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A MICROANALYTICAL MODEL OF MIGRATION:
THE INTERLAKE AREA OF MANITOBA

by

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ABSTRACT

The objective of this study is to construct a model of the migration process for the provision of information relevant for a regional labour force adjustment policy. The model is developed in the context of the Interlake Area of Manitoba. Subsidary objectives relate to the impact of manpower programs on the migration process, and an empirical investigation of the use of qualitative variables for quantifying social factors in economic research.

The model developed has two components. In the first section the probability of migration is related to characteristics of individuals in the labour force, including demographic characteristics, education levels, income and existing manpower services. The technique used in this section is a modification of ordinary least squares regression analysis with a dichotomous dependent variable and a set of 0,1 independent variables. In the second section the results from the first section are generalized to give volume of migration figures.

Construction, estimation and manipulation of components of the research model have isolated significant relationships between migration and characteristics of the labour force. The analysis shows that the process of migration is selective, however internal and out migration tend to be selective on the basis of different characteristics. Persons aged between 17 and 25 years are more likely to move out of the Interlake than older persons, as are persons who have been in the area for less

than ten years. Contrary to prior expectations, the probability of migration does not change markedly for persons with different education levels. Unemployed persons tend to be more mobile than persons who are employed for greater than ten months per year, although persons with less than $1,500 income are less mobile than persons with higher incomes. Whereas all manpower services increase the probability of migration, different programs affect migration at different levels. For married persons, persons working in the primary sector, unemployed persons and those with incomes below $1,500, expressed preferences for relocation differ from observed migration behaviour.

Estimates of the volume of migration indicate that underlying the small net change in the Interlake population attributable to migration, there are relatively large flows within and out of the area. The results show that large changes in labour force composition produce relatively small changes in the volume of migration.

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CHAPTER I

INTRODUCTION

THE ECONOMIST'S INTEREST IN MIGRATION

Regional disparities in economic and social development within both developed and less developed countries are a widespread phenomenon. Declining terms of trade for agriculture, changes in demand for produced goods, changes in technology and the discovery and depletion of natural resources lead to a continual change in the relative development of different areas. The human element relates to this system in two ways: firstly, as the resource to which economic and social development is directed, and secondly, as a factor of production. In both roles population change has an important association. Migration is one component of population change, and is the subject of this study particularly as it relates to the Interlake Area of Manitoba

The migration process and its consequences have been studied by several groups of social scientists, among them geographers, demographers and economists. All three groups deal with the measurement of human populations and to different degrees, their relationship to available resources. The interest of the economist in migration has centred on the labour force, specifically on concern about the efficient allocation of a factor of production, and concern about the welfare of individuals based on employment and income opportunities. Using the concept of marginal productivity, and assuming that each man's income is equal to the marginal productivity of what he produces, then both of these concerns would be taken care of by interactions within a perfect labour market.[1] However there is a breakdown in assumptions basic to the attainment of the welfare optimum of economic theory. Concern about observed outcomes of the labour market indicate that various kinds of adjustment to the operation and outcome of labour market interactions are required to increase human welfare. To the extent that migration is such an adjustment mechanism,[2] information concerning determinants and impacts of migration is required to permit the formulation of appropriate policies. This then, is the basis for economic research into the migration process.

MIGRATION AND THE INTERLAKE AREA

The Interlake Area of Manitoba is a predominately rural region[3] characterized by low levels of income and high levels of unemployment relative to the Provincial average.[4] A large proportion of the labour force is directly dependent on resource based industries, especially

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[1]A brief discussion of this concept is given in D. S. Watson, Price Theory and Its Uses (Boston: Houghton Mifflin Company, 1963), pp. 411.412.

[2]The concept of migration as an adjustment mechanism is outlined by Kuznets and Thomas in the Introduction to: E. S. Lee et al., Population Redistribution and Economic Growth, United States, 1870-1950, Vol. I (Philadelphia: Americal Philosophical Society, 1957), p. 2.

[3]In 1968 the total population was 49,690 of which 30,300 were classified as rural residents. C. F. Framingham, J. A. MacMillan and D. J. Sandell, The Interlake Fact (Manitoba: Planning and Priorities Committee of Cabinet Secretariat, 1970), p. 1.

[4]Canada Department of Forestry and Rural Development, Kah-Miss-Ahk (Ottawa: The Queen's Printer, 1969), p. 2.

agriculture. As labour in these industries becomes more productive, or if demand for products of those industries declines, increasing numbers of workers become unemployed or underemployed and must compete in the labour market for employment in secondary or tertiary industries. There are two major factors inhibiting the satisfactory employment of this pool of labour: (1) there are a large number of workers relative to the employment opportunities existing in the Interlake, and (2) in aggregate, this pool of labour lacks the skills and characteristics required to compete effectively in alternative labour markets. That is, they lack potential for spatial mobility, occupational mobility and the implied social mobility.[5]

Given that equitable income distribution over the Province and Canada, and low levels of unemployment are relevant goals, policies to improve the existing situation are required. Such goals have been expressed for the Interlake Area, and the FRED agreement signed in 1967 is designed to satisfy this demand.[6] Of the $85 million FRED contract, $28.6 million is designated for adult education and training, and $26.7 million for improvement of school and education programs--a total investment of $55.3 million dollars in human capital.[7] The need for migration

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[5]The concept of social mobility is presented and discussed in N. J. Smelser and S. M. Lipset, Social Structure, Mobility and Development, Reprint No. 292, Institute of Industrial Relations and Institute of International Studies (Berkeley: University of California, 1966).

[6]Department of Forestry and Rural Development, Interlake Area of Manitoba, Federal-Provincial Rural Development Agreement (Ottawa: Queen's Printer, 1967).

[7]Department of Forestry and Rural Development, Kah-Miss-Ahk, op. cit., pp. 8-9.

is specifically mentioned in the development strategy of the FRED Agreement. It is estimated that 3,500 workers would qualify for mobility assistance over the period of the agreement.[8] Other labour force adjustment policies adopted to decrease unemployment include job-specific training programs and referral and counselling programs designed to increase the mobility of workers between industries, occupations and areas in accord with market generated manpower needs.

A recent study of the manpower programs in the Interlake indicates that (1) benefits to individuals who have migrated are substantial,[9] and (2) in nine out of the thirteen groups surveyed, under 50 per cent of all workers preferred their present location.[10] These results suggest that migration programs could be a viable means of achieving the stated goals of the Interlake Development Plan as part of a regional labour force adjustment policy. Basic to a rational adjustment policy is information on the type of person who migrates and how existing manpower programs affect migration. It is also necessary to establish what volume of migration can be expected to occur, and what impact that migration is expected to have on the area economy and the individual. It is possible to derive some information on the process of migration from prior research. However previous studies of the characteristics of

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[8] Department of Forestry and Rural Development, Interlake Area of Manitoba, op. cit., p. 32.

[9] J. A. MacMillan, L. A. Bernat and J. J. Flagler, Benefits and Costs of Manpower Services in the Interlake Rural Development Area, Research Bulletin (Winnipeg: Department of Agricultural Economics, University of Manitoba), pp. 109-111.

[10] Ibid., p. 16.

migrants are primarily descriptive, based on percentages of migrants with given characteristics. As the number of characteristics under consideration increases, alternative techniques of analysis are required to obtain meaningful estimates of existing relationships.[11] Volume of migration estimates are typically obtained by such methods as simple projection of past trends, however these methods become unreliable if the structure underlying the observed values is changing. There is thus a requirement for additional information about the migration process.

OBJECTIVES

The primary objective of the research is to construct a model of the migration process for the provision of information for a regional labour force adjustment policy. The model is estimated using data from the Interlake Area of Manitoba, and as such, the results apply specifically to that area. However included in the primary objective is the provision of information on the process of migration in general, with applicability to other regions.

The model consists of two components: (1) behavioural equations relating characteristics of individuals in the labour force to migration, and (2) linkage of these behavioural equations to estimates of volume of migration. Attainment of the primary objective by use of such a model provides the basis for estimation of the economic impact of migration by use of an area input-output table.

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[11] G. H. Orcutt, et al., Microanalysis of Socioeconomic Systems: A Simulation Study (New York: Harper and Brothers, 1961), p. 224.

Subsidary objectives include determination of the impact of existing Interlake manpower programs on the migration process, and an empirical investigation of the use of qualitative dependent and independent variables for quantifying social factors in economic research.

OUTLINE OF THE STUDY

Following this introductory chapter, a general discussion of migration is presented which includes a review of previous studies. An outline of the overall research model and its component parts is presented in Chapter III. Aspects investigated and hypothesized relationships are given at this stage. Chapter IV includes a discussion of some of the technical problems which arise in estimation of the behavioural equations. Because of the importance of these problems in interpretation of results and a developing interest in this type of model,[12] the approach taken in each situation is outlined. The data used in each phase of the study is described in the following chapter. Chapter VI presents results obtained, and is followed by a consideration of the limitations, conclusions and implications of the research. Because of a lack of any comprehensive reference on the use of dummy variables, an appendix covering the main aspects of this technique is included.

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[12] A. Buse, "A Technical Report on the Uses, Problems and Potential of Qualitative Dependent Variables as Applied in the Social Sciences, Particularly Economics," (Edmonton: Alberta Human Resources Research Council, 1970). (Mimeographed.); see also J. Neter and E. S. Maynes, "On the Appropriateness of the Correlation Coefficient with a 0, 1 Dependent Variable," Journal of the American Statistical Association, Vol. 65, 1970.

CHAPTER II

MIGRATION

This chapter begins with an outline of theoretical concepts in migration research. Different types of migration research are then examined, including an examination of the impact of migration. The remainder of the chapter is an introduction to the model used in this study.

THE CONCEPTUAL BASIS OF MIGRATION

A theoretical basis for the migration process can be traced back to the work of Ravenstein, published in 1885.[1] In this work Ravenstein suggested the following relationships:

(1) that migration is an inverse function of distance,

(2) that migration proceeds by stages, migrants moving step by step towards an attractive source,

(3) that each main stream of migration produces a compensating counterstream,

(4) that persons in towns are less migratory than persons in rural areas,

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[1] E. G. Ravenstein, "The Laws of Migration," Journal of the Royal Statistical Society, XLVIII, Part 2 (June, 1885), pp. 167-227, cited by E. S. Lee, "A Theory of Migration," Demography, Vol. 3, No. 1 (1966), pp. 47-57.

(5) that females appear to predominate among short distance migrants,

(6) that as technology increases, migration increases, and

(7) that the dominant motive underlying migration is economic.

Ravenstein's generalizations have not been superseded by any comprehensive theory of migration. Much of the existing literature in migration research is based on attempts to measure and explain the factors which give rise to observed conditions such as those which underlie Ravenstein's conclusions.

Lee has attempted to develop a general schema which covers a variety of spatial movements.[2] The simple framework yet broad coverage of this schema provides a useful conceptual basis for the description, explanation and prediction of migrant behaviour. Lee suggests that the decision to migrate depends on four sets of factors:

(1) factors associated with the area of origin,

(2) factors associated with the area of destination,

(3) intervening obstacles, and

(4) personal factors.[3]

At both the origin and destination there will be factors which attract people and others which will tend to repel them (for example, climate, employment conditions). The relative weight put on any given factor, be it positive, negative or zero, will vary for every migrant or prospective migrant. The set of intervening obstacles, including such

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[2]E. S. Lee "A Theory of Migration," Demography, Vol. 3, No. 1 (1966), pp. 47-57.

[3]Ibid., p. 50.

factors as distance, physical barriers and social barriers, will also be subject to different interpretation by different persons. Personal factors which enter the decision include age, education, ethnic origin and other items, some of which remain constant over time and others which vary. This approach to the process of migration implies that it is not so much the actual factors at origin and destination which determine the level of migration, but the perception by individuals of those factors. Simple though this framework appears, the possible range of alternative combinations is vast when factors such as natural inertia and different levels of information about factors at origin and destination are included in the analysis.

Lee's analysis is essentially non-economic. However, economic theory suggests that the factors at origin and destination and the intervening obstacles are of an economic nature. Thus the schema suggested by Lee, restricted by the assumptions of a perfect labour market, forms a basis for the concept of migration found in microeconomic theory.[4] The assumptions commonly made are:

(1) workers possess perfect information about labour market conditions in all regions,

(2) homogeneity of labour,

(3) costs of movement can be neglected,

(4) workers have no location preferences,

(5) workers are economically rational, and

(6) employers are economically rational.

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[4]T. P. Lianos, "Labour Mobility and Market Imperfections," Canadian Journal of Agricultural Economics, Vol. 18, No. 3 (November, 1970), p. 97.

Under such conditions, at equilibrium the labour force will be fully employed at a wage rate common to all regions.[5] Any persistent regional movements of labour must be due to the existence of regional wage differentials. Thus, if the assumptions listed above are realized, migration will act as an adjustment mechanism to distribute population in a pattern that best serves the general interest.[6]

However the hypothesis suggested by this theory cannot totally explain the complex phenomenon of migration, because the personal factors referred to by Lee tend not to satisfy the assumptions given. The incidence of migration then, is a function of the perception and response to economic stimuli by individuals. Volume of migration thus becomes the aggregation of individual responses.

Emphasis at different levels of this approach to migration has resulted in different types of research. Lansing and Mueller[7] identify two groups of research types: firstly research based on volume of movement of the labour force as a function of broad economic forces, and secondly, research into the incidence of migration based on characteristics of the worker. The first group adopts the approach that the study of those who move in response to economic forces is a separate and secondary question to the volume of migration. The second approach takes the volume question as a secondary goal. In the following section examples

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[5]Ibid.

[6]J. Isaac, Economics of Migration (New York: Oxford University Press, 1947), p. 70.

[7]J. B. Lansing and E. Mueller, The Geographic Mobility of Labor (Ann Arbor: Institute for Social Research, 1967), p. 5.

of each of these types of research are considered.

MAJOR TYPES OF MIGRATION RESEARCH

Volume of Migration Studies

A study by Isaac,[8] although based on international migration, gives a very broad coverage of economic aspects of migration and the relationship between volume of migration and the concept of an optimum population size. Isaac discusses the breakdown of the optimum allocation theory based on the marginal productivity criterion, including different aspects of migration control. A study by Goodrich[9] is addressed to the question of what shifts in population would contribute to a more effective utilization of human and natural resources. In indicating the need for large scale movements of population from southern states and from agricultural to industrial sectors, the authors refer to a need for information on qualitative aspects of the migration process at the individual migrant level.[10] This same requirement is expressed by Kuznets and Thomas in introducing a study into the redistribution of population, labour force, manufacturing activity and income in the United States.[11]

The studies so far mentioned tend to be descriptive rather than

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[8]Isaac, op. cit.

[9]C. Goodrich et al., _Migration and Economic Opportunity_ (Philadelphia: University of Pennsylvania Press, 1936).

[10]Ibid., p. 660.

[11]E. S. Lee et al., _Population Redistribution and Economic Growth, United States, 1870-1950_, Vol. I (Philadelphia: American Philosophical Society, 1957), p. 3.

analyses of causal relationships. A large number of studies have been undertaken to test the hypothesis that the volume and direction of migration is a function of wage rate differentials. Raimon considers correlations between migration and income levels[12] in the source area, suggesting that the stimulus to move stems from low income at the source area.[13] Ichimura makes use of a regression equation with six of the eight explanatory variables based on income differentials between regions.[14] Gallaway, Gilbert and Smith found that income differentials between regions provided a better explanation of net migration than gross migration.[15] Stone, using a regression equation including income differentials found that the income variable did not always significantly affect interprovincial migration. Two reasons are suggested for this situation: (1) that income can only be significant if people are aware of the differences existing, and (2) that income is highly correlated with other variables in the equation leading to statistical problems.[16] Zaidi tests the same hypothesis in relation to job mobility using a correlation

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[12] Income and wages are not the same. Income may include economic gain unrelated to the area of residence. Both measures have problems associated with their use. A discussion of the relative benefit of each is given in L. O. Stone, Migration in Canada, Canada, 1961 Census Monographs (Ottawa: Dominion Bureau of Statistics, 1969), pp. 384-387.

[13] R. L. Raimon, "Interstate Migration and Wage Theory," Review of Economics and Statistics, Vol. 44 (November, 1962), pp. 428-438.

[14] S. Ichimura, "An Econometric Analysis of Domestic Migration and Regional Economy," Regional Science Association Papers and Proceedings, Vol. 16 (1966), pp. 67-76.

[15] L. E. Gallaway, R. F. Gilbert and P. E. Smith, "The Economics of Labour Mobility: An Empirical Analysis," Western Economic Journal, Vol. 5, No. 1 (December, 1966), pp. 211-223.

[16] Stone, op. cit.

statistic to test for wage and unemployment differentials between sectors.[17] Such a test could easily be applied to regional differentials to compare the actual efficiency of labour force allocation with the optimum given by economic theory. In a study of movements of the Canadian labour force, Courchene tests a series of hypotheses relating migration to factors in the source and destination areas using a multiple regression framework. Results of this study indicate that migration is an economic variable - workers responding to interprovincial earnings differentials and differentials in provincial unemployment rates "in a manner that is conducive to efficient resource allocation."[18]

The majority of these studies include variables other than income levels, indicating that allowance is made for other than complete correspondence with the assumptions given by economic theory. Using a multiple regression framework, Lianos tests specifically for the effect of labour market imperfections.[19] It is found that the psychic cost of migration (disutility anticipated by the potential migrant), transportation costs, lack of information, unemployment and labour unions all influence the magnitude and direction of interregional flows of migration.

A model developed by Trott estimates the likelihood of out

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[17] M. A. Zaidi, "Structural Unemployment, Labour Market Efficiency and the Intrafactor Allocation Mechanism in the U. S. and Canada," The Southern Economic Journal, Vol. 35, No. 3 (January, 1969), pp. 205-213.

[18] T. J. Courchene, "Interprovincial Migration and Economic Adjustment," Canadian Journal of Economics, Vol. 3, No. 4 (November, 1970), p. 574.

[19] Lianos, op. cit.

migration from an area for an age, sex, race specific cohort.[20] Gross out migration in volume terms is derived from this estimate. A matrix of propensities with respect to area selection is estimated from a set of economic and information flow variables, and in conjunction with the volume figures previously derived, the out migrants are distributed over the possible destinations.

The desire for information on volume of migration has led to the development of some intricate and imaginative stochastic models. Analytical models of the type outlined above, based primarily on economic relationships are often limited in their ability to predict actual migration flows. The complexity of the migration process strains the capabilities of many analytical techniques, and the importance of economically irrational behaviour forces the researcher to look for other ways of studying the process.[21]

Olsson has summarized the work of many researchers in the realm of general diffusion models, gravity models and potential models.[22] Cavanough has suggested an interactance hypothesis based on the size of two interacting populations and the distance between them.[23] In a study

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[20] C. E. Trott, "Differential Responses in the Decision to Migrate (paper read at the Regional Science Association Meetings, November, 1971, Ann Arbor, Michigan).

[21] G. Olsson, Distance and Human Interaction, A Review and Bibliography, Bibliography Series Number Two (Philadelphia: Regional Science Research Institute, 1965), p. 35.

[22] Ibid.

[23] J. A. Cavanough, "Formulation, Analysis and Testing of the Interactance Hypothesis," American Sociological Review, Vol. 15, pp. 763-766.

of job mobility, Blumen, Kogan and McCarthy utilize Markov Chains based on the assumption that people can be divided into "stayers" and "movers".[24] The same model has been applied to spatial mobility with different levels of mathematical sophistication.[25] Kulldorf utilized different probability functions to determine the effect of the shape of an area on the probability that a movement starting within an area would cross the border and end outside the region.[26]

The purely empirical emphasis of such non-analytical models means that predictions made from the relationship used are dependent on recurrence of the economic, social and political conditions which existed when the data used in the model were collected. That is, there is no allowance for these forces included within the model structure. Information from such models is restricted to the prediction made, there being no information obtained relating to the decision characteristics or motives of migrants.

Studies of Migrant Characteristics

The concept of migration as an observed outcome of economic stimuli underlies the stocks and flows approach to migration suggested by Lianos.[27] The existence of economic or other differentials between

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[24] I. Blumen, M. Kogan and P. J. McCarthy, The Industrial Mobility of Labour as a Probability Process, Cornell Studies in Industrial and Labour Relations, Vol. 6 (Ithaca: Cornell University, 1955).

[25] Some models of this type are discussed in Olsson, op. cit.

[26] G. Kulldorf, Migration Probabilities, Lund Series in Geography, Series B. Human Geography, No. 14 (Lund: Lund University, 1955).

[27] T. P. Lianos, "A Stocks and Flows Approach to Migration," American Journal of Agricultural Economics, Vol. 52, No. 3 (August, 1970), pp. 442-443.

regions at any point in time means that there will be a group of people who are willing to migrate, and who will migrate given sufficient time,[28] that is, a stock of migrants. The flow of migrants will be those persons who migrate in the given time period. Lianos suggests two types of time lags in the labour market which cause non-equality of stocks and flows: (1) a lag in the formation of a stock due to delays in diffusion of information about the underlying differentials, and (2) a lag in the response of people who make up the stock of migrants. Differences in response lags will be due to characteristics of individual members of the stock. To reduce response lags and make migration a more efficient adjustment mechanism, information on individual migrant characteristics is required.

One of the more comprehensive analyses of social and economic aspects of migrants is a study by Lansing and Mueller.[29] This study is comprehensive both in the coverage of area--it applies to the whole United States labour force, and in coverage of components of the migration process--economic, demographic and social factors are discussed. The report is based on sample surveys of the adult population of the United States living in private households. Some of the major findings of the study are:[30] (1) unemployed persons are only moderately more mobile than the employed, (2) economic differentials guided mobility most effectively for people who already had relative advantages in the labour force, (3) economic conditions do not have a symmetrical effect on

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[28]Ibid., p. 442.

[29]Lansing and Mueller, op. cit.

[30]Ibid., pp. 335-346.

in and out migration. Whereas high levels of employment and income tend to attract in migrants, high levels of unemployment and low income levels in an area do not stimulate out migration, (4) family and community ties influence geographic mobility, especially the direction of migration, (5) there is a good deal of inertia about moving, and (6) the cost of moving is generally not prohibitive. The implications of these results for policy decisions are obvious, however more detailed information at the regional level is required.

A similar study in the Canadian context has been presented by Stone.[31] Based on the 1961 Census, migration flows were related to economic conditions in provinces. Migration was found to be related to income differentials, age, education and natural increase in labour supply. The aggregate nature of factors used in the study restrict use of results for regional policy conclusions. A second study in the same series examines demographic factors as they relate to migration.[32]

Studies by Olson and Cohen and Schuh[33] relate to small communities. Utilizing data collected by personal interview, characteristics of members of the labour force, such as age, education, job skills and capital investment are related to job mobility and migration using chi square tests. Hypotheses on the basis of the type of relationship between variables--inverse or direct, are tested, and thus no

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[31]Stone, op. cit.

[32]M. V. George, Internal Migration in Canada, Canada 1961 Census Monographs (Ottawa: Dominion Bureau of Statistics, 1970).

[33]P. G. Olson, Job Mobility and Migration, Research Bulletin No. 708 (Lafayette: Purdue University Agricultural Experiment Station, November, 1960); see also L. K. Cohen and G. E. Schuh, Job Mobility and Migration, Research Bulletin No. 763 (Lafayette: Purdue University Agricultural Experiment Station, May, 1963).

quantitative measure of the relationships between characteristics and behaviour are obtained.

Eastman[34] bases a purely descriptive study of migrant characteristics on results enumerated from a mail questionnaire. Young single males, living at home, with a university education who are not satisfied with their present employment are found to be the most mobile. No measure of the magnitude of relationship between characteristics and migration is found.

As part of a broader study of returns from a mobility program, Jenness estimates the probability that a worker will move autonomously in response to observed income and relative status differentials between regions.[35] Significant variables obtained are marital status, incidences of unemployment, employment in the manufacturing industry before the move, and employment in primary or unskilled occupations before the move.

Studies of the Impact of Migration

The concept of migration as an adjustment mechanism implies that some benefit is to be obtained from a reallocation of population. In consideration of the benefits which arise in distribution of economic activity, Winnick distinguishes between place prosperity and people

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[34] B. D. Eastman, "Geographic Mobility of Labour" (unpublished Master's dissertation, University of Calgary, 1969).

[35] R. A. Jenness, "Manpower Mobility Programs," Cost-Benefit Analysis of Manpower Policies, eds. G. G. Somers and W. D. Wood (Kingston: Queen's University, 1969), pp. 184-229.

prosperity.[36] Place prosperity refers to well-being of the area, which could for example, be measured in terms of value of area output per capita, levels of employment, average income of area residents, etc. Winnick argues that place prosperity is not a sufficient condition for people prosperity--the well-being of an individual.

Different discussants of the impact of migration place different emphasis on the elements of this dichotomy. Sjaastad outlines a cost-returns framework for evaluation of an individual migrant's move, and indicates that the individual evaluation may not correspond to a social evaluation of a move.[37] A recent study of Manpower Services in the Interlake Area indicates that the average incomes of migrants increased.[38] Consideration of social costs and benefits has received more attention from researchers. Sjaastad indicates the need for a marginal rather than average approach to measuring gains and losses.[39] How the boundaries of a region under study are defined has an influence on the evaluation of costs and benefits, as indicated by Isaac.[40] In the example of the Interlake, Provincial analysis of the impact of migration

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[36] L. Winnick, "Place Prosperity vs People Prosperity: Welfare Considerations in the Geographic Redistribution of Economic Activity," Essays in Urban Land Economics (Los Angeles: Real Estate Research Program, 1966), pp. 273-283.

[37] L. A. Sjaastad, "The Costs and Returns of Human Migration," Journal of Political Economy, Vol. 70, No. 5, Supplement (October, 1962), p. 91.

[38] J. A. MacMillan, L. A. Bernat and J. J. Flagler, Benefits and Costs of Manpower Services in the Interlake Rural Development Area, Research Bulletin (Winnipeg: Department of Agricultural Economics, University of Manitoba), pp. 109-111.

[39] Sjaastad, op. cit., p. 91.

[40] Isaac, op. cit., pp. 197-209.

from the Interlake should take into account the effect on Winnipeg. Comay suggests that the cost of out migration of members of the labour force is high when costs of education and the potential contribution of the out migrant to area income are considered.[41] Because this loss imposes a burden on already lagging regions, it has been suggested that levels of government above the local level should finance education and training of the labour force.[42] Gavett has attempted to measure the effect that out migration has on the average quality of the remaining labour force.[43] Using education as a measure of quality, it is found that 45 per cent of total variation in the average quality of the labour force among states could be explained by migration rates.[44] The effect of out migration on regional employment is hypothesized to have a detrimental effect on level of employment in the source region in a paper by Vanderkamp.[45] The hypothesis is supported by consideration of a regional multiplier and the level of expenditure of unemployed persons.

These then are some aspects of the impacts migration has on areas, which have been discussed in the literature. The importance of

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[41] Y. Comay, "The Benefits and Costs of Study Abroad and Migration," Canadian Journal of Economics, Vol. 3, No. 2 (May, 1970), pp. 300-308.

[42] B. A. Weisbrod, "Geographic Spillover Effects and the Allocation of Resources to Education," The Public Economy of Urban Communities, ed. J. Margolis (Baltimore: The John Hopkins Press, 1965), pp. 192-206.

[43] T. W. Gavett, Migration and Change in the Quality of the Labour Force, West Virginia University Business and Economic Studies, Vol. 10, No. 2 (Morgantown: Bureau of Business Research, 1967).

[44] Ibid., p. 45.

[45] J. Vanderkamp, "The Effect of Out-Migration on Regional Employment," Canadian Journal of Economics, Vol. 3, No. 4 (November, 1970), pp. 541-549.

such research lies in the provision of information to policy makers so that data on alternative volumes of migration can be interpreted and used.

IMPLICATIONS FOR THE RESEARCH MODEL

Theories of migration behaviour and previous studies of the migration process provide the basis for development of a study of migration. An examination of the works presented in this chapter has provided a conceptual basis for the study, an indication of which characteristics should be included, a guide for hypotheses relating relevant variables, and a source for comparison of results obtained.

The function of this study is to provide information on the migration process, particularly as it applies to the Interlake Area of Manitoba. Information required includes a knowledge of how characteristics of individuals affect mobility potential, which corresponds to the personal factors referred to by Lee[46] and the flows suggested by Lianos.[47] Studies of migrant characteristics such as those by Lansing and Mueller[48] and Eastman[49] indicate the importance of such factors as age, education and unemployment which should be included in the analysis. Additional factors (specifically participation in manpower services) are included to increase the information obtained. A model based on such characteristics

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[46] Lee, op. cit., p. 50.

[47] Lianos, op. cit., p. 442.

[48] Lansing and Mueller, op. cit.

[49] Eastman, op. cit.

provides information on the type of person who can be expected to move autonomously, and information on which factors could best be used to influence the migration process. To determine the impact of migration, some estimate of volume of migration is required. Rather than use a form of model as reviewed in the literature, the model of migrant characteristics can be used for the transfer to volume.

The resultant model, based on considerations such as those considered above, is presented in the chapters following.

CHAPTER III

SPECIFICATION OF THE MODEL

This chapter presents the research process adopted to attain the stated objectives. Initially an overall research model of the migration process is outlined, followed by a description of the components of that structure estimated in this study.

A FRAMEWORK FOR MIGRATION RESEARCH

The research framework outlined in this section can be divided into three groups of components--inputs, processes and outputs. Figure 1 is a schematic representation of this procedure, which is summarized in Figure 2. The system inputs (collected data, prior research results and theoretical considerations) are utilized in a series of processes to yield system outputs (policy recommendations and an addition to the stock of research results). Information can be obtained from each stage of the system.

The system as presented in Figure 1 ends with a single cycle--a set of inputs is used to produce a set of outputs which are then examined for implications for labour force adjustment. However a dynamic system could be established with little modification. If a single cycle of the system as described above is related to a given time period, say one year, t, then the outputs from this cycle can be used to give the inputs for year t + 1. This process, illustrated in Figure 3, can be followed

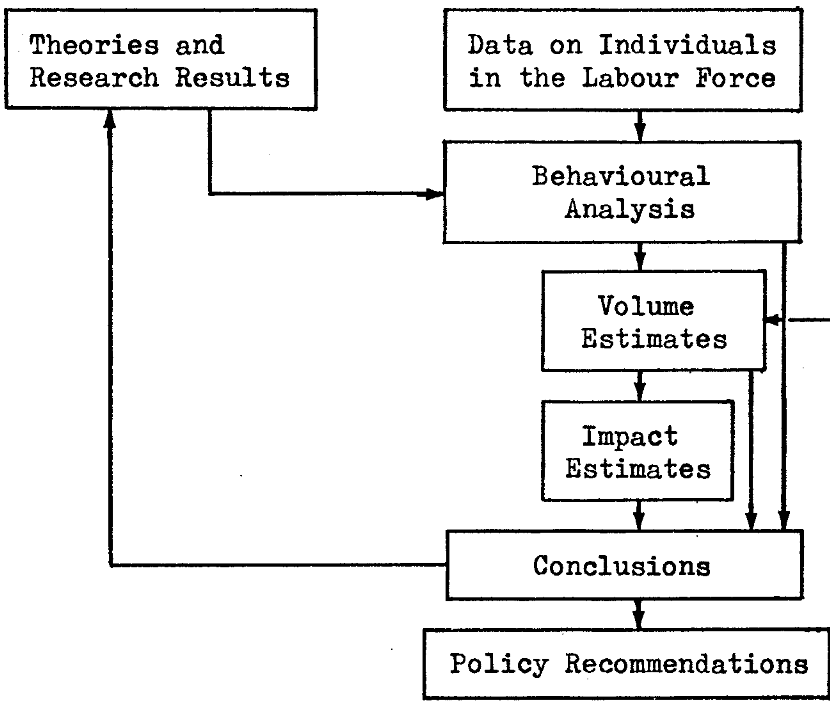

Figure 1. The Overall Research Framework

cyclically for as many time periods as required, giving a flow of information on the impact of the migration process on the structure of the labour force and the area economy.

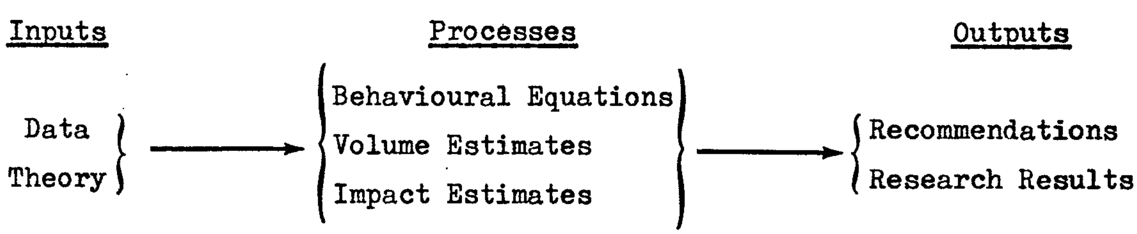

Figure 2. Summary of the Research Framework

The simulation nature of this process enables information to be generated under varying assumptions relating to structural and policy parameters[1] to provide decision makers with a range of alternative policy

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[1]Structural parameters refer to relationships between variables (eg. age, or education) and migration. Policy parameters include factors such as manpower retraining programs, taxation policies, etc.

impacts.[2] Coupled with data on the cost of alternative policies, the cost effectiveness of Government expenditures on labour force adjustment could be determined.

The structure of this system has a general application to labour force studies. However generality of the outputs from this system depends on the generality of the inputs, specifically the collected data, which will reflect the environment of the labour force under study.

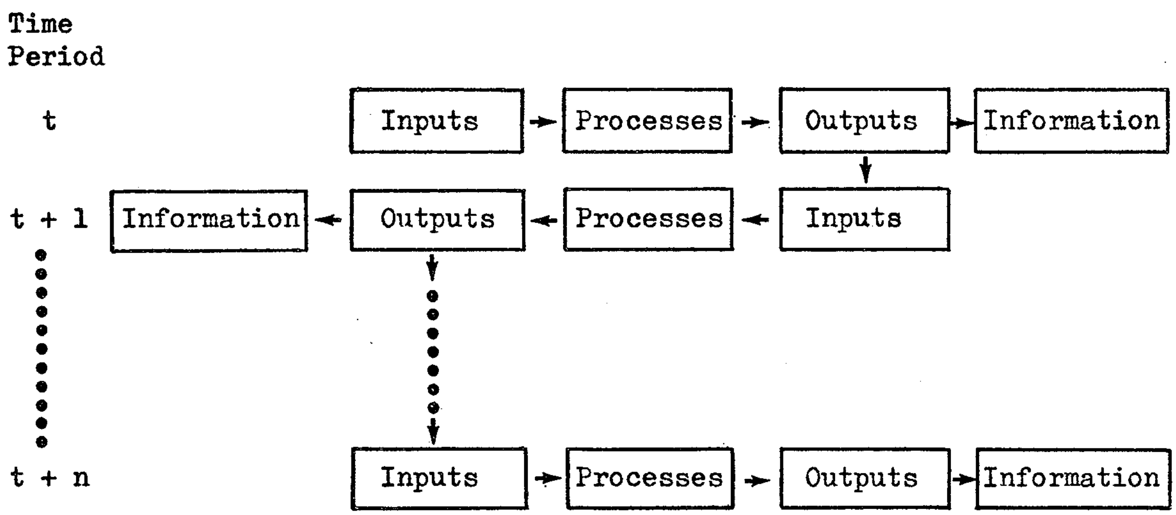

Figure 3. The Overall Model in a Dynamic Context

In this study two parts of the suggested framework are estimated–the behavioural section and the volume of migration estimates.[3] The remainder of this chapter presents and discusses the specification of these two system components.

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[2]A discussion of policy simulation can be found in: G. Fromm and P. Taubman, <u>Policy Simulations with an Econometric Model</u> (Washington: The Brookings Institution, 1968).

[3]The impact estimation section of the framework could be of several types, however an input-output model of the Interlake economy would provide the basis for impact estimation for that area.

THE BEHAVIOURAL EQUATIONS

Each of the processes used in the research procedure occupies a given position in the system. The first of these processes is the behavioural section, which relates migration to characteristics possessed by individuals in the labour force. This section provides the basis for volume of migration estimates (the next process), and also provides system outputs directly.

Analysis of a complex process such as migration requires the use of an analytical approach which enables the researcher to isolate the impact of each characteristic hypothesized to influence observed behaviour. One method of examining the significance of a given characteristic while allowing for the influence of other characteristics is to use conditional probabilities--the probability of persons in a given class of the population migrating (for example, persons aged less than 25 years) can be determined, conditional on the possession of other, specified, characteristics. This is the approach adopted in the behavioural section of the analysis. The model used to estimate these conditional probabilities is a modification of multivariate regression analysis. The remainder of this section outlines the formulation and specification of this model.

The Basic Model

Because of the double role of this part of the analysis several variations of the basic model are used. The basic model is a regression equation with a dichotomous dependent variable and a set of 0,1 dummy explanatory variables.[4] Models of this type have been used to study labour force participation,[5] air travel[6] and recreation.[7]

Equation (1) gives a generalized specification of the model.

$$P_m = a + \sum_{i=1}^{n} F_i (X_i) + u \qquad (1)$$

Where P_m is the probability of migrating,

a is the equation constant,

$i = 1 \ldots n$, the number of explanatory factors in the model,[8]

X_i is the i^{th} explanatory factor,

F_i is a function giving the value that relates the i^{th} factor to P_m, and

u is the error term.

To transform the above formulation into a linear regression problem, each factor, or characteristic X_i, is broken down into the classifications within which the effect of factor X_i is hypothesized to be homogenous. Each of these classifications j, for $j = 1 \ldots k$ (the

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[4]The mechanics of use and characteristics of such models are given in Appendix A.

[5]G. H. Orcutt et al., Microanalysis of Socio-economic Systems: A Simulation Study (New York: Harper and Brothers, 1961).

[6]J. B. Lansing and D. B. Blood, "A Cross Section Analysis of Non-Business Air Travel," Journal of the American Statistical Association, Vol. 53 (1958), pp. 928-947.

[7]P. Davidson, E. G. Adams and J. Seneca, "The Social Value of Water Recreational Facilities Resulting from an Improvement in Water Quality: The Delaware Estuary," Water Research, eds. A. V. Kneese and S. C. Smith (Baltimore: John Hopkins Press, 1965).

[8]A factor is defined here as a given characteristic, for example, age. As such, a factor is not the same as a variable, which represents a class of a factor.

number of classifications) is treated as an independent variable. Following the constraint required for estimation of such an equation by least squares, one classification of each factor is used as a base condition and dropped from the equation. The remaining variables are assigned values of 1 or 0, depending on the presence or absence respectively of the characteristic described by that variable. The dependent variable, P_m, is assigned a value of 1 if the individual migrated and 0 if not. The resultant equation, (2), is then estimated by least squares regression analysis to obtain values for the coefficients b_{ij}.

$$P_m = a + \sum_{i=1}^{n} \sum_{j=1}^{k-1} b_{ij} X_{ij} + u \qquad (2)$$

Where P_m, a, i and u are as above

k is the number of classifications of factor i

$j = 1 \ldots k-1$

b_{ij} is the regression coefficient of variable X_{ij}

X_{ij} is the variable representing the j^{th} class of the i^{th} factor.

To obtain the estimated probability of an individual migrating, values of zero and one are given to the appropriate X_{ij} as dictated by the individual's characteristics. The value of P_m is made up of the equation constant plus the sum of the b_{ij} for which $X_{ij} \neq 0$. If all X_{ij} equal zero, then the probability of a person with characteristics described by the base classification of each factor is given by the equation constant. Each b_{ij} then, gives the change in probability of migration associated with membership in the j^{th} class of the i^{th} factor, relative to membership in the omitted base class.

Chapter IV outlines some of the characteristics of this basic model which require careful inspection so that results obtained are interpreted correctly. The approach adopted in each situation is discussed at this time.

Relationships and Variables Used

Using the basic model as specified above, a series of equations are used to investigate hypothesized sets of relationships. The explanatory variables used in all equations are the same. Different relationships are specified by changing the dependent variable and the observations used in estimation. Table I lists the variables used in the analysis, with a brief description of each one. (A detailed description of each variable is given in the section describing the data used.) Each variable assumes a zero or one value depending on the characteristics of the individual represented by that observation.

The Manpower Service variables were used in two forms—an aggregated form using variable X_{16}, and a disaggregated form using variables X_{17} to X_{23}. An eighth Manpower Service, Mobility Assistance and/or Exploratory Grants, is not included in the analysis. From the data available it is not possible to determine characteristics of in migrants—persons who move into the Interlake from outside. Such an analysis would require observations on members of either the National or Provincial Labour Force, including those who moved into the Interlake. This section of the analysis is thus restricted to internal migrants and out migrants as described below. The remainder of this section outlines the relationships investigated and the hypothesized signs of coefficients.

TABLE I

VARIABLES USED IN THE BEHAVIOUR MODELS

Factor	Variable Description		
Residence	X_1	=	1 if person has rural residence
		=	0 otherwise
Age	X_2	=	1 if person aged 17-25 years
		=	0 otherwise
	X_3	=	1 if person aged 26-50 years
		=	0 otherwise
Sex	X_4	=	1 if person female
		=	0 otherwise
Marital Status	X_5	=	1 if person married
		=	0 otherwise
Time in Municipality	X_6	=	1 if in municipality less than 10 years
		=	0 otherwise
Ethnic Origin	X_7	=	1 if Indian or Metis
		=	0 otherwise
Education	X_8	=	1 if has grades between 8 and 13
		=	0 otherwise
	X_9	=	1 if has university education
		=	0 otherwise
Industry	X_{10}	=	1 if in a primary industry
		=	0 otherwise
	X_{11}	=	1 if in a secondary industry
		=	0 otherwise

TABLE I (continued)

Factor	Variable		Description
Unemployment	X_{12}	=	1 unemployed more than 8 weeks
		=	0 otherwise
Income	X_{13}	=	1 if less than $1500
		=	0 otherwise
	X_{14}	=	1 if in the range $1501-$3000
		=	0 otherwise
	X_{15}	=	1 if in the range $3001-$5000
		=	0 otherwise
Manpower Service[a]	X_{16}	=	1 if has taken any Manpower Service
		=	0 otherwise
	X_{17}	=	1 if taken BTSD[b] Level III and/or IV
		=	0 otherwise
	X_{18}	=	1 if taken Vocation or Special Training
		=	0 otherwise
	X_{19}	=	1 if taken Farm Management Course
		=	0 otherwise
	X_{20}	=	1 if taken Manpower Corps and/or VRT[c]
		=	0 otherwise
	X_{21}	=	1 if taken Training in Industry
		=	0 otherwise
	X_{22}	=	1 if taken BTSD Level I and/or II
		=	0 otherwise
	X_{23}	=	1 if taken Employment Referral
		=	0 otherwise
Dependent Variables	Y_1	=	1 if person migrated
		=	0 otherwise

TABLE I (continued)

Factor	Variable Description
	Y_2 = 1 if person migrated but remained in the Interlake
	= 0 otherwise
	Y_3 = 1 if person migrated out of the Interlake
	= 0 otherwise
	Y_4 = 1 if person migrated more than once
	= 0 otherwise
	Y_5 = 1 if expressed preference to relocate
	= 0 otherwise

[a]Description of each Manpower Service is given in Appendix B.

[b]BTSD - Basic Training for Skill Development

[c]VRT - Vocational Rehabilitation Training

Total Migration. Using all observations, two equations (aggregated and disaggregated manpower services) are estimated using variable Y_1 as the dependent variable. The results from these equations indicate which of the characteristics given by the independent variables significantly affect mobility.

Internal Migration. An internal migrant is defined as a member of the labour force who migrates, and whose address after relocation is still within the Interlake Area. Equations for internal migration are estimated using Y_2 as the dependent variable. One equation, using all observations and aggregated manpower services (X_{16}) is estimated for use in the transfer to volume estimation. Equations with aggregated and disaggregated manpower service variables are estimated using a data set with out migrant observations excluded. These equations are used to determine characteristics which significantly affect internal migration.

Out Migration. An out migrant is defined as a member of the labour force who migrates, and whose address after relocation is outside the Interlake Area. Using Y_3 as the dependent variable, equations corresponding to those estimated for internal migration are tested.

Multiple Migration. A multiple migrant is defined as a member of the labour force who relocates more than one time in the time period covered by the data, one year. The dependent variable used is Y_4. Separate analyses of multiple migration are run for all migration, internal migration and out migration.

Relocation Preference. Using variable Y_5 and all observations, equations with aggregated and disaggregated manpower service variables were run to determine the characteristics of persons who expressed a preference for relocation.

Table II summarizes the equations estimated in the behavioural analysis. The relationship under investigation in each phase is given on the left hand side of the table. Successive subdivisions of the relationship are given proceeding from left to right. Each of the numbered branches represents a single equation, thus 16 equations are estimated. Three subsidary equations are estimated to aid the interpretation of results obtained. Basically, the variables included in these equations are the same as those used in the 16 migration equations, except that variables representing unemployment (X_{12}), income below $1,500 ($X_{13}$) and participation in a manpower service (X_{16}) are used as dependent variables.

Hypotheses

Theoretical considerations, prior research results and judgment provide a basis for hypothesized relationships between independent and dependent variables, as given by the sign and the absolute value of estimated coefficients. A positive sign for any given coefficient means that a person who possesses the characteristic represented by that variable has a higher probability of migrating than a person in the base class of that factor. A negative coefficient would indicate the reverse situation.

As employment in the primary sector, specifically in agriculture, declines relative to employment in secondary and service sectors, members of the labour force in the primary sector can be expected to move to areas where opportunities for employment are higher. Between 1961 and 1968, both the total number of persons and the proportion of the Interlake

TABLE II

SUMMARY OF RELATIONSHIPS STUDIED IN BEHAVIOURAL SECTION

Relationship[a]	Observations Included[b]	Aggregation of Manpower Service Variable	Equation
1. All Migration (Y_1)	All Observations	Aggregated	1.1
		Disaggregated	1.2
2. Internal Migration (Y_2)	All Observations	Aggregated	2.1
	Non + Internal Migrants	Aggregated	2.2
		Disaggregated	2.3
3. Out Migration (Y_3)	All Observations	Aggregated	3.1
	Non + Out Migrants	Aggregated	3.2
		Disaggregated	3.3
4. Multiple Migration (Y_4)	All Observations	Aggregated	4.1
		Disaggregated	4.2
	Non + Internal Migrants	Aggregated	4.3
		Disaggregated	4.4
	Non + Out Migrants	Aggregated	4.5
		Disaggregated	4.6
5. Relocation Preference (Y_5)	All Observations	Aggregated	5.1
		Disaggregated	5.2

[a]Figure in brackets is dependent variable.

[b]Total Observations (400) = Non Migrants (299) + Internal Migrants (46) + Out Migrants (55).

labour force in primary sector occupations decreased.[9] Projections to 1980 indicate that this trend can be expected to continue.[10] Therefore the sign of variable X_1, rural residence, is expected to have a positive sign, reflecting a higher probability of relocating relative to urban dwellers. This hypothesis reflects the relationship suggested by Ravenstein.[11]

The age variables (X_2 and X_3) are expected to have positive coefficients, reflecting the higher probability of migration for persons under 50 years old. Other studies have shown that migration rates are highest for young adults and decrease as age increases.[12] For this reason, the coefficient for the variable representing the 17-25 age group (X_2) is expected to be larger than the coefficient for the 26-50 age group (X_3). The effect of age on migration is suggested by Lansing and Mueller to be indirect--young persons having more to gain from migration in terms of a stream of increased earnings. A second consideration is that age may be a proxy for stage in the family life cycle, younger persons having less responsibilities than older persons.[13]

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[9] J. A. MacMillan and Chang Mei Lu, Area Manpower Planning: Projection and Impact Models, Research Bulletin (Winnipeg: Department of Agricultural Economics, University of Manitoba), (In preparation), p. 69.

[10] Ibid., pp. 48-49.

[11] E. G. Ravenstein, "The Laws of Migration," Journal of the Royal Statistical Society, XLVIII, Part 2 (June, 1885), pp. 167-227, cited by E. S. Lee, "A Theory of Migration," Demography, Vol. 3, No. 1 (1966), pp. 47-57.

[12] J. B. Lansing and E. Mueller, The Geographic Mobility of Labour (Ann Arbor: Institute for Social Research, 1967), p. 335; see also T. J. Courchene, "Interprovincial Migration and Economic Adjustment," Canadian Journal of Economics, Vol. 3, No. 4 (November, 1970), p. 563.

[13] Lansing and Mueller, op. cit., pp. 41-43.

Females (X_4) are hypothesized to be less mobile than male members of the labour force. This relationship is expected to hold for older persons especially, such persons tending to be married and have family obligations. However the size of the coefficient is expected to be small.[14] Married persons (X_5) who will tend to have more barriers to migration in the form of family obligations relative to single persons, are hypothesized to be less mobile than that group. Persons in the municipality for less than ten years (X_6) are expected to be more mobile than longer term residents, reflecting the fewer ties such people will have in the area. Persons of Indian and Metis origin (X_7) are hypothesized to be more mobile than persons of other origins. This relationship is expected to be particularly strong in terms of multipe migration.

The probability of migration is expected to increase as the level of education increases. To find satisfactory employment in skilled occupations, persons are expected to move between labour markets more than relatively unskilled persons.[15] Courchene suggests that education will increase migration by increasing the benefits and decreasing the costs of migration, thus increasing the geographical size of the labour market.[16] In the example of the Interlake however, university trained persons are expected to be less mobile within the area than persons without university training. Such persons will tend to be employed in specialized occupations for which few alternative employment opportunities

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[14]Ibid., p. 40.

[15]Ibid., p. 44.

[16]Courchene, op. cit., pp. 555-556.

exist. These relationships will be reflected in the signs of the education coefficients--hypothesized to be positive for variable X_8 and negative for X_9.

Persons in primary industries are expected to be more mobile than persons in other sectors, reflecting the declining employment opportunities which exist in those industries.[17] However the size of the coefficient is hypothesized to be small, in recognition of the adjustment problems such persons tend to have in leaving the primary sector.[18] Because of the limited number of industrial centers in the area, internal migration of persons in secondary industries is expected to be low, however out migration of such persons is expected to be greater than for tertiary industries.

If migration is considered as an adjustment mechanism responding to differences in economic conditions between labour markets, the effect of unemployment will be to increase the probability of migration. Jenness found incidences of unemployment significant in the probability of migration[19] and Lansing and Mueller conclude that unemployment constitutes a push leading to migration for particular groups in the labour force.[20] The sign of the unemployment coefficient in this study (variable X_{12}) is

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[17]MacMillan and Lu, op. cit., pp. 37-39.

[18]Department of Forestry and Rural Development, Interlake Area of Manitoba. Federal-Provincial Rural Development Agreement (Ottawa: Queen's Printer, 1967), pp. 24-28.

[19]R. A. Jenness, "Manpower Mobility Programs," Cost-Benefit Analysis of Manpower Policies, eds. G. G. Somers and W. D. Wood (Kingston: Queen's University, 1969), p. 205.

[20]Lansing and Mueller, op. cit., p. 77.

hypothesized to be positive. Also consistent with the concept of migration as an adjustment mechanism is the hypothesis that persons with low incomes will tend to migrate more frequently than persons with higher incomes. However, to the extent that costs of migration are a barrier to migration, persons in very low income groups will tend to reflect low probability of migration values. Therefore coefficients of the income variables are expected to be low for the less than $1,501 income group and increase up to the coefficient for income in the $3,001-$5,000 range.

All manpower retraining services are expected to increase the probability of migration, which will be reflected in positive signs for those coefficients. The coefficients for the variables representing the Farm Management and the Training in Industry programs are expected to be small however--persons undertaking these programs tending to return to their farms, or remain in the employment where they receive their training.

TRANSFER TO VOLUME ESTIMATES

In addition to the information obtained from the behavioural equations it is necessary to determine the volume of migration flows which can be expected to occur. The behavioural equations describe the behaviour of individual members of the labour force, and the probability of migration of a given individual can be estimated by giving values of zero or one to those variables which reflect characteristics of the individual. A modification of this procedure provides the basis for estimation of volume of migration.

Volume of Labour Force Migration

If the coefficients of each variable are weighted by the proportion of the Interlake labour force possessing the characteristic represented by that variable, and then those weighted values are summed, the dependent variable gives the proportion of the total labour force that can be expected to migrate. For example, if the total labour force is 1,000, and 150 persons in the labour force are aged 17-25 years, then the coefficient for that age variable is multiplied by 0.15. This procedure is carried out for all the characteristics entering the equation, and the resultant values are summed. This value is an estimate of the probability of the labour force migrating, given the characteristics of that labour force. The volume of labour force migrating is then found by multiplying the size of the labour force by the value of the dependent variable. Using this procedure, estimates of internal and out migrants can be obtained from equations 2.1 and 3.1 respectively.

Estimates for the number of in migrants are obtained from a ratio of in migrants to existing labour force. The estimate used here is described in the chapter outlining the data used for the study.

Estimates of migrants for any particular cohort of the labour force can be obtained by weighting each coefficient in the relevant equation by the proportion of that cohort with that characteristic. The resultant dependent variable gives the proportion of that cohort estimated to migrate.

Volume of Population Migration

The volume of total population migrating is estimated by using a labour force to population ratio. Values for this ratio have been estimated by MacMillan and Lu.[21] To obtain population estimates, projected labour force migration is divided by the labour force to population ratio.

[21] MacMillan and Lu, op. cit., p. 69.

CHAPTER IV

CHARACTERISTICS OF THE BASIC BEHAVIOURAL MODEL

Five characteristics which apply to behavioural models such as those described in the previous chapter are of particular interest: the coefficient of multiple correlation (R^2); the variance of the error term; the functional form; continuous ranges within classifications; and data requirements. The first four of these characteristics are discussed in this chapter and the approach adopted in the study is given. Data requirements for this type of analysis are given in a later chapter.

THE COEFFICIENT OF MULTIPLE CORRELATION

Low values for the R^2 are often found in cross section survey analyses.[1] Also, values of this coefficient for studies in which the dependent variable is dichotomous are typically low.[2] This situation is outlined and illustrated geometrically in Appendix A.

There are several arguments which suggest that a test of an equation based on how closely the R^2 approaches a value of 1.0 is not valid in such situations. The choice of a standard of 1.0 to measure

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[1] E. Melichar, Least Squares Analysis of Economic Survey Data (Paper read at the Annual Meeting of the American Statistical Association, September, 1965, Philadelphia, Pennsylvania), p. 15.

[2] F. Juster, "Consumer Buying Intention and Purchase Probability: An Experiment in Survey Design," Journal of the American Statistical Association, Vol. 61 (1966), p. 690.

the validity of an equation against, based on the R^2, contains the implied assumption that 100 per cent of variance in the dependent variable is systematic. As it is not possible to determine a priori that portion of the R^2 which is systematic, the choice of any standard below 1.0 is equally defensible. If the variance in a given dependent variable cannot be explained to an acceptable level by a systematically structured equation which has firm logical support, then it may be necessary to conclude that mathematical forecasting of that phenomenon by use of regression analysis is not possible. This situation applies generally to regression models. More specifically, Orcutt and Rivlin in reply to a criticism by Solow,[3] suggest that in the situation where a 0, 1 dichotomous dependent variable is used to represent a probability observation, the variance explained by the regression is based on deviations of the zeros and ones from the estimated probabilities. However because it is a probability which can take on the value of any real number between zero and one being estimated, a more useful statistic than the R^2 is the standard error of the estimated probabilities. Melichar indicates that the estimated coefficients are not able to give very accurate estimates for any of the individual observations, however good estimates of the means of each classification are obtained.[4] Jenness explains a low value for the R^2 obtained in a study of the success of labour relocation, by indicating that some explanatory variables are missing from the

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[3]G. H. Orcutt and A. M. Rivlin, "An Economic and Demographic Model of the Household Sector: A Progress Report," Demographic and Economic Change in Developed Countries, National Bureau of Economic Research (Princeton: Princeton University Press, 1960), p. 322.

[4]Melichar, op. cit.

equation used.[5] Neter and Maynes argue that a more appropriate measure of the relationship between the independent and dependent variables may be the correlation ratio.[6] This argument is based on the unrestrained functional form of the correlation ratio in comparison with the R^2, which is a measure of linear association.

In any regression analysis, the higher the coefficient of multiple correlation the better, other things being equal. However, the arguments presented in this section indicate that interpretation of the R^2 and the significance of that measure is not clear for equation forms specified with a 0,1 dependent variable.

VARIANCE OF THE ERROR TERM

An assumption made for ordinary least squares regression analysis is that the residuals have constant variance,[7] a property known as homoscedasticity. If this assumption is violated, a condition known as heteroscedasticity exists. Estimation by ordinary least squares under conditions of heteroscedasticity yields unbiased but inefficient estimates of the regression coefficients, and biased and inconsistant

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[5] R. A. Jenness, "Manpower Mobility Programs," Cost Benefit Analysis of Manpower Policies, eds. G. G. Somers and W. D. Wood (Kingston: Queen's University, 1969), p. 205.

[6] The correlation ratio is a measure of the degree of total relation between independent and dependent variables. The ratio is based on the probabilities of the dependent variable assuming a value of 0 or 1 and the expected value of the dependent variable given a value for the independent variables. See J. Neter and E. S. Maynes, "On the Appropriateness of the Correlation Coefficient with a 0,1 Dependent Variable," Journal of the American Statistical Association, Vol. 65 (1970), p. 504.

[7] J. Johnston, Econometric Methods (New York: McGraw-Hill Book Company, 1963), p. 9.

estimators of the variance of these estimates.[8]

It can be shown that the variance of residuals from a regression equation with a dichotomous dependent variable is not constant.[9] That is, heteroscedasticity exists.

Consider the equation:

$$Y_i = a + b X_i + u_i \tag{3}$$

Where $Y_i = 1$ or 0 for each observation i

X_i is an explanatory variable

u_i is the residual.

From equation (3) consider possible values of the residual, u_i.

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[8] W. A. Bowen and T. A. Finegan, The Economics of Labour Force Participation (Princeton: Princeton University Press, 1969), p. 605. There are four statistical properties which are desirable in estimates of parameters:

(i) Unbiasedness. An estimate $\hat{b}$, is an unbiased estimate of the parameter b if $E(\hat{b}) = b$, where $E(\hat{b})$ is the expected value of the estimate.

(ii) Consistency. An estimate $\hat{b}$, is a consistent estimate of b if the probability distribution of $\hat{b}$ concentrates on the parameter value as the size of the sample tends to infinity.

(iii) Efficiency. Of any two unbiased and consistent estimators, the one with the lowest variance (the most efficient) is preferred.

(iv) Sufficiency. A statistic is sufficient if, given the value of that statistic, the conditional distribution is independent of the parameters.

See also D.A.S. Fraser, Statistics: An Introduction (New York: John Wiley and Sons, Inc., 1958), pp. 213-220.

[9] Much of the remainder of this section is based on: A. Buse, "A Technical Report on the Uses, Problems and Potential of Qualitative Dependent Variables as Applied in the Social Sciences, Particularly Economics" (Edmonton: Alberta Human Resources Research Council, 1970), pp. 21-26. (Mimeographed.)

$$\text{If } Y = 1 \ , \ u_i = 1 - a - b X_i \tag{4}$$

$$\text{If } Y = 0 \ , \ u_i = - a - b X_i \tag{5}$$

Obviously the value of u_i depends on X_i. Consider now the variance of u_i. It is assumed for ordinary least squares that the variance of u_i has a constant value.

Let the probability that Y = 1 be p_1, and the probability that Y = 0 be p_2. From the usual least squares assumptions, the expected value of the residuals equals zero.[10]

$$\text{ie. } E(u_i) = \sum_{j=1}^{2} u_j \ p_j \tag{6}$$

$$= 0$$

Also, the sum of probabilities equal 1.

$$\text{ie. } \sum_{j=1}^{2} p_j = 1 \tag{7}$$

Equations (6) and (7) can be solved for p_1 and p_2.

$$p_1 = a + b X_i \tag{8}$$

$$p_2 = 1 - a - b X_i \tag{9}$$

[10] Johnston, op. cit.

Now the variance of u_i can be derived:

$$\begin{aligned} \text{Var}(u_i) &= E(u_i^2) \\ &= \sum_{j=1}^{2} u_j^2 \; p_j \\ &= (1 - a - b\,X_i)\;(a + b\,X_i) \end{aligned} \tag{10}$$

Thus, the variance of u_i varies with X_i, and the model has heteroscedastic disturbances, which invalidates conventional tests of hypotheses based on the t test.

Invalid tests of hypotheses mean that ordinary least squares applied to an equation with a dichotomous dependent variable cannot provide adequate information relating independent and dependent variables. It is therefore necessary to determine how these tests are affected by heteroscedasticity. Taking the expected value of the variance of a regression coefficient with non-constant variances gives the expression shown in equation (11).

$$\text{Var}(b) = \frac{\sum x_i^2 \; z_i}{(\sum x_i^2)^2} \tag{11}$$

Where $x_i = X_i - \bar{X}$

X_i is a given observation on X

$\bar{X}$ is the mean value of X_i for all i

and $z_i = \text{Var}(u_i)$ given in equation (10).

All summations are over i for i = 1 .... n, the number of observations.

The direction of bias arising through use of the conventional formula[11] can be shown to be a function of the value of the independent variables of the sample. To determine the bias for a given sample requires estimation of (11). However evaluation of this expression requires a knowledge of z_i, which is a function of the coefficients to be estimated. Since the estimators from ordinary least squares are consistent, a consistent estimate of z_i can be obtained by use of parameters estimated by ordinary least squares and inserted in (10).

Conventional estimates of the variance of the error term are obtained by averaging the sum of squared residuals about the least squares surface over the number of samples.[12] Such an estimate cannot be negative. However it is possible for estimates of z_i to be negative. This situation arises whenever any of the estimates of the dependent variable are outside the zero-one range. These negative values are absorbed when the numerator in equation (11) is summed, which will tend to give an artificially low estimate of variance of regression coefficients. The same problem arises when dealing with weighted least

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[11]The conventional formula for the variance of the estimate is:

$$\text{Var (b)} = \frac{\sum(Y_i - \hat{Y}_i)^2 / (n - 2)}{\sum x_i^2}$$

where Y_i is the i^{th} value of the dependent variable,

$\hat{Y}_i$ is the estimate of Y_i,

x_i is as in equation (10), and

n is the number of observations.

[12]Johnston, op. cit., pp. 19-20.

squares, and although recognized and discussed in that context, no mention is made in the literature of the implications of negative variance estimates on the consistent standard error calculation. However, under certain conditions, use of negative estimates of z_i will give standard error estimates which are biased downwards to the extent that meaningless significance is attached to some coefficients. Early tests in this study indicated that when a variable with a low mean value is associated with a low mean value of the dependent variable, with few or no observations of the independent variable associated with a value of 1 for the dependent variable, the consistent standard error estimates are not reliable. Because this situation can arise often in an equation with all 0,1 dummy variables, an adjustment must be made to the estimate for z_i. Variance is a measure of the absolute dispersion about a given value. The z_i estimated by equation (10) are consistent estimates of variance, however the direction of dispersion is included. For use in the consistent standard error calculation of this study, the absolute value of the estimate of z_i is used. It is hypothesized that this value should be used in all such standard error estimates to prevent a downward bias. Results by Buse, Bowen and Finegan and Zellner and Lee[13] could well be biased for this reason.

Ordinary least squares estimates of the coefficients of a heteroscedastic model are inefficient. Unbiased and efficient estimates can

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[13] Buse, op. cit.; see also Bowen and Finegan, op. cit.; see also A. Zellner and T. H. Lee, "Joint Estimation of Relationships Involving Discrete Random Variables," Econometrica, Vol. 33, No. 2 (April, 1965), pp. 382-394.

be obtained through use of weighted least squares.[14] In weighted least squares, the observed values of the independent variables are weighted by their variance. That is, the squared deviations between observed and estimated values of the dependent variable are weighted such that the influence of less precise observations is deflated.[15] If the variance of the residuals is known then the data can be transformed to satisfy the condition of homoscedasticity. Use of ordinary least squares on the transformed data is the equivalent of weighted least squares and yields unbiased and efficient estimates.[16] Data transformation requires a knowledge of the variance. As is discussed previously, a consistent estimate of this variance can be obtained using parameters derived from ordinary least squares. Each observation is then divided by the standard error of the residual for that observation.[17] Bowen and Finegan suggest that generalized least squares is not suitable if any estimates of the dependent variable fall outside the zero-one interval.[18] To obtain data weights for the generalized least squares calculation, the absolute value of estimated z_i were used for the same reasons discussed for their

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[14] R. J. Wonnacott and T. H. Wonnacott, Econometrics (New York: John Wiley and Sons, Inc., 1970), p. 322. Weighted least squares is a special case of generalized least squares, and is sometimes referred to by that name.

[15] Ibid., p. 133.

[16] Ibid., p. 323.

[17] Buse, op. cit., p. 24. The weight for all variables in the i^{th} observation is:

$$\frac{1}{\sqrt{z_i}}$$

[18] Bowen and Finegan, op. cit., p. 646.

use in consistent standard error calculation.

To summarize, it can be shown that a model with a dichotomous dependent variable violates the assumptions of ordinary least squares regression. To determine the effect of this violation on the magnitude and significance of coefficients estimated by ordinary least squares, a consistent estimate of the variance of the regression coefficients is determined and weighted least squares estimates for the coefficients and their variance are obtained. Results from these three procedures are discussed in a later chapter.

FUNCTIONAL FORM

Regression analysis as conventionally used with continuous numerical values for the variables requires strong assumptions about the form of the equation.[19] Linear and log linear functions tend to dominate the form of equation used because of the computational ease associated with these forms. Alternative specifications are possible through use of quadratic relationships. However, step functions of the form used in this study are essentially free form functions.[20] With the restriction that the function remains flat over the range of the explanatory variable (the relaxation of this assumption is discussed in the next section) the expectation of the dependent variable can vary in complex ways. For

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[19] G. H. Orcutt, et al., Microanalysis of Socio-economic Systems: A Simulation Study (New York: Harper and Brothers, 1961), p. 241.

[20] A. S. Goldberger, Econometric Theory (New York: John Wiley and Sons, Inc., 1964), p. 222; see also Appendix A.

example, if age is divided into four variables each representing a different age group, then there are a large number of possible combinations of relative effect. As age increases, the effect may be an upright or inverted U shape, linear increasing or linear decreasing, S-shaped, etc. Since the form of relationship of each variable is determined empirically, interesting tests of hypotheses can be achieved. When dealing with a large number of explanatory factors however, statistical considerations, such as degrees of freedom, limit the range of hypotheses able to be tested in any one equation. Hypothesized relationships investigated in this study are presented in Chapter III.

However the step function form is restrictive in that the effect of separate explanatory variables are assumed to be additive. That is, the effect of any given explanatory variable is assumed to be independent of the other explanatory variables. Many of the variables used in socio-economic research can be expected to interact to produce an effect on the dependent variable. A discussion of the detection and treatment of interaction is given in Appendix A. One means of overcoming non-additivity is by use of interaction terms. For example, a dummy variable can be specified when a given combination of factors occur together, and be used in the analysis. Several variables of this type were constructed and used in the initial stages of model formulation in order to ascertain the extent of interactions existing in the relationships under study. Included were interaction terms combining unemployment and age, sex and marital status, industrial affiliation and the length of time in the area, ethnic origin and education, income and education and income and number of dependents. Significant relationships existing between migration and variables combining the length of time in the area and industrial affiliation and sex and marital status were determined. However in later stages of the analysis, interaction terms were not included, primarily for computational reasons. When dealing with a large number of variables, the total possible number of interaction terms combining two or more variables becomes extremely large. Investigation of the influence of these terms requires large amounts of data processing time, and severely strains the capacity of regression packages commonly used for less demanding data sets. However results obtained under the assumption of additivity must be interpreted with the possible violation of that condition being recognized.

A second problem associated with the assumption of additivity arises when the zero-one range of a dummy dependent variable is interpreted as a probability. Probabilities must lie in the range zero to one, however estimates of probability obtained by the addition of several components can take on values beyond this range. A reason for this possibility can be illustrated by using migration as an example. The possession of any one characteristic may be a sufficient condition for an individual to migrate. However, an individual may possess two or more of these sufficient characteristics, and under the additivity assumption, the combined total probability estimate can be greater than one. A similar argument holds for values of less than zero. This reason has been given for the use of suitable non-linear functions with asymptotes zero and one such as exponential and integrated normal functions.[21] The additive dummy variable form has been used in this model as an

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[21]Buse, op. cit., p. 8.

approximation to the underlying function. The choice of such a specification avoids the more difficult estimation procedures required for alternative formulations[22] at the expense of some theoretical constructs. Whether this choice is justified can be measured by the frequency of correct inferences about the influence of explanatory variables on the probability of response.[23] Results obtained from the migration model are presented in a later chapter.

CONTINUOUS RANGES FOR VARIABLES

The basic step function form dictates that the function remains flat over the range of the explanatory variable.[24] This restriction can be avoided to allow for a slope within the variable range and changes in slope between variables, provided that the variable can be measured on a numerical scale. Using the formulation given by equation (21) in Appendix A income and age variables were used in an equation to determine the advantages of this method. Results obtained indicate that the theoretical appeal of the formulation is not reflected in the applied situation. To allow for both intercept and slope changes, any one characteristic range (say ages 17-25 years) is represented by three variables. Although estimates are obtained for each segment of the structure, the significance of any one estimate, or the combined effect cannot be established. For this reason continuities were left out of the final models used.

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[22]For example, see Goldberger, op. cit., pp. 261-262.

[23]Buse, op. cit., p. 51.

[24]See Appendix A, Figure 5.

CHAPTER V

THE DATA

This chapter begins with a short discussion of socio-economic data, which contains many properties not found in data used in bio-economic studies. Data for the behavioural equations is described in the next section, followed by an examination of the volume of migration data and the estimate of in migration.

SOCIO-ECONOMIC DATA

The data required for analysis of phenomena such as migration can be described as referring to a socio-economic system. Data for analysis of such a system is generated by the interrelationship of social and economic factors. Introduction of the social component to economic data complicates the analytical problem of isolating relevant causal relationships within the system because of the many and varied intercorrelations and interactions. The complexity of the problem is again increased as data is disaggregated to the personal level. At this level, the behaviour of a given individual cannot be offset against the behaviour of another in the form of averages. This is the stage where the divergent behaviour of observed man and the rational economic man of theory is most obvious.

Comparisons of results from different socio-economic analyses of the same phenomenon, for example migration, invariably reveal conflicting conclusions about the underlying behavioural relationships. However before any general theory about an aspect of socio-economic behaviour can be established it is necessary to recognize and allow for variance in the phenomenon under study which is attributable to characteristics peculiar to a particular piece of research. Data collected for use in socio-economic studies is commonly obtained through the use of surveys. The properties of data obtained in different surveys will vary according to different survey emphasis, differences in quality of the data obtained (for example measurement error and response rate) and differences in the type of sample used to obtain respondents for the survey. Subsequent analysis of the data should be designed to remove, or at least identify variance attributable to these three sources.

This problem is not restricted to comparisons between data collected from different surveys. Perhaps an even more important comparison is between the data collected in any one survey and the theoretical constructs which are to be tested using that data. Conclusions drawn from such a study will depend on the correspondence of the data and theoretical constructs. Thus another level of interrelationships is introduced. In addition to the interrelationships within the actual socio-economic system and between different data sources, there is interaction and substitution within the data, resulting in surrogate correlations which connect data to the theoretical structures. To isolate meaningful relationships within socio-economic systems for use in decision making, different techniques of multivariate analysis are extremely useful. However the application of these techniques must be made with careful consideration of how closely attributes of the data correspond to the conditions for which these techniques were developed.

These are some of the problems which arise when studying socio-economic systems. To take all these problems and allow for their influence in any one study would be an extremely long procedure. However where this has not been done in the study, some allowance must be made in interpreting those study results. So that persons interpreting results are aware of where problems arise, the conceptual approach, analytical techniques and data used should be clearly documented. The remainder of this chapter outlines the data used in the study. (Chapters II and III give the other two requirements.)

DATA FOR THE BEHAVIOURAL EQUATIONS

Migration analysis requires data which exhibits both cross sectional and time series characteristics. The extensive cross section data on the labour force required for use in constructing explanatory variables is coupled with a dependent variable representing migration, a phenomenon with temporal characteristics. Depending on the aspects of migration under study, more or less emphasis can be placed on the temporal component than the cross section component. In this analysis the latter component is emphasized.

As the area of analysis becomes more strictly defined, the problems of obtaining suitable data for the calculations become more difficult, once the alternative of conducting a specific sample survey has been rejected. Several alternative sources of data were investigated for this study, however few of the sources considered contained sufficient information on the incidence of migration. The data used to estimate the model were taken from a survey carried out for a study of the benefits and costs associated with manpower services in the

Interlake Area.[1] The sample used in the above mentioned study consisted of 413 members of the labour force. This total includes 41 persons taken as a random sample from the list of households used in a 1968 survey of the Interlake,[2] 22 persons selected randomly from labour force lists obtained from the Department of Indian Affairs, and 350 persons selected from participants in 13 Manpower Survey categories.[3] For this study, clients of the Mobility program were removed from the sample, leaving 400 persons in the analysis. Initially, a target of 30 persons in each of these groups was set. The procedure actually used was to select 50 names at random from each group, and to then attempt to contact all of these persons. A 60 per cent response rate would then provide the 30 persons. The overall valid response rate was 63 per cent for the service groups, and 43 per cent for the norm group. The distribution of contacts by service and norm groups is given in table form in MacMillan, Bernat and Flagler.[4] Reasons for non-response include persons not able to be located, refusals, persons ill or in jail, ineligible or invalid questionnaires, deceased persons and a group classed as "distant clients". This latter group includes persons who originally lived in

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[1] J. A. MacMillan, L. A. Bernat and J. J. Flagler, Benefits and Costs of Manpower Services in the Interlake Rural Development Area, Research Bulletin (Winnipeg: Department of Agricultural Economics, University of Manitoba).

[2] C. F. Framingham, J. A. MacMillan and D. J. Sandell, The Interlake Fact (Winnipeg: Planning and Priorities Committee of Cabinet Secretariat, 1970).

[3] A more complete description of the sample and how it was derived is given in MacMillan, Bernat and Flagler, op. cit.

[4] Ibid., p. 8. This table is reproduced in Appendix B.

the survey area, but had moved away and were not contacted. A total of 63 persons are classified in this group. The exclusion of these persons would be expected to exert a downward bias on the value of the estimators. It is not possible to determine the extent of this bias without some knowledge of the migration behaviour of the other 355 persons in the non-response group.

Because of the nature of the analysis for which the survey was undertaken, data on individuals were collected for one year prior to taking a manpower service and for one year after the service. The two periods are referred to as the base and exposure periods respectively. Extensive data was collected for each individual, including demographic characteristics, labour market characteristics, communication channels, income and expenses, employee satisfaction, and mobility. The mobility information refers to the exposure period, so that where appropriate, characteristics of the individual are related to that period.

Data Used for the Behavioural Equations

In this section, the data used to provide observations on the variables used in the regression equations as outlined in Chapter III are discussed. A list of the variables is given in Table I of that chapter. All variables are transformed into zero-one dummy variables following subdivision into suitable characteristic classifications.

1. Residence: Variable X_1 takes on the value 1 if the individual resides in a rural area, that is, places which have a population of less than 350.

2. Age: Age is broken into groups of persons 17-25 years and 26-50 years. The age range 17-25 is chosen to include those persons who

leave school, through to an age at which persons tend to be undertaking more responsibilities. The age 50 is chosen as a cutoff with the hypothesis that persons over that age will be well established in their area of residence and less mobile than younger persons. An alternative division of the age range was used in early stages of the analysis, however the results obtained were not satisfactory. Because of the criticism that can be leveled at the choice of any clear-cut division of the age continuum, an attempt was made to reduce the severity of this specification and the implied assumptions, by introducing continuous ranges within each classification. However this approach did not improve the analysis.

3. Sex, Marital Status and Ethnic Origin: These variables enter the analysis as dummy variables reflecting presence or absence of the relevant characteristic.

4. Time in Municipality: If an individual had resided in that municipality of current residence for less than 10 years, variable X_6 takes on a value of unity. Such persons are hypothesized to have fewer ties to that particular residence in terms of relatives and emotional connections. A more meaningful relationship could perhaps be obtained using a period of less than 10 years, however the data available did not provide a breakdown into less than 10 year periods.

5. Education: The education variables (completion of grades 8-13, and university or Post Secondary education) refer to the highest grade completed in the regular school system. The university variable includes persons who have any university training, not just those who have completed a degree.

6. Industry: On the basis of 13 divisions of the Standard Industrial Classification, the data is divided into two groups entitled "Primary" and "Secondary" groups. The first includes persons in Agriculture, Forestry, Fishing and Trapping, and Mining. The secondary group includes persons in Manufacturing, Construction and Trade industires.

7. Unemployment: The unemployment variable, X_{12}, was given a value of one if the person was unemployed for more than eight weeks in the exposure period.

8. Income: The income value used to derive variables X_{13} to X_{15} was taken from the sum of wage earner's total income, gross income from piece work, net income of self-employed businessmen and returns to labour and capital on farms. This latter value was obtained by subtracting farm expenses from farm sales, inventory change and farm perquisites. The remainder of values were taken directly from the questionnaire.

9. Manpower Services: Eight categories of services were defined in the study for which the data were collected. Seven of these categories were used as independent variables in the analysis. A description of the groups is given in Appendix B. Persons taking the Mobility Assistance program were not included in the analysis because of the direct focus of this program on migration. An eighth variable is used in this group, which assumes a value of one if the person took any Manpower program. In the analysis either this variable or the alternative seven disaggregated variables were used.

10. Migration: The dependent variables used in the regression equations were all of the zero-one dummy specification. For migration

four variables were used--three of these took a value of 1 if an individual migrated, referring to all migration, internal migration or out migration. The fourth variable assumes a value of 1 if a person migrated more than one time in the exposure period, and zero otherwise. A fifth dependent variable was used which assumed a value of one if an individual expressed a preference to relocate his home in the exposure period, and zero otherwise.

Table III gives the distribution of persons in the sample over each of the independent and dependent variables used in the analysis, classified by types of migration behaviour. From the table it is possible to determine the distribution of characteristics in the data used for each equation. Referring to Table II, the observation groups included in each equation correspond to the column headings in Table III. Summing the relevant observation groups horizontally thus provides the required distributions.

DATA FOR TRANSFER TO VOLUME

The data required to obtain volume of labour force migration from the behavioural equations refers to the total labour force of the Interlake Area for the time period under consideration. For this study the year 1968 was chosen so that data from the Interlake Fact could be used.[5]

Type of Data

The data required for volume estimates are the same for the

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[5]Framingham, MacMillan and Sandell, op. cit.

TABLE III

DISTRIBUTION OF SAMPLE OVER MIGRANT CLASSES[a]

Variable	Total Sample	Non Migrants	All Migrants	Internal Migrants	Out Migrants	Multiple Migrants
X_1 Rural Residence	248	191	57	24	33	25
X_2 Age 17-25	150	89	61	24	37	28
X_3 Age 26-50	205	169	36	20	16	15
X_4 Female	55	40	15	8	7	6
X_5 Marital Status	279	219	60	28	32	25
X_6 Time in Municipality	148	113	35	11	24	14
X_7 Indian or Metis	144	95	49	16	33	26
X_8 Education Gr. 8-13	237	177	60	32	28	24
X_9 University	2	1	1	1	0	0
X_{10} Primary Industry	66	38	28	13	15	15
X_{11} Secondary Industry	104	71	33	9	24	13
X_{12} Unemployment	146	93	53	17	36	27
X_{13} Income less than $1500	135	104	31	17	14	16
X_{14} Income $1501-$3000	72	46	26	8	18	11
X_{15} Income $3001-$5000	84	63	21	9	12	6
X_{16} All Manpower Service	336	237	99	46	53	42
X_{17} BTSD Level III or IV	70	49	21	9	12	15
X_{18} Voc. or Spec. Training	56	34	22	12	10	9
X_{19} Farm Mgt. Training	26	24	2	2	0	0

TABLE III (continued)

Variable	Total Sample	Non Migrants	All Migrants	Internal Migrants	Out Migrants	Multiple Migrants
X_{20} Manpowers Corps or VRT	48	31	17	7	10	4
X_{21} Training in Industry	24	19	5	1	4	1
X_{22} BTSD Level I or II	60	43	17	7	10	8
X_{23} Employment Referral	52	37	15	8	7	5
Y_1 All Migrants	101	0	101	46	55	43
Y_2 Internal Migrants	46	0	46	46	0	17
Y_3 Out Migrants	55	0	55	0	55	26
Y_4 Multiple Migrants	43	0	43	17	26	43

[a]Numbers represent number of persons. Total sample is 400 persons.

projection of internal migrants and out migrants. For each explanatory variable used in the behavioural equations an estimate of the proportion of the Interlake labour force possessing that characteristic is required. For example, if two thirds of the labour force have rural residence, then the proportion 0.67 is used to weight the corresponding coefficient. To obtain an estimate of in migration, which is not possible from the behavioural section, the number of in migrants in 1968 were expressed as a ratio to the existing Interlake labour force. Transfer from labour force to population estimates requires an estimate of the ratio of labour force to population.

Source of Data

The detailed breakdown of labour force data required for the proportion estimates meant that data had to be obtained from several sources. The major source used was the Interlake Fact, a statistical volume giving extensive data on human and natural resources for the 1968 calendar year.

The proportion of persons with rural residence is derived from data in Table 19 of the Interlake Fact. Those persons with rural residence are taken as those in the Rural Farm or Rural Non-farm sections. The labour force age groups used in the behavioural section do not correspond to those in the Interlake Fact. Because a year by year age breakdown of the labour force was not available, it was assumed that labour force participation rates were the same for all age groups in the relevant population (ages 17-64) and these population proportions used.

Data were obtained from Population of Manitoba.[6] The proportion of females in the labour force was obtained from Table 17 of the Interlake Fact after adjustment for multiple job positions,[7] as were values for affiliation to Industrial groups. Education values were obtained from Table 6 of the Interlake Fact after adjustment. The estimate of the proportion of persons with education of Grades 8-13 will be biased downwards, as the values for Grades 9-12 are used. The proportion of persons who were unemployed for greater than eight weeks in 1968 was derived from Table 19 of the Interlake Fact. The data obtained from the Interlake Fact and Population of Manitoba does not include Indian members of the labour force. The weight for this coefficient is therefore zero, and the results obtained do not include these people. Data for persons in the income ranges less than $1,500 and $1,501 to $3,000 were obtained from Table 21A of the Interlake Fact. The proportion of labour force members who received Manpower Services was obtained from a study by Flagler, MacMillan and Bernat.[8] Indian Affairs clients and Canada Manpower Counselling clients were excluded from this estimate. External estimates were not available for the number of persons in the

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[6] Manitoba, Continuing Programs Secretariat, Planning and Priorities Committee of Cabinet, Population of Manitoba (Winnipeg: 1971).

[7] Because data on the labour force is obtained by recording statistics for each employment position, the reported figures must be adjusted by the number of multiple job positions held by employed persons. From Table 19 of the Interlake Fact, the average number of jobs per person in each occupation is calculated. This ratio is used to adjust labour force figures cross classified by occupation and sex, industry, etc. Implied in these transformations are the assumptions that multiple job holding and unemployment are evenly distributed over the characteristic (sex, industry, etc.) being adjusted.

[8] MacMillan, Bernat and Flagler, op. cit., p. 6.

labour force who were married, those who had been in the area for less than ten years, or the number of persons in the \$3,000-\$5,000 income group. Data for these variables were taken from the sample used to estimate the behavioural model.

Table IV gives the weights used for each of the variable coefficients for the transfer to volume figures.

The behavioural model does not allow estimation of in migrants to the Interlake Area. Several problems prevent derivation of in migrants by this procedure. The concept underlying the internal and out migration estimates is that from a pool of labour force members, some individuals will migrate, and the incidence of migration is causally related to certain characteristics of this pool. To continue this concept to in migrant estimates, data for the labour force for all areas but the Interlake should be used, with migration to the Interlake being recorded as a positive response for the dependent variable. Lack of a suitable data source prevents this alternative from being realized. A changed approach could be used, where in migration is recorded as a function of the pool of labour force characteristics at the destination area. However, for the purposes of this analysis, an external point estimate is taken for the calendar year 1968. The estimate is derived from data collected on household characteristics in an earlier survey of the area.[9] The survey was stratified by urbanization and municipality. Thus, to derive an estimate of in migration, counts were taken of persons

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[9]A description of this survey is given in J. A. MacMillan and C. F. Framingham (eds.), Seminar on the Evaluation of the Manitoba Interlake Area Development Plan, Occasional Series No. 1 (Winnipeg: Department of Agricultural Economics, University of Manitoba, 1969.

TABLE IV

WEIGHTS USED FOR EACH VARIABLE IN THE TRANSFER TO VOLUME FIGURES

Factor	Variable[a]	Weight
Residence	X_1	0.62
Age 17-25	X_2	0.25
26-50	X_3	0.50
Sex	X_4	0.20
Marital Status	X_5	0.70
Time in Municipality	X_6	0.37
Ethnic Origin	X_7	0.00
Education - 8-13	X_8	0.45
University	X_9	0.06
Industry - Primary	X_{10}	0.39
Secondary	X_{11}	0.25
Unemployment	X_{12}	0.16
Income - less than $1,500	X_{13}	0.15
$1,501-$3,000	X_{14}	0.17
$3,001-$5,000	X_{15}	0.21
Manpower Service	X_{16}	0.12

[a]Variables correspond to those in Table I.

within the Interlake who had resided out of the area the previous year. These counts were then weighted for class of urbanization and by municipality to obtain an estimate of the number of in migrants as a percentage of the Interlake population.[10] The weighted estimate obtained is 3.1 per cent.

The ratio of labour force to population was obtained from a study by MacMillan and Lu.[11] The estimated ratio for 1968 is 0.3345. Multiplying the inverse of this ratio by the labour force estimates gives an indication of the magnitude of population movements.

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[10]The weighting procedure used to obtain the mean percentage of in migrants (P) as a function of labour force size is given by a two step process. First, the weighted mean percentage of in migrants (P_i) is estimated for each municipality, weighted by class of urbanization:

$$P_i = \sum_j \frac{N_{ij}}{N_i} \cdot P_{ij}$$

N_{ij} is the number of heads of household in municipality i, urbanization class j,

N_i is the total number of heads of household in municipality i, and

P_{ij} is the sample proportion in stratum ij.

The second step is to derive the weighted mean percentage of in migrants for the Interlake, weighted by municipality.

$$P = \sum_i \frac{N_i}{N} \cdot P_i$$

N is the total number of heads of household in the Interlake and N_i and P_i are as above.

This process is derived from G. W. Snedecor and W. G. Cochran, Statistical Methods (Ames: Iowa State University Press, 1967), pp. 526-528.

[11]J. A. MacMillan and Chang Mei Lu, Area Manpower Planning: Projection and Impact Models, Research Bulletin (Winnipeg: Department of Agricultural Economics, University of Manitoba), p. 70, (In preparation).

CHAPTER VI

RESULTS

Contained in this chapter are two main sections. The first section presents results obtained from the behavioural equations--initially the coefficient results are given, followed by some statistical considerations associated with the estimation procedures used. The section presents results of the volume of migration estimates. Included in this section is discussion of the effect of changes in labour force characteristics.

Numerical results are given in table form where they relate to the discussion, however a complete set of results from each equation estimated are given in Appendix C.

BEHAVIOURAL RESULTS

Coefficients estimated in the behavioural equations represent deviations in migration behaviour attributable to the class of factor represented by the variables, relative to the base class of that factor. In this section characteristics of all, internal and out migrants are examined, including consideration of the characteristics possessed by persons who migrate more than once, and of persons who express a desire to relocate.

Behavioural Equation Results

In general the signs of estimated coefficients are in agreement with the relationships hypothesized. Where signs obtained are opposite to those hypothesized, the coefficients tend not to be significantly different from the base class.[1] There is a general tendency for the size of significant coefficients for all migration to be higher than for internal and out migration. This is to be expected, reflecting the different probability of each type of behaviour. Table V gives coefficient values for each type of migration. The equation depicting all migration gives an aggregate impression of what characteristics tend to be more or less significant than others. Breaking the data into internal and out migrant groups gives an indication of the composition of these aggregate results. In general the same characteristics are significant for all and internal migration. However significant characteristics for internal and out migrants are quite different. This overall pattern indicates that the process of migration is selective with respect to characteristics of the individual. Furthermore, out migration is a selective process in terms of those persons who migrate. There are two important implications of these results. Firstly, the process of migration, over time, will change the characteristics of the remaining labour force, and secondly, the impact of any program designed to influence migration will be affected by these existing tendencies. Further consideration of these results is given later in the study.

Residence. In general, rural residents do not exhibit different migration behaviour than urban residents as indicated by the non-

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[1]All tests of significance of regression coefficients are based on a one-tailed t test.

significant coefficients for that variable.[2] This relationship exists for all three groups of migrants. It is possible that some of the variance in migration behaviour attributable to this variable is included in the variable representing primary industry participation (X_{10}), although the low simple correlation coefficient between these two variables suggests that this is not the situation.[3] However there is a tendency for persons who have rural residences to be less likely to move more than once, relative to persons who have an urban residence.

Age. Persons in the 17-25 year age group are more likely to migrate than persons of all other ages. Persons aged 26-50 years do not exhibit different migration behaviour than persons older than 50 years. Both internal and out migration are affected in the same direction, although the coefficient for out migration is greater than for internal migration. Persons in the 17-25 age range are more likely to move more than once than all other persons. This is more significant for internal migrants than for out migrants. There also is a slight tendency for persons aged 26-50 to move more often than older persons.

Sex. Migration behaviour of females does not differ significantly from that of males for all, internal and out migration. No difference is observed in the incidence of multiple migration for these two groups.

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[2]Tables V to VIII give the coefficient values relevant to the remainder of this section of the Chapter. Values of the R^2 are included as typical values of that coefficient obtained with a model of this type.

[3]Table XVIII gives the simple correlation coefficients between independent variables used in the analysis.

TABLE V

REGRESSION EQUATION COEFFICIENTS FOR ALL, INTERNAL AND OUT MIGRATION. AGGREGATED MANPOWER SERVICES

	Variable	All Migration	Internal Migration	Out Migration
X_1	Residence	-0.039	-0.031	-0.020
X_2	Age 17-25	0.153**	0.061+	0.144**
X_3	Age 26-50	0.001	0.001	-0.013
X_4	Female	0.032	0.031	0.020
X_5	Marital Status	-0.042	-0.021	-0.018
X_6	Time in Municipality	0.069*	-0.016	0.113**
X_7	Indian or Metis	0.097*	0.017	0.094*
X_8	Education Grades 8-13	0.062+	0.065*	0.028
X_9	University	0.390	0.423	-0.018
X_{10}	Primary Industry	0.179**	0.149**	0.123*
X_{11}	Secondary Industry	0.071+	-0.029	0.114**
X_{12}	Unemployment	0.112**	0.013	0.145**
X_{13}	Income less than $1500	-0.116**	-0.047	-0.119**
X_{14}	Income $1501-$3000	0.039	0.007	0.051
X_{15}	Income $3001-$5000	-0.061	-0.051	-0.044
X_{16}	Manpower Service	0.207**	0.143**	0.104**
	Intercept	-0.073	-0.010	0.108
	R^2	0.18**	0.09**	0.22**
	Equation	1.1	2.2	3.2

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE VI

REGRESSION EQUATION COEFFICIENTS FOR ALL, INTERNAL AND OUT MIGRATION. DISAGGREGATED MANPOWER SERVICES

	Variable	All Migration	Internal Migration	Out Migration
X_1	Residence	-0.031	-0.025	-0.017
X_2	Age 17-25	0.141**	0.047	0.143**
X_3	Age 26-50	0.002	0.003	-0.015
X_4	Female	0.033	0.035	0.017
X_5	Marital Status	-0.041	-0.022	-0.017
X_6	Time in Municipality	0.073*	-0.017	0.113**
X_7	Indian or Metis	0.106**	0.009	0.101**
X_8	Education Grades 8-13	0.053	0.060+	0.019
X_9	University	0.353	0.385	-0.021
X_{10}	Primary Industry	0.175**	0.147**	0.126*
X_{11}	Secondary Industry	0.064+	-0.031	0.108*
X_{12}	Unemployment	0.107**	0.012	0.148**
X_{13}	Income less than $1500	-0.148**	-0.088*	-0.128**
X_{14}	Income $1501-$3000	0.017	-0.021	0.044
X_{15}	Income $3001-$5000	-0.081+	-0.073+	-0.050
X_{17}	BTSD Level III and IV	0.221**	0.183**	0.106*
X_{18}	Vocational or Special Training	0.300**	0.232**	0.132*
X_{19}	Farm Management Training	0.140**	0.077+	0.092*
X_{20}	Manpower Corps or V.R.T.	0.185**	0.146*	0.062
X_{21}	Training in Industry	0.152*	0.055	0.115+
X_{22}	BTSD Level I and II	0.244**	0.138**	0.135**
X_{23}	Employment Referral	0.216**	0.155**	0.105*
	Intercept	-0.062	0.011	-0.104
	R^2	0.19**	0.11*	0.22**
	Equation	1.2	2.3	3.3

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE VII

REGRESSION EQUATION COEFFICIENTS FOR MULTIPLE MIGRATION FOR ALL, INTERNAL AND OUT MIGRATION. AGGREGATED MANPOWER SERVICES

	Variable	All Migration	Internal Migration	Out Migration
X_1	Residence	-0.031	-0.042⁺	0.008
X_2	Age 17-25	0.126**	0.111**	0.048⁺
X_3	Age 26-50	0.041⁺	0.026	0.009
X_4	Female	-0.004	-0.003	0.008
X_5	Marital Status	0.002	0.042⁺	-0.031
X_6	Time in Municipality	0.031	-0.019	0.063*
X_7	Indian or Metis	0.079*	-0.006	0.095**
X_8	Education Grades 8-13	0.035	0.003	0.047+
X_9	University	-0.049	-0.125**	0.061**
X_{10}	Primary Industry	0.106	0.047	0.111*
X_{11}	Secondary Industry	0.022	-0.022	0.051⁺
X_{12}	University	0.076*	-0.002	0.093**
X_{13}	Income less than $1500	-0.051⁺	0.025	-0.091**
X_{14}	Income $1501-$3000	-0.008	0.042	-0.037
X_{15}	Income $3001-$5000	-0.076*	-0.024	-0.075*
X_{16}	Manpower Service	0.066*	0.024	0.058⁺
	Intercept	-0.075	-0.029	-0.078
	R^2	0.11**	0.07	0.15**
	Equation	4.1	4.3	4.5

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

⁺Significant at the 10 per cent level.

TABLE VIII

REGRESSION EQUATION COEFFICIENTS FOR MULTIPLE MIGRATION FOR ALL, INTERNAL AND OUT MIGRATION. DISAGGREGATED MANPOWER SERVICES

	Variable	All Migration	Internal Migration	Out Migration
X_1	Residence	-0.034	-0.041+	0.002
X_2	Age 17-25	0.104**	0.103**	0.036
X_3	Age 26-50	0.024	0.021	-0.003
X_4	Female	-0.008	-0.017	0.012
X_5	Marital Status	0.004	0.041+	-0.025
X_6	Time in Municipality	0.035	-0.018	0.062*
X_7	Indian or Metis	0.090**	0.001	0.096**
X_8	Education Grades 8-13	0.032	0.004	0.047+
X_9	University	-0.052*	-0.110*	0.050**
X_{10}	Primary Industry	0.126**	0.066+	0.121*
X_{11}	Secondary Industry	0.024	-0.023	0.052+
X_{12}	Unemployment	0.084	0.005	0.103**
X_{13}	Income less than $1500	-0.086**	0.013	-0.120**
X_{14}	Income $1501-$3000	-0.030	0.038	-0.058+
X_{15}	Income $3001-$5000	-0.103**	-0.037	-0.089*
X_{17}	BTSD Level III and IV	0.153**	0.065*	0.131**
X_{18}	Vocational or Special Training	0.101*	0.020	0.097*
X_{19}	Farm Management Training	0.033	0.011	0.038
X_{20}	Manpower Corps or V.R.T.	-0.045	-0.040	-0.022
X_{21}	Training in Industry	0.004	0.002	0.008
X_{22}	BTSD Level I and II	0.118**	0.048	0.084*
X_{23}	Employment Referral	0.067+	0.057	0.029
	Intercept	-0.054	-0.026	-0.061
	R^2	0.15**	0.09	0.18**
	Equation	4.2	4.4	4.6

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

Marital status. No difference is observed in the migration behaviour of married or single persons apart from the tendency for married internal migrants to be more likely than single persons to move more than once.

Time in municipality. Those members of the labour force who have resided in the municipality in which they now live for ten years or less are more likely to migrate than longer term residents. This difference in behaviour is specific to out migrants. To the extent that length of time in a municipality is an indication of an individual's ties to the area this result is expected. Persons who have arrived in the area more recently would tend to be less reluctant to leave. A more meaningful relationship could be obtained if data for a period of less than ten years were available. Of the multiple migrants, persons resident in the area for less than ten years who move out of the area are more mobile than other persons.

Ethnic origin. The same relationship exists for Indian and Metis members of the labour force. These people are more likely to migrate out of the Interlake than their European counterparts, however in terms of internal migration there is no significant difference. Of the out migrants, Indian and Metis persons are more likely to move more than once, relative to other persons.

Education. There is a tendency for persons with education to between Grades 8-13 to be more mobile internally than persons with less than Grade 8 education. It was expected that the relationship would be stronger, as has been found in other studies.[4] The hypothesis that persons aged 17-25 would tend to dominate this education group is not supported by the simple correlation coefficient for these two variables (0.07). The only significant difference indicated in the behaviour of persons with university education relative to all other education groups is that such persons are less likely to migrate more than once. However since only two of the 400 persons included in the study had university education, one of whom moved internally, the other who did not move at all, the reliability of this estimate should be further tested. For the same reason, the significant coefficients relating university education to multiple migration are not considered reliable.

The relatively few significant coefficients in the relationship between education and migration could be a function of the breakdown of education groups. Alternatively, it could be that technical or other education may be more significant than regular school education. This latter possibility is supported by the results obtained from manpower services, which are discussed below.

Industry group. Persons in primary industries are more likely to migrate than persons in those industries designated secondary industries,[5]

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[4]Strong relationships between education and migration are generally discussed in studies based on percentages of migrants in education groups. Results supporting the relationships found in this study have been established using multivariate analysis. For an example of both situations see J. B. Lansing and E. Mueller, The Geographic Mobility of Labour (Ann Arbor: Institute for Social Research, 1967), pp. 43-44 and pp. 397-417.

[5]Primary Industry is defined to include persons in agriculture, forestry, fishing and trapping and mining. Secondary Industry includes persons in manufacturing, construction and trade.

who are more likely to migrate than persons not in these two industrial groups. This three-way relationship is most significant for out migration. The sign of the coefficients for secondary industries indicates that members of the labour force do tend to move between secondary industries in different parts of the Interlake more than persons in the service sector.

The size of the coefficient and significance for the relationship between multiple migration of out migrants and primary industries adds to the evidence that this industrial group is the most mobile.

Unemployment. An individual unemployed for more than eight weeks is more likely to migrate than persons not unemployed, or unemployed for a shorter period. This relationship is specific to out migration.

Equation 6.1, the results of which are given in Table IX, gives an indication of characteristics of the unemployed. Two highly mobile groups are significant--Indian and Metis persons and those in a primary industry. A less mobile group, persons in the less than $1,500 income bracket is also significant, however the direction of causation of this relationship is not clear, income being a function of weeks worked. Of the out migrants, those unemployed for more than eight weeks move more often than the remainder of the labour force. The relationships indicated by these results suggest that persons in this group do not move to a specific area ("pull" effect) but move in response to unfavourable conditions at the source area ("push" effect). The pull effect is operative to the extent that better conditions are anticipated at the destination area. This relationship is strongest for the out migrant

TABLE IX

REGRESSION RESULTS RELATING LABOUR FORCE CHARACTERISTICS TO UNEMPLOYMENT, INCOME AND PARTICIPATION IN MANPOWER PROGRAMS

Variable		Coefficients		
		6.1[a]	6.2[b]	6.3[c]
X_1	Residence	0.024	-0.017	-0.105**
X_2	Age 17-25	0.028	-0.186**	0.356**
X_3	Age 26-50	-0.052+	-0.129**	0.288**
X_4	Female	-0.061	0.367**	0.044
X_5	Marital Status	-0.106**	-0.132**	0.059+
X_6	Time in Municipality	0.030	-0.108**	-0.076*
X_7	Indian or Metis	0.290**	0.053	-0.052+
X_8	Education Grades 8-13	-0.043	-0.117**	0.049+
X_9	University	-0.090	-0.280**	-0.411
X_{10}	Primary Industry	0.112*	-0.037	0.056
X_{11}	Secondary Industry	0.094*	-0.245**	0.132**
X_{12}	Unemployment	-	0.243**	0.047+
X_{13}	Income less than $1500	0.384**	-	0.205**
X_{14}	Income $1501-$3000	0.263**	-	0.090*
X_{15}	Income $3001-$5000	0.101*	-	0.140**
	Intercept	0.118	0.598**	0.426**
	R^2	0.34**	0.32**	0.21**

[a]Dependent Variable: X_{12} Unemployed more than eight weeks.

[b]Dependent Variable: X_{13} Income less than $1500.

[c]Dependent Variable: X_{16} Participation in Manpower Service.

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

group, internal migrants do not tend to move more than once any more than persons not unemployed for more than eight weeks.

Income. Members of the labour force with less than $1,500 income are less likely to migrate than members with higher incomes, shown by the relatively high negative value of the coefficients for that variable. Again this relationship holds for out migrants rather than for internal migrants. Persons in the $1,501-$3,000 group do not migrate in a pattern which is significantly different than that for persons in other income groups. The migration behaviour of persons in the $3,001-$5,000 group shows a weak tendency for less mobility than all persons other than those in the under $1,500 group. A possible explanation of this behaviour is that persons in the under $1,500 income group, although they may wish to migrate out of the area cannot afford to do so (analagous to Lee's intervening obstacles discussed in Chapter II). Persons in the $1,500-$5,000 group do not have the same incentive to move even though they may be able to afford to do so.

Referring to results from equation 6.2 in Table IX, which relates characteristics of the labour force to the probability of having less than $1,500 income, dominant characteristics of this low income group are age greater than 50 years, female, single, in the area of residence for more than ten years, less than Grade 8 education, in primary or tertiary industries, and unemployed for more than eight weeks in the year. The age, length of time in the municipality and education characteristics of this group will tend to decrease their mobility potential. The unemployment and industrial characteristics will increase this potential. The relatively l arge size of the coefficients relating these latter two characteristics to migration will tend to dominate an estimate of migration probability for persons of the characteristics indicated in equation 6.2, but the negative coefficient for less than $1,500 income tends to offset these values, indicating an obstacle to realization of migration potential.

<u>Manpower services</u>. In aggregate, manpower service participation increases the probability of migration for an individual substantially. The same situation exists, although at a lower level, for the effect of manpower programs on multiple migration. Table VI gives the coefficients for disaggregated manpower services. Different manpower programs affect the probability of migration at different levels. Apart from the Training in Industry program, all programs significantly increase the probability of internal migration. The relative sizes of the significant coefficients for each service indicate that Vocational and Special Training increases migration probability the most followed by the BTSD Level III and IV upgrading programs, the Employment Referral program, the Manpower Corps programs, the Level I and II BTSD programs, and finally with the least effect is the Farm Management program.

A different ordering of effect holds for out migration. The programs with most effect are the Level I and II BTSD programs, followed by the Vocational and Special programs, Training in Industry, Employment Referral and the Level III and IV BTSD programs, the Farm Management program and finally the Manpower Corps programs which have no significant effect on out migration.

The probability of migrating more than once is increased by the BTSD Level III and IV programs, for both internal and out migrants. The Vocational and Special Training programs and the Level I and II BTSD programs increase multiple migration probability for out migration.

The results from inclusion of the manpower service variable show that these programs can be used to offset the negative influence some characteristics have on the probability of migration. That is, they can be used to increase mobility potential. The coefficients of equation 6.3, shown in Table IX give an indication of which type of person is most likely to participate in the manpower retraining programs, thus showing if these programs do offset the characteristics which tend to inhibit migration. Examination of the significant characteristics shows that the mobility potential of urban residents, aged 17-50, who are married, have spent more than ten years in the area, have European origins, education between Grades 8-13, work in a secondary industry, are unemployed more than eight weeks and have incomes below $5,000 is increased more than for persons without these characteristics. Of most interest is the tendency for persons in the under $1,500 income group to participate in manpower programs, thus helping to offset their mobility disadvantage.

Relocation preference. In general, the characteristics significant in the equations reflecting preference for relocation are the same as characteristics significant in observed migration behaviour, however several interesting differences are shown when results in Table V and Table X are compared. Whereas the probability of migration of married persons does not differ significantly from the probability of single

TABLE X

REGRESSION EQUATION COEFFICIENTS FOR RELOCATION PREFERENCE. AGGREGATED AND DISAGGREGATED MANPOWER SERVICES.

Variable		Aggregated Manpower Services	Disaggregated Manpower Services
X_1	Residence	0.014	-0.006
X_2	Age 17-25	0.134**	0.108**
X_3	Age 26-50	-0.043	-0.051+
X_4	Female	0.031	0.021
X_5	Marital Status	-0.136**	-0.149**
X_6	Time in Municipality	0.067*	0.063+
X_7	Indian or Metis	0.101**	0.058+
X_8	Education Grades 8-13	0.027	0.057+
X_9	University	-0.107	-0.098
X_{10}	Primary Industry	0.050	0.038
X_{11}	Secondary Industry	0.057	0.062+
X_{12}	Unemployment	-0.019	-0.019
X_{13}	Income less than $1500	0.044	0.001
X_{14}	Income $1501-$3000	0.092*	0.062
X_{15}	Income $3001-$5000	0.021	-0.001
X_{16}	Any Manpower Service	0.152**	-
X_{17}	BTSD Level III or IV	-	0.245**
X_{18}	Vocational or Special Training	-	0.130+
X_{19}	Farm Management Training	-	0.081*
X_{20}	Manpower Corps or V.R.T.	-	0.282**
X_{21}	Training in Industry	-	0.053
X_{22}	BTSD Level I or II	-	0.172**
X_{23}	Employment Referral	-	0.001
	Intercept	0.024	0.074
	R^2	0.15**	0.18**
	Equation	5.1	5.2

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

persons migrating, married persons are less likely to have a preference for relocating. That is, the expressed preference for relocation reflects the relationship hypothesized in Chapter III, but observed migration behaviour shows no significant difference. Persons in the primary sector do not prefer to relocate more than persons in other sectors, shown by the results of equation 5.1. However such persons do tend to migrate more than other persons. This dichotomy between expressed preference and actual behaviour suggests that persons in primary industries tend to be motivated to migrate by unfavourable conditions in the source area--a push effect. The same relationship exists for unemployed persons. Persons with an income less than $1,500 do not have relocation preferences different than persons in other income groups. However these low income persons have a lower probability of migrating in general, thus indicating that this section of the population is less able to achieve relocation preferences. Participation in any manpower service except the Training in Industry and Employment Referral courses increases preference for relocation, perhaps reflecting increased awareness of alternative opportunities.

Summary of Behavioural Equation Results

The behavioural analysis shows that the process of migration is selective, however internal and out migration tend to be selective on the basis of different characteristics. Persons aged between 17 and 25 years are more likely to move out of the Interlake than older persons, as are persons who have been in the area for less than ten years. Contrary to prior expectations, the probability of migration does not change markedly for persons with different education levels. Unemployed persons tend to be more mobile than persons who are employed for greater than ten months per year, although persons with less than $1,500 income are less mobile than persons with higher incomes. Whereas all manpower services increase the probability of migration, different programs affect migration at different levels. For married persons, persons working in the primary sector, unemployed persons and those with incomes below $1,500, expressed preferences for relocation differ from observed migration behaviour.

Statistical Considerations

Some of the problems arising when an equation of the form used in this study is estimated and interpreted are outlined and discussed in Chapter IV. The effects of these problems as they influence the results of the research are outlined in this section. The additivity problem is considered initially, followed by a comparison of results from the heteroscedasticity adjustment procedures.

Additivity. A probability must lie in the range zero to one. However probability estimates obtained from an additive equation form as specified in Chapter III can fall outside this range. For example, the maximum positive value for the probability of migration possible for equation 1.1[6] is 1.205, and the maximum negative value is -0.270. However, the estimated probabilities for the 400 observations used to estimate this equation were all less than 1.0, although 39 (9.75%) observations had negative estimates. The maximum of these was -0.199. This

[6] See Table XVIII.

suggests that the combination of characteristics which give estimates beyond the zero-one range are not common. Considering each of the 16 behavioural equations estimated, no estimated value for the probability of migration of sample members exceeded 1.0. However 16.1 per cent of the total number of estimates are below zero. (The range is from 27.7 per cent less than zero in equation 4.6 to 7.00 per cent less than zero in equation 5.1.) This problem of negative probability estimates is most obvious as the number of observations in which the person migrated decreases as a proportion of the total observations, and the fitted surface lies close to the zero axes. An example is estimation of the probability of multiple migration. All of these values lie within the standard error of estimate for each equation, which averages 0.316, with a range from 0.404 to 0.214.[7] It is interesting to note that of the 17 per cent of the estimates obtained from the generalized least squares equation, 8.75 per cent were greater than 1.0 and 8.25 per cent were less than 0. The range of estimates was from 1.882 to -0.763. These estimates are clearly less useful than those obtained using ordinary least squares.

Interpretation of negative estimates where they occur should be as an indication that no migration will occur. That is, the probability of migration equals zero.

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[7]The standard error of estimate is a measure of the absolute dispersion of Y values about the estimated regression function. In a model of this type the true standard error of estimate is not the same as that given by the regression program, which is based on dispersion about the observed 0 and 1, not the probability range between those values. The values given above will thus tend to be biased upwards. Further discussion of this point in relation to the R^2 is given in Chapter IV.

Heteroscedasticity adjustments. In an attempt to determine the degree of bias in ordinary least squares estimators for variance which arises under conditions of heteroscedasticity, generalized least squares and a consistent standard error estimate were calculated.

Using generalized least squares, different estimates of coefficients were obtained, as given in Table XI. The average absolute change in coefficients was 0.011, with a range from 0.029 to 0.0. The average percentage change was 53 per cent, ranging from 600 per cent to 0 per cent. Some of the changes refer to non-significant variables and are therefore of little importance. As indicated in the previous section, estimated probabilities from the generalized least squares program cover a wide range outside the 0 to 1 limits relative to the ordinary least squares estimates.

Examination of the standard error estimates shown in Table XI indicate that for this sample, ordinary least squares estimates tend to be biased upwards in comparison to the unbiased estimates obtained by generalized least squares and the consistent estimate for ordinary least squares.[8] Table XII gives the magnitude of the bias for both estimation procedures. For comparison, results of other studies are included in

[8]This discussion refers to the estimates obtained for equation 1.1, however in general the same relationship holds for all equations for the consistent standard error estimates. Generalized least squares was only applied to equation 1.1 because of the high cost of this procedure.

TABLE XI

COMPARISON OF RESULTS ESTIMATED BY CONSISTENT AND INCONSISTENT ESTIMATORS

	Variable	Coefficient		Standard Error		
		O.L.S.[a]	G.L.S.[b]	O.L.S.	G.L.S.	C.S.E.[c]
X_1	Residence	-0.039	-0.048+	0.046	0.033	0.043
X_2	Age 17-25	0.153**	0.162**	0.081	0.063	0.045
X_3	Age 26-50	0.001	0.007	0.072	0.042	0.041
X_4	Female	0.032	0.038	0.066	0.063	0.060
X_5	Marital Status	-0.042	-0.050	0.051	0.039	0.047
X_6	Time in Municipality	0.069**	0.057*	0.045	0.033	0.042
X_7	Indian or Metis	0.097*	0.083*	0.055	0.044	0.044
X_8	Education Grades 8-13	0.062+	0.033	0.049	0.034	0.042
X_9	University	0.390	0.361	0.296	0.325	0.350
X_{10}	Primary Industry	0.179**	0.185**	0.062	0.063	0.062
X_{11}	Secondary Industry	0.071+	0.071+	0.052	0.046	0.050
X_{12}	Unemployment	0.112**	0.111*	0.051	0.051	0.045
X_{13}	Income less than $1500	-0.116**	-0.104*	0.066	0.057	0.043
X_{14}	Income $1501-$3000	0.039	0.012	0.066	0.043	0.057
X_{15}	Income $3001-$5000	-0.061	-0.066+	0.061	0.048	0.051
X_{16}	Manpower Services	0.207**	0.197**	0.062	0.058	0.044
	Intercept	-0.073	-0.079	0.121	0.242	
	R^2	0.18**	0.15**			

[a]Ordinary Least Squares.

[b]Generalized Least Squares.

[c]Consistent Standard Error.

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XII

MAGNITUDES OF BIAS IN STANDARD ERROR ESTIMATES AS INDICATED BY GENERALIZED LEAST SQUARES AND CONSISTENT STANDARD ERROR CALCULATIONS

	This Study		Buse		Zellner and Lee		Bowen and Finegan
Deviation	G.L.S.[a]	C.S.E.[b]	G.L.S.	C.S.E.	G.L.S.	C.S.E.	C.S.E.
Mean	0.012	0.011	0.030	0.028	0.011	0.013	0.260
Largest Absolute	0.030	0.054	0.053	0.049	0.022	0.025	0.69
Smallest Absolute	0.0	0.0	0.007	0.006	0.0	0.001	0.02
Mean[c] per cent	18.6	23.2	54.5	48.8	39.6	47.1	4.3
Largest per cent	41.7	100.0	62.4	57.7	44.4	55.6	12.0
Smallest per cent	0.0	0.0	46.7	40.0	34.7	38.6	0.3

[a]Generalized Least Squares.

[b]Consistent Standard Error.

[c]Percentages are deviations as a per cent of the ordinary least squares estimate.

the table.[9]

The general direction of bias observed for standard error estimates tends to be upwards. That is, ordinarily least square estimates tend to be greater than both generalized least squares and the consistent standard error estimate. The direction of change in standard error estimates varies between data sets and different dependent variables. The factor common to both situations is a change in the number of observations on the probability of migrating that equal 1, the lower the mean of the dependent variable for a data set, the more ordinary least square estimates that are biased downwards. Variables which at some point have downward biased ordinary least squares estimates of standard error include University Education, Residence, Time in Municipality and Unemployment. The overall direction of bias however remains upward. Dominance of an upward bias reflects the results obtained by Buse[10] and Bowen and Finegan,[11] but is the reverse of results given by Zellner and Lee.[12] The effect of an upward bias in standard error estimates is to bias t values downwards, increasing the possibility of a Type II error--

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[9] A. Buse, "A Technical Report on the Uses, Problems and Potential of Qualitative Dependent Variables as Applied in the Social Sciences, Particularly Economics" (Edmonton: Alberta Human Resources Research Council, 1970). (Mimeographed.) See also A. Zellner and T. H. Lee, "Joint Estimation of Relationships Involving Discrete Random Variables," Econometrica, Vol. 33, No. 2 (April, 1965), pp. 382-394; see also W. G. Bowen and T. A. Finegan, The Economics of Labour Force Participation (Princeton: Princeton University Press, 1969), pp. 641-649.

[10] Buse, op. cit., p. 43.

[11] Bowen and Finegan, op. cit., p. 648.

[12] Zellner and Lee, op. cit., p. 392.

acceptance of the null hypothesis when it is false. In equation 1.1, of the 16 coefficients tested, t tests based on the ordinary least squares standard error estimate meant that the significance of three coefficients was reduced from 1 per cent to the 5 per cent level, one coefficient from 5 per cent to 10 per cent, and one coefficient significant at the 10 per cent level was removed from that group. The coefficient of variable X_9, University Education, which was significant at the 10 per cent level lost that significance.[13] These changes in significance levels indicate that ordinary least squares standard error estimates are not reliable for coefficient tests, and adjusted values must be estimated for each variable in each equation.

Generalized least squares estimates are costly to obtain in terms of computer time, and coefficient estimates obtained are not acceptable under the additivity assumption as outlined above.

Because of the biased ordinary least squares significance tests of coefficients and non-suitability of generalized least squares coefficient estimates, results from this study are based on coefficients estimated by ordinary least squares, tested for significance using t tests based on the consistent standard error calculation.

TRANSFER TO VOLUME ESTIMATES

To derive estimates of the volume of labour force migrating, the coefficients obtained from equations 2.1 and 3.1 are weighted by the

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[13] The change in significance is based on the results obtained from ordinary least squares in comparison to the consistent standard error calculation.

proportion of the labour force possessing the relevant characteristics, and the resultant values are summed. Net migration is determined by subtracting the estimate of out migration from estimated in migration.[14] Volume of population migration is estimated by use of a labour force to population ratio.

The estimates refer to one year, 1968, being the year for which data on characteristics of the labour force, estimates of in migrants and the labour force to population ratio are based.

Volume of Migration

The estimated volume of internal migration is greater than gross out or gross in migration estimates, shown by the estimates given in Table XIII. Gross out migration levels are less than gross in migration levels, yielding a net in migration of 93 persons for 1968. Over the period 1961 to 1968 the net population change for the Interlake was a decrease of 2,694 persons, an average decrease of 0.77 per cent per year.[15] The direction of change in net migration rates varied over different parts of the Interlake with a decrease in eight and an increase in five of the 13 municipalities. This evidence of net out migration over the 1961 to 1968 period suggests that the expected net population change for 1968 would be negative. However this long term average does not allow for information on year to year variations in the direction of net migration. It is argued in Chapter VII that there is a possibility

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[14] The values and derivation of these values for components of this procedure are given in Chapter V.

[15] C. F. Framingham, J. A. MacMillan and D. J. Sandell, The Interlake Fact (Winnipeg: Planning and Priorities Committee of Cabinet Secretariat, 1970), p. 5.

that the estimate for out migration will be biased downwards, which could account for the net increase in Interlake population estimated.

TABLE XIII

ESTIMATED VOLUME OF GROSS AND NET MIGRATION

	Gross Internal Migration	Gross Out Migration	Gross In Migration	Net Migration[a]
Percentage of Interlake Labour Force	7.3	2.9	3.1	+0.2
Volume of Labour Force[b]	1160	461	492	+31
Volume of Population	3468	1378	1471	+93

[a]A positive value indicates a movement into the area.

[b]Volume figures are based on a total labour force of 15,884 persons. See J. A. MacMillan and Chang Mei Lu, Area Manpower Planning: Projection and Impact Models, Research Bulletin (Winnipeg: Department of Agricultural Economics, University of Manitoba), p. 7, (In preparation).

The Effect of Changes in Labour Force Characteristics

Volume estimates given in Table XIII reflect the 1968 characteristics of the Interlake labour force. However useful information on the response of migration behaviour to changes in aggregate labour force characteristics can be obtained by varying the proportion of the labour force in each group. Implied is the assumption that equation coefficients are constant over the range of the changes.

If the level of general education and university education are increased, equations 2.1 and 3.1 would indicate changes in the percentage of the population migrating. Increasing the proportion of persons educated to within the range Grades 8 to 13 will increase migration internally. However because of the low significance of the Grade 8-13 coefficient and the lack of significance of the university coefficient, the reliability of these estimates is not considered sufficient as a basis for policy recommendations.

The industrial composition of the Interlake labour force can be expected to change over time, as emphasis changes from a dominance of primary industries to a larger proportion of secondary and tertiary employment. The effect of a change of this nature on migration is to decrease the expected volume of migration, both for internal and out migration. For example, if there is a decrease of 20 per cent in the proportion of the labour force in primary industries, all of who move into secondary industries, the change in percentage internal migration would be a decrease of 1.1, representing 175 persons in the labour force. A decrease in migration can be expected as the distribution of employment becomes more satisfactory. However as this distribution changes the value of the coefficients would be expected to change also.

Migration response to an increase in unemployment is to increase both internal and out migration. A 20 per cent increase in the proportion of the labour force unemployed can be expected to increment internal migration by 0.1 per cent[16] (16 persons) and out migration by 0.4 per cent (64 persons).

The equations estimated indicate that both internal and out migration are significantly affected by manpower retraining services.

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[16] The changes in migration probability refer to increments. For example, from 7.3 to 7.4 per cent, not 0.1 per cent of 7.3.

Considering the aggregated situation, an increase of 20 per cent in the proportion of the labour force receiving manpower services can be expected to increase internal migration by 0.2 per cent (32 persons) and also out migration by 0.2 per cent.

In this section, the impact of different factors on migration has been based on statistically significant variables. Mathematically, non-significant variables also influence the estimates obtained, however the reliability of the coefficient values of such estimates is not sufficient for their use in manipulation of the model characteristics.

Results obtained from both the behavioural and volume sections of the study provide information for the evaluation and modification of existing manpower adjustment programs. Implications and conclusions drawn from these results are presented in Chapter VIII, following an outline of some of the limitations of the results obtained.

CHAPTER VII

LIMITATIONS

To analyse and interpret components of the migration process, a series of statistical techniques formulated into models have been applied to socio-economic data. Because it is not possible to fully represent reality by use of such models, and the data available does not always correctly reflect the population under investigation, the results obtained are subject to certain limitations. This chapter outlines these limitations in two sections--limitations of the model and limitations of the data.

LIMITATIONS OF THE MODEL

The Overall Model Structure

The definition of migration as used in this study refers to a relocation of residence. A time period of one year is used for the analysis, and an individual's address at the end of this period is taken as his final residence. However an individual may move from the Interlake to Winnipeg, to Brandon and then back to the Interlake and be classified as an internal migrant for the purposes of the study. It is not feasible to include such behaviour in the model.

The overall model is based on a sequence of processes, the behavioural equations give input for the volume estimates which give input for impact estimation. Any errors or biases in the early stages of the process are carried through to the other stages. In a dynamic context, such errors would be compounded over time, leading to less accurate output estimates as time increases.

The Behavioural Equations

The concept underlying the behavioural section is based entirely on characteristics of individuals. As such, the estimates are based entirely on conditions within the Interlake Area. Other conditions (the "pull" effect) enter the estimation process only as they have influenced the data values. For example, the effect of distance and economic conditions outside the Interlake influence an individual's behaviour. When used as data input to the behavioural estimates, the data reflect the distance and economic conditions. Thus any one set of coefficient estimates is based on the general economic and social conditions which exist when the data were collected. It is not possible to include these conditions directly in the behavioural equations due to the microanalytical nature of the variables. One possible way to determine the influence of outside economic conditions would be to estimate the equations using data collected under different conditions. Problems would still arise however due to variation in factors other than the economic conditions under study.

A second shortcoming of the conceptual approach taken to migration behaviour is that it is not possible to derive an estimate of in migration by the same procedure without the collection and processing of a huge volume of data on the Manitoban and Canadian labour force. An outside estimate of in migration must therefore be obtained.

Dummy variable regression analysis, the technique used in the behavioural equations, implies several behavioural assumptions which do not always reflect the actual situation. Included in these are the assumptions of no significant interaction between independent variables, and homogenous behaviour in the characteristic ranges specified by the variables. Further discussion of these problems is given in previous chapters.

Two statistical problems are relevant in interpreting results obtained. The first is the existence of heteroscedasticity in the estimated equations, thus requiring use of an adjustment routine to approximate the true standard error estimates. The second problem is that no measure of the amount of variance explained by the equations is obtained.

Transfer to Volume

Transfer to volume estimates based on the behavioural equations also transfers the shortcomings of those equations. If the estimates are to be used for prediction, no indication of the variance explained is available on which to base the choice between alternative equations.

LIMITATIONS OF THE DATA

General Considerations

The model specified for this study provides information on a range of characteristics of the migration process. However to obtain this information a very large volume of input data is required. This data must be detailed so that information on individual characteristics is obtainable. A sample can be used to estimate coefficients of the behavioural equations, however for the transfer to volume, information on proportions of the population possessing each characteristic is required. Estimation of migration for any particular cohort of the labour force requires information on the proportions of that cohort in each of the groups represented by the variables. To the extent that the data required is not available, this characteristic of the model becomes a limitation.

Data for the Behavioural Section

The data used to estimate the equations of the behavioural section are taken from a stratified sample of the Interlake labour force. Characteristics of this sample are outlined in Chapter V. Mobility data in the sample refer to a one year period, and therefore data on characteristics of the labour force refer to that period. Data on these characteristics refer to the last job held, which in the case of migrants could be the job after migration. An attempt to use the second to last job in the case of migrants was not successful as several persons who migrated reported on one job only. Thus, to retain the conceptual basis that an individual's characteristics before migration determine the migration probability, it is necessary to assume that migrants remain in the same industrial group before and after migration, and secondly, that if a person is unemployed for more than eight weeks, he is unemployed for at least eight weeks before migration. A similar assumption is necessary for the income groups, this value being taken over the whole year. It is hypothesized that these assumptions do not severely limit the meaning of results obtained, although no test of this hypothesis is undertaken.

For the purposes of the behavioural analysis the data are separated into three groups--non migrants, internal migrants and out migrants. Of the total number of contacts attempted in the survey, 63 persons were classed as "distant clients"--persons who had moved out of the survey area and were not able to be contacted. The effect of this group of non respondents on the sample is to reduce the number of out migrants included. In the behavioural equations, one effect is to bias the absolute value of estimated coefficients downwards for the probability of out migration, although it is not possible to determine the extent of this bias. It is suggested that the effect of not including the distant clients in the data sets does not affect the significance levels for coefficients, as is argued in the context of manpower programs in the previous chapter.

Volume Estimates

The exclusion of distant clients from the data used to estimate equations for projection is expected to decrease the size of the coefficients for out migration, and increase the size of coefficients estimated for internal migration. Because the gross out migration estimate is used in conjunction with the estimate for in migration to derive net migration for the area, there will be a downward bias in the net out migration estimate.

CHAPTER VIII

IMPLICATIONS AND CONCLUSIONS

The results obtained in this study indicate several important implications of the migration process in general, and more specifically, as it relates to the Interlake Area. Some of the implications are discussed in this chapter, followed by a review of the major conclusions reached in the study.

Implications of the Research Results

Residence. Rural people do not tend to be more mobile or to move more often than persons with urban residences. However this relationship does not imply that relative rural-urban settlement patterns will remain constant, as no information on the urbanization of the destination area of either rural or urban migrants is provided. That rural and urban residents exhibit similar rates of migration implies that there are two possible ways by which relative rural-urban residence patterns could be altered--by changing the relative rates of migration of the two groups, and secondly, by changing the destination of persons who already migrate. Comparison of the cost of these two policy alternatives would indicate the lowest cost method of changing residence patterns. Given that participation in the mobility program offered in the Interlake Area has been less than anticipated,[1] the second policy suggested could be investigated as a viable alternative.

Age. The coefficient for out migration of persons aged 17 to 25 years is relatively large and highly significant, indicating that persons in that age group tend to move out of the Interlake more than older persons. Data on the migrants used for the estimation of in migration show that none of the in migrants were in the 17-25 age group. The net effect then will be a decrease in the proportion of the Interlake labour force in that age group. Over time this pattern will reduce the mobility (and therefore adjustment) potential of the labour force, suggesting an increasing requirement for policies designed to increase mobility, if the objectives remain the same.

Sex and marital status. The results imply that the composition of the Interlake labour force in terms of sex distribution and marital status will not be significantly affected by migration.

Time in municipality. Persons resident in the area for less than 10 years are more likely to move out of the area than longer term residents. Thus it can be considered that there is a base group of the labour force who are long term residents, and fluctuations in the labour force size and composition are caused largely by a more mobile group of persons moving in and out. That is, there is no tendency towards an overall replacement of the labour force.

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[1] J. A. MacMillan and Chang Mei Lu, Regional Developmental Planning and Evaluation: An Impact Analysis of Manitoba's Interlake Area Development Plan, Research Bulletin (Winnipeg: Department of Agricultural Economics, University of Manitoba), p. 7, (In preparation).

Ethnic origin. Indian and Metis persons tend to migrate out of the Interlake Area more than all other persons. However it is likely that such persons tend to be more mobile in general than other persons, as indicated by the high significance of the coefficient for multiple migration for this group. That is, that relocation to any one destination is not considered a permanent move by Indian and Metis persons.

Education. Results obtained indicate that formal education in general does not significantly affect the migration behaviour of individuals. Because out migration is not thus affected, concern about the declining quality of the labour force and a loss of investment of educated persons moving out may not be warranted. However the actual education and skill level of the labour force are not necessarily accurately measured by formal education. A preferable indicator may be length of job experience or specific trades training. The significance of coefficients for various manpower retraining programs support this suggestion. The formal education level of the sample of in migrants included four persons only with less than Grade 8 education, the remainder of in migrants had education in the range of Grades 8 to 13. If these relationships hold over time, then the average level of education of the Interlake labour force can be expected to increase. However further research is required into the relationship between migration and education, specifically including absent sons and daughters who are not included in this analysis.

Industrial composition. The mobility of persons in primary industries is greater than for other persons. Therefore as the emphasis of industrial composition of the labour force changes from primary to other industries, then the mobility of the labour force will decrease. It can also be expected that the size of the coefficient for primary industry will decrease simultaneously as the need for adjustment through mobility decreases for that group in the labour force. From the analysis of relocation preferences, persons in primary industries do not tend to have significantly different preferences than all other persons in the labour force, despite the higher probability of migration for this group. This relationship implies that commuting may be a more acceptable alternative to enable such persons to achieve satisfactory employment situations.

Level of unemployment. The results show that levels of migration vary directly with the level of unemployment, reflecting the adjustment role of migration. Persons who tend to be unemployed are likely to be in a more mobile group than other persons increasing the mobility potential of unemployed persons, particularly for migration out of the Interlake. Because unemployed persons do not differ from other persons in their preferences for relocation, it is implied that the adjustment role of internal migration is replaced by persons commuting to jobs within the Interlake, while retaining their initial address.

Income. Migration behaviour varies between persons of different incomes. The results indicate that those members of the labour force with less than $1,500 income are less mobile than any other income group. Coupled with the relationship that persons in this income group have similar relocation preferences to all other income groups, the need for some policy to increase the mobility potential of such persons is indicated. Results from the equation with income below $1,500 as the dependent variable indicate that existing manpower services do tend to increase the estimated mobility potential of these low income persons. However further research into the income-migration relationship is required to determine whether low income is a barrier to migration, unable to be offset by alternative measures such as manpower service participation.

Manpower services. All manpower services studied increase the probability of migration. Different services have different levels of influence on the migration process. One possible mechanism by which manpower services influence migration is by raising program participants' preference for relocation. If the increased mobility resulting from manpower service participation reflects a satisfactory adjustment of the labour force, then the existing programs may be sufficient. However, projections made for the Interlake indicate that by 1980, about 5.7-8.8 thousand of the area labour force will need to be employed out of the area, in government or finance sectors, or they will be unemployed.[2] Thus the existing manpower programs will not fulfill the required adjustment role of increasing the potential for out migration. A program of Mobility Assistance and Exploratory Grants has been offered in the area, although the program has had low participation.[3] A need for programs

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[2] J. A. MacMillan and Chang Mei Lu, Area Manpower Planning: Projection and Impact Models, Research Bulletin (Winnipeg: Department of Agricultural Economics, University of Manitoba), p. 63, (In preparation).

[3] MacMillan and Lu, op. cit.

designed specifically to increase the potential for out migration is therefore indicated.

Volume of migration. Estimates of the volume of migration indicate that underlying the small net change in the Interlake population attributable to migration, there are relatively large flows within the Interlake and out of the Interlake. Varying the figures representing the proportion of the Interlake labour force with a given set of characteristics yields alternative estimates of the volume migration. The results thus obtained show that large changes in labour force composition produce relatively small changes in the volume of migration. This relationship holds for participation in manpower services, supporting the suggestion of a requirement for programs specifically to increase migration potential.

Conclusions

The stated objective of this study was to construct a model of the migration process for the provision of information relevant for a regional labour force adjustment policy. Subsidary objectives relate to the impact of manpower programs on the migration process, and an empirical investigation of the use of qualitative variables for quantifying social factors in economic research. These three objectives have been met in the study:

(a) Construction, estimation and manipulation of components of the research model have isolated significant relationships between migration and characteristics of the labour force. The analysis shows that the process of migration is selective, however internal and out migration tend to be selective on the basis of different characteristics. On the basis of characteristics of the labour force, a method of projecting volume of migration has been developed. Estimated values show that the net change in population of the Interlake Area attributable to migration is low.

(b) All manpower programs have some impact on migration. Different programs affect different aspects of the migration process in different ways, however the general impact is to increase the probability of migration for program participants.

(c) The use of qualitative dependent and independent variables in a multiple regression framework provides a convenient and meaningful technique of analysing complex relationships, subject to some conceptual and statistical limitations. Procedures are developed to overcome these problems.

One overriding conclusion dominates all aspects of the study--the need for further research, particularly into the relationship between manpower policies and migration. Other areas of concern are the relationships between migration and disadvantaged groups in the labour force--persons in low income groups, the primary sector and the unemployed.

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APPENDIX A

TECHNIQUES OF DUMMY VARIABLE REGRESSION ANALYSIS FOR QUANTIFYING SOCIAL FACTORS

Much of the data used for the analysis of socio-economic systems is in the form of classifications (eg. sex, ethnic origin, marital status, occupational classification). There are various alternative techniques available to account for the behaviour of a dependent variable as a function of a group of independent variables, some or all of which are categorical in nature. Two examples are analysis of variance and multiple regression analyses run on a separate set of numerical variables for each classified set of relationships.

Such techniques however become less satisfactory as the number of cross classifications increase, the number of cells with few or no observations in them increasing. As this problem extends to more cells the sampling variability increases.[1] One of the properties of fitting a surface by least squares is that information from other parts of the sample is brought to bear on these "thin" cells.[2] Therefore, a modification of multiple regression is required so that categorical data can be introduced. This can be achieved through the use of dummy variables.

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[1] G. H. Orcutt et al., Microanalysis of Socio-economic Systems: A Simulation Study (New York: Harper and Brothers, 1961), p. 224.

[2] Ibid.

DUMMY VARIABLE ASSIGNMENT

Dummy variables can be assigned to data which is able to be divided logically into mutually exclusive classes or groups, and where the effect of a class difference is to change the intercept of the regression equation and not the slope.[3] (This latter condition can be relaxed however.) Notice that this formulation does not restrict the use of dummy variables to attribute data--variables conventionally measured on a numerical scale can also be broken into appropriate categorical factors. Disregarding estimation problems momentarily, each class of each categorical factor is represented by a separate independent variable. Each of these variables is given a value of one or zero for a given observation, depending on whether that observation is, or is not a member of the class represented by that variable. (Values such as a series of positive integers can be used for trend analyses, however in many cases the ordering of value allocation imposes an outside scale effect on the data.)

For the purposes of illustration, consider two independent factors, say age and sex, being used to explain a dependent variable. We will divide age into three variables, say 0-20, 21-50, 51+. The sex factor has two classes, male or female. Our model for regression is then:

$$Y = a_1 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 Z_1 + b_5 Z_2 \qquad (12)$$

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[3] N. G. Tomek, "Using Zero-One Variables with Time Series Data in Regression Equations," Journal of Farm Economics, Vol. 45 (1963), p. 814.

Where Y is the dependent variable,

X_1, X_2, X_3 are the three age variables,

Z_1 and Z_2 are the two sex variables,

a_1 is the equation constant,

b_i are the regression coefficients for $i = 1 \ldots 5$.

Notice that the variables are exhaustive--all possible age and sex combinations are covered, and mutually exclusive--no one person can be represented by more than one variable for each categorical factor.

Numerical values for each of the six combinations of age and sex would be given as in Table XIV.[3A] Technically, equation (12) based on such data is indeterminate, since there are more coefficients than there

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[3A]The choice of this particular specification of the age variables is in fact arbitrary. It is possible to derive the marginal coefficients of the classifications of a continuous factor by alternative assignments of the zeros and ones. Continuing the above example, age could be represented by a set of three dummy variables X_1^*, X_2^*, X_3^*, where;

$$X_1^* = X_1$$
$$X_2^* = X_1 + X_2$$
$$X_3^* = X_1 + X_2 + X_3$$

Thus $X_1^* = 1$ for age 0 - 20 years

$= 0$ for age greater than 20

$X_2^* = 1$ for age 0 - 50 years

$= 0$ for age greater than 50

$X_3^* = 1$ for all ages.

It can be shown that the estimates of the marginal coefficients under this assignment are the same as those obtained with the assignment given in Table XIV.

TABLE XIV

CODING OF VARIABLES FOR REGRESSION ANALYSIS

Characteristic		Independent Variable				
		X_1	X_2	X_3	Z_1	Z_2
1. Male						
Age	0–20	1	0	0	1	0
	21–50	0	1	0	1	0
	51 plus	0	0	1	1	0
2. Female						
Age	0–20	1	0	0	0	1
	21–50	0	1	0	0	1
	51 plus	0	0	1	0	1

are independent normal equations based on the least squares criterion.[4] That is, there is perfect linear multiple correlation among the independent variables of each class, so that any attempt to estimate the regression parameters of equation (12) will fail because of singularity in the moments matrix.[5]

Solution of such an equation then requires the imposition of additional constraints on the parameters. Three types of constraints are possible, each designed to remove the perfect intercorrelation among the variables.

1. Constrain one of the coefficients for each of the independent classes to zero.

2. Constrain the constant term to zero.

3. Constrain to zero the sum of the coefficients for each group of variables that represents a single factor.[6]

For example, given equation (12) above, each of the constraints would give a different specification.

<u>Constraint 1</u>

Using constraint 1 the equation to be estimated would be:

$$Y = a_2 + b_2 X_2 + b_3 X_3 + b_4 Z_2 \qquad (13)$$

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[4] E. Melichar, "Least Squares Analysis of Economic Survey Data" (Paper read at the Annual Meeting of the American Statistical Association, September, 1965, Philadelphia, Pennsylvania), p. 3.

[5] D. B. Suits, "Use of Dummy Variables in Regression Equations," <u>Journal of the American Statistical Assocation</u>, Vol. 52 (1957), p. 549.

[6] Tomek, op. cit., p. 819.

Where Y_1, X_2, X_3 and Z_2 are as in equation (12),

a_2 is the new equation constant, and

b_2, b_3 and b_5 are estimated coefficients.

Here, variables X_1 and Z_1 have been used as "base" conditions for the equation. That is, the value of Y, if all the independent variables are zero, represents a male aged 0-20 years. If X_2, X_3 and Z_2 are zero, $Y = a_2$. If a person is a male aged between 21 and 50, $Y = a_2 + b_2$. Thus the b coefficients estimated under this constraint represent deviations from the omitted classes. The effect of the omitted classes are embodied in the constant term.[7]

Constraint 2

Using constraint 2, the equation to be estimated would be:

$$Y = b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 Z_1 + b_5 Z_2 \qquad (14)$$

The regression coefficients in this case represent deviations from zero.

Constraint 3

Under constraint 3, there are two suggested approaches--to constrain the unweighted sum of coefficients to zero,[8] or to weight the coefficients by the number of observations in the respective class and constrain the sum to zero. This latter constraint involves estimating a regression equation on a transformed data set, and substituting back to

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[7]Ibid., p. 821.

[8]Ibid., p. 819.

find the individual coefficients.[9] When the unweighted sum is set equal to zero the constraint is satisfied by changing the dummy variable assignment to use ones, zeros and minus ones. Table XV shows the dummy variable assignment for the example given in equation (12). For a dichotomy the assignment becomes 1 and -1, and for a trichotomy or greater becomes 1, zeros and -1. As with the first constraint discussed, one variable from each classification is dropped (in Table XV, X_3 and Z_2 are given this role). Thus the equation estimated is:

$$Y = a_4 + b_1 X_1 + b_2 X_2 + b_4 Z_1 \quad (15)$$

TABLE XV

DUMMY VARIABLE ASSIGNMENT UTILIZING CONSTRAINT 3

Characteristic	Independent Variable X_1	X_2	Z_1
1. Male			
Age 0-20	1	0	1
21-50	0	1	1
51 plus	-1	-1	1
2. Female			
Age 0-20	1	0	-1
21-50	0	1	-1
51 plus	-1	-1	-1

The normal zero-one assignment holds for presence or absence in the classes represented by X_1, X_2 and Z_1. However when an observation falls

[9]Melicher, op. cit., pp. 4-6.

in an omitted class, each of the remaining variables representing the same factor assume the value of -1. The intercept term, a_4, is equal to the mean of the dependent variable, Y. The coefficient estimated for each independent variable is then the deviation from the mean associated with membership in that class.[10]

The results obtained through use of each of these constraints are identical. The estimated value of the dependent variable will be the same for any one set of data. The tests of significance under each constraint yield identical values.[11] The only difference is the actual value of the coefficients, each form of which has a different interpretation. However, the parameters of each form are related by a linear transformation and it is possible to transform coefficients estimated under one constraint into the values that would be obtained by estimation under an alternative constraint.[12]

The choice of which constraint is to be used thus becomes a function of ease of computation and the objectives of the researcher. Since the computational characteristics of each constrained form is similar (except where the weighted version of constraint 3 is used) the latter criterion assumes dominance.

Remarks in the remainder of the paper will deal with the application of dummy variables utilizing the first constraint.

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[10]Ibid., p. 6.

[11]Ibid.

[12]These transformations are given in Suits, op. cit., p. 549; see also Melichar, op. cit., p. 7.

CHARACTERISTICS OF THE ANALYSIS

Functional Form

Dummy variables can be used alone on the right hand side of an equation or in combination with conventionally measured numerical variables. Where the independent variables are all in dummy format the function specified is a step function as illustrated in Figure 4.[13]

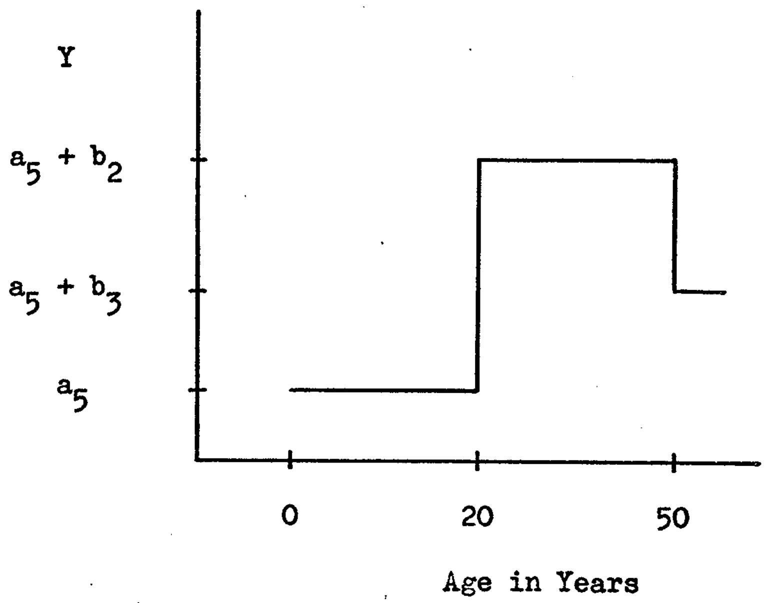

Figure 4. Example of a Step Function

In this figure, the three age classifications used as an example above, are shown in relation to the dependent variable as specified in equation (16), for assumed values of the coefficients ($b_2 > b_3 > 0$).

$$Y = a_5 + b_2 X_2 + b_3 X_3 \tag{16}$$

[13]Correct representation requires three dimensions.

Over the ranges specified by the classification intervals, the value of the dependent variable takes on the value of the base class (ages 0-20) plus any deviations attributable to membership of another class. That is, the conditional expectation of the dependent variable is:

$$E\ (Y \mid X_1) = a_5 \tag{17}$$

$$E\ (Y \mid X_2) = a_5 + b_2 \tag{18}$$

$$E\ (Y \mid X_3) = a_5 + b_3 \tag{19}$$

This specification can be applied in n-dimensions leading to a step function which is very free in form--the path of the expectation of the dependent variable being free to vary in complex ways as the independent variables vary.[14] Such a functional form at first glance does not appear to correspond to the continuous linear and curvolinear relationships specified in much of economic theory, eg. production functions and consumption functions. However because the multidimension step function is free in form, a prespecified functional form--linear, quadratic, etc. is not forced onto the data. In this way, the use of such a function can provide an interesting and informative test of existing theory with little more effort than is required for the omnipresent computer generated linear and log linear functions.

Analysis of Variance and Covariance

Statistically, multiple regression on all dummy variables is

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[14] A. S. Goldberger, Econometric Theory (New York: John Wiley and Sons, Inc., 1964), p. 222.

equivalent to the Analysis of Variance.[15] The coefficients are similar to row and column effects in a multiple analysis of variance, except that they represent differences from a pivotal cell rather than from the grand mean.[16] This pivotal cell is the variable dropped from the equation when one of the coefficients in each class is constrained to zero. This is a very efficient method of computing a multiple analysis of variance, especially where cell frequencies are unequal. The ready availability of multiple regression programs enables an easy transition, through use of this technique, to the analysis of variance routine.

Where both dummy variables and numerical independent variables are included in the equation the model becomes that known as the Analysis of Covariance.[17] In this model the effect of class difference is to change the intercept of the regression equation without changing the slope coefficients. Let age be represented as a set of three dummy variables, and income as a continuous variable. Consider a dependent variable Y. A possible response of Y to changes in age and income using a covariance model is illustrated in Figure 5.

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[15] R. J. Wonnacott and T. H. Wonnacott, Econometrics (New York: John Wiley and Sons, Inc., 1970), p. 77.

[16] Orcutt, op. cit., p. 227.

[17] Wonnacott, op. cit.

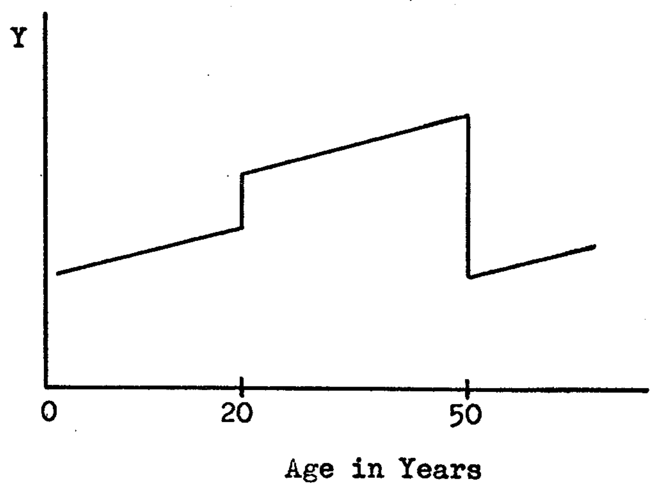

Figure 5. Illustration of Regression Using Covariance Model[18]

Notice in Figure 5 that the slope is constant for each age class, however the position of the line changes by the deviation of each age class coefficient from the equation intercept. Such a specification can be used to highlight effects such as geographical differences in demand or differences over time. It is possible to test if the difference between each class is significant by testing the significance of the dummy variable coefficients. Gujarati has outlined the use of dummy variable regression analysis as an alternative to analysis of variance and analysis of covariance methods.[19]

Utilizing a step function as specified in either the analysis of variance or analysis of covariance model implies the assumption that the effect of a class difference is to change the level of the intercept by a constant amount for all observations within that class. If the

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[18]Correct representation requires three dimensions.

[19]D. Gujarati, "Use of Dummy Variables in Testing for Equality Between Sets of Coefficients in Linear Regressions: A Generalization," American Statistician, Vol. 24, No. 5 (December, 1970), pp. 18-21.

requirements of this assumption are to be approached, non-categorical data must be divided into causally homogenous classes. There are two possible ways in which these assumptions can be overcome--to allow for changes in slope within a given category in the equation specification and/or to build interaction terms into the equation. The first of these techniques is outlined below. A discussion of interaction follows in the next section.

Slope Changes

A second form of covariance analysis is to allow for both intercept and slope changes. Obviously it is only possible to introduce a slope change for variables able to be measured on a numerical scale. Consider for example the equation used previously, with a dependent variable as a function of two independent factors, age and sex. Age is divided into three variables--ages 0-20, 21-50 and 51 plus. The equation is:

$$Y = a + b_2 X_2 + b_3 X_3 + c_1 Z_2 \qquad (20)$$

Where Y is the dependent variable,

X_2 = 1 for ages 21-50,

= 0 otherwise,

X_3 = 1 for ages 51 plus,

= 0 otherwise,

Z_2 = 1 for female,

= 0 otherwise, and

a and b_2, b_3, c_1 are the equation parameters.

Such an equation specification assumes zero slope for each variable, that is, changes in intercept only. To introduce slope changes within the range of the age division, three new variables must be introduced.

X_4 = age in years

X_5 = age in years for range 21-50

= 0 otherwise

X_6 = age in years for range 51 plus

= 0 otherwise

Thus $X_5 = X_4 X_2$, and

$X_6 = X_4 X_3$

Equation (20) now becomes:

$$Y = a + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + c_1 Z_2 \qquad (21)$$

Where b_4, b_5, b_6 are the coefficients of variables X_4, X_5 and X_6

Now, consider a male aged between 21-50, whose behaviour, Y, is to be analysed by equation (21):

$$Y = a + b_2 + b_4 X_4 + b_5 X_5 \qquad (22)$$

But $X_4 = X_5$, so let $(b_4 + b_5) = k_1$, a constant, and $(a + b_2) = k_2$ another constant. k_1 is the slope of the regression line, and k_2 is the intercept.

Consider a male aged more than 50 years old.

$$Y = a + b_3 + b_4 X_4 + b_6 X_6 \qquad (23)$$

As $X_4 = X_6$, let $(b_4 + b_6) = k_3$ and $(a + b_3) = k_4$.

Since $k_1 \neq k_3$ there is a change in slope, and since $k_2 \neq k_4$ there is a change in the intercept. This situation is shown in Figure 6.

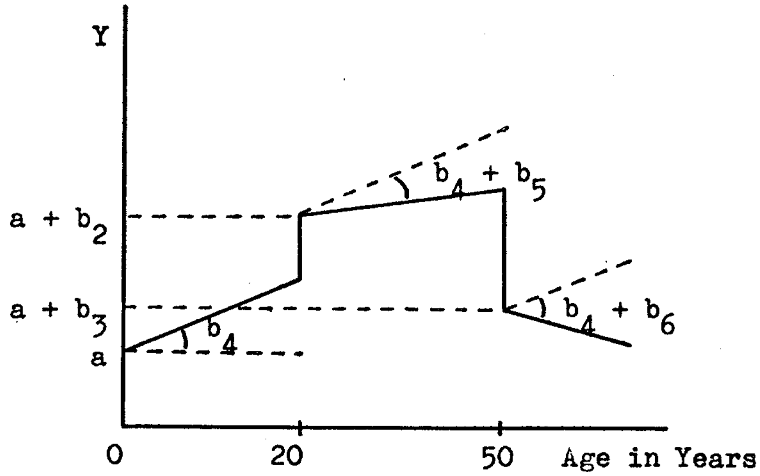

Figure 6. Illustration of Slope and Intercept Changes

In Figure 6, the coefficients give deviations from the coefficients of the base age, 0-20. In this example $b_2 > b_3 > 0$ and $b_6 < b_5 < 0$. Logarithmic or other transformations of the continuous data could be introduced.

Interaction

Interaction is the situation which exists when one or more characteristics jointly determine the value of the dependent variable. That is, the effect of each characteristic is not necessarily additive. For example, an advanced education can be expected to increase a man's job status more than a woman's. To use an equation specification which includes these two characteristics, as additive factors, will prevent a true assessment of the relative importance of each variable. Interaction is not the same relationship as intercorrelation. To continue the above example, income and education may be highly correlated with one another but not interact. However, sex and education, although not correlated with each other, may interact to influence the dependent variable jointly.

Detection of interaction may be by one of several ways.[20] An analysis initially carried out on the entire sample may be re-run for some sub-group of the sample not containing the hypothesized interaction and the two sets of results compared to see if the results from analysis of the whole sample are biased. A second method is to examine two and three way tables of residuals from an additive multivariate analysis and look for any pattern indicating interaction. A third alternative is to isolate a sub-group of the sample of given characteristics, and derive an expected average value for that sub-group utlizing the multivariate coefficients. Deviation of the expected value from the actual average for that sub-group indicates something more than an additive effect is present. Yet another alternative is to use an analysis of variance on cell means to look directly for interaction effects. Perhaps a less empirically oriented alternative is to hypothesize interaction effects based on _a priori_ expectations, and to test such relationships in the analysis.

Having detected interaction at a level serious enough to make the additivity assumption untenable, there are several suggested alternative methods of introducing the interaction terms. Firstly, a combination dummy variable can be used. For example, a dummy variable may be given a value of one if the observation is both male and has education to Grade 12, and the value zero for all other combinations. Many such combinations are possible--the number increasing rapidly with an

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[20]The following section is based on: J. N. Morgan and J. A. Sonquist, "Problems on the Analysis of Survey Data, and a Proposal," _Journal of the American Statistical Association_, Vol. 58 (1963), pp. 415-434.

increase in explanatory factors. Secondly, where the majority of interactions involve the same dichotomy, two separate analyses may be used. A third method is to run an analysis with a given set of explanatory variables. The residuals from this first analysis can then be run against a second set of variables, and if required, the resultant residuals run against yet a third set. However, for the successful application of this alternative, there must be some logical reason why one set of variables takes prescedence over another set such as a chain of causation. This last alternative is similar to that suggested by Morgan and Sonquist.[21]

Allowance for interaction effects increases the computational burden of the analysis, and taken to the possible limits, strains the capacities of the data and available computer programs. However, for results of an analysis of this nature to be at all satisfactory, it is necessary to investigate the possibility of interactions and where necessary to allow for them in the equation specification.

Qualitative Dependent Variables

Dummy variables can also be used as the dependent variable in an equation specification.[22] In such cases the dependent variable takes on a value of unity if the observation falls in the class of dependency, and zero if it does not. The independent variables can be either numerical or dummy variables or both. Examples of such dependent variables are

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[21] Ibid.

[22] J. Johnston, Econometric Methods (New York: John Wiley and Sons, Inc., 1964), p. 224.

whether or not a persons owns a car or does not, whether a person has a a mortgage on his farm or does not, or whether a person migrates or does not.

If a multiple regression is run on such a dichotomous dependent variable Y, and a series of independent variables, X, then the calculated value of Y for any given X is an estimate of the conditional probability of Y, given X.[23] The least squares coefficients of the dummy variables are actually the cell means. Two studies utilizing all dummy variables are those by Orcutt studying the mortgage-debt holdings of United States spending units,[24] and Lansing and Blood in the study of non-business air travel.[25]

The method of discriminant analysis is essentially regression analysis with a dichotomous dependent variable. The purpose of such analysis is to find the linear combination of various factors which will best discriminate between two groups of variables.[26]

Testing the Equation

The evaluation of an equation using dummy variables covers the same components considered in a conventional regression equation. The significance of any one factor (treating the variables into which that

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[23]Ibid.

[24]Orcutt, op. cit.

[25]J. B. Lansing and D. M. Blood, "A Cross-Section Analysis of Non-Business Air Travel," Journal of the American Statistical Association, Vol. 53 (1958), pp. 928-947.

[26]C. Tintner, Econometrics (New York: John Wiley and Sons, Inc., 1965), p. 96.

factor is divided as a group) can be tested by use of an F-ratio, in combination with partial R^2 for that factor.[27] Each individual coefficient can be tested using the t test printed out in the computer output. However, Melichar indicates that, under the type of constraint where one variable is omitted, a test of whether a coefficient is significantly different from zero is in effect testing for the significance of the deviation of that class from the omitted class.[28] A further complication, associated more with sample survey data in general rather than this specific use of such data, arises when tests based on simple random samples are applied to data from stratified or clustered samples.

Values of the R^2 can be expected to be low for cross section survey analyses in general.[29] More specifically, values of this coefficient will tend to be extremely low where a dichotomous dependent variable is used in conjunction with dummy independent variables, unless the survey data tends to be distributed with the mean centered on one of the two possible values, 0 or 1. This situation can be illustrated diagramatically. Figure 7 shows a situation with one independent dummy variable, X and a dichotomous dependent variable Y. (It is easy to conceptualize this simple example expanded to n-dimensions.)

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[27] Melichar, op. cit., p. 17.

[28] Ibid., p. 18.

[29] Ibid., p. 15.

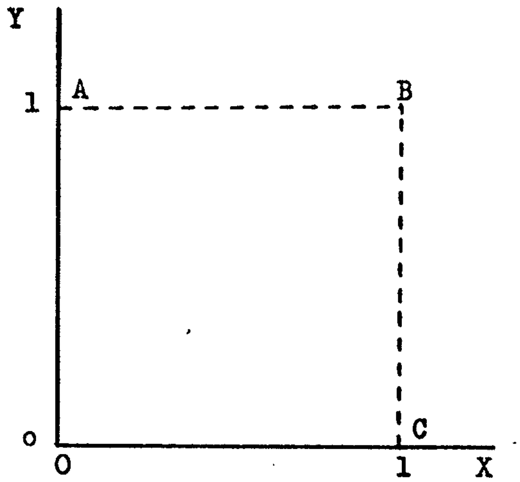

Figure 7. Illustration of Data Distribution for Data Classified into Dummy Variables

All observations, classified in this format, must lie at one of the four points O (0,0), A (1,0), B (1.1) or C (0,1). The value of the coefficient of X will be the mean value of all observations classified X = 1.[30] Now if the majority of observations are clustered at C, the value of the regression coefficient will be low. Similarly if they are clustered at B, the value will be high (near 1). In both cases, the explained variance, given by the R^2 will tend to be high. The more even the distribution of observations between B and C however, the more nearly the coefficient will tend to 0.5, and the lower the R^2 will be. Because socio-economic data relating to such phenomena as migration or mortgage-debt patterns contain elements of human behaviour, and because human behaviour is so variable, low values of the coefficient of multiple correlation are to be expected. A discussion of the appropriateness of

[30] Johnston, op. cit., p. 227.

the R^2 in such situations is given in Neter and Maynes.[31]

Several important problems arise with the use of a dummy dependent variable. Tobin has suggested that utilizing a limited dependent variable may violate the assumptions of the normal model under certain conditions.[32] An example of a limited dependent variable is the 0,1 value of a dichotomous variable. The basis of the criticism is that at the limiting values it is not possible to have deviations from the expected limiting value in both positive and negative directions. Where a zero-one dependent variable is used, for some X the value of Y will lie outside the zero-one interval, which leads to problems of interpretation as a probability. If such a situation is untenable then it is necessary to consider non-linear functions with asymptotes zero and one. Three examples are the integrated normal (probit) model, the logistic curve and the simple exponential.[33]

It can be shown that the assumption of homoscedastic disturbance variances does not hold with dichotomous dependent variables.[34] The consequences of heteroscedasticity are that least squares is unbiased, but inefficient, and that the conventional least squares

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[31] J. Neter and E. S. Maynes, "On the Appropriateness of the Correlation Coefficient with a 0.1 Dependent Variable," Journal of the American Statistical Association, Vol. 65 (1970), pp. 501-509.

[32] J. Tobin, "Estimation of Relationships for Limited Dependent Variables," Econometrica, Vol. 26 (1958), pp. 24-36.

[33] A. Buse, "A Technical Report on the Uses, Problems and Potential of Quantitative Dependent Variables as Applied in the Social Sciences, Particularly Economics" (Edmonton: Alberta Human Resources Research Council, 1970). (Mimeographed.) This reference develops the models indicated.

[34] W. G. Bowen and T. A. Finegan, The Economics of Labour Force Participation (Princeton: Princeton University Press, 1969), p. 645.

estimator for the variance of the estimates is biased and inconsistent, which in turn invalidates conventional tests of hypotheses.[35] Use of generalized least squares transforms the model to comply with the homoscedastic assumption.[36] However, if any of the observations fall outside the zero-one interval then the calculated variance will become negative, which is not possible. Bowen and Finegan cite this problem as a reason for not using generalized least squares, however they do attempt to estimate unbiased and consistent variances.[37] This same estimation procedure is used in the text of this thesis.

In testing variables for multicollinearity, simple correlations between the independent variables are examined. Jenness suggests that such correlations are not meaningful for dummy variables.[38] However no support for Jenness' conclusion has been uncovered either in the literature or by examination of the calculation procedure.

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[35] Buse, op. cit., p. 22.

[36] Wonnacott and Wonnacott, op. cit., p. 322.

[37] Bowen and Finegan, op. cit., p. 646.

[38] R. A. Jenness, "Manpower Mobility Programs," Cost-Benefit Analysis of Manpower Policies, ed. G. G. Somers and W. D. Wood (Kingston: Queen's University, 1969), p. 207.

APPENDIX B

EXPLANATORY NOTES ON MANPOWER SERVICES AND DISTRIBUTION OF SURVEY RESPONSES

These notes are taken from the enumerator guide used in the survey for the study by MacMillan, Bernat and Flagler.[1]

(a) BTSD[2] - An academic upgrading program which upon successful completion of various levels enables the student to proceed into a vocational skills course - usually offered at one of the province's 3 community colleges.

Level IV which is the lowest of the upgrading levels is a prerequisite entrance requirement to Level III.

Successful completion of Level III will permit the individual to proceed into Level II or enter upon a waiter-waitress training course or a heavy equipment operator's course.

Graduation from Level II with a standing of 80% or better in the three academic subjects (English, Maths and Science) which are taught in Level II will permit the individual to enter Level I upgrading. With a pass mark of 60% or better in all 3 subjects in Level II the individual may choose from a wide variety of vocational skills courses of 1 year or less in duration upon which to enter. These courses would normally only accept an academic Grade 10 standing as an entrance requirement.

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[1] J. A. MacMillan, L. A. Bernat and J. J. Flagler, Benefits and Costs of Manpower Services in the Interlake Rural Development Area, Research Bulletin (Winnipeg: Department of Agricultural Economics, University of Manitoba).

[2] Basic Training for Skill Development.

Graduation from Level I will permit the successful individual to enter upon a course of 1 year or less in duration but which normally only accepts a complete Grade XI standing as an entrance requirement.

Grade equivalents are usually not identified with the various levels of BTSD upgrading. For those individuals with less than a complete Grade X academic standing a level placement test is given to determine at which level of the BTSD program the individual is functioning.

(b) Vocational and Special Training - This category mainly consists of vocational skills courses (1 year or less in duration), which are offered at the community colleges. Courses may also be taken at some of the private trade schools throughout the province.

Indentured apprentices are obliged to take special theory courses in the various trades to which they belong. The theory courses vary in length, but are usually from 4 to 6 weeks in duration.

Special training includes such courses as the heavy equipment operator's course, carpentry upgrading courses, and various other skills courses of a 'special' nature.

(c) Farm Management Course - A 5-month course for farm operators to improve their farm operation skills. Course sessions include instruction in soil and crop management, animal husbandry, farm accounting and business techniques, and applied science and mathematics.

(d) Manpower Corps - The Manpower Corps program combines occupational skills training with special social skills training (money management, confidence building, employer-employee relations, etc.). Projects under the Manpower Corps program are usually associated with a provincial public works project. Some of the several types of projects under the Manpower Corps program include: construction of Community Education Centres; construction of Fisheries Training Centre at Hnausa; diamond drillers' helpers course; beach development at Winnipeg Beach; crafts building construction at Gimli Recreational Leadership Training Centre; Manpower Corps Training Plant - Selkirk; etc.

(e) Training-in-Industry - Includes classroom instruction in a business establishment. Individuals are hired as employees of the firm. A separate contract is negotiated between the federal government and the firm. The contract will provide for payment of a certain percentage of the employee's wage or salary by the federal government. The classroom training is to be separate from the actual production process.

(f) Employment Referral - Referral by a Canada Manpower Counsellor of an individual to a potential job offer. Individuals may accept the job offer, fail to report, or not be accepted by the employer for the job position.

(g) Mobility Assistance and/or Exploratory Grants[3] - Mobility assistance is usually for the relocation of an individual and his immediate family in a centre where a permanent job is available to the individual.

Exploratory grants are made for the purpose of exploring feasible job opportunities in centres other than where an individual is currently residing.

For the analysis in the above mentioned study, some of these programs were broken into two groups--completion and non-completion. Completion refers to persons who complete the service program, and non-completion includes persons who failed to complete the program.

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[3]Persons participating in this service were not included in the analysis.

TABLE XVI

TOTAL INTERVIEW CONTACTS AND DISPOSITION

Cat. No.	Service Category	Questionnaires Used for Analysis	Not Home when Located[a]	No Contact[b]	Refusals	Ill or in Jail	Ineligible or Invalid[c]	Distant Clients[d]	Deceased	Total Attempted Contacts
1	Training in Industry	23	7	7	2	0	7	1	1	48
2	Mobility	13	3	9	0	0	7	11	0	43
3	Farm Management Course	26	3	2	2	0	15	1	0	49
4	Manpower Corps Comp.	27	6	6	0	1	4	4	0	48
5	Manpower Corps Non-Comp.	24	5	12	1	1	4	2	0	49
6	Employment Referral Comp.	29	3	5	1	0	9	3	0	50
7	Employment Referral Non-Comp.	23	9	6	4	1	9	7	0	59
8	B.T.S.D. III and IV Comp.	33	7	4	2	1	0	0	0	47
9	B.T.S.D. III and IV Non-Comp.	36	5	8	2	0	2	1	0	54
10	B.T.S.D. I and II Comp.	33	1	4	2	0	4	3	0	47
11	B.T.S.D. I and II Non-Comp.	27	9	14	1	1	3	4	0	59
12	Voc. and Special Comp.	29	2	3	4	0	3	4	1	46
13	Voc. and Special Non-Comp.	27	3	4	1	1	4	3	0	43
	TOTAL SERVICE	350	63	84	22	6	71	44	2	642
	Indian Norm	22	8	8	0	1	10	16	0	65
	Farm Norm	20	6	12	0	0	12	0	0	50
	Rural Non-Farm Norm	11	5	6	2	0	8	1	0	33
	Urban Norm	10	5	8	2	1	13	2	0	41
	TOTAL NORM	63	24	34	4	2	43	19	0	189

[a]Not Home When Located--This means that place of residence was found, but client was either at work, away from home or somewhere else unknown to the residents of that particular home. At work, in many cases, appeared to be an excuse to avoid completing a questionnaire.

[b]No Contact--This means no contact at all with the client or family. This was a result of wrong directions or of the client never being heard of.

[c]Ineligible--Clients who were not in the labour force prior to receiving their service (student), retired (control mainly), or already surveyed for another service, insufficient data and exclusions such as 3 training in industry on a management course and 2 farm management trainees who did not farm. Invalid-Consistently checks on the questionnaire and checks with information on agency forms resulted in exclusion of the questionnaire from the analysis. This occurred for a large number of farm management clients.

[d]Distant Clients--Clients who originally lived in the survey area, but have since moved out of the area.

Source:

MacMillan, Bernat and Flagler, op. cit.

APPENDIX C

CORRELATION COEFFICIENTS AND REGRESSION EQUATION RESULTS

TABLE XVII

SIMPLE CORRELATION COEFFICIENTS BETWEEN INDEPENDENT VARIABLES USED IN THE BEHAVIOURAL EQUATIONS

Variable	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
X_1	1.00							
X_2	-0.14	1.00						
X_3	0.14	-0.80	1.00					
X_4	-0.07	0.10	-0.05	1.00				
X_5	0.07	-0.40	0.30	-0.23	1.00			
X_6	-0.09	-0.19	0.03	0.00	0.18	1.00		
X_7	0.34	0.09	0.02	0.04	-0.08	-0.12	1.00	
X_8	-0.21	0.07	-0.05	0.07	-0.02	0.01	-0.45	1.00
X_9	-0.09	0.09	-0.07	-0.03	0.05	-0.05	-0.05	-0.09
X_{10}	0.13	0.10	-0.05	-0.12	-0.05	-0.12	0.33	-0.24
X_{11}	-0.10	0.06	0.00	-0.13	0.07	-0.04	-0.05	0.03
X_{12}	0.16	0.16	-0.12	0.08	-0.22	-0.08	0.45	-0.27
X_{13}	0.08	0.03	-0.06	0.34	-0.24	-0.11	0.24	-0.20
X_{14}	0.07	0.06	-0.07	-0.02	0.01	0.00	0.07	-0.06
X_{15}	-0.01	0.05	0.01	-0.12	0.09	0.03	-0.04	0.02
X_{16}	-0.11	0.20	-0.03	0.07	-0.08	-0.21	0.01	0.04
X_{17}	0.15	0.04	0.04	0.03	-0.06	-0.05	0.28	-0.24
X_{18}	-0.08	0.10	-0.07	0.03	-0.10	-0.09	-0.03	0.09
X_{19}	0.21	-0.18	0.23	-0.07	0.13	-0.06	-0.13	0.07
X_{20}	0.10	0.10	-0.09	-0.12	0.01	-0.03	0.31	-0.26
X_{21}	-0.17	-0.13	0.12	-0.04	0.05	0.08	-0.06	0.12
X_{22}	-0.08	0.11	-0.05	-0.01	0.03	-0.08	-0.20	0.14
X_{23}	0.25	0.10	-0.11	0.23	-0.10	0.00	-0.22	0.18

TABLE XVII (continued)

Variable	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
X_9	1.00							
X_{10}	-0.03	1.00						
X_{11}	-0.04	-0.27	1.00					
X_{12}	-0.05	0.23	-0.04	1.00				
X_{13}	-0.05	0.11	-0.28	0.35	1.00			
X_{14}	-0.03	0.02	0.07	0.11	-0.33	1.00		
X_{15}	0.05	0.04	0.08	-0.10	-0.37	-0.24	1.00	
X_{16}	-0.06	0.07	0.08	0.10	0.10	0.08	0.08	1.00
X_{17}	-0.03	0.07	-0.03	0.14	0.18	0.01	0.01	0.22
X_{18}	0.07	0.02	0.00	0.07	0.09	-0.06	-0.06	0.19
X_{19}	-0.02	-0.11	-0.16	-0.20	-0.18	-0.03	-0.03	0.12
X_{20}	-0.03	0.30	-0.02	0.24	0.08	0.00	0.00	0.17
X_{21}	-0.02	-0.11	0.22	-0.12	-0.11	-0.05	-0.05	0.12
X_{22}	-0.03	-0.07	0.06	-0.08	-0.03	0.14	0.14	0.20
X_{23}	-0.03	-0.07	0.05	-0.03	-0.01	0.06	0.06	0.18

	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}	X_{22}	X_{23}
X_{17}	1.00						
X_{18}	-0.18	1.00					
X_{19}	-0.12	-0.10	1.00				
X_{20}	-0.16	-0.14	-0.09	1.00			
X_{21}	-0.11	-0.10	-0.06	-0.09	1.00		
X_{22}	-0.19	-0.16	-0.11	-0.15	-0.10	1.00	
X_{23}	-0.17	-0.15	-0.10	-0.14	-0.09	-0.16	1.00

TABLE XVIII

REGRESSION RESULTS FOR EQUATION 1.1

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.039	0.046	0.043	0.8542	0.9191
X_2	Age 17-25	0.153**	0.081	0.045	1.8885	3.3783
X_3	Age 26-50	0.001	0.072	0.041	0.0207	0.0363
X_4	Female	0.032	0.066	0.060	0.4866	0.5309
X_5	Marital Status	-0.042	0.051	0.047	0.8232	0.8909
X_6	Time in Municipality	0.069*	0.045	0.042	1.5419	1.6457
X_7	Indian or Metis	0.097*	0.055	0.044	1.7560	2.1922
X_8	Education Grades 8-13	0.062+	0.049	0.042	1.2724	1.4855
X_9	University	0.390	0.296	0.350	1.3149	1.1118
X_{10}	Primary Industry	0.179**	0.062	0.062	2.8633	2.8889
X_{11}	Secondary Industry	0.071+	0.052	0.050	1.3571	1.4197
X_{12}	Unemployment	0.112**	0.051	0.045	2.1727	2.5008
X_{13}	Income less than $1500	-0.116**	0.066	0.043	1.7524	2.6955
X_{14}	Income $1501-$3000	0.039	0.066	0.057	0.5940	0.6957
X_{15}	Income $3001-$5000	-0.061	0.061	0.051	1.0024	1.1913
X_{16}	Manpower Service	0.207**	0.062	0.044	3.3672	4.7191
	Intercept	-0.073	0.121		0.6088	
	R^2	0.18**				
	F Ratio	5.1591				

Dependent Variable: Y_1

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XIX

REGRESSION RESULTS FOR EQUATION 1.2

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.031	0.049	0.043	0.6276	0.7268
X_2	Age 17-25	0.141**	0.082	0.045	1.7121	3.1321
X_3	Age 26-50	0.002	0.073	0.041	0.0222	0.0398
X_4	Female	0.033	0.068	0.060	0.4865	0.5504
X_5	Marital Status	-0.041	0.051	0.047	0.7923	0.8699
X_6	Time in Municipality	0.073*	0.045	0.042	1.5942	1.7340
X_7	Indian or Metis	0.106**	0.059	0.044	1.8113	2.4096
X_8	Education Grades 8-13	0.053	0.050	0.042	1.0500	1.2716
X_9	University	0.353	0.299	0.346	1.1807	1.0209
X_{10}	Primary Industry	0.175**	0.064	0.062	2.7183	2.8339
X_{11}	Secondary Industry	0.064+	0.056	0.050	1.1394	1.2841
X_{12}	Unemployment	0.107**	0.052	0.045	2.0595	2.4070
X_{13}	Income less than $1500	-0.148**	0.072	0.043	2.0707	3.4477
X_{14}	Income $1501-$3000	0.017	0.069	0.057	0.2452	0.3000
X_{15}	Income $3001-$5000	-0.081+	0.064	0.051	1.2556	1.5834
X_{17}	B.T.S.D. Level III or IV	0.221**	0.078	0.055	2.8154	3.9859
X_{18}	Vocational or Special Training	0.300**	0.082	0.065	3.6644	4.5881
X_{19}	Farm Managment Training	0.140**	0.103	0.056	1.3642	2.5127
X_{20}	Manpower Corps or V.R.T.	0.185**	0.087	0.070	2.1286	2.6490
X_{21}	Training in Industry	0.152*	0.105	0.083	1.4415	1.8317
X_{22}	B.T.S.D. Level I or II	0.244**	0.083	0.060	2.9423	4.0675
X_{23}	Employment Referral	0.216**	0.087	0.063	2.4776	3.4243
	Intercept	-0.062	0.113		0.5495	
	R^2	0.19**				
	F Ratio	3.9063				

Dependent Variable: Y_1

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XX

REGRESSION RESULTS FOR EQUATION 2.1

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.022	0.036	0.034	0.6211	0.6570
X_2	Age 17-25	0.026	0.063	0.035	0.4081	0.7384
X_3	Age 26-50	0.003	0.056	0.032	0.0501	0.0876
X_4	Female	0.025	0.051	0.050	0.4838	0.4944
X_5	Marital Status	-0.020	0.040	0.037	0.5087	0.5477
X_6	Time in Municipality	-0.031	0.035	0.032	0.8961	0.9886
X_7	Indian or Metis	0.001	0.043	0.033	0.0324	0.0421
X_8	Education Grades 8-13	0.054*	0.038	0.032	1.4079	1.6755
X_9	University	0.436	0.232	0.353	1.8811	1.2361
X_{10}	Primary Industry	0.106**	0.049	0.051	2.1656	2.0657
X_{11}	Secondary Industry	-0.035	0.041	0.035	0.8669	1.0138
X_{12}	Unemployment	-0.014	0.040	0.034	0.3532	0.4216
X_{13}	Income less than $1500	-0.018	0.052	0.035	0.3501	0.5235
X_{14}	Income $1501-$3000	-0.006	0.052	0.042	0.1222	0.1490
X_{15}	Income $3001-$5000	-0.032	0.048	0.038	0.6776	0.8437
X_{16}	Manpower Service	0.123**	0.048	0.033	2.5479	3.7361
	Intercept	0.014	0.094		0.1434	
	R^2	0.07*				
	F Ratio	1.7281				

Dependent Variable: Y_2

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

TABLE XXI

REGRESSION RESULTS FOR EQUATION 2.2

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.031	0.041	0.039	0.7672	0.8041
X_2	Age 17-25	0.061+	0.071	0.043	0.8714	1.4355
X_3	Age 26-50	0.001	0.062	0.038	0.0178	0.0292
X_4	Female	0.031	0.058	0.056	0.5355	0.5497
X_5	Marital Status	-0.021	0.046	0.044	0.4547	0.4797
X_6	Time in Municipality	-0.016	0.040	0.037	0.4052	0.4443
X_7	Indian or Metis	0.017	0.051	0.040	0.3386	0.4322
X_8	Education Grades 8-13	0.065*	0.044	0.037	1.4914	1.7774
X_9	University	0.042	0.246	0.353	1.7203	1.2004
X_{10}	Primary Industry	0.149**	0.058	0.063	2.5890	2.3651
X_{11}	Secondary Industry	-0.029	0.047	0.042	0.6061	0.6772
X_{12}	Unemployment	0.013	0.047	0.041	0.2743	0.3141
X_{13}	Income less than $1500	-0.047	0.059	0.039	0.7928	1.2016
X_{14}	Income $1501-$3000	0.007	0.060	0.053	0.1217	0.1395
X_{15}	Income $3001-$5000	-0.051	0.054	0.442	0.9477	1.1540
X_{16}	Manpower Service	0.143**	0.053	0.037	2.7123	3.8292
	Intercept	0.010	0.105		0.0910	
	R^2	0.08				
	F Ratio	1.4794				

Dependent Variable: Y_2

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XXII

REGRESSION RESULTS FOR EQUATION 2.3

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.025	0.044	0.039	0.5615	0.6314
X_2	Age 17-25	0.047	0.071	0.043	0.6516	1.0916
X_3	Age 26-50	0.003	0.063	0.038	0.0467	0.0777
X_4	Female	0.035	0.060	0.057	0.5873	0.6257
X_5	Marital Status	-0.022	0.046	0.044	0.4687	0.4984
X_6	Time in Municipality	-0.017	0.041	0.037	0.4173	0.4636
X_7	Indian or Metis	0.009	0.053	0.040	0.1723	0.2299
X_8	Education Grades 8-13	0.060+	0.045	0.037	1.3324	1.6237
X_9	University	0.385	0.248	0.350	1.5515	1.1004
X_{10}	Primary Industry	0.167**	0.061	0.063	2.4222	2.3403
X_{11}	Secondary Industry	-0.031	0.051	0.042	0.6148	0.7374
X_{12}	Unemployment	0.012	0.047	0.041	0.2600	0.3006
X_{13}	Income less than $1500	-0.088*	0.065	0.039	1.3604	2.2384
X_{14}	Income $1501-$3000	-0.021	0.063	0.053	0.3263	0.3919
X_{15}	Income $3001-$5000	-0.073+	0.057	0.045	1.2762	1.6238
X_{17}	B.T.S.D. Level III or IV	0.183**	0.069	0.050	2.6575	3.6233
X_{18}	Vocational or Special Tr.	0.232**	0.072	0.066	3.2122	3.5040
X_{19}	Farm Management Training	0.077+	0.086	0.056	0.8982	1.3711
X_{20}	Manpower Corps or V.R.T.	0.146*	0.079	0.065	1.8448	2.2631
X_{21}	Training in Industry	0.055	0.094	0.060	0.5839	0.9224
X_{22}	B.T.S.D. Level I or II	0.138**	0.072	0.052	1.9158	2.6400
X_{23}	Employment Referral	0.155**	0.075	0.059	2.0612	2.6362
	Intercept	0.011	0.100		0.1081	
	R^2	0.11				
	F Ratio	1.7636*				

Dependent Variable: Y_2

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XXIII

REGRESSION RESULTS FOR EQUATION 3.1

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.017	0.036	0.036	0.4668	0.4683
X_2	Age 17-25	0.127**	0.064	0.039	1.9872	3.2502
X_3	Age 26-50	-0.001	0.057	0.035	0.0234	0.0378
X_4	Female	0.007	0.052	0.051	0.1372	0.1407
X_5	Marital Status	-0.022	0.040	0.040	0.5387	0.5408
X_6	Time in Municipality	0.101**	0.035	0.037	2.8394	2.7497
X_7	Indian or Metis	0.096**	0.044	0.039	2.1913	2.4521
X_8	Education Grades 8-13	0.008	0.038	0.036	0.2173	0.2306
X_9	University	-0.046	0.234	0.120	0.1974	0.3860
X_{10}	Primary Industry	0.073+	0.049	0.053	1.4816	1.3837
X_{11}	Secondary Industry	0.106**	0.041	0.044	2.5764	2.3889
X_{12}	Unemployment	0.126**	0.041	0.039	3.1007	3.1979
X_{13}	Income less than $1500	-0.098	0.052	0.037	1.8722	2.6672
X_{14}	Income $1501-$3000	0.046	0.052	0.052	0.8731	0.8868
X_{15}	Income $3001-$5000	-0.029	0.048	0.043	0.5984	0.6727
X_{16}	Manpower Service	0.085*	0.049	0.040	1.7410	2.1004
	Intercept	-0.087	0.095		0.9128	
	R^2	0.18**				
	F Ratio	5.3721				

Dependent Variable: Y_3

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XXIV

REGRESSION RESULTS FOR EQUATION 3.2

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.020	0.040	0.041	0.5102	0.4992
X_2	Age 17-25	0.144**	0.069	0.044	2.0967	3.2631
X_3	Age 26-50	-0.013	0.061	0.039	0.2119	0.3270
X_4	Female	0.020	0.058	0.057	0.3528	0.3556
X_5	Marital Status	-0.018	0.044	0.045	0.4140	0.4058
X_6	Time in Municipality	0.113**	0.038	0.040	2.9407	2.8352
X_7	Indian or Metis	0.094*	0.048	0.043	1.9482	2.1794
X_8	Education Grades 8-13	0.028	0.042	0.040	0.6708	0.7096
X_9	University	-0.018	0.0339	0.020	0.0537	0.9349
X_{10}	Primary Industry	0.123*	0.057	0.062	2.1563	1.9846
X_{11}	Secondary Industry	0.114**	0.044	0.048	2.5637	2.3819
X_{12}	Unemployment	0.145**	0.046	0.043	3.1868	3.3515
X_{13}	Income less than $1500	-0.119**	0.057	0.041	2.0783	2.9056
X_{14}	Income $1501-$3000	0.051	0.057	0.056	0.8860	0.9049
X_{15}	Income $3001-$5000	-0.044	0.053	0.047	0.8396	0.9354
X_{16}	Manpower Service	0.104**	0.051	0.043	2.0441	2.4135
	Intercept	-0.108	0.103		1.0490	
	R^2	0.22**				
	F Ratio	5.9353				

Dependent Variable: Y_3

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

TABLE XXV

REGRESSION RESULTS FOR EQUATION 3.3

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.017	0.043	0.041	0.3976	0.4161
X_2	Age 17-25	0.143**	0.070	0.044	2.0306	3.2321
X_3	Age 26-50	-0.015	0.062	0.039	0.2372	0.3738
X_4	Female	0.017	0.060	0.058	0.2875	0.2977
X_5	Marital Status	-0.017	0.045	0.045	0.3738	0.3723
X_6	Time in Municipality	0.113**	0.039	0.040	2.8963	2.8345
X_7	Indian or Metis	0.101**	0.051	0.043	1.9790	2.3531
X_8	Education Grades 8-13	0.019	0.044	0.040	0.4386	0.4844
X_9	University	-0.022	0.342	0.020	0.0638	1.1165
X_{10}	Primary Industry	0.126*	0.059	0.062	2.1479	2.0260
X_{11}	Secondary Industry	0.108*	0.048	0.048	2.2511	2.2584
X_{12}	Unemployment	0.148**	0.047	0.043	3.1629	3.4001
X_{13}	Income less than $1500	-0.128**	0.062	0.041	2.0474	3.1153
X_{14}	Income $1501-$3000	0.044	0.060	0.056	0.7256	0.7790
X_{15}	Income $3001-$5000	-0.050	0.057	0.048	0.8817	1.0480
X_{17}	B.T.S.D. Level III or IV	0.106*	0.066	0.055	1.6049	1.9342
X_{18}	Vocational or Special Tr.	0.132*	0.072	0.065	1.8483	2.0253
X_{19}	Farm Management Training	0.092*	0.088	0.053	1.0522	1.7514
X_{20}	Manpower Corps or V.R.T.	0.062	0.075	0.067	0.8267	0.9216
X_{21}	Training in Industry	0.115+	0.088	0.080	1.3130	1.4506
X_{22}	B.T.S.D. Level I or II	0.135**	0.070	0.057	1.9137	2.3774
X_{23}	Employment Referral	0.105*	0.075	0.058	1.3953	1.8185
	Intercept	-0.104	0.098		1.0622	
	R^2	0.22**				
	F Ratio	4.312				

Dependent Variable: Y_3

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XXVI

REGRESSION RESULTS FOR EQUATION 4.1

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.031	0.034	0.032	0.9010	0.9508
X_2	Age 17-25	0.126**	0.060	0.035	2.1155	3.5865
X_3	Age 26-50	0.041+	0.054	0.032	0.7724	1.3095
X_4	Female	-0.004	0.049	0.045	0.0737	0.0800
X_5	Marital Status	0.002	0.038	0.037	0.0547	0.0566
X_6	Time in Municipality	0.031	0.033	0.032	0.9323	0.9616
X_7	Indian or Metis	0.079*	0.041	0.036	1.9369	2.2352
X_8	Education Grades 8-13	0.035	0.036	0.032	0.9647	1.0786
X_9	University	-0.049	0.220	0.054	0.2209	0.9041
X_{10}	Primary Industry	0.106*	0.046	0.053	2.2817	1.9921
X_{11}	Secondary Industry	0.022	0.039	0.037	0.5743	0.6013
X_{12}	Unemployment	0.076*	0.038	0.036	1.9938	2.1345
X_{13}	Income less than $1500	-0.051+	0.049	0.034	1.0454	1.5183
X_{14}	Income $1501-$3000	-0.008	0.049	0.045	0.1546	0.1686
X_{15}	Income $3001-$5000	-0.076*	0.045	0.036	1.6937	2.1260
X_{16}	Manpower Service	0.066*	0.046	0.036	1.4406	1.8324
	Intercept	-0.075	0.089		0.8387	
	R^2	0.11**				
	F Ratio	2.9735				

Dependent Variable: Y_4

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XXVII

REGRESSION RESULTS FOR EQUATION 4.2

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.034	0.036	0.033	0.9486	1.0520
X_2	Age 17-25	0.104**	0.060	0.035	1.7287	2.9390
X_3	Age 26-50	0.024	0.054	0.032	0.4483	0.7575
X_4	Female	-0.008	0.050	0.046	0.1632	0.1754
X_5	Marital Status	0.004	0.038	0.036	0.0971	0.1002
X_6	Time in Municipality	0.035	0.033	0.032	1.0593	1.0924
X_7	Indian or Metis	0.090**	0.043	0.035	2.1103	2.5598
X_8	Education Grades 8-13	0.032	0.037	0.033	0.8794	0.9944
X_9	University	-0.052*	0.218	0.023	0.2400	2.2633
X_{10}	Primary Industry	0.126**	0.047	0.052	2.6840	2.4080
X_{11}	Secondary Industry	0.024	0.041	0.037	0.5906	0.6493
X_{12}	Unemployment	0.084**	0.038	0.035	2.2042	2.3671
X_{13}	Income less than $1500	-0.086**	0.052	0.034	1.6448	2.5571
X_{14}	Income $1501-$3000	-0.030	0.051	0.045	0.5953	0.6694
X_{15}	Income $3001-$5000	-0.103**	0.047	0.038	2.1799	2.6899
X_{17}	B.T.S.D. Level III or IV	0.153**	0.057	0.050	2.6751	3.0870
X_{18}	Vocational or Special Tr.	0.101*	0.060	0.050	1.6945	2.0142
X_{19}	Farm Management Training	0.033	0.075	0.037	0.4407	0.9056
X_{20}	Manpower Corps or V.R.T.	-0.045	0.064	0.045	0.7027	0.9870
X_{21}	Training in Industry	0.004	0.077	0.055	0.0505	0.0708
X_{22}	B.T.S.D. Level I or II	0.118**	0.061	0.046	1.9532	2.5607
X_{23}	Employment Referral	0.067+	0.064	0.045	1.0512	1.4958
	Intercept	-0.054	0.083		0.6571	
	R^2	0.15**				
	F Ratio	2.9065				

Dependent Variable: Y_4

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XXVIII

REGRESSION RESULTS FOR EQUATION 4.3

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.042+	0.026	0.027	1.5953	1.5441
X_2	Age 17-25	0.113**	0.045	0.031	2.4484	3.5672
X_3	Age 26-50	0.026	0.040	0.026	0.6495	0.9902
X_4	Female	-0.003	0.037	0.038	0.0736	0.0720
X_5	Marital Status	0.042+	0.030	0.029	1.4089	1.4271
X_6	Time in Municipality	-0.019	0.026	0.025	0.7382	0.7771
X_7	Indian or Metis	-0.006	0.033	0.027	0.1726	0.2095
X_8	Education Grades 8-13	0.003	0.028	0.025	0.0996	0.1108
X_9	University	-0.125**	0.159	0.017	0.7864	7.3053
X_{10}	Primary Industry	0.047	0.037	0.043	1.2637	1.0901
X_{11}	Secondary Industry	-0.022	0.031	0.028	0.7154	0.7678
X_{12}	Unemployment	-0.002	0.030	0.028	0.0501	0.0537
X_{13}	Income less than $1500	0.025	0.038	0.027	0.6567	0.9239
X_{14}	Income $1501-$3000	0.042	0.039	0.039	1.0726	1.0852
X_{15}	Income $3001-$5000	-0.024	0.035	0.029	0.6884	0.8247
X_{16}	Manpower Service	0.024	0.034	0.027	0.7196	0.9081
	Intercept	0.068	0.068		0.4253	
	R^2	0.07				
	F Ratio	1.5399				

Dependent Variable: Y_4

**Significant at the 1 per cent level.

+Significant at the 10 per cent level.

TABLE XXIX

REGRESSION RESULTS FOR EQUATION 4.4

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.041+	0.028	0.028	1.4650	1.4980
X_2	Age 17-25	0.103**	0.046	0.031	2.2483	3.3013
X_3	Age 26-50	0.021	0.040	0.026	0.5167	0.7873
X_4	Female	-0.017	0.039	0.039	0.4383	0.4336
X_5	Marital Status	0.041+	0.030	0.030	1.3665	1.3577
X_6	Time in Municipality	-0.018	0.026	0.025	0.6906	0.7273
X_7	Indian or Metis	0.001	0.034	0.028	0.0303	0.0377
X_8	Education Grades 8-13	0.004	0.029	0.026	0.1404	0.1574
X_9	University	-0.110*	0.160	0.066	0.6874	1.6624
X_{10}	Primary Industry	0.066+	0.039	0.043	1.6847	1.5219
X_{11}	Secondary Industry	-0.023	0.033	0.029	0.6893	0.7819
X_{12}	Unemployment	0.005	0.030	0.029	0.1765	0.1883
X_{13}	Income less than $1500	0.013	0.042	0.028	0.3106	0.4664
X_{14}	Income $1501-$3000	0.038	0.041	0.039	0.9372	0.9894
X_{15}	Income $3001-$5000	-0.037	0.037	0.030	1.0160	1.2404
X_{17}	B.T.S.D. Level III or IV	0.065	0.044	0.039	1.4571	1.6759
X_{18}	Vocational or Special Tr.	0.020	0.047	0.039	0.4401	0.5219
X_{19}	Farm Management Training	0.011	0.055	0.030	0.2008	0.3738
X_{20}	Manpower Corps or V.R.T.	-0.040	0.051	0.037	0.7748	1.0681
X_{21}	Training in Industry	0.002	0.061	0.038	0.0361	0.0580
X_{22}	B.T.S.D. Level I or II	0.048	0.046	0.040	1.0357	1.1915
X_{23}	Employment Referral	0.057+	0.049	0.044	1.1659	1.2814
	Intercept	-0.026	0.064		0.4092	
	R^2	0.09				
	F Ratio	1.4003				

Dependent Variable: Y_4

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XXX

REGRESSION RESULTS FOR EQUATION 4.5

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	0.008	0.030	0.032	0.2662	0.2528
X_2	Age 17-25	0.048+	0.052	0.034	0.9260	1.4035
X_3	Age 26-50	0.010	0.046	0.031	0.2157	0.3163
X_4	Female	0.008	0.044	0.045	0.1850	0.1793
X_5	Marital Status	-0.031	0.034	0.036	0.9265	0.8581
X_6	Time in Municipality	0.063*	0.029	0.032	2.1779	1.9796
X_7	Indian or Metis	0.095**	0.036	0.036	2.6143	2.6699
X_8	Education Grades 8-13	0.047+	0.032	0.032	1.4877	1.4752
X_9	University	0.061**	0.256	0.016	0.2392	3.9417
X_{10}	Primary Industry	0.111*	0.043	0.055	2.5874	2.0265
X_{11}	Secondary Industry	0.051+	0.034	0.036	1.5243	1.4073
X_{12}	Unemployment	0.093**	0.034	0.035	2.7033	2.6295
X_{13}	Income less than $1500	-0.091**	0.043	0.034	2.1122	2.7215
X_{14}	Income $1501-$3000	-0.037	0.043	0.043	0.8498	0.8536
X_{15}	Income $3001-$5000	-0.075*	0.040	0.036	1.8848	2.0604
X_{16}	Manpower Service	0.058+	0.039	0.036	1.5127	1.6249
	Intercept	-0.078	0.077		1.0097	
	R^2	0.15**				
	F Ratio	3.5955				

Dependent Variable: Y_4

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XXXI

REGRESSION RESULTS FOR EQUATION 4.6

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	0.002	0.032	0.032	0.0581	0.0568
X_2	Age 17-25	0.036	0.052	0.035	0.6908	1.0295
X_3	Age 26-50	-0.003	0.046	0.032	0.0565	0.0819
X_4	Female	0.012	0.044	0.046	0.2741	0.2625
X_5	Marital Status	-0.025	0.033	0.037	0.7428	0.6738
X_6	Time in Municipality	0.062*	0.029	0.032	2.1380	1.9264
X_7	Indian or Metis	0.096**	0.038	0.036	2.5292	2.6984
X_8	Education Grades 8-13	0.047+	0.033	0.032	1.4450	1.4537
X_9	University	0.050**	0.253	0.016	0.1963	3.1569
X_{10}	Primary Industry	0.121*	0.043	0.055	2.7798	2.2043
X_{11}	Secondary Industry	0.052+	0.036	0.037	1.4680	1.4206
X_{12}	Unemployment	0.103**	0.035	0.036	2.9885	2.9086
X_{13}	Income less than $1500	-0.120**	0.046	0.034	2.5930	3.5277
X_{14}	Income $1501-$3000	-0.058+	0.045	0.044	1.3029	1.3378
X_{15}	Income $3001-$5000	-0.089**	0.042	0.038	2.1215	2.3232
X_{17}	B.T.S.D. Level III or IV	0.131**	0.049	0.049	2.6754	2.6694
X_{18}	Vocational or Special Tr.	0.097*	0.053	0.054	1.8272	1.7848
X_{19}	Farm Management Training	0.038	0.065	0.040	0.5927	0.9693
X_{20}	Manpower Corps or V.R.T.	-0.022	0.055	0.050	0.4031	0.4492
X_{21}	Training in Industry	0.008	0.065	0.057	0.1214	0.1397
X_{22}	B.T.S.D. Level I or II	0.084*	0.052	0.042	1.5996	1.9744
X_{23}	Employment Referral	0.029	0.056	0.045	0.5135	0.6351
	Intercept	-0.061	0.073		0.8371	
	R^2	0.18**				
	F Ratio	3.2314				

Dependent Variable: Y_4

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XXXII

REGRESSION RESULTS FOR EQUATION 5.1

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	0.014	0.045	0.041	0.3154	0.3465
X_2	Age 17-25	0.134**	0.078	0.044	1.7102	3.0308
X_3	Age 26-50	-0.043	0.070	0.040	0.6144	1.0869
X_4	Female	-0.031	0.063	0.059	0.4821	0.5169
X_5	Marital Status	-0.136**	0.049	0.047	2.7688	2.8799
X_6	Time in Municipality	0.067*	0.043	0.040	1.5518	1.6762
X_7	Indian or Metis	0.101**	0.054	0.043	1.8885	2.3535
X_8	Education Grades 8-13	0.027	0.047	0.040	0.5802	0.6820
X_9	University	-0.107	0.287	0.209	0.3745	0.5137
X_{10}	Primary Industry	0.050	0.060	0.058	0.8270	0.8579
X_{11}	Secondary Industry	0.057	0.050	0.047	1.1309	1.2233
X_{12}	Unemployment	-0.019	0.050	0.042	0.3799	0.4453
X_{13}	Income less than $1500	0.044	0.064	0.042	0.6887	1.0427
X_{14}	Income $1501-$3000	0.092*	0.064	0.055	1.4338	1.6736
X_{15}	Income $3001-$5000	0.021	0.059	0.048	0.3634	0.4438
X_{16}	Manpower Service	0.152**	0.060	0.043	2.5433	3.5688
	Intercept	0.024	0.117		0.2028	
	R^2	0.15**				
	F Ratio	4.1102				

Dependent Variable: Y_5

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

TABLE XXXIII

REGRESSION RESULTS FOR EQUATION 5.2

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.006	0.047	0.040	0.1184	0.1399
X_2	Age 17-25	0.108**	0.078	0.043	1.3776	2.4914
X_3	Age 26-50	-0.051+	0.070	0.039	0.7354	1.3057
X_4	Female	0.021	0.065	0.059	0.3176	0.3499
X_5	Marital Status	-0.149**	0.049	0.047	3.0271	3.1802
X_6	Time in Municipality	0.063+	0.043	0.039	1.4480	1.6004
X_7	Indian or Metis	0.058+	0.056	0.042	1.0388	1.3765
X_8	Education Grades 8-13	0.057+	0.048	0.040	1.1917	1.4443
X_9	University	-0.100	0.285	0.180	0.3433	0.5415
X_{10}	Primary Industry	0.038	0.061	0.057	0.6198	0.6630
X_{11}	Secondary Industry	0.062+	0.053	0.046	1.1655	1.3608
X_{12}	Unemployment	-0.019	0.050	0.042	0.3904	0.4621
X_{13}	Income less than $1500	0.001	0.068	0.042	0.0136	0.0221
X_{14}	Income $1501-$3000	0.062	0.066	0.054	0.9372	1.1459
X_{15}	Income $3001-$5000	-0.001	0.061	0.048	0.0170	0.0219
X_{17}	B.T.S.D. Level III or IV	0.245**	0.075	0.058	3.2708	4.2337
X_{18}	Vocational or Special Tr.	0.130*	0.078	0.059	1.6676	2.2237
X_{19}	Farm Management Training	0.081*	0.098	0.047	0.8268	1.7255
X_{20}	Manpower Corps or V.R.T.	0.282**	0.083	0.071	3.3863	3.9555
X_{21}	Training in Industry	0.053	0.101	0.066	0.5257	0.7990
X_{22}	B.T.S.D. Level I or II	0.172**	0.079	0.059	2.1734	2.9267
X_{23}	Employment Referral	0.001	0.083	0.052	0.0151	0.0239
	Intercept	0.074	0.108		0.6820	
	R^2	0.18**				
	F Ratio	3.6908				

Dependent Variable: Y_5

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XXXIV

REGRESSION RESULTS FOR EQUATION 6.1

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	0.024	0.045	0.041	0.5333	0.5892
X_2	Age 17-25	0.028	0.077	0.043	0.3578	0.6498
X_3	Age 26-50	-0.052+	0.069	0.040	0.7537	1.2955
X_4	Female	-0.061	0.065	0.063	0.9331	0.9664
X_5	Marital Status	-0.106**	0.050	0.046	2.1084	2.3257
X_6	Time in Municipality	0.030	0.044	0.042	0.6851	0.7315
X_7	Indian or Metis	0.290**	0.053	0.044	5.4935	6.5994
X_8	Education Grades 8-13	-0.043	0.048	0.042	0.8982	1.0325
X_9	University	-0.090	0.293	0.160	0.3082	0.5648
X_{10}	Primary Industry	0.112*	0.062	0.056	1.8188	1.9969
X_{11}	Secondary Industry	0.094*	0.051	0.046	1.8428	2.0186
X_{13}	Income less than $1500	0.384**	0.062	0.045	6.2313	8.5579
X_{14}	Income $1501-$3000	0.263**	0.064	0.059	4.0942	4.4734
X_{15}	Income $3001-$5000	0.101*	0.060	0.050	1.6908	2.0359
	Intercept	0.118	0.102		1.1637	
	R^2	0.34**				
	F Ratio	13.8948				

Dependent Variable: X_{12}, Unemployment.

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.

TABLE XXXV

REGRESSION RESULTS FOR EQUATION 6.2

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.017	0.045	0.042	0.3690	0.3997
X_2	Age 17-25	-0.186**	0.076	0.042	2.4476	4.4292
X_3	Age 26-50	-0.129**	0.069	0.041	1.8849	3.1445
X_4	Female	0.367**	0.061	0.058	5.9882	6.2792
X_5	Marital Status	-0.132**	0.050	0.045	2.6475	2.9019
X_6	Time in Municipality	-0.108**	0.044	0.042	2.4561	2.5564
X_7	Indian or Metis	0.053	0.054	0.044	0.9737	1.2118
X_8	Education Grades 8-13	-0.117**	0.047	0.043	2.4698	2.7426
X_9	University	-0.280**	0.291	0.021	0.9641	13.5904
X_{10}	Primary Industry	-0.037	0.061	0.060	0.6027	0.6182
X_{11}	Secondary Industry	-0.245**	0.049	0.042	4.9993	5.8220
X_{12}	Unemployment	0.243**	0.048	0.044	5.0500	5.4657
	Intercept	0.598**	0.098		6.0978	
	R^2	0.32**				
	F Ratio	14.8434				

Dependent Variable: X_{13}, Income less than $1500.

**Significant at the 1 per cent level.

TABLE XXXVI

REGRESSION RESULTS FOR EQUATION 6.3

	Variable	Coefficient	S.E.	C.S.E.	T.	C.T.
X_1	Residence	-0.105**	0.038	0.035	2.7637	3.0090
X_2	Age 17-25	0.356**	0.064	0.034	5.5299	10.6194
X_3	Age 26-50	0.288**	0.058	0.035	4.9736	8.1944
X_4	Female	0.004	0.054	0.045	0.0672	0.0817
X_5	Marital Status	0.059+	0.042	0.036	1.4025	1.6435
X_6	Time in Municipality	-0.076*	0.037	0.039	2.0413	1.9573
X_7	Indian or Metis	-0.052+	0.046	0.037	1.1508	1.4345
X_8	Education Grades 8-13	0.049+	0.040	0.036	1.2237	1.3516
X_9	University	-0.411	0.244	0.351	1.6823	1.1731
X_{10}	Primary Industry	0.056	0.052	0.044	1.0778	1.2627
X_{11}	Secondary Industry	0.132**	0.043	0.036	3.1038	3.6238
X_{12}	Unemployment	0.047+	0.042	0.035	1.1025	1.3263
X_{13}	Income less than $1500	0.205**	0.054	0.035	3.8100	5.8413
X_{14}	Income $1501-$3000	0.090*	0.055	0.046	1.6473	1.9565
X_{15}	Income $3001-$5000	0.140**	0.050	0.042	2.8047	3.3375
	Intercept	0.426**	0.087		4.9046	
	R^2	0.21**				
	F Ratio	6.6254				

Dependent Variable: X_{16}, Manpower Service.

**Significant at the 1 per cent level.

*Significant at the 5 per cent level.

+Significant at the 10 per cent level.