, sales and service occupation group.

(2) Males aged 20-34, who resided in Canada on 1 June 1966, and worked in 1970, were married with spouse present, had English mother tongue, university education, and were in the professional and related occupation group.

Source: 1971 Census, unpublished tabulation.

TABLE 3.2. Multivariate Analysis[1] of the Inter-municipal Mobility Distribution of the Population Aged 35 - 64, Canada, 1966 - 71

Effect	Contribution to reduction in chi-square[2]	Coefficient of association[3]
Model asserted	100.0	0.49
Zero-order effects:		
Age[4]	34.5	0.50
Mother tongue	2.7	0.03
Schooling	15.0	0.18
Occupation	11.8	0.12
Higher-order effects:		
Schooling given age	9.4	0.10
Occupation given age and schooling	5.4	0.05
Marital status given age and mother tongue	15.6	0.16

[1] See Appendix B for a specification of the sample universe and the categorization of the variables.
[2] See Table 3.1, footnote 2.
[3] See Table 3.1, footnote 3.
[4] Only two age groups are considered, 35 - 49 and 50 - 64.

Source: 1971 Census, unpublished tabulation.

Tables 3.3 and 3.4 show that movement to and from post-secondary educational institutions (especially universities) between 1966 and 1971 is not dominating the results of the analysis with respect to age or schooling. To obtain Table 3.3 the model was applied to the data for the 20 - 34 age group only, thus age does vary in the underlying set of data. For Table 3.4 the model was applied to the data for the 35 - 49 age group only. Generally, there is broad similarity between the results shown in these tables with respect to the relative contribution of schooling and to overall pattern of the contributions of the compositional effects. The principal exception to this observation pertains to the zero-order effect of mother tongue which is (relative to the other effects) much larger in the 20 - 34 age group than it is in the 35 - 49 age group.

It is apparent from these data that a great deal of the pattern of inter-municipal mobility remains to be "explained" statistically within each of the 20 - 34 and 35 - 49 age groups even after schooling and occupation are taken into account. However, the crude categorization of these attributes may produce a downward bias in their contributions. It is notable that the zero-order effect of mother tongue and the higher-order effect of marital status are of magnitudes quite similar to those of schooling and occupation in Table 3.3.

TABLE 3.3. Multivariate Analysis[1] of the Inter-municipal Mobility Distribution for the Age Group 20-34, Canada, 1966-71

Effect	Contribution to reduction in chi-square[2]	Coefficient of association[3]
Model asserted	100.0	0.62
Zero-order effects:		
Mother tongue	21.2	0.28
Schooling	22.4	0.23
Occupation	20.2	0.21
Higher-order effects:		
Marital status given mother tongue	25.2	0.25
Occupation given schooling	4.2	0.04

[1] See Appendix B for a specification of the sample universe and the categorization of the variables.
[2] See Table 3.1, footnote 2.
[3] See Table 3.1, footnote 3.

Source: 1971 Census, unpublished tabulation.

TABLE 3.4. Multivariate Analysis[1] of the Inter-municipal Mobility Distribution for the Age Group 35-49, Canada, 1966-71

Effect	Contribution to reduction in chi-square[2]	Coefficient of association[3]
Model asserted	100.0	0.53
Zero-order effects:		
Mother tongue	9.4	0.12
Schooling	29.4	0.31
Occupation	23.8	0.25
Higher-order effects:		
Marital status given mother-tongue	23.6	0.24
Occupation given schooling	5.3	0.05

[1] See Appendix B for a specification of the sample universe and the categorization of the variables.
[2] See Table 3.1, footnote 2.
[3] See Table 3.1, footnote 3.

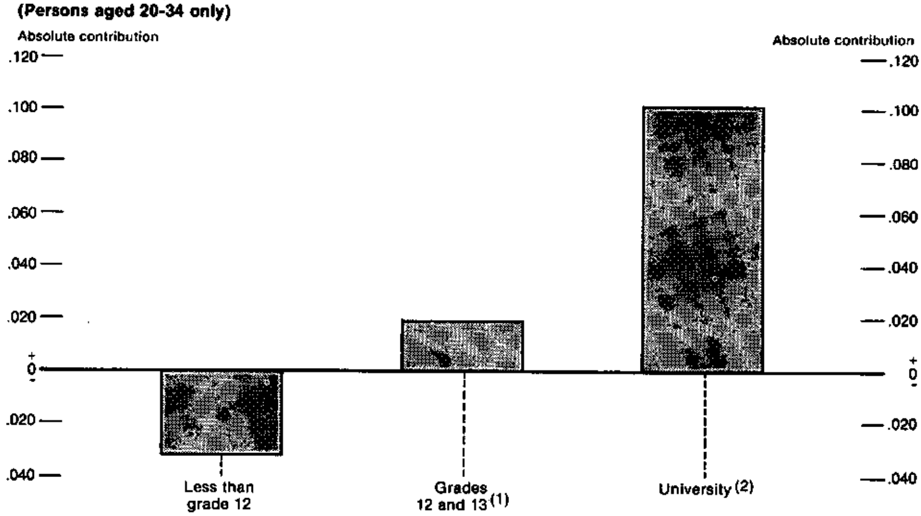
Source: 1971 Census, unpublished tabulation.

Charts 3.11 - 3.13 depict the "independent" zero-order contributions of schooling, mother tongue, and occupation to the distribution of population by number of inter-municipal moves within the 20 - 34 age group. In each case the effect of a given attribute is measured after other compositional effects that exclude it are taken into account. Thus the effects that are shared due to intercorrelation of the attributes are not reflected. The patterns are broadly the same as those shown by the corresponding zero-order effects assessed for the whole 20 - 64 age range (where age is classified into three categories).

It has already been suggested that the census data are less than ideal for the explanatory analysis of the mobility pattern of a population group. (The problem is not as severe when we are trying to relate the migration rates of regions to characteristics of those regions.) The main reason for this inadequacy is the emphasis of census data upon the measurement of individuals' attributes at a specific time, rather than of changes (recent or forthcoming) in attributes. In order to test this suggestion the data set was changed in two ways, and an altered model was applied to the changed data. Firstly, marital status was replaced by a five-category marital-status-by-date-of-marriage attribute, as in Chapter 2. Secondly, a crude proxy attribute for previous mobility (whether the 1966 province of residence was the same as the province of birth) was introduced in the place of sex.

Chart — 3.11

Measures of the Contribution of Each Schooling Category to the Mean Number of Inter-Municipal Moves
(Persons aged 20-34 only)

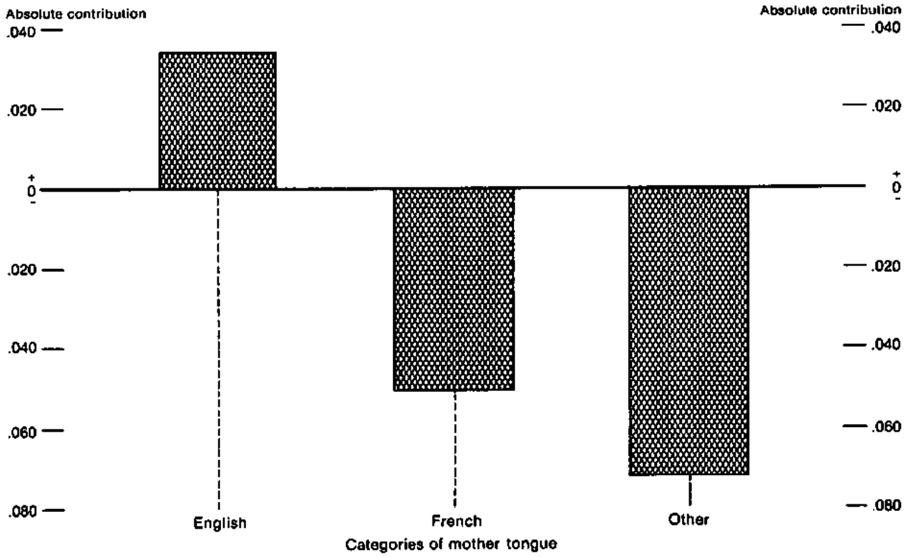


(1) See chart 3.2, footnote 1.
(2) See chart 3.2, footnote 2.

Source: 1971 Census, unpublished tabulation.

Chart — 3.12

Measures of the Contribution of Each Mother-Tongue Category to the Mean Number of Inter-Municipal Moves
(Persons aged 20-34 only)



Source: 1971 Census, unpublished tabulation.

In introducing a proxy for previous geographic mobility, it was assumed that previous mobility would be significantly correlated with recent changes in some relevant dimensions of status (e.g., change in occupation). However, it would be desirable that geographic mobility in a time period close to 1966, but before 1 June 1966, be measured. Unfortunately, a measure of whether a person was residing in his or her province of birth on 1 June 1966 is a weak indicator of mobility close to the 1 June 1966 date. However, the above-mentioned proxy is the best that is available with census data.

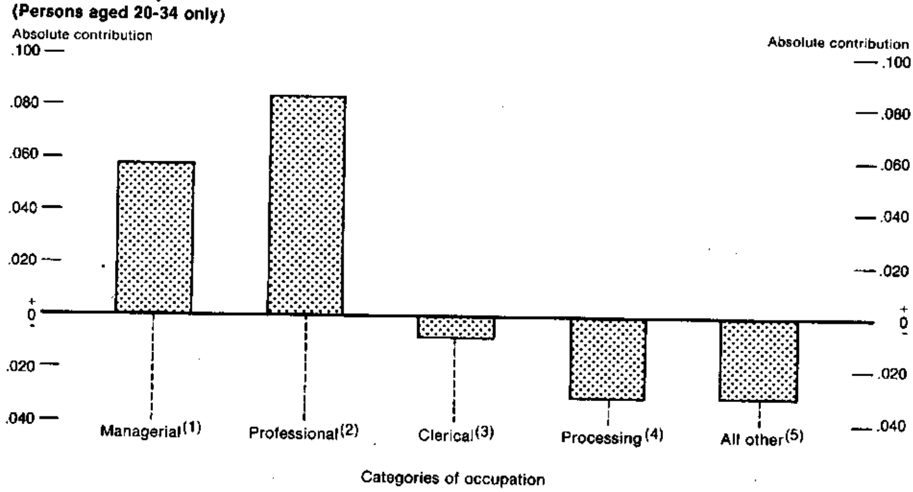
When the data set was changed in the manner outlined above it was necessary to alter the model. As the two preceding paragraphs might suggest we are asserting the substantive hypothesis that marital status changes and recent geographic mobility (prior to 1 June 1966) have a direct relation to the number of inter-municipal moves undertaken by a respondent. (Some general theory that can be used to rationalize these loosely stated hypotheses is provided in Stone, 1975.) This viewpoint would suggest the hypothesis that the zero-order effects of marital-status-by-date-of-marriage and province of birth status (whether or not the 1966 province of residence was the same as the province of birth) contribute substantially to a statistical "explanation" of the number of moves distribution of the sample population. In consequence, these two zero-order effects are introduced into the model, with the result of changing the power coefficient from one quarter to one sixth (see expression (2)).

Given the changes in both the data set and the model, we cannot routinely compare coefficients of the predictive accuracy of this augmented model with those of the model represented in expression (2). However, we can see whether the introduction of two attributes that are more sensitive to recent or prospective status changes than those used in expression (2), will significantly affect the indicated relative "unique" contribution of age.[13] The hypothesis that the strong dominance of the age attribute in the previous analysis (see Table 3.1) arises partly because age is standing for (correlated with) unmeasured aspects of status change that are important in explaining mobility would be in conformity with the data if the relative contribution of age drops sharply with the augmented models (when compared to the model represented by expression (2)), as a result of a statistical effect that is jointly shared by age and other attributes specified in the model.

See footnote(s) on page 90.

Chart — 3.13

Measures of the Contribution of Each Occupation Category to the Mean Number of Inter-Municipal Moves
(Persons aged 20-34 only)



(1) See chart 3.2, footnote 3.
(2) See chart 3.2, footnote 4.
(3) See chart 3.2, footnote 5.
(4) See chart 3.2, footnote 6
(5) See chart 3.2, footnote 7.

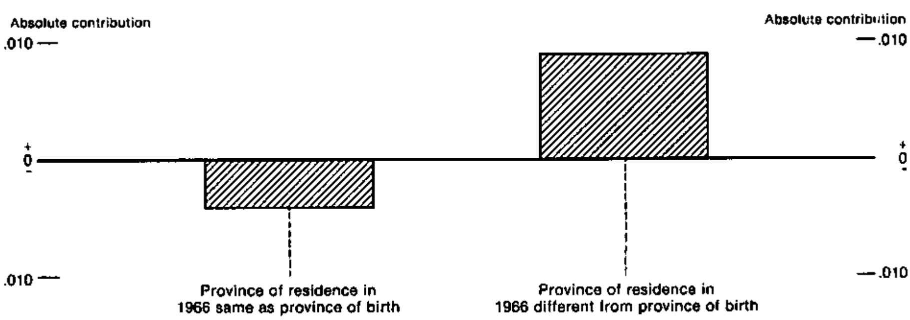
Source: 1971 Census, unpublished tabulation.

Such a drop is strongly suggested when one compares Tables 3.1 and 3.5. In Table 3.5 the dominance of the zero-order effect of age in the performance of the model is much less impressive than in Table 3.1. In the augmented model, the marital-status-by-date-of-marriage categories show substantial relative contribution to the model performance. In Table 3.1 the zero-order effect of age could be said to account for 64% of the performance of the asserted model (see Table 3.1); while in Table 3.5 the corresponding percentage drops to 39%. The drop does not result from a strong correlation of age with the proxies for marital status change, however.

It may be noted that the province-of-birth attribute introduced with the augmented model makes a minor contribution to the performance of the model. However, this contribution is in the expected direction (see Chart 3.14). Among those whose province of birth was not the same as their 1 June 1966 province of residence, the average number of moves was higher than for those where both provinces were the same. Chart 3.14 shows that this pattern is evident even after all the other six attributes in the augmented model have been allowed to take out their contributions to that average.

Chart — 3.14

Measures of the Contribution of Each Province-of-Birth Category to the Mean Number of Inter-Municipal Moves



Source: 1971 Census, unpublished tabulation.

The pattern of the contribution of the marital-status-by-date-of-marriage attribute is also in the expected "direction". As the related discussion in Chapter 2 indicated, those who were married after 1 June 1966, had significantly higher than average levels of mobility. It should be noted, however, that among such persons census data do not permit us to disentangle (through hypothesis testing) the cause-and-effect connections between migration and marital status change. We know only that marital status change after 1 June 1966, was associated with higher than average levels of inter-municipal mobility (well-known reasons are applicable here). What Chart 3.15 shows is that this pattern is observed even after the other compositional effects that do not involve marital status have been allowed statistically to take out their contributions to the mean level of inter-municipal mobility (thus taking out contributions that are shared with marital status due to intercorrelation among the explanatory attributes).

TABLE 3.5. Multivariate Analysis of the Number of Moves Distribution of the Population Aged 20 - 64, Canada, 1966 - 71

(Date of Marriage and Province of Birth Status Included)[1]

Effect	Contribution to reduction in chi-square[2]	Coefficient of association[3]
Model asserted	100.0	0.45
Zero-order effects:		
Age	39.1	0.45
Schooling	6.3	0.07
Province of birth status	1.1	0.01
Marital status by date of first marriage	27.3	0.30
Occupation	4.1	0.04
Mother tongue	2.7	0.03
Higher-order effects:		
Occupation given age and schooling	1.4	0.01
Schooling given age	3.0	0.03
Marital status by date of first marriage given age and mother tongue	8.7	0.09

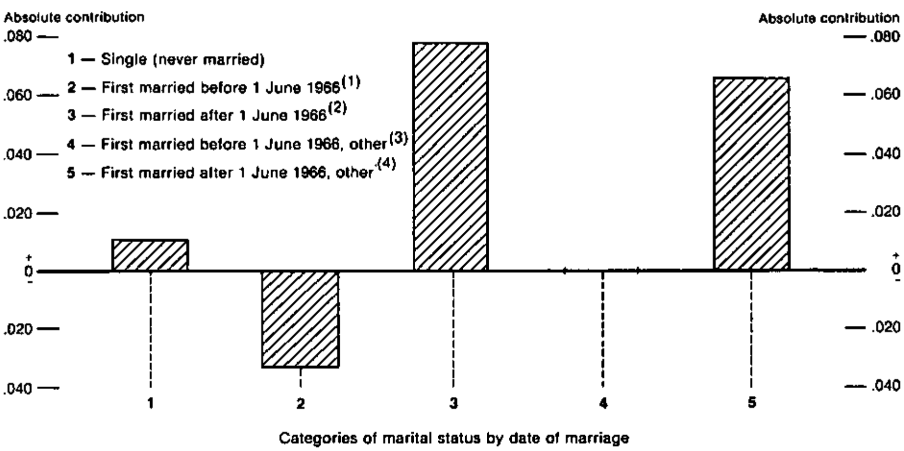
[1] Appendix B shows the categorization of the attributes. The dataset for this analysis differs from that of Table 3.1 in that the former has no breakdown of the population by sex, and includes date of marriage and province of birth status. As a result coefficients are not comparable between these two analyses unless degrees of freedom are taken into account.
[2] See Table 3.1, footnote 2.
[3] See Table 3.1, footnote 3.

Source: 1971 Census, unpublished tabulation.

In sum, the data in Tables 3.1 and 3.5 and Chart 3.15 fail to cast much light on the hypothesis that the dominance of age in the analysis arises partly because age is correlated with aspects of status change such as marital status change, job mobility, or educational status change, that are important determinants of geographic mobility. Unfortunately, census data are not well suited to the further study of the interconnections of geographic mobility with status changes. Also, the underlying theory needs further development (see Stone, 1975). Thus, given the central role played by age in the study of mobility, much research must be done in dissecting the age effect probably using non-census data.

Chart — 3.15

Measures of the Contribution of Each Marital-Status-by-Date-of-Marriage Category to the Mean Number of Inter-Municipal Moves



(1) Married-spouse present, date of first marriage before 1 June 1966.
(2) Married-spouse present, date of first marriage after 1 June 1966.
(3) Married-spouse absent, separated, widowed or divorced, date of first marriage before 1 June 1966.
(4) Married-spouse absent, separated, widowed or divorced, date of first marriage after 1 June 1966.

Source: *1971 Census, unpublished tabulation.*

3.8. Concluding Remarks

The concluding remarks for this chapter shall be very brief, because a discussion of findings appears in Section 3.1. This chapter has deliberately avoided discussion of the characteristics of the Canadian regions to and from which people migrate. It has concentrated on the population characteristics that tend to distinguish migrants from non-migrants, and high-frequency migrants from low-frequency migrants. It is a demographic study of the behaviour of groups of

Canadians, rather than a study of the migration levels among Canadian geographic regions. Its relevance to useful knowledge about Canadians will be discussed in the next chapter.

In developing this analysis we wanted to see what 1971 Census data might indicate, within the context of a particular research design and explanatory model, about the importance of taking the composition of a population group into account in attempting to understand its level of mobility frequency (the numbers of times its members moved between municipalities within Canada). The problem was put in terms of the extent to which we might improve the accuracy of "prediction" of the distribution of inter-municipal mobility for a given population group by postulating, in a specific model, some relations between that distribution and the composition of the population group. We also wanted to use a method of analysis which presupposes that the raw data are in the form of tabulations rather than of individual records, since this is the form to which almost all users of census data are restricted. In applying the method, the objectives were to allocate the improvement in "prediction accuracy" among the effects of specific explanatory attributes, and to reveal statistical measures of the patterns of the contributions of the specified effects. The detailed method used has been developed specifically for this study although its general strategy is described in existing literature. It is a substantial adaptation of some recently published procedures for the multivariate analysis of cross-tabulations (contingency tables), and it has wide applicability to census-type data.

Not suprisingly, given the body of already existing literature, the analysis indicates a definite systematic multivariate association between the level of mobility frequency shown by a population group and several aspects of the group's demographic and socioeconomic composition. However, the enhancement of "predictive accuracy" yielded by the chosen model was only modest; although the patterns of the contributions of the specified effects of the selected explanatory attributes were almost all in the theoretically expected directions.

The general thrust of the substantive findings of the study is not particularly new, since it largely confirms what was previously reported in the literature. However, the confirmation just mentioned is notable because it arises within the context of analysis of a unique body of census data – data on the frequency of inter-municipal mobility. The study also provides specific quantitative measures related to the broad study findings, using 1971 Census data.

There are a few areas of concern to analysts of migration for which the findings of this study ought to be provocative of further research. Firstly, some analysts believe that theories of geographic mobility which give first prominence to attributes possessed **at a single point of time** by potential migrants (e.g., age, education, occupation) basically employ a misdirected analytical thrust. Although the census data are seriously inadequate for the task of pursuing this point in a definitive manner, this analysis supports the view that the analytical thrust of migration theories should be redirected toward the relations between migration and changes in individual or family attributes. Specifically, the predominance of the "age effects" over the "occupation effects" and the "education effects" (where the latter are measured at a specific time) is striking in the census data, as is the strong suggestion that measures of pertinent status changes contribute substantially to statistical explanation of the frequency distribution of mobility. Status changes are highly bunched around specific age levels in the individual life cycle. Secondly, by leaving such a strong impression of the "indepedent" effect of the age composition of a population on its mobility frequency pattern, the study should prompt researchers to re-examine these findings in census and other contexts and to dissect the "age effects" into their components.

FOOTNOTES

[1] The word "predict" is often placed within quotes in this text because it is not intended to be interpreted literally. This caution is usually pertinent when the cross tabulation that provides the data used to test the model is the same one used to estimate the parameters of the model. In this situation one normally uses the concept of fitting the model to the data.

[2] The term "explanatory" is being put within quotes to indicate that it has a special meaning within the context of the sort of research that this study represents. In this type of work it is customary (but no invariable) that a particular variable be chosen as the object of explanation, and called the "dependent variable". Then an attempt is made to interpret or understand the variation of the dependent variable by relating it to other variables. The latter variables are referred to as explanatory. The designation of a particular variable as dependent or explanatory is meaningful only within the context of a specific problem of analysis, and within that context the designation is a matter of arbitrary choice by the analyst. In the remainder of the text quotes will not be used around "explanatory", but the special meaning being cited here should always be assumed.

[3] A variant is produced when one or more elements of the model are deleted (or set equal to one).

[4] Measurement of the strength or pattern of the contribution of a given attribute to the performance of a model necessarily involves a two-step process of statistical manipulations and causal interpretation. Consideration of the nature of this process shows clearly that the attribution of any contributions to specific explanatory factors is meaningful only within the context of a stated model and its specified measured variables. The contribution that is attributed to a given factor is relative to the contributions attributed to other factors that are also measured within the chosen model. To see the great importance of this point, one need only consider the case of a measured explanatory variable that in fact has no causal significance (in determining the dependent variable); but which stands for (is highly correlated with) a combination of relevant but measured factors.

[5] This type of model presupposes that the raw data pertain to population groups and not to individuals. Thus, the influence of a particular "explanatory" attribute is measured in terms of certain conditional proportions (see Appendix C, Section C.1) that are appropriate for data on population groups, rather than in terms of the concrete values assumed by the attribute.

Regression analysis also deals with "prediction" of a pattern of multivariate associations; but in regression models a particular attribute is represented by its actual value (each value observed being estimated for a sample individual or case). The influence of that attribute is then measured in terms of aspects of statistical associations among the estimated values of all the attributes. This approach presupposes that the raw data pertain to individual cases, rather than to population groups. Census data users most often have to deal with data in the form of tabulations for population groups.

[6] The concepts of direct effect and higher-order effects are discussed in Section C.1 of Appendix C.

[7] Taken together, the four hypotheses are analogous to a first-degree multiple regression model, which is the most common type of regression model used in migration studies.

[8] To compute the predicted conditional mean number of moves, the values of the terms $\hat{Pr}(M_k | S_v A_q N_p X_g W_b E_u)$ generated by expression (2) are used. For a specific combination of values of v, q, p, g, b, and u, the predicted conditional mean number of moves is given by

$$\bar{M}_{k|vqpgbu} = \sum_k M_k \cdot Pr(M_k | S_v A_q N_p X_g W_b E_u), \text{ where}$$

M_k = (0, 1, 2, 3, 5). The average of such conditional means for a specific value of v is defined as

$$\frac{1}{QM.PM.GM.BM.UM.} \sum_{q=1}^{QM} \sum_{p=1}^{PM} \sum_{g=1}^{GM} \sum_{b=1}^{BM} \sum_{u=1}^{UM} \overline{M}_{k|vqpgbu}.$$

The corresponding average of the observed means is obtained by the same formulas, except that the superscript "^" is dropped to indicate that $Pr(M_k|S_vA_qN_pX_gW_bE_u)$ are observed data, and not the results of applying expression (2).

The completed means are transformed into the inter-municipal mobility by multiplying by 100 and dividing by five.

[9] Under the model derivation procedure outlined in Appendix C, there are 63 possible compositional effects for six explanatory attributes. When all 63 are specified in a model we have the so-called "full" model (also called "saturated model"). The full model is analogous to a regression model in which the number of variables is exactly equal to the number of sample observations, a model in which the R^2 is necessarily 1.0, if the data used to test the model are the same used to estimate its parameters.

[10] Let "$\hat{P}r(M_k|S_vA_qN_pX_gW_bE_u)$" represent the conditional proportion in number-of-moves category k (given v, q, p, g, b, and u) that is "predicted" by a particular model. For a specific value of age, A_q, the average predicted proportion can be defined as

$$\frac{1}{VM.PM.GM.BM.UM.} \sum_{v=1}^{VM} \sum_{p=1}^{PM} \sum_{g=1}^{GM} \sum_{b=1}^{BM} \sum_{u=1}^{UM} \hat{P}r(M_k|S_vA_qN_pX_gW_bE_u).$$

A rough approximation to the average predicted distribution of population over categories of k, for a specific value of q, is obtained by applying the formula just shown to each value of k. The sum of the KM (k = 1, 2, . . . , KM) average proportions so computed can be divided into each of these proportions to adjust them, so that the adjusted sum is 1.0.

For a fixed value of k (i.e., considering one specific number-of-moves category) the average proportion just defined will be invariant over age groups if all compositional effects that involve age are excluded from the model. When a single compositional effect that involves age is reinserted into the model, we can get variation (by age) in the average proportion. The differences between the varying proportions and the constant ones just mentioned comprise the measures of the average absolute contributions of the individual age categories.

[11] Footnote 10 indicates that for each value of age there is an associated average predicted distribution of the population by number of inter-municipal moves. Using these distributions and the procedure outlined in footnote 8, a predicted mean number of moves can be computed for each value of age. Now, in a variant of the model that completely excludes the age attribute the mean will be invariant over age. When a compositional effect that involves age is reinserted into the model there will be variation (by age) in the model. The differences between the varying means and the constant ones just mentioned are the measures of the average absolute contribution of the compositional factor that involves age to the overall mean number of inter-municipal moves in the population.

[12] The general procedure used to arrive at these means is outlined in footnote 10 above.

[13] This contribution is measured within the context of a specified model, and is thus relative to the other attributes specified in the model, but is "unique" in the sense that the other factors are first allowed to "take out" their contributions. If a substantial portion of the effect of age, as shown in the model expressed by equation (2), is the result of a correlation

between age and the two newly introduced proxies for status change then the relative size of the "unique" contribution of age will fall substantially. However, that fall could occur because of a strong independent contribution of the proxies of status change. If the fall occurs and the latter is the cause, then the **shared** effect of the explanatory attributes will be small while the "unique" effect of the proxies will be large, in relative terms. This is the pattern shown by the data.

CHAPTER 4

RAMIFICATIONS OF THE WORK AND FURTHER RESEARCH

Readers who consult this work in the hope of learning more about Canadian regions and why they gain or lose migrants will be disappointed. The writer has been concerned with another kind of knowledge about Canadian mobility – knowledge about the kinds of people who tend to be mobile, how they are meaningfully differentiated from people who are not mobile, and what personal characteristics help to explain the incidence of hypermobility. In short this is a study in the demography of Canada, not one in its regional geography. The focus is on Canada's people and their migratory behaviour.

The 1971 Census has provided Canadians with a unique body of information about the number of times groups of Canadians changed residence from one municipality to another between 1 June 1966 and 1 June 1971 (the frequency of inter-municipal mobility). Few countries have asked this question in their censuses, and the Census of Canada had never before included this question. The information yielded by this question provides a far more accurate picture of the degrees of inter-municipal mobility undertaken by different groups of Canadians than it is possible to gain from the more common census questions on migration. This information can be used to shed light on a dimension of Canadian geographic mobility that had never been revealed before, except in the most superficial way through estimates of annual mobility for the national or provincial populations as wholes. Essentially, this study is intended to help interested Canadians capitalize upon the national investment in the census by making available synthesized information that deals with the frequency of inter-municipal mobility. The study attempts to explain the pattern of mobility frequency shown by a population group in terms of selected features of the composition of the group with respect to attributes such as age, mother tongue, schooling, marital status, occupation, etc. It could validly be asked why is this kind of information useful?

Most people who are concerned with the development, implementation, or evaluation of policies for which the population mobility is a crucial variable have a natural interest in systematic knowledge about the migratory behaviour of Canadians. This includes public officials who are grappling with the problems of growth management in specific parts of Canada, specialists in manpower mobility, those who deal with the provision of services that depend on the turnover of specific population subgroups in particular areas of Canada, and citizens who are concerned with the equity, appropriateness, and effectiveness of policies for which population mobility is important. What population characteristics provide them with useful clues about the volume of mobility a population group will experience or about the kinds of people who are likely to be most responsive to policies that implicitly or explicitly involve incentives (or disincentives) to population mobility? What are the realistic propects of inducing certain levels of mobility (high or low) within a population group that has a specific composition? These are some of the questions which this study helps to answer. In making or evaluating the kinds of policy just mentioned, assumptions about these answers cannot be avoided.

Some provincial governments have adopted as a policy the "stay option" with regard to some of their rural communities. The intention is to induce residents of those communities to stay there, i.e., to reduce the rate of out-migration (keep it low), or to attract non-residents toward such areas. Presumably this objective is to be achieved by altering certain characteristics of the areas or by subsidizing non-migrants. But in so doing assumptions must be made about the normal level of mobility, about the mobility propensity of the populations of potential in-migrants and out-migrants for such areas, and about the kinds of people who are most likely to respond to perceived changes in area characteristics or in income subsidies. Systematic knowledge about the migratory behaviour of Canadians is essential to the process of achieving an adequate foundation for such assumptions.

In some parts of Canada where high population and labour turnover are chronic, local authorities are anxious to achieve a more stable labour supply by making those areas more attractive to the type of migrant who is likely to put down roots. What are the attributes of this type of migrant? What proportions of migrants normally engage in repeated mobility, and thus are unlikely to put down roots anywhere? Questions like these are answerable only by concentrated study of the mobility patterns shown by the Canadians.

In the future, repeated government attempts may be made to induce immigrants to reside in selected parts of Canada. Will the success of such attempts imply that new immigrants will be expected to show levels of mobility far below normal? If so, what inducements will sustain such a pattern? One cannot even begin to answer these questions without first developing some basic knowledge about the ways in which different groups of Canadians vary in their patterns of mobility frequency.

From time to time governments announce assisted mobility programs aimed at inducing people to move out of depressed areas. In some cases policies are designed to discourage people from coming into certain areas to take up residence. These policies may be part of a general program to impede population growth in such communities. But the response of individuals to those policies will depend upon their demographic and socioeconomic attributes. What will be the net impact of the policies when the response is much higher in some population groups than in others? Will a successful assisted mobility program, for example, tend to rob depressed areas of too many of the very kinds of people that are needed there? Again, these and similar questions cannot be answered adequately without studies that focus on the migratory behaviour of the Canadian people, separate from the levels of migration experienced by specific Canadian regions.

In sum, studies concentrated upon the geographic mobility patterns of Canadians, abstracted from the regions into and out of which they move, are an important source of useful knowledge. In fact, various kinds of migration studies are needed, and a single work cannot be expected to so adequately deal with all aspects of mobility as to make further research superfluous.

Clearly, the usefulness of the kind of information yielded by this study is enhanced when the knowledge it contributes is merged with other information about Canadian mobility, especially the regional aspects of migration. In this way, there should be more accurate assessments of what can realistically be anticipated about the effects that regional policies will have on patterns of geographic mobility.

The interest of the concerned citizen is as pertinent in the foregoing remarks as that of the public or private official who must take population mobility patterns into account in carrying out his or her work. It is the citizen who is expected to respond and evaluate policies. Intelligent response and pertinent evaluation require that the citizen be directly supplied with information that can permit him or her to form his or her own opinions about the reasonableness, the likely impact, and the equity of policies relating to mobility. To be in this position citizens need to be provided with synthesized information about the mobility of Canadians.

Finally, but ultimately by no means of lesser importance are the interests of those who simply have a thirst for knowledge about the different groups of people who make up Canada. The patterns of geographic mobility they exhibit form a major aspect of their demographic and economic behaviour, and it is fair to view the study of these patterns as an inquiry into an important dimension of the people and the organization of Canadian communities. The interest in such study is notable among students and teachers, and among those whose intellectual curiosity about the Canadian people has been stimulated by a variety of factors. Their interest in the people of Canada is as legitimate an object for the creation of public goods by government as is the public's thirst for health, military preparedness, art galleries, and entertainment (various aspects of these areas are also objects of creation of public goods by government). Indeed, the creation of public goods for the information and enlightenment of the citizenry must be a basic function of any viable modern democracy.

One of the most important things that a study like this should attempt to do is to stimulate further research aimed at contributing to useful knowledge about Canadian mobility. This function has been fulfilled in at least two ways.

Firstly, it was our aim to bring out and interpret some significant patterns in repeated residence change by Canadians. Much more work is needed to bring about substantially improved understanding of these patterns using data from a variety of sources. One recommended direction of such work is that of a careful decomposition of the strong correlation between age and mobility frequency, so as to see more clearly what normally unmeasured variables are being reflected in the "age effects".

In this connection the author has taken but a few deficient steps using the available census data. It is thought that age is reflecting the close connections between status changes and geographic mobility; but unfortunately the 1971 Census data (and indeed data from most national censuses) provide scant opportunity to measure status changes that may be associated with geographic mobility.

What the census data do strongly suggest is a broad similarity in pattern of mobility frequency among different population groups, accompanied by some degree of systematic variation related to the groups' composition with respect to age, mother tongue, schooling, and marital status. This study has further quantified the statistical contributions of selected explanatory factors through the use of a model that is especially designed to deal with the form in which census data are normally available. It is hoped that the exposition and application of this model will help to stimulate much wider usage of census cross-tabulations in work that requires a multivariate analysis strategy.

APPENDIX A

1971 CENSUS MIGRATION DATA

A.1. Census Questions and Sample Estimation Procedure

The 1971 Census migration data used in this study are based mainly on two questions that were administered to a one-third systematic sample of private households in all self-enumeration areas, to all households in canvasser areas, and to all permanent residents of collective dwellings. In the 1971 Census, 97% of the population was enumerated by the self-enumeration method, while 3% was enumerated by the more traditional personal interview method. This 3% consisted mostly of residents of remote areas (northern areas of 10 provinces, Northwest Territories, Yukon, etc.) and residents of institutions.

Some general features of census migration data and their major sources of error were outlined in Appendix B of a 1961 Census monograph on migration (Stone, 1969). Readers who are interested in exploring data quality issues should consult that reference, since the general points made there will not be repeated below. For details of the sampling methods used for the 1971 Census, readers are referred to Dodds (1971).

The households of Canada were divided into two types for the 1971 Census. The first was a private household, which consisted of a person or a small group of persons occupying an ordinary dwelling. The second, the "collective" type of household, included hotels, large lodging houses of 10 or more lodgers, institutions, hospitals, military camps, lumber camps, and other establishments of a similar nature. Persons living in collective households were subdivided into two groups, "permanent" and "temporary". Permanent residents of collective dwellings had no usual place of residence elsewhere in Canada and were counted as part of the population of the collective dwelling. Temporary residents were enumerated at the collective dwelling, but were included in the population count of their usual place of residence. In 1971, the number of Canadians residing in private households was approximately 97.5% of the total population.

The two questions which yielded the great bulk of the data used in this study were:

26. Where did you live 5 years ago, on June 1, 1966 ?

- O Same dwelling ———→ **SKIP TO QUESTION 28**
- O Same city, town, village or municipality (*not same dwelling*)
- O Outside of Canada
- O Different city, town, village or municipality in Canada, give its name ———

City, town, village, municipality, etc.

---------------------- ----------------------
County Province

IMPORTANT: *If outside city or town limit, specify name of suburban municipality and not of city or town.*

27. How many times have you **MOVED** from one Canadian city, town, village or municipality to another since June 1, 1966 ?
Count moving away and returning to the same place as 2 moves.

O None	O 2	O 4
O 1	O 3	O 5 or more

In addition the study also made some use of mobility data generated from another question addressed to persons who were not born in Canada. This question was as follows:

12. If born **OUTSIDE** Canada, in what period did you first immigrate to Canada?

O Before 1931	O 1956–1960	O 1967–1968
O 1931–1945	O 1961–1964	O 1969
O 1946–1950	O 1965	O 1970
O 1951–1955 •	O 1966	O 1971 •

Unfortunately, year of immigration to Canada was not asked for persons who were born in Canada, had emigrated to another country, and were returning as immigrants to Canada.

These questions were asked of all persons in the sample who were at least 15 years old on 1 June 1971 (i.e., born before 1 June 1956). Persons in the sample who were born since 1 June 1966 were excluded from the migration data. For family persons aged 5 - 14 on 1 June 1971, the migration status of the head of the family was assigned. For non-family members aged 5 - 14 the mobility status of the household head was assigned. In addition to the mobility status assignments for persons aged 5 - 14 there was an elaborate procedure of data editing and mobility status assignments for persons who gave certain kinds of incomplete answers to the mobility questions (see Section A.2).

Estimates of totals were derived from the sample responses by a ratio estimation procedure that was a sophisticated version of the one used for the 1961 Census (see Stone, 1969, p. 329). The ratio estimation technique made use of population figures from the 100% count to inflate figures drawn from the sample counts. The estimate for the total population having a characteristic "x" is given by a formula that has the following general form:

$$N_x = C_x \cdot \left[\frac{N}{C} \right] \text{ where}$$

C_x is the sample count of persons with characteristic x; N/C is a weight; C is a function of the size of the sample; and N is a function of the size of the total population.

In principle, the functions N and C are defined for a particular subgroup of the population – e.g., males aged 20 - 34, and residing in Ottawa. The attributes in terms of which the subgroup is defined were all covered in the 100% of the census. Thus, the functions could be evaluated by simply letting N be the total number of enumerated members of the designated subgroup, while C is the portion that actually fell in the sample. However, when we sum N_x over all values of x and over all categories of the attributes that define the above-mentioned subgroup, we would not necessarily obtain the same total as the enumerated in the 100% count. To resolve this problem a multistep calculation was used to arrive at the chosen value of N/C.

The first step in the calculation of the weight, N/C, was the determination of a geographical level where agreement between sample estimates and comparable population counts was to be ensured. The next step was to specify the subgroups to which the estimator would be applied. The subgroups were defined in terms of individual cells of a cross-classification of variables: language (English, French or other), age, sex, marital status, whether or not a person's residence is a farm, a person's status within his/her family, and his/her family's composition. Weights were then calculated for each cell (defining a specific subgroup) of the cross-classification in such a way that selected sums (over cells) of the estimates equaled predetermined control totals drawn from the 100% census count. In order to achieve this result an iterative calculation algorithm was used (Nargundkar, 1971; and Brackstone, 1971). The final step in the calculation of the weights was the conversion of the weights to integers. This was an innovation from the 1961 Census data where fractional weights were accepted.

A.2. Data Editing and Imputation

The scale of data editing and imputation with regard to the migration questions was much greater with the 1971 Census returns than with those of the 1961 Census. There was substantial imputation of responses for many persons who failed to provide complete answers to the questions on migration. Generally, where the respondent failed to answer a portion (or the whole) of the migration questions an "artificial" answer was coded on his/her record (using a computer program).

A definite priority order was assigned to the source of the auxiliary information used to estimate the missing response. Firstly, related presumably correct information provided by the respondent was used. For example, if a person recorded that he/she immigrated to Canada in a year after 1966 (Question 12) then a portion of his/her response to the five-year migration question could be imputed.

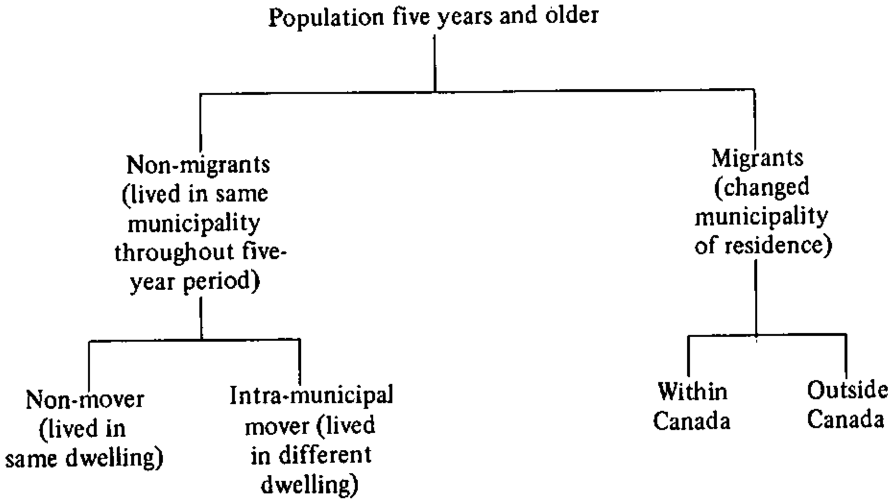
Secondly, presumably correct information provided by members of the pertinent respondent's family was used. Priority was given to close relatives where a match existed between certain information on a close relative's record and that on the respondent's record. For example if a spouse was found and if it was determined that the spouse and the respondent had the same date of first marriage, then the migration information recorded by the spouse was coded on the respondent's record, assuming that the latter was incomplete.

Thirdly, an "artificial" response was imputed from information given by the last respondent examined who had the same values on a specific set of variables (e.g., sex, age, and education) as those of the pertinent respondents.

A.3. Mobility Concepts

Question 26 on the 1971 Census questionnaire is the basis of several of the mobility concepts used in this report and in census bulletins. This question yields what are known as "five-year migration data", whose main features and limitations have already been outlined in Stone (1969, pp. 6 - 8, 329 and 330). In this study, the following network of migration concepts was used.

Migration Status



Migrants are persons who changed municipality of residence during the five-year period, 1 June 1966 - 1 June 1971;

non-migrants are persons who were living in the same municipality throughout the five-year period; and

intra-municipal movers are persons who were living in the same municipality throughout the five-year period but who were living in different dwellings on 1 June 1966 and 1 June 1971.

It is important to note that unlike the 1971 Census bulletins or the 1961 monograph on migration, this study includes in the category of migrants people who had changed municipality of residence at least once between 1 June 1966 and 1 June 1971, but who reported themselves as residing in the same municipality at both dates. Except for this difference, however, the concepts are the same as those used in 1971.

A.4. Evaluation of the Data

As a result of the edit and imputation procedure described in Section A.2, no totals of non-respondents from the census main file assuredly gives an adequate picture of the latter's attributes. To obtain that picture we would need a representative sample of the census records prior to the initiation of the imputation steps. Five per cent of the records were preserved in the form they had before the initiation of the computer edit procedure. However, difficulties in accessing the file of unimputed data and peculiarities in the format of the data on this file, preclude the analysis of these records within the time and other resources available for the production of this monograph. The records could not truly be described as unedited because they have been subjected to some clerical editing procedures. In consequence, no 1971 Census tables similar to the key tables shown in Appendix B of the author's 1961 Census monograph are available. We are simply unable at this time to comment substantially on the possible biases in the census migration data due to incomplete response to the migration questions.

As was the case at the time of writing the 1961 Census migration study, the data quality evaluation studies for the 1971 Census migration data are not available (cf. Norland, *et al.*, 1977). The possible types of evaluation and the relevant sources of error have been previously outlined in Stone (1969, pp. 330 and 331).

It is hoped that a 1971 Census Evaluation Study that includes the quality of responses to the migration questions may be undertaken in due course, perhaps based on a sample of unedited records obtained from the original questionnaires.

APPENDIX B

CATEGORIZATION OF ATTRIBUTES

The specification of variables has been guided by the requirement that all variables be represented as polytomies, and by concern for economy in running the various tests. Accordingly, relatively crude categorization is used for certain of the attributes. However, based on past experience in research using these attributes, it is believed that the categories chosen will capture most of the crucial aspects of the pattern of population distribution for each attribute chosen. Ideally, the general pattern of the results of statistical analysis should be tested for sensitivity to reasonable alterations of attribute categories.

Two factors helped to dictate the chosen detail of categorization. Firstly, the computer core storage area available for running the analysis program limited the input matrix size. Secondly, detailed categorizations of such variables as occupation and schooling would have provided unduly large matrices of "effect" measures, given the relatively small number of observations. It was assumed that although the categorization of a variable like occupation is inadequate by itself, when we consider the simultaneous cross-classification of occupation and other variables we should be able to achieve a good deal of "variance explaining power" that a more detailed breakdown of occupation alone would provide.

The need for relatively crude categorizations of variables in any problem where a large number of variables is involved, and the sensitivity of the results of the analysis to the specific categorization chosen, is an important limitation of the analysis of contingency tables. No multivariate analysis procedure is without limitations, however, and the one chosen here does have significant advantages that should be balanced against its shortcomings (see Goodman, 1972).

The following is a list of the sample universe and the attributes used in Chapter 3, showing the relevant categorizations.

Sample Universe

Persons aged 20 - 64 in 1971, not attending school in the 1970 - 71 school year, who worked in 1970 and who resided in Canada on 1 June 1966.

Attributes

Number of Inter-municipal Moves (4)

No moves in past five years

Moved once in past five years

Two moves in past five years

Three or more moves in past five years

Occupation (5)

Managerial, administrative, and related occupations

Professional and related occupations

Clerical, sales and service (excluding Armed Forces) occupations

Processing occupations, machining and product fabricating, assembling and repairing occupations, construction trades occupations, and transport operating occupations

All other occupations (excluding not stated)

Level of Schooling (3)

Less than Grade 12

Grades 12 and 13 and non-university

Some university and university degree

Age (3)

20 - 34 years

35 - 49 "

50 - 64 "

Marital Status (2)

Married, spouse present

Other

Marital Status by Date of First Marriage (5)

Never married

Married, spouse present, and first marriage before 1 June 1966

Married, spouse present, and first marriage on or after 1 June 1966

Other marital status, and first marriage before 1 June 1966

Other marital status, and first marriage after 1 June 1966

Province of Birth Status (2)

Province of residence on 1 June 1966, same as province of birth

Province of residence on 1 June 1966, different from province of birth

Mother Tongue (3)

English

French

Other

Sex (2)

Male

Female

APPENDIX C

MULTIPLICATIVE POWER MODELS FOR THE MULTIVARIATE ANALYSIS OF CONTINGENCY TABLES

The purpose of this appendix is to supplement the methodological discussion provided in Chapter 3 and offer further information about the type of analysis that is being used. A variety of features of the chosen technique of analysis are outlined briefly. For reasons of economy, a more complete discussion cannot be provided here. Further details are provided in Stone (1976a); Bishop, Fienberg and Holland (1974); and Goodman (1972, 1973a, 1973b).

The method whose features are outlined in this appendix is designed for use when a problem of explanatory analysis arises with data that are in the form of cross-tabulations (contingency tables). When such a problem arises, there should, where feasible, be a substantive theory that served to rationalize either by strict deduction or plausible argument a specific explanatory model.[1]

Typically, the model is then applied empirically in the multivariate analysis of a contingency table, where it postulates a definite set of dependent attributes and some specific causal ordering among these and a set of explanatory attributes.[2] A variable may be explanatory in one equation but dependent in another. Use of the model may serve a variety of objectives, one of them being to see how well the distribution of a population over categories of the dependent attributes can be predicted from defined and estimated statistical "effects" of the explanatory attributes. Another possible objective may be to compare the fit or predictive performance of a model that assumes a specific pattern of relationship between the dependent distributions and values of selected explanatory attributes with that of a null model that denies any such dependence. Yet another kind of aim would be to use variants of the model to examine the strength and pattern of the contributions of individual explanatory attributes to the performance of the model. A combination of one or more of these objectives may be pursued in a given empirical analysis. The results of such analysis would ideally involve revision and/or elaboration of the theory.

The concepts of dependent distribution, nth-order conditional proportions, and effect measures are central to the exposition which follows.

In this text the term "distribution" designates a set of proportions that indicate the relative sizes of the parts of a given whole. The proportions therefore add to 1.0 – e.g., the proportions of a selected sample in categories of educational attainment. A distribution may be hypothesized as being dependent upon the effects of specified attributes.

See footnote(s) on page 124.

What is meant by the concept that a distribution is a "dependent variable" with respect to a set of specified "explanatory attributes"? One way of dealing with this question is to indicate a type of statistical observation a person would expect to make when the dependence "exists" in a suitably chosen body of data. The hypothesis of dependence implies that one will observe systematic changes in the distribution as one ranges over substantially different combinations of values on the chosen explanatory attributes. However, to make such an observation we are forced for practical reasons to specify arbitrary categorizations of the ranges of each of the attributes. The detailed results of any subsequent statistical analysis will assume the chosen categorizations as being given. It is advisable to test the sensitivity of major findings from the analysis to reasonable variations in the categorization of the selected attributes. Partly on the basis of substantive theory, changes in the "dependent" distribution are assumed to be the results of specified "effects" of the "explanatory" attributes. Under certain assumptions, it is possible to define measures of parameters that reflect these effects and to state the overall relationship between the effects and the "dependent" distribution in terms of a "model" that can be given mathematical expression.

The effect measures are defined as ratios of conditional proportions. A conditional proportion may be of the nth-order ($n = 0, 1, 2, \ldots$). A proportion is a ratio whose denominator is the aggregate of a particular group in the population and whose numerator is a **subset** of that group. A **condition** applies when a member of the population can be counted in the denominator only if he or she has a specified set of values on particular attributes. For example, the proportion that moved once among university-educated males aged 20 - 34 is a third-order conditional proportion, because three attributes (sex, age, and education) were cited in identifying the denominator of the proportion. Generally, the order of the condition is the number of attributes involved in specifying requirements for membership in the group that comprises the **denominator** of the proportion. "**Zero-order conditional proportion**" means a proportion whose denominator is the total sample size for the analysis in question. Evidently, the order of a conditional proportion depends upon the chosen universe of discourse.

Generally, a **zero-order effect** is measured by the ratio of a first-order conditional proportion to a zero-order proportion. An nth-order partial effect is the ratio of an (n+1)th-order conditional proportion to an nth-order conditional proportion. More formal definitions follow:

Let "$Pr(Y_i)$"	mean the proportion of the entire sample that has the value i on attribute Y.
Let "$Pr(Y_i \mid X_j)$"	mean the conditional proportions who have the value i on attribute Y among those who have the value j on attribute X.
Let "$Pr(Y_i \mid X_j, U_k)$"	mean the conditional proportions who have the value i on attribute Y among those who have the value j on X and the value k on U.

The measure chosen to reflect the zero-order effect of X_j on Y_i is $Pr(Y_i|X_j)/Pr(Y_i)$. Speaking loosely, this measure indicates the extent to which our "prediction" (or the statistical probability) of Y_i is changed when we assume X_j compared with the case when we do not assume X_j. The more our knowledge of X_j alters this "prediction" the greater is the zero-order effect of X_j.

Whenever an effect is insignificant, its measure diverges from 1.0 by a negligible amount. Thus if we hypothesize that a particular effect is insignificant we simply fail to specify it when the model is formulated.

Although the phrase, "interaction effect", will often be used for the sake of convenience it will sometimes be preferable to refer to the "nth-order partial effect" of an explanatory attribute upon the specified dependent attribute, given specific values of a particular set of other explanatory variables. The measure that is chosen to reflect the first order partial effect of U_k on Y_i, given X_j, is $Pr(Y_i|X_jU_k)/Pr(Y_i|X_j)$. This measure tells us how much the additional knowledge, U_k, should alter our "prediction", or the statistical probability of Y_i given that we already know X_j. The alteration of our prediction is a result of the interactive effect of X_j and U_k upon Y_i. The more this ratio diverges from 1.0 the greater is the partial effect of U_k on Y_i given X_j. When this ratio is equal to 1.0 the partial effect is insignificant. An effect of a given order is a weighted average of certain of the effects at the next higher-order, generally.

A statistical hypothesis about the direction of an effect is easily accommodated. We merely think in terms of whether the presence (or absence) of a specific explanatory attribute value will increase or decrease the statistical probability of a given value of the dependent attribute. In dealing with the first order term $Pr(Y_i|X_jU_k)/Pr(Y_i|X_j)$, for example, we can formulate and test the hypothesis that the addition of condition U_k to X_j will increase the statistical probability of Y_i – a hypothesis that this term exceeds 1.0 significantly. By articulating a network of hypotheses of this sort we can readily extend the explanatory model to include the incorporation of notions about directions of co-variation between the dependent attribute and other variables in the model. We could go even a step further and specify a functional relation between expected values of the dependent attribute and the given values of the explanatory ones. This point is elaborated in Stone (1976a).

A model is normally expressed as a function of the product of selected effect measures. What happens when the model is applied to data may be summarized by a rough analogy with analysis of variance. In this analysis, variance is partitioned into components according to a network of defined "between and within group" variations. In multivariate contingency table analysis we first develop the concept of the expected frequency distribution over the cells of a defined contingency table. The model that is specified usually on the basis of substantive theory, partitions the expected frequency of a cell (or a transformation of this frequency) into components that are viewed as measures of specified effects of attributes that are represented in the dimensions of the contingency table. A concrete application of the model involves estimation of the effect measures and "prediction", in terms of the model, of the expected frequency distribution over cells of the table. On the basis of various comparisons of observed and expected frequency distributions several tests are then conducted. The general statistical analysis strategy that has been outlined is amply illustrated in the recent literature on "new" techniques for multivariate analysis of contingency tables. Several mathematical statisticians have contributed to the literature, and the reader may find it helpful to consult Goodman (1970, 1972, 1973a, and 1973b); Fienberg (1970, 1972, and 1973); and Bishop, Fienberg and Holland (1974), as well as the references cited by these authors. Drawing heavily on this literature, the general form of the kind of statistical model outlined above will be indicated in Section C.1.

We will define effect measures following the outline of the general form of the statistical model. These measures are different from those encountered in the literature (although under certain conditions they are simple transformations of Goodman's (1972 and 1973) odd ratio effect measures). Where there is a specified dependent attribute (with the other attributes being treated as explanatory), the effect measures introduced in this appendix have the advantage of being interpretable, in substantive terms, more simply than those previously encountered in the literature.

The specific type of model used here is not widely discussed in the literature. This type is designed for the situation in which there is a specified dependent attribute and a set of explanatory ones. Goodman (1973b) deals with this situation in terms of "logit-type" models, and excepting the use of a derivation procedure (outlined below) that gives rise to fractional powers of the effect measures, the model discussed in this paper is very similar to the logit-type model discussed by Goodman (1973b) and other (cf. Bishop, 1969).

C.1. General Form of Single-equation Models

For the sake of brevity let us assume that our theory postulates that a dependent attribute Y, is a function of explanatory attributes X, U, and Z. Let "F_{ijkh}" be the expected number of observations in cell (Y_i , X_j , U_k , Z_h) if the specified model is correct, and let "T(F_{ijkh})" be some transformation of F_{ijkh} . T(F_{ijkh}) is the dependent variable of the single-equation model, and it is to be distinguished from the dependent attribute Y (see footnote 1).

Let "M(X)" mean the defined zero-order effect of attribute X on the dependent variable and "I(X,U)" be the defined "interaction" effect of variables X and U on the dependent variable. It should be noted that "M" and "I" have not yet been defined. One strategy of analysis is to "derive" from the theory (by deduction or plausible reasoning) the hypothesis that T(F_{ijkh}) can be adequately "predicted" by a function that includes zero-order effects and selected higher-order effects of the explanatory attributes on the dependent variable.

In terms of the foregoing symbols an example of the general form of a statistical model could look as follows:

$$T(F_{ijkh}) = \left[M(X_j) \cdot M(U_k) \cdot M(Z_h) \cdot I(X_j\,, U_k) \cdot I(U_k\,, Z_h) \right]^{\beta} \cdot \lambda_{ijkh} \qquad (4)$$

The symbol λ_{ijkh} refers to an adjustment factor whose definition will depend on the precise definitions of "M", "I", and "$T(F_{ijkh})$". The symbol β refers to a parameter. (In most special cases of the general form that are discussed in the literature, $\beta = 1$.)

In the illustrative general-form expression (4), the first three terms on the right-hand side represent zero-order effects of the explanatory attributes on the dependent variable. The following two terms on the right-hand side represent two higher-order effects of explanatory attributes on the dependent variable. This particular model in general form involves the postulate that the interaction effects $I(X_j\,, Z_h)$ and $I(X_j\,, U_k\,, Z_h)$ are insignificant, and that is why they are not shown in (4). An illustrative special case of the general form is given by the following expression:

$$\hat{Pr}(Y_i | X_j U_k Z_h) = Pr(Y_i) \left[\frac{Pr(Y_i | X_j)}{Pr(Y_i)} \cdot \frac{Pr(Y_i | U_k)}{Pr(Y_i)} \cdot \frac{Pr(Y_i | Z_h)}{Pr(Y_i)} \right]^{1/3}$$

$$\cdot \left[\frac{Pr(Y_i | X_j U_k)}{Pr(Y_i | X_j)} \cdot \frac{Pr(Y_i | U_k Z_h)}{Pr(Y_i | U_k)} \right]^{1/3} \cdot \lambda_{ijkh} \qquad (5)$$

The set of ratios in the first pair of brackets on the right are the zero-order effects that are postulated as being significant. The ratios in the second pair of brackets are those that measure the first-order effects postulated as being significant. The term λ_{ijkh} is an adjustment factor (its definition is discussed below). The first-order effect $Pr(Y_i | Z_h X_j)/Pr(Y_i | Z_h)$ is hypothesized as being insignificant and thus it is not specified in the model. The superscript "^" over a term means an estimate. The terms on the right-hand side of (5) are parameters that must also be estimated from data.

The illustrative expression (1) that was given in Section 3.2 is another special case of the general form (4) indicated above. For the purpose of convenient reference and identification among the various special cases discussed in the literature (cf. Bishop, Fienberg and Holland, 1974; and Goodman, 1972), we shall call the types of cases being discussed here "multiplicative power models" (or, still shorter, "power models"). The term "power" is used because the parameter in expression (4) will not usually be equal to 1.0 in the case discussed below.

Instead it will generally be a fraction (see Section C.2 for related discussion), so that all effect measures specified in a model of the type discussed below enter the model after being raised to fractional power.

C.2. Steps in Specifying a Model

The role of relevant substantive theory in formulating a specific case of the general model just illustrated is crucial. As already noted, the substantive theory is involved in the specification of the list of explanatory attributes, given the dependent attribute. The theory must also be employed to postulate which are the insignificant effects that, because of their postulated insignificance, will not be included in the formulation of the explanatory model. It will be seen below that, for a particular kind of model, the substantive theory must be used in selecting the appropriate alternative among a small variety of somewhat different ways of measuring a given effect. The various ways in which substantive theory is relevant may briefly be outlined in the following list of steps in specifying a multiplicative power model.

1. A substantive theory should at least be sketched so that it implies (by deductive argument) or strongly suggests (by plausible argument) that Y is a function of X, U and Z. (There are problems connected with the omission of important explanatory variables that are substantially independent of X, U and Z.)

2. The substantive theory should strongly suggest which of the possible zero-order and higher-order effects are significant. These are the effects that will be specified in the model.

As regards a zero-order effect, $Pr(Y_i|X_j)/Pr(Y_i)$ for example, we should specify it in the model if the theory implies or strongly suggests that there is a substantial direct effect of X on Y whose direction and strength are not greatly altered by values assumed by the other variables in the model. That is, even after we take into account the interactive effects of X with other explanatory variables upon Y, there remains, in theory, a substantial effect that is due to X alone among the other variables included in the model.

As regards the first-order interactive effect, $Pr(Y_i|X_jU_k)/Pr(Y_i|X_j)$ for example, we should specify it in the model if the theory implies or strongly suggests that there is a marked substantive effect of U which depends on the value that X assumes. It is possible for this "intermediation" of X between Y and U to exist even though there is also a substantial direct effect of U on Y.

It is readily observed that instead of $Pr(Y_i|X_jU_k)/Pr(Y_i|X_j)$ one could use $Pr(Y_i|X_jU_k)/Pr(Y_i|U_k)$ as a measure of the interactive effect of X and U upon Y. These two ratios will generally not have the same value. Again it is the substantive theory that ought to indicate which is the appropriate ratio for use in a given model. The theory should imply or strongly suggest the "order of causal priority" between X and U. If X has "causal priority" over U, according to the theory, then U enters into the determination of Y after the effect of X is established; and the appropriate alternative, among the two ratios indicated above, is $Pr(Y_i|X_jU_k)/Pr(Y_i|X_j)$.

If the substantive theory is unable to indicate the order of causal priority between X and U then the interaction effect should be defined as

$$\left[Pr(Y_i|X_jU_k)\right]^2 \Big/ \left[Pr(Y_i|X_j) \cdot Pr(Y_i|U_k)\right] .$$

That is, both ratios should be included in the model. However, when this is done we must not separate the two ratios when partitioning the chi-square of the model to measure the contributions of different effects (see Section C.4). Also, the interaction term must now be interpreted as measuring the joint effect, in the prediction of Y, of (a) additional knowledge of X given U; and (b) additional knowledge of U given X.

Major reliance on the substantive theory is also required when the model is applied to a given body of data and the effects are estimated. This reliance involves the important distinction between statistical significance and substantive significance. If X is highly correlated with Z, and Z determines both X and Y, then both $Pr(Y_i|Z_h)/P_r(Y_i)$ and $Pr(Y_i|X_j)/Pr(Y_i)$ can diverge far from 1.0. In this case, the latter ratio is likely to be reasonably considered substantively insignificant (in more traditional terms, the correlation between X_j and Y_i is spurious). Fortunately, if both Z_h and X_j are included in the model as explanatory variables for Y_i, an analysis of their contributions by partitioning the chi-square of the model will reveal their high intercorrelation (see Section C.4).

Also, if $Pr(Y_i|X_j)/Pr(Y_i)$ is included in the model but is very close to 1.0 in value, it does not follow that X_j is substantively insignificant. It is possible for the zero-order effect of X_j to be insignificant because the higher-order effects of which it tends to be an average have sharply differing "directions" of relationship with Y_i. However, in this case ideally these sharply differing higher-order effects should have been anticipated by the substantive theory.

Also it is possible for $Pr(Y_i|X_jU_k)/Pr(Y_i|X_j)$ to diverge sharply from 1.0 even though in the real world there is in fact no interactive effect of X with U upon Y. This result can occur when $Pr(Y_i|X_jU_k) = Pr(Y_i|U_k)$ and $Pr(Y_i|U_k)$ diverge sharply from $Pr(Y_i|X_j)$. In this case either the substantive theory that led to the insertion of $Pr(Y_i|X_jU_k)/Pr(Y_i|X_j)$ into a model must strongly imply that there is an interactive effect of X with U upon Y or the existence of this effect should be verified from inspection of the data (i.e., we should verify that $Pr(Y_i|X_jU_k) \neq Pr(Y_i|U_k)$ if we propose to use $Pr(Y_i|X_jU_k)/Pr(Y_i|X_j)$ as a measure of the interactive effect of X with U on Y).

In sum, substantive theory plays a crucial role in specifying the model. Thus, in this type of analysis, we would not use the given data for the purpose of deciding which one of a set of alternative models is substantively the most correct. However, by exploring alternative models that yield different statistical results, and by examining the pattern of deviations between the observed and the predicted values of $Pr(Y_i|X_jU_kZ_h)$, we can develop information that is useful in improving the theory for future applications.

3. Having specified the explanatory attributes and their significant effects, the next step is to specify the form of the model in which these effects appear. In this paper, the "multiplicative power model" form is used, based on the strategy of partitioning a conditional proportion that is illustrated below. We apply this strategy to find the value of the exponent β in the general model given by equation (4). The value of this parameter is given by the minimum number of different partitionings needed to include all the effects specified as being significant. For example, $Pr(Y_i|X_j)/Pr(Y_i)$ and $Pr(Y_i|U_k)/Pr(Y_i)$ cannot properly appear in the same partitioning of $Pr(Y_i|X_jU_kZ_h)$. At least two partitionings are required to properly include both terms in the model. The precise nature of each member of the minimum set of partitionings needed to form the model is somewhat arbitrary; but because at the end of the partitioning process the model shows only those effects specified by the substantive theory, the problem of arbitrary partitioning eventually disappears. (Of course, the problem of arbitrary categorization of each attribute does not disappear.)

In this appendix we shall provide the mathematical rationalization for an expression like (5) shown above. The simple procedure will be described for the case of three explanatory attributes and one dependent attribute. It is applicable in principle to any finite number of explanatory variables, although it will be obvious to the reader that the formal derivation steps become rather tedious, when we have more than six such variables involved.

Generally, the strategy involves formulating statements that are true by definition. (The procedure is roughly analogous to the explication of partial derivatives in regression analysis.) Each of these statements is called a "partitioning" of the dependent variable. For example, using the notation introduced earlier in this paper, one partitioning of the conditional proportion $Pr(Y|XUZ)$, dropping the subscripts and assuming them to be understood in the remainder of the following discussion, is:

$$Pr(Y|XUZ) = Pr(X) \cdot \frac{Pr(Y|X)}{Pr(X)} \cdot \frac{Pr(U|YX)}{Pr(U|X)} \cdot h_1 \qquad (6)$$

$$\text{Where } h_1 = Pr(Z|YUX)/Pr(Z|UX) \qquad (7)$$

Also

$$Pr(Y|XUZ) = Pr(U) \cdot \frac{Pr(Y|U)}{Pr(U)} \cdot \frac{Pr(Z|YU)}{Pr(Z|U)} \cdot h_2 \qquad (8)$$

$$\text{Where } h_2 = Pr(X|ZYU)/Pr(X|ZU) \qquad (9)$$

Conditional proportions have the same mathematical properties as finite conditional probabilities.

$$Pr(U|YX)/Pr(U|X) = Pr(Y|UX)/Pr(Y|X) \tag{10}$$

Following the same procedure as that used to establish (10) we can thus rewrite (6) and (8) as follows:

$$Pr(Y|XUZ) = Pr(Y) \cdot \frac{Pr(Y|X)}{Pr(Y)} \cdot \frac{Pr(Y|UX)}{Pr(Y|X)} \cdot h_1 \tag{6a}$$

$$= Pr(Y) \cdot \frac{Pr(Y|U)}{Pr(Y)} \cdot \frac{Pr(Y|ZU)}{Pr(Y|U)} \cdot h_2 \tag{8a}$$

We seek the minimum number of partitionings of Pr(Y|XUZ) that properly include all the effects specified as being significant by equation (5). (Notice from (6a) and (8a) that Pr(Y|X)/Pr(Y) and Pr(Y|U)/Pr(Y) cannot properly appear in the same partitioning.) Expressions (6a) and (8a) already exhibit four of the five effects mentioned in (5). To cover the other effect we can use:

$$Pr(Y|XUZ) = Pr(Z) \cdot \frac{Pr(Y|Z)}{Pr(Z)} \cdot h_3 \tag{11}$$

$$= Pr(Y) \cdot \frac{Pr(Y|Z)}{Pr(Y)} \cdot h_3 \tag{11a}$$

Where a possible value of h_3 is:

$$h_3 = \frac{Pr(X|YZ)}{Pr(X|Z)} \cdot \frac{Pr(U|XYZ)}{Pr(U|XZ)} \tag{12}$$

By asserting only the effects indicated in equation (5) the model is in effect hypothesizing that the product of the higher-order effects ($h_1 \times h_2 \times h_3$) is insignificant. Replacing this product by the adjustment factor λ, and then taking the product of both sides of equations (6), (8) and (11a) we arrive at expression (5) explicitly. The net effect of this derivation procedure is merely to establish the value of the general exponent β, which is one-third in this case.

It should be noted that the rationalization procedure outlined above shows that it is not quite correct to refer to (5) only as "the model". In fact, the model also includes the auxiliary explicit hypothesis that $h_1 \times h_2 \times h_3 \cong 1$. In these terms we may view the test of the performance of the model to be implicitly a test of this hypothesis. (In regression analysis the effects that are assumed to be zero are also not explicitly set forth in asserting the model. Thus calling (5) "the model" follows an established precedent, although the explication that is conducted in the partitioning procedure is helpful in clarifying the full extent of the assertions being made in setting forth an expression like (5).)

C.3. Estimation Procedures

Except for computational difficulties that arise with the more complex models that may be devised, estimation of effect measures and the "predicted" dependent distributions is fairly routine using an electronic computer. One procedure involves simplifying the model to reveal its minimal set of conditional proportions.

The procedure can be exemplified by using the illustrative expression (5). Expression (5) can be simplified to reveal the following form:

$$\hat{Pr}(Y_i|X_jU_kZ_h) = \left[Pr(Y_i|Z_h) \cdot Pr(Y_i|X_jU_k) \cdot Pr(Y_i|U_kZ_h)\right]^{1/3} \cdot \lambda_{ijkh} \quad (5a)$$

Inserting proportions estimated from a given sample this expression can be re-written as:

$$\hat{Pr}(Y_i|X_jU_kZ_h) = \left[\frac{N_{i..h}}{N_{...h}} \cdot \frac{N_{ijk.}}{N_{.jk.}} \cdot \frac{N_{i.kh}}{N_{..kh}}\right]^{1/3} \cdot \lambda_{ijkh} \quad (5b)$$

where,

"$N_{i..h}$" is the number of observations with the attributes (Y_i, Z_h)

"$N_{...h}$" is the number of observations with the attributes (Z_h)

"$N_{ijk.}$" is the number of observations with the attributes (Y_i, X_j, U_k)

"$N_{.jk.}$" is the number of observations with the attributes (X_j, U_k)

"$N_{i.kh}$" is the number of observations with the attributes (Y_i, U_k, Z_h)

"$N_{..kh}$" is the number of observations with the attributes (U_k, Z_h)

Under a wide class of simple sampling schemes the ratios in (5b) are maximum likelihood estimates of the corresponding ratios in (5a). (See Goodman, 1970; Bishop, Fienberg, and Holland, 1974, Chapter 3.)

Then the expected cell frequencies generated by the model are:

$$\hat{F}_{ijkh} = \hat{Pr}(Y_i|X_jU_kZ_h) \cdot N_{.jkh} \quad (13)$$

Using (5b) and (13) we can compute the estimated expected frequencies for all cells in the table. Using these estimated expected frequencies we can then compute the effect measures as defined in expression (5). For example,

$$\frac{Pr(Y_i|X_j)}{Pr(Y_i)} = \frac{(\sum_{kh} \hat{F}_{ijkh})/(\sum_{ikh} \hat{F}_{ijkh})}{(\sum_{jkh} \hat{F}_{ijkh})/(\sum_{ijkh} \hat{F}_{ijkh})} \quad (14)$$

$$\frac{Pr(Y_i|X_jU_k)}{Pr(Y_i|X_j)} = \frac{(\sum_h \hat{F}_{ijkh})/(\sum_{ih} \hat{F}_{ijkh})}{Pr(Y_i|X_j)} \qquad (15)$$

where the formula for $Pr(Y_i|X_j)$ is shown in (14).

When variants of the asserted model (5) are to be applied, it will often be convenient to work directly with (5) rather than with (5a). Such variants are normally specified by setting equal to one some of the effect as measures indicated in the asserted model, expression (5) in this case. In order to work directly with (5), the effect measures are first computed directly from the selected sample data, using expressions like (14) and (15) but replacing expected frequencies with observed frequencies. Then the expected frequencies are calculated using expression (13).

A generalized computer program for handling most kinds of power models and usable by persons with minimal knowledge of programming has been developed. It is available for a nominal fee payable to the Receiver General for Canada, by writing to the author. The user can elect to modify this program to take care of the less common kinds of power models. The common kinds are those in which every effect measure is raised to the same power, and the denominator of each effect measure is comprised of one conditional proportion. The less common kinds violate one or both of these conditions; but they still present no insurmontable computing problems.

It should be noted that the tabulation used to estimate the observed frequencies that are used to test the fit of the model need not be the one used to estimate the effect measures. These measures are defined as ratios of conditional proportions, and the definitions imply no restrictions as to the data source for estimates. As a result, it is easy to deal with problems in which it is advantageous to estimate effect measures from sources other than the table that contains the observed joint distribution of the population among categories of the explanatory and the dependent attributes. When such independent sources are used it seems quite legitimate to speak of predicting the dependent distributions from estimated parameters of the composition of population with respect to the explanatory attributes.

Following the estimation procedures outlined above, a model like (5) can be used to generate the expected values of F_{ijkh}, and from these and their corresponding observed values a chi-square statistic can be computed. Before we can do so, however, the adjustment factor λ_{ijkh} must be defined. One approach is to respecify λ_{jkh} as λ_{ijkh} and define it in terms of the following symbols.

Let "$\hat{P}r(Y_i|X_jU_kZ_h)$" be the value that is predicted by the model **without** the use of λ_{jkh}.

Then define:

$$\lambda_{jkh} = 1/\sum_i \hat{P}r(Y_i | X_j U_k Z_h). \qquad (16)$$

In other words, we specify the adjustment factor so that the sum of the predicted conditional proportions over the domain of Y is 1. This procedure causes us to lose an "error minimizing" criterion in the procedure for estimating the model; but this should not be a serious problem since the critical "performance" of the model is eventually assessed relative to a specified "null" model rather than relative to the observed cell frequencies (i.e., the critical assessment is not the usual goodness of fit test).

C.4. Hypothesis Testing

Goodman has provided several useful discussions of the procedures for hypothesis testing by means of the tactic of partitioning chi-square (Goodman, 1970, pp. 247 - 249; Goodman, 1972, pp. 1049 - 1056; and Goodman, 1973b, pp. 181 - 183). This paper offers an introductory commentary on the procedures only because the nature of the appropriate tests for the kind of model discussed in this appendix are not immediately obvious from a study of the cases covered in Goodman's discussions.

All of the tests envisaged in this discussion involve comparisons of estimated expected cell frequencies with observed cell frequencies for the contingency table in question. The initial test may be of the goodness of fit of the model – a test of how closely the estimated expected and the observed frequencies match. Typically, this is a routine test that involves merely the calculation of an appropriate chi-square statistic. However, this is not the critical test.

To envisage the critical test clearly, the more familiar procedures in regression analysis may be cited. In this analysis the critical test of the overall performance of the model involves the question of the proportion of the variance of the dependent variable that is accounted for by the explanatory ones. A relevant measure is R^2, and in regression analysis we ask whether R^2 is significantly greater than zero. Now, zero R^2 is observed when there is no systematic relation between the dependent and the explanatory variables. Thus we do not ask how significant is the divergence of the "predicted" from the observed values of the dependent variable (which is the question "asked" in the initial goodness of fit test mentioned above). Instead we ask how much of an improvement in "prediction" we have when we use the specified model as compared with the assumption that there is no relation (zero systematic covariation) between the dependent and the explanatory attributes.

What we need then is a specified null hypothesis, and a value of the chi-square statistic associated with it. Since the model essentially postulates that Y_i is dependent on (X_j, U_k, Z_h) in a certain way, a suitable null hypothesis is that there is no such dependence. The appropriate test of the performance of the model examines whether the chi-square statistic associated with the model is substantially lower than the chi-square statistic associated with the null hypothesis. In order to conduct this test we will have to derive the model that is implied by the null hypothesis, compute the estimated expected cell frequencies implied by this model, and then compute the associated chi-square statistic. In the case of the model which (5) expresses, the corresponding null hypothesis would be given by:

$$\hat{P}r(Y_i|X_jU_kZ_h) = Pr(Y_i) \tag{17}$$

Hence, from (15) the estimated expected cell frequencies under the null hypothesis are given by:

$$\hat{F}_{ijkh} = N_{ijk.} Pr(Y_i) \cdot \lambda_{ijkh} \tag{18}$$

$$= N_{ijk.}(N_{i...}/N_{....}) \cdot \lambda_{ijkh} \tag{19}$$

where "$N_{i...}$" is the number of observations with attribute Y_i and "$N_{....}$" is the total number of observations.

Let "χ^2 (m)" mean the chi-square statistic associated with the model and "χ^2 ($\tilde{m}$)" be the chi-square statistic associated with the null hypothesis. Then the statistic that tests the performance of the model is $\chi^2(\tilde{m}) - \chi^2(m)$ and its number of degrees of freedom is equal to the difference between the numbers of degrees of freedom associated with $\chi^2(\tilde{m})$ and $\chi^2(m)$, respectively.

We can get into some minor complications when we wish to test the significance of individual effects. In principle, to test the significance of a given effect we can start with the original model and then derive the modified model that is implied by assuming the effect to be insignificant. Then if the chi-square statistic associated with the modified model is significantly larger than that associated with the original model the effect in question would be judged to be significant. In some cases it is quite a routine matter to set a particular effect measure in the original model equal to one, and immediately derive the modified model. However, often one particular effect measure is necessarily interrelated with others and it cannot be set equal to one without altering the values of the others. In these cases the proper test of significance for a single effect may not be immediately obvious. These concepts will now be illustrated using the model expressed by (5).

Consider, for example, the two effect measures $Pr(Y_i|U_kZ_h)/Pr(Y_i|U_k)$ and $Pr(Y_i|Z_h)/Pr(Y_i)$ in expression (5). The zero-order effect, the latter, is an average of higher-order effects and thus should not be set equal to 1 while leaving related higher-order effects unchanged. Thus, in dealing with these two effects we need to initially test the first-order effect. In this particular model we can set $\Pr(Y|UZ)/\Pr(Y|U) = 1$ without getting into much difficulty. When this is done the derived modified model becomes

$$\hat{\Pr}(Y_i|X_jU_kZ_h) = \left[\Pr(Y_i|X_jU_k) \cdot \Pr(Y_i|U_k) \cdot \Pr(Y_i|Z_h)\right]^{1/3} \cdot \lambda_{ijkh} \qquad (20)$$

Let χ^2 (m_1) be the chi-square statistic associated with this model. Then the significance of the interaction effect $\Pr(Y_i|U_kZ_h)/\Pr(Y_i|U_k)$ depends on the extent to which χ^2 $(m_1) - \chi^2$ (m) is greater than zero; and again the degrees of freedom for the difference between the two chi-square values is given by the difference between the degrees of freedom for χ^2 (m_1) and χ^2 (m), respectively.

The situation gets slightly more complicated when we want to test the zero-order effect $\Pr(Y_i|Z_h)/\Pr(Y_i)$ for significance. As noted above we cannot simply set this ratio equal to 1 without constraining $\Pr(Y_i|U_kZ_h)/\Pr(Y_i|U_k)$ and the appropriate constraint is by no means obvious. To circumvent this problem we may assume that the difference between χ^2 (m_1) and the chi-square statistic associated with the model that assumes both the zero- and higher-order effects to be insignificant is a measure of the contribution of the main effect.

For the latter model we assume $\Pr(Y|UZ)/\Pr(Y|U) = \Pr(Y|Z)/\Pr(Y) = 1$; i.e., both effects are simultaneously insignificant. Applying this assumption to (5), the derived modified model (model M_2) is

$$\hat{\Pr}(Y_i|X_jU_kZ_h) = \left[\Pr(Y_i|U_kX_j) \cdot \Pr(Y_i) \cdot \Pr(Y_i|U_k)\right]^{1/3} \cdot \lambda_{ijkh} \qquad (21)$$

Let "χ^2 (m_2)" be the chi-square statistic associated with model M_2 given by (21) above. Then the significance of the zero-order effect $\Pr(Y_i|U_k)/\Pr(Y_i)$ depends on the extent to which χ^2 $(m_2) - \chi^2$ (m_1) is greater than zero; and again the degrees of freedom for the difference between the two chi-square values are given by the difference between the degrees of freedom for χ^2 (m_2) and χ^2 (m_1), respectively.

In short, in this case the zero-order effect may be considered as being a nested effect; and its significance cannot be assessed by merely setting its measure equal to one. In general, any effect (in a postulated model) that is an average of higher-order effects that were also specified in that same model is a nested effect, and its significance has to be tested by roundabout routes similar to that outlined for the zero-order effect.

The general upshot is that tests of effects must be conducted in a definite order, starting with higher-order effects and going to intrinsically related lower-order effects. Also as soon as we reach a nested effect its significance has to be tested by the indicated route. However, using the general procedures just outlined we can assess performance of the model as a whole and then of all effects postulated as being significant. A complete battery of tests is thus available. For important related discussion see Goodman (1970, 1972, and 1973b).

C.5. Coefficients of Association

Measures of degree of goodness of fit of the model in terms analogous to multiple correlation, and of the overall contribution of individual effects in terms analogous to partial correlation, have been presented by Goodman (1972, pp. 1056-1058). They are quite applicable in the approach outlined in this paper. A few examples are given below, based on the chi-square statistic defined above.

The degree of goodness of fit of the model presented by (5), pursuing the illustration explored above, is measured by

$$0 \leqslant \frac{\chi^2(\bar{m}) - \chi^2(m)}{\chi^2(\bar{m})} \leqslant 1 \tag{22}$$

The overall relative contribution of effect $Pr(Y_i|X_jU_k)/Pr(Y_i|U_k)$ is

$$0 \leqslant \frac{\chi^2(m_1) - \chi^2(m)}{\chi^2(\bar{m})} \leqslant 1 \tag{23}$$

The proportion of "explained variation" attributable to effect $Pr(Y_i|X_jU_k)/Pr(Y_i|U_k)$ after all other effects have made their contributions is

$$\frac{\chi^2(m_1) - \chi^2(m)}{\chi^2(\bar{m}) - \chi^2(m)} \tag{24}$$

The overall relative contribution of effect $Pr(Y_i|U_k)/Pr(Y_i)$ is

$$\left[\chi^2(m_2) - \chi^2(m_1)\right] / \chi^2(\bar{m}) \tag{25}$$

The more closely each of the above-mentioned coefficients approximates the value of one, the better is the fit of the model or the stronger is the contribution of a given effect (as the case may be).

C.6. Some Limitations of the Method

Like most techniques of multivariate analysis, the type discussed in this paper has significant disadvantages or limitations, Goodman (1972 and 1973a) has commented upon the advantages. Another paper is needed to outline the limitations and comment on the ways and degrees to which they can be overcome. For the present, we shall merely list a number of the more important limitations:

1. In most applications involving demographic data arbitrary categorization of some of the variables is unavoidable, and the precise values of coefficients are sensitive to the categories chosen. (See Appendix B.)
2. Like most multivariate analysis techniques, the coefficients derived for the effects of a given variable are meaningful only within the context of the specified model and variables. Some potentially serious degrees of "specification bias" can result from a variety of sources such as serious omission of relevant variables or of important effects. This problem has received almost no attention so far in the literature or multivariate contingency table analysis.
3. Unless the explanatory variables are mutually independent statistical indications of the relative importance of the different specified effects can be seriously misleading.
4. Serious practical difficulties can arise when the tables become very large (in terms of their number of cells). The tendency in dealing with this problem is to collapse categories (as is done in this study). The reader should consult the related discussion by Bishop, Feinberg, and Holland (1974, Chapter 5).
5. Special procedures are often required for handling tables that contain cells that are necessarily zero or relevant zero marginals (cf. Bishop, Fienberg, and Holland, 1974, Chapter 5).
6. An important problem that deserves further attention is the question of the applicability of the formal theory and procedures of statistical inference with certain types of data. The question of the appropriate statistical theory rationale arises naturally because the human population that is distributed over the relevant attribute space is usually a sample from a larger human population. Even when the entire relevant human population is involved, the analyst often wants to rationalize the use of statistical inference in tests of goodness of fit of the explanatory model or of individual effects of selected attributes. In this connection the analyst must deal explicitly with the question of error (sampling) distributions. Also there is the problem of estimating theoretical expected values from sample observations in a contingency table. Here the analyst must be concerned with the properties of the chosen estimator in the light of the nature of the sampling process that generated the observations in the table.

The statistical inference aspects of contingency table analysis have been discussed at length by several mathematical statisticians (cf. Fienberg, 1970; Goodman, 1970, 1972, 1973a; and the references cited there). It would appear that the practising analyst already has a battery of published results for conducting a wide variety of tests of significance in connection with his statistical model. Typically, these tests involve one or two forms of the chi-square statistic, and the assumption that for the problem and data in hand this statistic has the chi-square sampling distribution. The validity of this assumption typically requires that the observations within any cell of the contingency table are independent and were generated by some simple sampling scheme, such as simple random sampling. An identification of pertinent sampling schemes is given by Fienberg (1973, p. 6) and Goodman (1971, pp. 37 and 38).

Difficulties in satisfying the conditions for valid application of the chi-square sampling distribution for the tests mentioned above are likely to arise when the data are drawn from administrative records or from a full-count census. In both types of data source it is often difficult to specify the sampling process that generated the observations in the contingency table. However, in some problems the nature of the data may be such as to partially warrant the assumption that the observations within any particular table cell are largely independent and that the total number of observations is fixed.[3] In any event, with the two kinds of data source in question the application of statistical inference procedures should probably be justified principally on the grounds that the chosen procedures embody a set of "ground rules" for decision-making which are sufficiently objective that any two investigators using the same rules ought to reach the same conclusion or take the same acceptance or rejection decision. (See Fienberg, 1970, pp. 424 - 427, Bishop, Fienberg, and Holland, 1974, Chapter 3.)

Another kind of problem arises in regard to the estimation of the theoretical expected cell counts from the observations in a contingency table. Fienberg's (1970, pp. 421 - 424) discussion suggests that we have to make rather strong assumptions about the sampling process generating the observations in the table in order to derive sharp information about properties of certain estimators being used, especially iterative fitting of cell counts to fixed marginals. The reasonableness of such assumptions may be quite clear in regard to certain kinds of sample survey data; but there are large blocks of demographic data, presentable in a contingency table format, in which such assumptions will instantly be seen to be rather arbitrary. In this situation it would be wise to attempt to rationalize the results of a particular estimation procedure on informal substantive grounds, if we are unable to be reasonably sure that a suitable sampling process generated the observations in our contingency tables.

FOOTNOTES

[1] The term "model" is subject to a variety of meanings in the social science literature. In one usage it means the same as "theory". In the present work we have a different usage that may be illustrated as follows. By an "explanatory theory" of the relations between y a dependent variable, and x and z explanatory variables, we mean a network of statements that purport to (a) give reasons why such relations exist and/or (b) characterize generally the nature of such relations under specified conditions. A **specific model** that may seem plausible in the light of the theory may then be $y = a + bx + cv$ (where a, b and c are constants). Another **specific model** that may seem plausible might be $y = axy$. The model may thus be seen as being one kind of hypothesis (one about the functional form of the relation being studied) that may be said to be plausible in the light of the theory.

In referring to a hypothesis that seems plausible in the light of the theory it is assumed here that logical implication of the hypothesis by the theory is not required in order to claim that the latter rationalizes the former. The author adheres to the philosophy of science school which holds that the probabilistic rationalization (signified by a statement to the effect that the hypothesis is **plausible** in the light of the theory) of hypotheses by theory is a legitimate and common practice in scientific work (see Hempel, 1965, pp. 381 - 412 and Chapter 12).

[2] Two different, though related, kinds of dependent variable are mentioned in this paper. The first refers to the **dependent attribute** (e.g., educational attainment) that is considered in the theoretical discussion to be related to certain **explanatory attributes** (e.g., age). In some explanatory analysis problems it is considered that what the formal explanatory model will treat as the **dependent variable** is not the dependent attribute per se; but **the distribution of a population over designated categories of this attribute.** For example, explanatory analyses of migration often are developed in such a way that although the theory deals with the factors and mechanisms by which a person becomes a migrant (the attribute here is **migration status**), the dependent variable of the formal model is the proportion who are migrants out of a given population (the **distribution** of population by migration status).

In this report the phrase "dependent **variable**" is usually used to refer to the latter type of variable (the distributional variable) while the phrase "dependent **attribute**" is usually used to refer to the variable that is initially considered in the relevant theory. The distinction between the two terms is rather arbitrary, and it is made only to reflect the fact that we are dealing with two "levels" of dependent variables. Usually the context of a particular remark should make clear which "level" is in question.

[3] For a discussion of the significance of this point see Goodman, 1970, p. 232.

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