GOVERNMENT POLICIES, UNEMPLOYMENT RATES, AND INTERPROVINCIAL MIGRATION IN CANADA

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ABSTRACT

Because the process of interprovincial labour migration is an important interregional adjustment mechanism, a better understanding of it can help us to understand the causes of regional disparities in incomes and unemployment rates. This thesis focuses on two issues involving interprovincial migration in Canada: the effect of government policies on migration, or fiscally-induced migration; and the effect of unemployment rates on migration. Though other economists have examined these issues, the empirical evidence obtained to date remains inconclusive.

In chapter II of the thesis a multinomial logit model of interprovincial migration is developed, in which individuals are assumed to choose the province which maximizes their indirect utility. Two versions of the model are considered: a perfect certainty version in which individuals face no uncertainty about employment at each possible destination, and an expected utility version in which individuals face a nonzero probability of being unemployed. In both versions of the model per capita provincial government spending enters the utility function directly, while provincial income tax rates and transfer payments enter the model through the budget constraint. This treatment of fiscal variables contrasts with that of other studies, most of which have either replaced provincial government spending variables with government revenue variables such as intergovernmental transfer payments, or employed a measure of net fiscal benefits. After consideration of the assumptions necessary to adapt the model for use with aggregate rather than individual data, it is estimated in log-odds form using the

generalized least squares method of Parks (1980). Annual aggregate data for the period 1962 to 1981 are used.

As far as both government variables and the unemployment rate are concerned, the empirical results are far more conclusive than those obtained elsewhere. Total per capita spending by provincial and local governments is shown to have a significant positive effect on interprovincial migration. Higher levels of per capita spending on health and education in province j will also encourage in-migration to province j, but higher levels of spending on social services will reduce in-migration. These results imply that intergovernmental transfer payments, which allow provincial governments to increase expenditures without raising taxes, have the potential to influence migration decisions in Canada. However, since not all types of government spending have the same effect on migration, the exact impact of intergovernmental transfer payments will depend on how they affect the composition of provincial government spending.

Other fiscal variables such as provincial government income tax rates and unemployment insurance benefits do not enter the estimating equations independently of other variables in the model. However, this does not prevent them from having a significant impact on interprovincial migration as well. The unemployment rate, which appears only in the expected utility version of the model, also proves to have a significant effect on migration. The results indicate that other things being equal, individuals will prefer to move to provinces with lower unemployment rates.

Further testing of the model revealed a few problems. The parameter estimates are sensitive to the choice of denominator for the log-odds ratio and are unstable over time. Also, the model does not predict well during the sample period. The latter problem can be traced to the relative lack of intertemporal variation in the migration data. The poor within-sample predictive power does not invalidate the earlier conclusions, but it does mean that no particular weight should be attached to the actual numerical values of the parameter estimates.

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INTRODUCTION

Canada's geographical diversity is accompanied by considerable diversity in the economic fortunes of the country's regions. This economic diversity can be seen in comparisons using a wide variety of indicators; in some provinces unemployment rates are significantly higher and average weekly wages are significantly lower than in others. While income is not an exact indicator of welfare differences, the gaps are sufficiently large to suggest that the average family in the Maritimes is distinctly worse off than the average family in British Columbia. Moreover, it would appear that these disparities are converging only slowly over time, despite the efforts of the federal and provincial governments. The magnitude and persistence of these disparities can only serve to weaken the sometimes fragile bond of Canadian unity.[1]

A natural question to ask upon observing these disparities is whether or not any market mechanisms exist that would work toward eliminating them. In the absence of moving costs and other barriers to mobility, labour will tend to move from low-wage to high-wage regions, decreasing the supply of labour in the former and increasing it in the latter. Consequently, wages will fall in the high-wage regions and rise in the low-wage regions, until an equilibrium is reached in which wages have been equalized across regions. Introducing moving costs and differences in skill levels and allowing regions to vary in characteristics other than wages (for example, prices or the level of government services provided) leads to

[1]For a recent discussion of regional disparities in Canada see Mansell and Copithorne (1986).

a more equivocal conclusion: wage differentials can now be consistent with a migration equilibrium.

In a similar manner, economic theory also suggests that migration will tend to reduce regional unemployment rate disparities. As in the case of wages, moving costs and regional differences in the provision of local public goods may prevent the complete elimination of unemployment rate disparities. Thus persistent regional disparities in wages and unemployment rates are not inconsistent with a simple neoclassical model of interregional adjustment, and their magnitude will be largely determined by the interaction of the various factors that influence interregional migration.

As a first step towards a better understanding of regional disparities in wage and unemployment rates, then, one must identify the factors that influence interregional migration. In Canada the determinants of interprovincial migration have been studied by quite a number of authors. These studies have shown that migrants do tend to move from low-wage to high-wage regions, other things being equal, and that moving costs (as measured by distance) pose a significant barrier to migration. However, two issues in particular remain unresolved: the effect of unemployment rates on migration, and the role of government policies in influencing migration decisions. As far as unemployment rates are concerned, the evidence is mixed, with some studies finding that unemployment rates have a significant effect on migration and others finding that they do not. If migration is as unresponsive to unemployment rates as some of the studies suggest, it will not be able to play much of a role in reducing regional disparities in unemployment rates.

Many of the most recent studies of interprovincial migration in Canada have focused on the effect of government policies on migration, known as fiscally-induced migration. According to the theory of local public goods, differences in provincial government tax and expenditure policies should influence migration decisions, with individuals choosing the province with the tax and expenditure package they most prefer. If this is the case, then intergovernmental transfer payments, which allow poorer provinces to provide more services without raising taxes, are likely to influence migration. In particular, like regionally-extended unemployment insurance benefits, they are likely to discourage out-migration from high-unemployment, low-wage regions, since they make such regions more attractive to potential migrants than they otherwise would be. In this manner these policies may actually be helping to perpetuate regional disparities.

Unlike most of the other determinants of migration, government policies can be altered if they can be shown to be having deleterious effects on migration. However, thus far there is no agreement in the literature as to whether or not such effects exist. In chapter I it will be argued that this failure to obtain conclusive results regarding the effects of fiscal variables on migration is largely the result of improper specification of fiscal variables. Even if it is not, because of the important policy implications for regional disparities this issue needs to be resolved.

This thesis, then, will focus on two issues: the effect of unemployment rates on migration, and the existence of fiscally-induced migration. As a theoretical model of migration is developed, particular attention will be devoted to the delineation of the channels through which unemployment rates and fiscal variables affect migration. It is hoped that a heavier reliance on economic theory when specifying the estimating equation will lead to more conclusive results, thereby enabling one to draw inferences about the relationship between these variables and regional disparities.

Although a better understanding of interprovincial migration will help us to understand regional disparities in Canada, the limitations of this study must be kept in mind. Many important questions about the relationship between migration and regional disparities can be answered only with the aid of a simultaneous model in which migration, wages, and unemployment rates are jointly determined. Though the development of such a model would be worthwhile, it will not be attempted here. However, the performance of the model estimated here will be carefully evaluated to see whether it would be suitable for inclusion in a simultaneous model. If it performs well, it may be used as a building block for future research; otherwise, this study may provide some indication of how the model needs to be improved.

CHAPTER I

A SURVEY OF THE LITERATURE

Judging by the number of articles and books on the subject, a great many economists seem to have been intrigued by the process of labour migration. This interest is no doubt due to the importance of labour migration as an adjustment mechanism in a world that consists of many geographically-separated labour markets. Within a single country, the ease with which labour moves from one region to another can help to determine interregional wage differentials. In order to understand why such differentials persist, then, it is necessary to understand how the process of labour migration works, at the individual level and in the labour market as a whole. Policy-makers can then use this knowledge in formulating policies to reduce regional disparities and increase individual welfare. This brief review of the literature will summarize what economists have discovered about migration thus far, and indicate some of the questions that remain to be answered.

The earliest studies of labour migration in Canada were descriptive. They were somewhat limited in scope by the fact that the only available data were estimates of net migration during the ten-year intervals between each census of the population.[2] Using these estimates, researchers drew the following general conclusions about labour migration in Canada: (i) despite considerable interprovincial migration, the population shares of Canada's ten provinces did not

[2]Two examples of these early historical studies are Farrar (1962) and Anderson (1966). One set of historical estimates was produced by Buckley (1962).

change substantially between 1911 and 1960; (ii) between 1921 and 1961, the volume of net internal migration was considerably greater than net international migration; (iii) during the period 1921-1961, Ontario and British Columbia consistently enjoyed positive net inflows of migrants, while net migration to Prince Edward Island, New Brunswick, and Manitoba was consistently negative; (iv) the areas that gained population were characterized by comparatively high income levels, while the losing areas, with the exception of Manitoba, had comparatively low income levels; and (v) there did not seem to be any strong relationship between net migration flows and the rate of natural increase of the population.[3] Thus there was evidence that interprovincial wage differentials were important determinants of interprovincial migration flows. However, it was impossible to measure the precise impact of wage differentials because the necessary data were unavailable.

Today there exist a number of data bases which provide information about interprovincial migration in Canada. Beginning in 1961, each census included a question asking respondents where they had lived five years previously. Answers to this question provide estimates of the number of migrants over a five-year period. In addition, Statistics Canada publishes annual and quarterly estimates of gross flows of migrants, based on the movements of that part of the population that receives family allowance payments and on information from income tax returns.[4] Vanderkamp (1973) and Grant and Vanderkamp (1976) utilized data bases established by the Unemployment Insurance Commission. Thess data bases were created for the purpose of analyzing the impact of unemployment insurance,

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[3]The first two points are drawn from Anderson (1966), while the remaining three are among the conclusions of Farrar (1962).

[4]These data are published in Statistics Canada catalogue 91-208, International and Interprovincial Migration in Canada.

but also proved useful for investigating labour migration. Finally, a data set based on a ten percent sample of income tax returns over the period 1967-1977, disaggregated by income class, is also available and was employed by Winer and Gauthier (1982a).

These new data sources provided enough information to make regression analysis of migration flows feasible. Most econometric models of migration behaviour are based on the human capital model of migration, formalized by Sjaastad (1962). In this model a move from one location to another is viewed as an investment in human capital. The principal returns to the investment are increased future earnings, while the costs consist of the monetary cost of moving, wages foregone while moving, and any psychic costs that might be associated with leaving family and friends behind. The individual will choose the location where the expected present value of his or her net returns is highest.

Despite this theoretical foundation, the first econometric models of migration seem a bit ad hoc by today's standards. The dependent variable was usually net migration to some region i, or the rate of migration from i to another region j. The independent variables were factors assumed to affect either the benefits or the costs of migration; factors tending to increase benefits were expected to have a positive sign, while factors tending to increase costs were expected to have a negative sign. The estimating equation was normally either linear or log-linear. A typical example of such studies is that undertaken by Vanderkamp (1973). The rate of migration from i to j is assumed to depend on a number of variables: average incomes in i and j; the distance between i and j; the population of j and unemployment rates in i and j (to measure employment opportunities); and the proportion of French-speaking people in both sending and receiving regions, to account for any language barriers to migration. Distance is included as a proxy for the dollar costs of moving, the disutility of moving, and imperfect information about job opportunities in the destination region. His results indicated that income in the receiving province was positively correlated with migration, while there was a negative correlation between migration and income in the sending province. The coefficients of unemployment rates and the population in region j proved to be insignificant. Finally, there was a strong negative correlation between the migration rate and distance. Similar results were obtained in a number of other studies.[5]

However, there were a number of conceptual problems with this type of migration model. First, it could be applied only to aggregate data, since the dependent variable is either a sum of migrants or a relative frequency of migration. Second, the simple linear equations describing migration from i to j ignored the fact that conditions in all possible destinations, not just i and j, are relevant to individuals making migration decisions. In principle, it would have been possible to include in the estimating equation the variables describing other alternatives as well, but in practice there were insufficient degrees of freedom. Finally, there is an important constraint on migration flows that cannot be imposed when estimating a single linear equation: if working with flows of migrants, the sum over all possible destinations of net migration flows must equal zero; or, if working with migration rates, the sum over all possible destinations of migration rates from a given province of origin must be one.[6]

One method of dealing with all of these conceptual problems is to recognize that the migration decision involves a discrete choice. McFadden (1974) showed that the multinomial logit model could be derived from a theoretical model in

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[5]For example, see McInnis (1968), Courchene (1970), and Greenwood (1975).

[6]Note that staying is also considered to be an option for the potential migrant.

which individuals used utility maximization to choose among a set of discrete alternatives. He began by assuming that individual preferences can be described by a utility function that is the sum of two components, one deterministic and one stochastic. Under this assumption, the probability that an individual drawn at random from the group i will choose alternative j can be written as

$$(1.1) \qquad P_{ij} = \text{Prob } (V_{ij} + \mu_{ij} > V_{ik} + \mu_{ij}),\ k=1,\dots,\ J,\ k\neq j;$$

where V and μ represent the deterministic and stochastic components of the utility function respectively, and J is the total number of alternatives. If one further assumes that the μ_{ij} are independently and identically distributed over the population with an extreme value distribution, then one obtains the following closed-form expression for P_{ij}:

$$(1.2) \qquad P_{ij} = \exp\ (V_{ij})\ /\ \sum_{k=1}^{J}\ \exp\ (V_{ik})\ ,\quad j=1,\dots,\ J,$$

where exp(·) is the exponential function.

In the migration context, P_{ij} can be interpreted as the probability of migrating from i to j. In contrast to simple linear models of migration, the characteristics of all J regions enter equation (1.2) without causing problems with degrees of freedom. Also, McFadden describes how maximum likelihood techniques can be used to estimate the parameters of the model if microdata are available. Furthermore, by construction the sum of these probabilities over all alternatives j, j=1,..., J, will be one.

This model has the additional feature that, if aggregate data exist for which relative frequencies can be calculated, the model can be transformed in the following fashion:

$$(1.3) \qquad \ln(P_{ij} / P_{ik}) = V_{ij} - V_{ik} .$$

If the utility levels V_{ij} and V_{ik} are assumed to be linear in parameters, this equation can be estimated using linear regression techniques.[7]

Both Grant and Vanderkamp (1976) and Winer and Gauthier (1982a) chose this econometric method of modelling migration behaviour.[8] Their empirical results are qualitatively the same as those obtained using the traditional model: they indicate that the higher the average income in region j and the closer region j is to the origin region, the greater will be the rate of in-migration to region j. Grant and Vanderkamp also showed that the magnitude of these effects varied with sex, age, and occupational group. This additional support for economic models of migration is encouraging, especially since the models from which it is derived have stronger theoretical foundations than the earlier generation of models.

An alternative approach which deals with two of the three problems mentioned above is presented by Foot and Milne (1984). They develop a multi-regional model consisting of ten net migration equations whose formulation is a synthesis of economic and gravity models of migration.[9] As their name suggests, gravity models of migration are analogous to the theory of gravitational force, and hypothesize that migration flows are directly related to the size of the origin and destination regions and inversely related to the distance between them. Foot and Milne use distance to create "all-other-provinces" versions of each of the

[7]Theil (1970) and Parks (1980) discuss the appropriate estimating technique for this type of equation.

[8]Other studies which use discrete choice models are MacNevin (1984), Robinson and Tomes (1982), Mueller (1982), and Shaw (1985,1986).

[9]They estimate only nine equations jointly, since the requirement that the sum over provinces of net migration flows be zero results in a singular variance-covariance matrix for the ten-equation system.

explanatory variables. Thus in the equation describing net migration to province i, the value of the explanatory variable X for province i will appear, together with XO, which is a weighted sum of the values of X in all the remaining provinces. The weights are normalized inverses of the distance between i and each other region. In this manner they avoid the degrees of freedom problem that would result if the values of X for each region were allowed to enter separately in each equation. Using pooled time-series cross-section data for the period 1961-1981, they employ an iterated seemingly-unrelated-regressions technique to obtain their empirical results. One of the major features of their results was that equations for the western provinces performed much better than those for the Atlantic provinces. Many important variables (e.g., other population, other wage, own and other unemployment rates) had insignificant coefficients or incorrect signs in the equations for the Atlantic provinces. The equations for Ontario and Quebec also had a few problems, particularly with the unemployment rate variables. It is possible that some of these problems are the result of the high degree of aggregation that results when net migration, rather than gross migration, is used as a dependent variable. By comparison, multinomial logit models employ gross flow data in the form of migration rates; this reduces somewhat the degree of aggregation in the model. While Foot and Milne's multi-equation method represents an improvement over the single-equation models, some information is lost when net migration is used as the dependent variable, and the construction of the "all-other-provinces" variables is arbitrary.

As was mentioned earlier, fiscally-induced migration has been the subject of many recent Canadian studies of migration.[10] The idea that migration might

[10]See, for example, Courchene (1970), Dean (1982), MacNevin (1984), Winer and Gauthier (1982a), Mills, Percy, and Wilson (1983), Foot and Milne (1984), and Shaw (1985, 1986).

be affected by the mix of taxes and services provided by local governments originated in the local public goods literature. In models of local public goods, consumers "vote with their feet" by choosing the community in which they wish to live. Since individuals presumably derive utility from government-supplied services, while taxes reduce their disposable income, it is quite reasonable to hypothesize that these factors will have some impact on people's migration decisions. The recent surge of interest in the issue stems from a debate in the literature over whether or not such migration is efficient, in the sense of maximizing national output. In a world with no public goods, a nation's output will be maximized when the marginal product of labour is equalized across regions. If migration depends only on the real wage, then this outcome will be achieved automatically in a migration equilibrium. But if local public goods exist and influence migration decisions, then an equilibrium in which national output is maximized is no longer assured.

One of the first economists to draw attention to the potential inefficiency of fiscally-induced migration was Courchene (1970, 1978). He argued that intergovernmental transfer payments, which allow local governments to supply more services than they otherwise would, make low-wage regions more attractive places to live. As a result, potential migrants will be less likely to leave these regions and move elsewhere, where the marginal product of their labour would be higher. Regionally-extended Unemployment Insurance (UI) benefits are likely to have a similar effect, since they reduce the cost of remaining in a high unemployment region relative to other options. In this manner intergovernmental transfer payments and regionally-extended UI benefits may help to perpetuate regional disparities in wage rates.

In a further contribution to the debate on the efficiency of migration in the presence of intergovernmental transfer payments, Boadway and Flatters (1982a,b) demonstrated that under certain circumstances such transfers might be necessary to restore efficiency. For example, suppose that one provincial government has access to a revenue source that is unavailable to the others, such as the rent from a natural resource that can be found only in that province. With the help of this additional revenue the province will be able to provide more services without raising other taxes, thereby attracting large numbers of in-migrants. In such a situation, in-migration to the province may continue beyond the point where the marginal product of labour equals that in other provinces. If so, then a system of equalization payments that redistributes revenue from the resource-rich province to the others would be required to prevent excessive in-migration.

Though there appears at first to be a conflict between the views of Courchene on the one hand and of Boadway and Flatters on the other, that conflict is more apparent than real. All three authors base their arguments on the premise that migration flows are affected by regional differences in tax rates and the supply of local public goods. Boadway and Flatters have shown that given this premise, some system of equalization payments may be necessary to achieve economic efficiency. The question that remains unanswered is an empirical one: does the present fiscal system in Canada promote or discourage an economically efficient allocation of labour across the country?

Before this question can be answered, however, it first must be established that fiscally-induced migration does occur. For this reason many recent studies of interprovincial migration have focused on this issue. To date the empirical evidence on the subject is somewhat mixed, as a brief review of the empirical results will show. First, Courchene (1970) found that federal intergovernmental transfers to province i per member of the labour force in i and unemployment insurance transfers to province i per dollar of earned income in province i, when included in a simple equation explaining the rate of migration from i to j, were significant with signs indicating that these variables reduced out-migration from province i. Second, Dean (1982) included tax variables in a simple linear model of migration rates, using data on the movements of families between 1972 and 1979. His results suggest that the higher the differentials in provincial income tax rates and average provincial direct tax rates, the lower will be the rate of migration from province i to province j. In a third study, Mills, Percy, and Wilson (1983) include the difference in net fiscal benefits between regions i and j in linear equations explaining the rate of migration between i and j. Full adjustment, perpetual flow, and stock-flow models are estimated for each of seven regions. They conclude that fiscal surplus appears to have an influence on migration in all regions except Ontario and Quebec; however, for no region is the fiscal variable significant in all three versions of the model. Their results also suggest that for the Atlantic provinces, Saskatchewan, and Alberta, "migrants are much more responsive to a dollar's worth of fiscal surplus than to a dollar's worth of market income."[11] Next, Foot and Milne (1984) use a measure of real per capita net fiscal transfers in their net migration equations, but while the own-province variable is significant in eight of the ten migration equations, in two of these cases it has an unexpected negative sign. At the same time, the other-provinces fiscal variable is insignificant in six equations.

Three remaining studies examine the effect of fiscal variables on migration within the framework of a multinomial logit model. MacNevin (1984) uses pooled time-series cross-section data on migration rates for the period 1963-1979. As fiscal variables he includes per capita consolidated provincial and local government

[11]Mills, Percy, and Wilson (1983), p. 225.

expenditures likely to be relevant to migrants, and three alternative specifications of taxes.[12] The government expenditure variables are often insignificant in the several versions of the model that he estimates, though the tax variables perform well. The best results are obtained in an equation including the lagged value of the dependent variable, with "taxes" defined to be total consolidated provincial and local government personal and commodity taxes, expressed as a percentage of provincial personal income. This equation strongly supports the hypothesis that individuals prefer lower taxes and higher levels of government expenditures.

Shaw's (1985, 1986) work is unique in that it examines flows of migrants between Census Metropolitan Areas (CMAs) rather than provinces or regions. However, most of the fiscal variables employed are of necessity defined on a provincial basis. Included are the generosity and availability of UI benefits, measured by the ratio of average weekly UI benefits to the average weekly wage; the probability of receiving UI benefits if unemployed; per capita unconditional grants from the federal government to the provincial governments; and per capita provincial natural resource revenues. Of interest is Shaw's "core hypothesis:" that the impact on migration of traditional market variables has diminished over time, while that of fiscal variables (with the exception of natural resource revenues) has increased. He tests this hypothesis by dividing his data set into two parts, pre-1971 observations and post-1971 observations, and running separate regressions on each portion of the sample. Traditional labour market influences on migration are represented by four variables: wages, employment growth, unemployment rates, and dwelling starts. As is the case with the four fiscal variables listed above, both

[12]MacNevin includes expenditures on health; education; recreation and culture; social welfare; protection of persons and property; transportation and communication; environment; housing; regional planning and development; and labour, employment, and immigration.

the origin and destination values of these variables are assumed to affect the probability of migrating from i to j.

Shaw estimates log-linear equations similar to equation (1.3) using ordinary least squares (OLS). He finds that the generosity of UI benefits in the origin area i has a significant negative coefficient, both pre- and post-1971. Unconditional intergovernmental grants in both origin and destination CMAs are significant both pre- and post-1971, but grants to area i have an unexpected positive sign prior to 1971, indicating that they increased out-migration. In the regression using the pooled data set, the generosity of UI benefits at the origin and unconditional grants to the provinces are the only fiscal variables that are both significant and have the expected sign.

With respect to Shaw's core hypothesis, the conclusions to be drawn depend on how one interprets that hypothesis. Shaw prefers a broad interpretation, viewing it as a hypothesis about the overall effects of the explanatory variables. The overall effect of a given explanatory variable on migration depends on two factors: the size of the coefficient of the variable, and the magnitude of the variable. Therefore Shaw looks at both the change in the coefficients after 1971 and the trend in each of the explanatory variables. He concludes that "fiscal variables matter in Canadian migration to the extent that they appear to be 'crowding out' the impact of more traditional market variables."[13]

It is certainly true that fiscal variables such as UI benefits and intergovernmental grants have grown considerably since 1971. Since this is the case, it is not surprising that their overall impact on migration may have grown. However, Shaw does not pay a great deal of attention to the alternative and perhaps more interesting question of whether people's preferences have changed

[13]Shaw (1986), p. 665.

in such a manner as to favour fiscal variables over the traditional determinants of migration. This question can be answered simply by examining the changes in the magnitudes of the coefficients after 1971. When this interpretation of Shaw's core hypothesis is applied to his results, no strong conclusions can be drawn. Of the eight traditional variables appearing in Shaw's Model 5 (the only equation which contains the fiscal variables), five (including wages in both origin and destination regions) have coefficients that are greater in absolute value after 1971, rather than smaller. Furthermore, in the post-1971 equations there are more significant coefficients among the traditional market variables (four as opposed to three) than there were prior to 1971. As for the coefficients of the fiscal variables, four are significant in the post-1971 regression while only two are significant prior to 1971, which would tend to support Shaw's hypothesis. However, one of the coefficients which is significant in both periods has a lower coefficient after 1971; in total, three of the six variables have lower coefficients post-1971. On the basis of these results, it does not seem possible to draw an unequivocal conclusion that there has been a shift in people's preferences from traditional market variables to fiscal variables.

Unlike Shaw and MacNevin, Winer and Gauthier (1982a) estimate separate equations for different income classes and a variety of migration streams. They also incorporate a decisive voter model of government decision-making in their migration model. According to the decisive voter model, each provincial government chooses its level of expenditures so as to maximize the utility of the decisive voter. From this model Winer and Gauthier obtain reduced-form expressions for the levels of government expenditures, taxes, and transfers to persons, which they then substitute into their migration equations. In this manner they are able to replace provincial government expenditures, taxes, and transfers with gross income (already included for other reasons), per capita unconditional grants, and natural resource revenues in their estimating equation. In addition, they include an index of the generosity of the unemployment insurance system, UIDEX, which is defined by

$$UIDEX_k = (MAX_k \;/\; MIN_k)(CA_k \;/\; CF_k) \;, \tag{1.4}$$

where k refers to the province, MAX is the maximum number of weeks that a person with the minimum number of qualifying weeks can draw, MIN is the minimum number of weeks required to qualify, CA is initial claims accepted, and CF is initial claims filed. Finally, they also include non-wage, non-defence federal purchases as an additional fiscal variable.

It is difficult to draw any general conclusions with respect to fiscal variables from Winer and Gauthier's results. Their own summary of their results shows that in a total of eighty estimated equations, the six fiscal variables that they include were significant with the expected signs only 19% of the time.[14] Their most conclusive results involve the variables $UIDEX_i$ and $UIDEX_j$ - they are always significant with the expected sign in equations describing out-migration from the Atlantic provinces by low-income people. This result is not surprising, since the incidence of unemployment is highest among low-income people. However, this is the only general conclusion regarding fiscal variables that can be drawn from their results.

It is evident from the preceding discussion that the empirical results with respect to fiscally-induced migration are mixed. Each study finds that some fiscal

[14] The six variables are $UIDEX_i$, $UIDEX_j$, the difference in per capita federal purchases between provinces i and j, the difference between i and j in per capita unconditional grants, the difference in per capita natural resource revenues, and per capita federal transfers excluding unemployment insurance in the origin province. In eighty equations, these six variables appear a total of 432 times.

variables have a significant effect upon migration in some of the equations estimated. Rather than being an indication that the effects of fiscal variables are weak, these inconclusive results may be the result of the improper specification of the fiscal variables. An appeal to economic theory suggests that potential migrants will be interested in the goods, services, and transfer income they receive from local governments, together with the amount of tax they must pay. The first two items will increase the utility level of the individual, while the latter two enter into his or her budget constraint. Thus as fiscal variables one should employ some measure of the quantity of publicly-supplied services, together with transfer payments received and the amount of tax paid. Different types of taxes will have different effects on individuals, so it would be more appropriate to allow each type of tax -- e.g., sales tax or income tax -- to enter the budget constraint and thus the estimating equation in a different fashion. Similarly, it would be desirable to disaggregate local public goods by type in the individual's utility function, since the Tiebout hypothesis concerns the mixture of goods and services provided, not the total level of government expenditure. For example, families with school-age children will be particularly interested in the educational system, while senior citizens may be more interested in health care.

This analysis implies that neither the level of intergovernmental transfer payments nor a measure of net fiscal benefits are appropriate fiscal variables for inclusion in migration functions. Winer and Gauthier's (1982a) use of a decisive voter model to replace the level of local government expenditures with intergovernmental transfer payments and other components of provincial government income is a theoretically correct procedure, and though they do not actually do so, other authors could use the same argument to justify their choices of fiscal variables as well. The problem with this approach is that the estimation of the resulting migration equation involves the joint testing of two hypotheses: that migration is sensitive to tax rates and the level of public spending, and that individuals are aware of the provincial government's decision-making rule. In effect, these authors have assumed the existence of a particular form of rational expectations on the part of consumers, and their poor empirical results may result from a rejection of that assumption, rather than a rejection of the hypothesis that fiscal variables influence migration. The inconclusive results with respect to fiscal variables that one finds in the literature may simply indicate that individuals do not pay attention to the government budget constraint, and therefore are not influenced by the components of provincial government revenue.

Another problem with this method of dealing with government expenditures is that it precludes an investigation of the impact of different types of government expenditure on migration, since the components of provincial government income are for the most part not earmarked for specific purposes. Net fiscal benefit measures also suffer from this latter restriction. In addition, net fiscal benefit measures introduce an asymmetry into the treatment of public and private goods in an individual's utility function. It is never assumed that the value of a private good to an individual is equal to the difference between its cost of production and its price, yet this is the implicit assumption that net fiscal benefit measures make about the value of public goods. Instead of treating net fiscal benefit as an argument of individual utility functions, only the quantity of services supplied should enter the utility function directly.

Thus most studies of fiscally-induced migration can be criticized on the grounds that they have inappropriately specified their fiscal variables. Of the studies surveyed here only that of MacNevin (1984) comes close to employing correctly-specified fiscal variables. MacNevin includes government expenditures rather than revenues in his estimating equations, and subtracts personal taxes from income variables in a number of his equations. However, he allows a commodity tax variable, which includes property taxes, consumption taxes, taxes on insurance premiums, privileges, licenses and permits, sales of goods and services by government, and remittances from government enterprises, to enter the estimating equations separately. Since most of these taxes influence prices, it would have been more appropriate to incorporate them through the price index MacNevin uses to deflate nominal variables.

Until now, the discussion in this chapter has centered on the basic models of migration behaviour and empirical tests of these models. It is also important to examine some of the problems in modelling migration behaviour and the attempts of various authors to deal with them. Six issues in particular come to mind: (1) the intertemporal nature of investments in human capital through migration; (2) uncertainty and imperfect information about job opportunities; (3) return migration; (4) the selectivity of migration; (5) simultaneous equations bias; and (6) the role of the family in migration decisions. Of these, the first is probably the most difficult to deal with. It is easy to design a theoretical model of migration in which the potential migrant takes into account a discounted stream of net benefits from migration, as did Sjaastad (1962). However, to deal properly with this problem in an applied model, one would need to specify the process by which individuals form their expectations about the future values of all the variables assumed to affect migration. Instead, most researchers use current values for all the explanatory variables, which is equivalent to assuming that individuals have a time horizon of only one period. Grant and Vanderkamp (1976) do experiment with several other alternatives to current average income (YA): average gross income of all movers from a particular region (YB); the average gross income of all individuals who move from region i to region j (YC); and

(1.5) $$YD_j = YA_j \, (YB_i \, / \, YA_i) \, ,$$

where j is the destination province, and i is province of origin. The second measure most closely approximates what migrants actually receive, while the third assumes that individuals expect to occupy the same position in the income distribution regardless of which province they live in. The measures that performed best were average income and YD; these two measures generally produced similar results, though with some differences in the magnitude of particular coefficients. Winer and Gauthier (1982a) employ a measure similar to the YD measure above; they define expected income in destination j in year t to be

(1.6) $$Y_{jt} = YS_{jt} \, (YM_{i,t-1} \, / \, YS_{i,t-1}) \, ,$$

where $YM_{i,t-1}$ is the actual average employment income of movers from province i to province j in a given income class in the year before their move; and YS_{it} is the average employment income of stayers in province i in all income classes in year t. They found that this measure resulted in more significant coefficients and correct signs for the income variables than did current average income.

Mueller (1982), who studies labour migration in the United States using a micro data set, attempts to estimate the lifetime earnings of migrant n at each alternative destination j. This variable (WAG_{nj}) is calculated using the formula

(1.7) $$WAG_{nj} = Y_{0nj} \int_{0}^{65-a_n} \exp[(g_j - d)t] \, dt \, ,$$

where Y_{0nj} is an estimate of the annual income the nth migrant might earn at alternative j in year t=0, a_n is the potential migrant's age in year t=0, g_j is the rate of growth of average nominal wages in region j and d is the discount rate, assumed to be 14 per cent. Annual income Y_{0nj} is estimated by multiplying a base income measure (which depends on the industry in which person n works) by the average employment rate at j. Unfortunately this carefully-constructed measure of expected lifetime earnings does not have a significant coefficient in any of his equations. He suggests that one of the problems with this variable may be the fact that it is only industry-specific, not industry- and occupation-specific.

In general, it would appear that given the difficulties involved, current average income may be just as useful as any measure of expected income, especially in studies using aggregate data. In addition, the studies mentioned above do not completely capture the intertemporal nature of the migration decision because they effectively assume that all the other explanatory variables remain constant over time. It is difficult to say whether or not this partial solution to the problem is to be preferred to the simpler alternative, which treats all the explanatory variables in a similar fashion.

Closely related to the problem of making empirical models intertemporal is the question of how to deal with uncertainty and imperfect information. At least three alternative methods of doing so can be found in the empirical literature. The first and easiest method is to hypothesize that a potential migrant's knowledge of job opportunities at possible destinations is inversely related to his distance from them. Thus the distance variable in migration equations becomes a proxy for the availability of information as well as moving costs. A second alternative is found in the work of Harris and Todaro, who model the process of rural-urban migration in developing countries.[15] They assume that migration decisions are based on the expected wage, defined to be the money wage rate multiplied by the probability of obtaining a job. Following Todaro (1969), Laber and Chase (1971) define the probability of obtaining a job to be

$$P = \Delta E / U , \tag{1.8}$$

where ΔE is the change in employment between t and t-1, and U is the number of people unemployed. This measure of the probability of obtaining a job stems from a hiring model in which all new jobs are filled in the current period from the ranks of the unemployed. They then estimate simple linear equations in which migration from i to j depends on the differential in expected wages and the distance between i and j. When equations are estimated for each of four Canadian regions, the expected wage variable is always significant.[16] However, Shaw (1985) found that two similarly-defined expected wage variables, one of which also incorporates the probability of receiving UI benefits if unemployed, did not perform as well as a simpler wage variable.

Mueller (1982) incorporated uncertainty in his multinomial logit model by assuming that each potential migrant considered the attributes of alternative destinations to be random variables. Potential migrants were further assumed to know the mean and variance of each element of the vector of attributes. These means and variances were then substituted into the expectation of the indirect utility function. To simplify the process, the variance of each attribute was assumed to be proportional to a single common variance. An estimate of this

[15]See Harris and Todaro (1970), and Todaro (1976a, b).

[16]The four regions are the Atlantic provinces, Ontario and Quebec, Manitoba and Saskatchewan, and Alberta and British Columbia.

common variance was constructed for estimation purposes by assuming that it was a function of information flows between the origin and destination regions, which were in turn assumed to be functions of the flows of migrants between the two regions.

While theoretically appealing, this innovative method of incorporating uncertainty has two faults. Firstly, the ease with which Mueller is able to incorporate the variance of the attributes in the indirect utility function is due to the fact that the functional form chosen is quadratic in the attributes of the alternatives.[17] Thus the method can be easily implemented only when using a restricted class of functional forms. Secondly, the empirical results with respect to this variable were somewhat disappointing. While the coefficient of the variance term always had the correct sign, it was significant in only three cases. There appeared to be some multicollinearity between the estimated variance and an origin-specific constant also included in the regression. Once again, it seems that further work needs to be done on the modelling of expectations in migration models.

Economists often cite return migration as a problem because they suspect that it may be motivated by different factors than other migration flows. In particular, the decision to return may result from disappointment due to expectations that were unrealized. Vanderkamp (1972) has estimated the magnitude of return migration for Canada during the period 1966-68. He found that return migrants constituted 19.9 per cent and 22 per cent of total migration flows in the sample, in 1966-67 and 1967-68 respectively. Regressions of return

[17]Mueller introduces the mean and variance of each attribute X into the quadratic indirect utility function by taking its expected value, and then replacing $E(X)$ and $E(X^2)$ by μ_x and $(\mu_x^2+\sigma_x^2)$ respectively, where μ_x is the mean of X and σ_x is the standard deviation of X.

migration from region i to region j on average incomes in both regions, distance, and unemployment rates produced no significant coefficients. However, he notes that return migration may link flows in opposite directions. To test this hypothesis, he estimates a simple equation in which migration from i to j depends on migration from j to i in year t-1, this time obtaining a significant coefficient. The conclusion to be drawn from these results is that since return migration does not seem to depend on the same variables that influence first-time migration, large return flows may cause the coefficients in migration equations to be insignificant or have unexpected signs. If empirical models were better able to deal with uncertainty the problem of return migration might be eliminated, since return migration is caused by a revision of expectations that shows the initial location to have been the most desirable for the individual. However, because most data sets do not distinguish return migrants from other migrants, return migration is likely to remain a problem.

The problem of the selectivity of interregional migration was first raised by Myrdal (1957). He argued that the younger, better-educated members of a region's population would be the most likely to leave, in search of higher incomes in wealthier regions. Their departure would cause the average quality of the workforce to decline in their region of origin and increase at their destination, thereby tending to widen interregional wage differentials. In other words, he argued that if migration is selective, it would tend to be a destabilizing force rather than an equilibrating adjustment mechanism.

Myrdal's concern is more with the effects of migration than with its determinants. However, the destabilizing process that he envisions will not occur unless the probability of migrating is influenced by such variables as age and education. This hypothesis can easily be tested by including these variables in migration functions. If their coefficients prove to be significantly different from zero, then a Myrdal effect may potentially occur.

Variables such as age and level of education are not always included in studies that use aggregate data because of the difficulty of obtaining continuous time series data. However, Courchene (1970) does examine the effects of both age and education with the help of Census data. He finds that there is a strong positive relationship between migration and the percentage of the labour force in the province of origin with an education beyond grade ten. He also estimates migration functions for different age groups; these equations indicate that migration rates are highest for those between 20 and 29 years of age. Grant and Vanderkamp (1976) estimate a series of migration equations for males in white collar occupations, and find a similar pattern in their data set.

The possibility that migration may be selective does not necessitate the use of any special estimation techniques. However, if migration is selective one must take this fact into account when estimating the returns to migration; otherwise estimates of the returns to migration will be biased. Robinson and Tomes (1982) correct for selectivity bias when they examine the returns to migration in conjunction with estimating migration functions for Canada. Since they use a microdata set from the 1971 Census of Canada, they are able to include in their model quite a number of individual characteristics, such as years of schooling, age, marital status, and family size. Their results reinforce those of Courchene regarding the impact of age and education on migration, and confirm that migration is selective. However, the implications of this finding for regional disparities have yet to be determined.

Simultaneous equations bias is a widespread problem in econometric models, since very few relationships between economic variables can realistically be viewed as being unidirectional. In studies which use microdata this type of bias is unlikely to be a problem, because to each individual prices, wage rates, and other variables are likely to be exogenous. However, it is impossible to argue that aggregate migration flows do not influence such aggregate variables as prices, wages, employment, unemployment rates, and the level of regional government expenditures. While it may be impossible to completely eliminate simultaneous equations bias, it can be substantially reduced by including migration in a simultaneous model in which migration, wages, unemployment rates, and other variables are jointly determined. In addition to producing better estimates of the parameters of migration equations, such models would enable one to examine the effects of migration on other economic variables.

One of the biggest problems facing researchers who wish to estimate simultaneous models involving migration is to decide on the size of the model. Should they specify separate models for each region, or should they simply pool the regional data and estimate only one version of each equation? If they choose the former option, the size of the model will increase with the number of regions. Most authors seem to prefer the second option of pooling the data, though by doing so they constrain all the parameters of the model to be the same for each region. Rosenbluth (1987) follows an intermediate course by allowing some parameters, mostly constant terms, to differ across regions.

Another problem that researchers must deal with is how to model migration. Should they use gross or net flows? If they decide to model gross flows or rates, they will have n^2 interregional flows or rates to deal with, where n is the number of regions.[18] Not surprisingly, most researchers choose to deal with n net migration flows instead. However, most also choose to pool their regional data for

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[18]Of these n^2 flows, n represent people who choose to stay where they are.

the net migration equation. As a result, most models fail to satisfy the constraint that net migration must sum to zero. In order to satisfy the constraint, one could use a model similar to that of Foot and Milne (1984), who estimate a set of net migration equations as a system with cross-equation restrictions imposed.[19] Rosenbluth (1987) also takes care to ensure that his net migration rate equation satisfies the adding-up constraint.[20] Unfortunately, as Greenwood and Hunt (1984) demonstrate, the imposition of adding-up restrictions may severely reduce the fit of the model and its usefulness for forecasting.

Yet another specification problem that may arise involves the error structure of the migration equations. In addition to requiring restrictions on the parameters, the adding-up constraint ensures that net migration to one region will be correlated with net migration to all other regions. Failure to take these correlations into account will lead to parameter estimates that are inefficient. Even worse, an equation describing in-, out- or net migration will suffer from heteroskedasticity if it is derived from a model of gross migration rates. For example, in-migration to region j is defined by the identity

$$IN_j = \sum_{\substack{k=1 \\ k \neq j}}^{J} POP_k \, P_{kj} \,, \tag{1.9}$$

[19]Foot and Milne do not estimate a simultaneous model; their attention is restricted to net migration.

[20]Rosenbluth achieves this by starting with a migration rate equation that satisfies the restriction that the sum of migration rates must be one, and then aggregating up. However, the specification of his migration rate equation is somewhat unusual. He assumes that the rate of migration from i to j is equal to region j's share of the total population times a linear function which contains the usual determinants of migration such as wage rates and fiscal variables. The population share is intended to account for differences in employment opportunities. While it is not unusual to use regional population as a proxy for employment opportunities, it is not clear why it should enter the migration rate equation in a multiplicative fashion.

where POP_k is the population of region k, P_{kj} is the rate of migration from k to j, and J is the number of regions. Even if the migration rate equations are assumed to have homoskedastic errors, the presence of POP_k in the equation will cause the aggregate variable to be heteroskedastic. None of the simultaneous models reviewed here seem to take these problems into account.[21]

Thus many difficulties are likely to be encountered when trying to build a simultaneous model of migration. Most of the models that appear in the literature are fairly simple and consist of a migration equation, an income or wage equation, and in some cases equations for employment or unemployment. Examples of such studies are Garcia-Ferrer (1980), Lowry (1966), Muth (1971), Okun (1968), and Salvatore (1980). In each of these models the migration functions are linear and rather ad hoc, similar to the migration functions estimated in the earlier single-equation studies.

There seem to be only two studies which estimate simultaneous models of migration for Canada.[22] The first of these is a study by Vanderkamp (1988). Because he uses census data for the period 1921 to 1981, the time period in his model is a decade. The model itself consists of a net migration equation, an employment change equation, an equation for the ratio of employment to potential labour supply, a wage equation, and an identity defining the change in regional labour supply. The four stochastic equations are estimated using two-stage least squares. Though the value of R^2 for his net out-migration equations is no higher

[21]Rosenbluth (1987) is one author who derives his net migration equation by beginning with an equation for the gross migration rate. However, he does not correct for heteroskedasticity when he estimates his model.

[22]Boadway and Green (1981) specify a labour market model for Newfoundland that includes migration, but estimate the equations using OLS. Similarly, Schweitzer (1982) builds a simulation model of the Alberta economy but does not use simultaneous equations methods to estimate it.

than 0.6, Vanderkamp's results are consistent with the earlier literature. He finds that the lower are a region's wage relative to the national average and the lower are net fiscal benefits, the higher will be net out-migration.

The model of Rosenbluth (1987) is slightly more complex than that of Vanderkamp, and his equation for the rate of net in-migration does satisfy the adding-up constraint. In addition, he allows some parameters of the model to vary across regions, though most of the parameters are constrained to be the same across equations. The model includes an equation describing the rate of net in-migration, a participation rate equation, an employment equation, a wage equation, and several identities. The model is estimated using two-stage least squares and annual data for the period 1966-1983. But despite his care in specifying the migration equation, Rosenbluth's results are not as good as those of Vanderkamp. Though the unemployment rate and real per capita transfer payments to persons have significant coefficients with the expected signs, the coefficient of the wage variable turns out to be negative or insignificant in three of the five equations reported.

Though they are relatively simple, the simultaneous models of Vanderkamp and Rosenbluth represent an important first step along the road to a better understanding of the relationship between migration, employment, and wages in Canada. Both authors use their models to simulate the behaviour of regional disparities under certain government policies, and both conclude that although there are equalizing tendencies in the economy, they operate very slowly. Wages in particular seem to be very rigid. These conclusions are similar to those of Wrage (1981), who estimates a two-equation reduced-form model of regional wages and unemployment rates in Canada. It would be interesting to see what a more complex model that permitted more scope for regional differences would tell us about the relationship between migration and regional disparities.

The last problem in migration modelling that will be discussed here is the role of the family in migration decisions. This is a problem that has not yet received a great deal of attention in the literature. Mincer (1978) was one of the first to deal with the issue directly. He argued that married couples, particularly those with school-aged children, would tend to be less mobile than single individuals. He also suggested that the deterrent effect of marriage on migration would be stronger the higher the wife's earnings and the greater her attachment to her job (if she were employed). Mincer's examination of U.S. data tended to support these hypotheses.

Stark and Bloom (1985) briefly discuss some more recent developments relating to the migration decisions of families. However, they find that most of the recent work in this area concerns the behaviour of migrant workers from less-developed countries, rather than the problems of dual wage-earner couples. They suggest using models of constrained consumer choice, in which "the labour market activities of one family member impose a constraint on the migration behaviour of another family member," to analyze such cases.[23] Another issue that needs to be dealt with is the nature of equilibrium in a world in which migration decisions are the outcome of family rather than individual migration decisions; in such a world migration might not be able to eliminate regional wage disparities even in the absence of moving costs. Regardless of the approach taken, families with two wage earners now account for a large enough proportion of the population that their migration behaviour should not be ignored.

It is clear from this discussion that there are many directions in which the current literature on interregional migration could be extended. The roles which

[23]Stark and Bloom (1985), p. 178.

fiscal variables and unemployment rates play in determining migration rates need to be clarified, and a better treatment of expectations is needed. In addition, more effort needs to be devoted to the estimation of simultaneous models of migration, and to understanding return migration and the role of the family in making migration decisions. As econometric methods become more sophisticated and computer facilities more powerful, it will become easier to tackle these problems in empirical models.

But the fact that there is room for improvement in migration research does not mean that past studies have accomplished little. On the contrary, the research to date has established quite conclusively that a strong relationship exists between migration on the one hand and wages and distance on the other, and that the directions of these relationships are those predicted by economic theory. These important findings have two implications: (i) that the potential exists for interregional migration to act as an equilibrating force that tends to reduce regional wage disparities; and (ii) that even if migration does tend to reduce regional wage disparities, it can never completely eliminate them because of the existence of distance-dependent moving costs. It is to be hoped that future research on interregional migration will add to these conclusions and improve our understanding of the relationship between migration and regional disparities.

CHAPTER II

A MODEL OF INTERPROVINCIAL MIGRATION

As the literature survey in the previous chapter indicated, there are many ways in which existing empirical models of migration could be improved and many questions about migration that have yet to be answered. However, it would be impossible to deal with all of these issues in a single thesis. Instead, this thesis will focus on the influence of fiscal variables on migration and their implications for regional disparities. The issue of how best to incorporate unemployment in a model of migration will also be addressed. In this chapter, a multinomial logit model of migration will be developed, since the discussion in the previous chapter indicated that this type of model is superior to other models that appear in the literature. Like all theoretical models of migration, it will be based on the hypothesis that individuals will move when they believe that a move will increase their welfare. Because one of the objectives of this study is to determine the effects of local government tax and expenditure policies, the channels through which these policies affect migration will be clearly delineated. Once the theoretical model has been fully specified, a method of estimating the model using aggregate data will be discussed.

A. A Theoretical Model of Migration

Multinomial logit models belong to the class of discrete choice models, which were developed for the analysis of problems involving a choice from among a set of discrete alternatives. The individual's migration decision, which consists of choosing a province in which to live, is just such a choice problem. Consider how an individual living in province i would make his or her migration decision. Suppose that the individual has preferences defined over consumption goods (X_j), leisure-time, the level of provincially-provided public services (G_j), and a vector A_{ij} of other variables that represent characteristics of province j from the point of view of an individual living in province i. It will be assumed that these preferences can be represented by a continuous, increasing, and strictly quasi-concave utility function,

$$u_{ij} = U(X_j, T-L_j; G_j, A_{ij}) \ , \tag{2.1}$$

where T is the total time available to the individual, L_j is time spent working, and the subscript j refers to the province under consideration. The individual will maximize utility by choosing X_j and L_j subject to the following budget constraint:

$$\begin{aligned} q_jX_j &= (w_jL_j + B_i + R_j)(1 - \tau_j) - C_{ij} \\ &= \omega_jL_j + I_{ij} \ , \end{aligned} \tag{2.2}$$

where

$$\omega_j = w_j(1 - \tau_j) \ ,$$

$$I_{ij} = (B_i + R_j)(1 - \tau_j) - C_{ij} \ ,$$

q_j is the price of goods, w_j is the money wage rate, B_i is nonwage income excluding transfers from the provincial government[24], C_{ij} is the cost of moving to province j

[24]Mobility grants from the government could be interpreted either as an increase in B or a reduction in C.

(which is zero for individuals living in province j)[25], R_j measures transfers from the provincial government, and τ_j is the combined federal-provincial income tax rate. Note that B is assumed to depend only on the province of origin, since nonwage income, with the exception of transfer payments from the provincial governments, is unlikely to depend on where one lives. The monetary costs of moving (C_{ij}), however, will depend on both the origin and the destination because they are dependent on distance. Under these assumptions, the indirect utility function can be defined as

$$(2.3) \qquad V(q_j, \omega_j, I_{ij}; G_j, A_{ij}) = \max \{ U(X_j, T\text{-}L_j; G_j, A_{ij}): q_jX_j = \omega_jL_j + I_{ij}\}.$$

The individual will then choose to live in the province k for which

$$(2.4) \qquad V(q_k, \omega_k, I_{ik}; G_k, A_{ik}) > V(q_j, \omega_j, I_{ij}; G_j, A_{ij}), \ \forall \ j \neq k.$$

Qualitative choice models assume that, from the point of view of the researcher, each individual's utility function has a random component, such that the utility associated with alternative j can be decomposed in the following manner:

$$(2.5) \qquad \tilde{V}(q_j, \omega_j, I_{ij}; G_j, A_{ij}, \mu_{ij}) = V(q_j, \omega_j, I_{ij}; G_j, A_{ij}) + \mu_{ij} \ ,$$

where the function $V(\cdot)$ is assumed to be identical for all individuals in the population. The random component μ_{ij} represents the effect on the individual's utility of unobservable characteristics of both the individual and alternative j, and is assumed to have some distribution over the population. Then if some

[25]Equation (2.2) is written as if moving costs were not tax-deductible. However, there is a reduction in before-tax income due to time spent moving that will lead to a corresponding decrease in taxes paid. Also, beginning in 1972 the monetary costs of moving became tax-deductible in Canada. These facts were taken into account in the empirical work.

individual is drawn at random from the population, the probability that he or she will choose to live in province k will be given by

$$(2.6) \qquad P_{ik} = \text{Prob } (V_{ik} + \mu_{ik} > V_{ij} + \mu_{ij} \text{ , } \forall \text{ } j \neq k) \text{ ,}$$

where $V(q_j, \omega_j, I_{ij}; G_j, A_{ij})$ is replaced by V_{ij} for simplicity. This equation can be rewritten as

$$(2.7) \qquad P_{ik} = \text{Prob } (\mu_{ij} - \mu_{ik} < V_{ik} - V_{ij} \text{ , } \forall \text{ } j \neq k).$$

Under the assumption that the μ_{ij} have identical independent extreme value distributions, the multinomial logit model is obtained. P_{ik} will be given by

$$(2.8) \qquad P_{ik} = \exp (V_{ik}) \ / \ \sum_{j=1}^{J} \exp (V_{ij}) \text{ , } k=1,\dots, J, \ i=1,\dots, J,$$

where J is the number of alternatives.[26]

The multinomial logit model produces an equation describing the probability that an individual chosen at random from the population of province i will choose a particular alternative k. To obtain the aggregate rate of migration from province i to province k, one would take the average of the choice probabilities over all the individuals n in the sample who had moved from i to k:

$$(2.9) \qquad P_{ik} = \frac{1}{N_i} \sum_{n=1}^{N_i} P_{nik} \text{ ,}$$

where N_i is the number of individuals who moved from i to k and P_{ik} is now the

[26]In the case of migration, the number of origins i is equal to the number of destinations. In other problems i would indicate the cell to which the individual belonged, and the number of cells might not equal the number of alternatives.

aggregate rate of migration.[27] However, replacing P_{nik} in (2.9) by the expression in (2.8) does not lead to an equation for P_{ik} that can be estimated using aggregate data. Instead, one needs an expression for P_{ik} in which the explanatory variables on the right-hand side are aggregate variables such as aggregate wage income or the average wage rate. In order to obtain such a model it is necessary to make some additional assumptions. First, it will be assumed that aggregate preferences can be represented by a utility function which depends on average nonwage income, average wages, and the average of the μ_{ij}. Next, it will be assumed that the aggregate migration rate depends on the utility of the representative consumer; that is,

$$P_{ik} = \text{Prob}\ (V_{ik} + \mu_{ik} > V_{ij} + \mu_{ij}\ ,\ \forall\ j \neq k\ )\ , \tag{2.10}$$

where V_{ij} now represents the utility of the representative consumer and

$$\mu_{ij} = \frac{1}{N_i} \sum_{n=1}^{N_i} \mu_{nij}\ .$$

Thus the value of P_{ik} will depend on the distribution of the mean error terms μ_{ij}, $j=1,\ldots,J$.

Under the assumption that the random variables μ_{nij}, $n=1,\ldots,N_i$, have identical independent extreme value distributions, it is shown in appendix 1 that the exact distribution of μ_{ij} is a multivariate extreme value distribution. Unfortunately, this information does not enable one to solve (2.10). However, the exact distribution of μ_{ij} is approximated to the first order by an extreme value distribution identical to that of the μ_{nij}.[28] Using this approximation to the

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[27]At this point a subscript n identifying the individual is introduced.

[28]See appendix 1 for further discussion of this point.

distribution of μ_{ij}, (2.10) can be solved to obtain an expression similar to (2.8). Thus the multinomial logit model can be applied to aggregate data if it is assumed that a representative consumer exists, and that a univariate extreme value distribution is a good approximation to a multivariate extreme value distribution.

Before actually using the MNL model to analyze any problem, with or without aggregate data, it is important to consider whether the "independence of irrelevant alternatives" axiom underlying the model is likely to be satisfied. This axiom requires that the relative odds of choosing one alternative over another depend only on the characteristics of the two alternatives in question, a condition that will be violated if there are strong similarities between two or more alternatives. In the case of interprovincial migration in Canada, the provinces most likely to cause a problem of this type are the Atlantic provinces, which are smaller and perhaps share more similarities than the other six provinces. The axiom would also be violated if all the options involving moves shared some characteristics which the staying option did not. However, since testing for this problem would lead to other difficulties, it will simply be assumed that all ten options are distinct enough to avoid violating the axiom.[29]

Equations (2.1) to (2.10) describe a complete model of the determination of aggregate migration rates. One of the most important components of this model is the underlying model of consumer choice defined by equations (2.1) to (2.4). Though simple, the model is quite general in that it is able to incorporate all the traditional determinants of migration decisions. The model also adds structure to the estimating equations by specifying how certain variables influence migration decisions. Consider, for example, the model's treatment of moving costs.

[29]See McFadden (1978, 1981) for a discussion of violations of the axiom of independence of irrelevant alternatives and methods of dealing with them.

Moving costs can be divided into several components. First there is the monetary cost of moving, which is equal to the dollar cost of moving oneself and one's belongings plus the foregone wage cost of moving. These costs are likely to be dependent on distance, as well as on wage rates and the cost of transportation services. Second, there is the non-monetary or psychic cost of moving, which is the cost associated with leaving one's family and friends and settling in a new location. This cost is also likely to be dependent on distance. Finally, both the monetary and non-monetary costs of moving are likely to have a fixed component that is not dependent on distance. Certain costs must be incurred regardless of the distance moved; for instance, a new home must be located and one must adjust to a new job.

In equations (2.1) to (2.4), moving costs are represented by the variable C_{ij}, which enters the model as a reduction in nonwage income. However, C_{ij} represents only one of the components of moving costs -- the monetary cost of moving. The other two components of moving costs can easily be incorporated in the model by including them in the vector A_{ij}, which represents other factors that influence migration decisions. The nonmonetary cost of moving can be proxied by D_{ij}, the distance between regions i and j, while the fixed costs of moving can be represented by a dummy variable which takes on the value one if an individual does not move and zero otherwise. Thus the model is flexible enough to incorporate all three aspects of moving costs. Moreover, it helps to define the structure of the equation by specifying that the monetary costs of migration should enter the equation as a component of full income, rather than as a separate explanatory variable.

Since the influence of government on migration decisions is one of the questions which the model has been designed to address, it is also useful to review the manner in which government enters the model. First, provincial government transfer payments, which include such factors as old age pensions and workmen's compensation benefits, are represented by the variable R_j, a component of nonwage income. Second, it is assumed that individuals' consumption decisions depend on after-tax wages and incomes, so that the average income tax rate in region j, τ_j, also enters the model through the wage and full income variables. Note that like the monetary costs of moving, average income tax rates and provincial government transfer payments should not enter the estimating equation as separate explanatory variables. Third, government spending in region j, G_j, enters directly as an argument of the utility function. A simple extension of the model would be to redefine G_j as a vector of government spending variables, thus allowing different types of government expenditures to have different marginal utilities.

One important limitation of the model is the omission of any type of uncertainty. Uncertainty about whether or not the individual will be able to find a job can be introduced fairly easily in the following manner. Suppose that the individual faces a known probability π_j of being unemployed if he or she moves to province j. If unemployed, the individual may be eligible to receive unemployment insurance (UI) benefits. The probability of receiving such benefits, δ_j, is also assumed to be known to the individual. There are thus three possible states of the world in province j: (1) the individual is employed; (2) the individual is unemployed and receiving UI benefits; and (3) the individual experiences unemployment but does not receive UI benefits. The expected utility function of the representative individual will be given by

(2.11)
$$E[u_{ij}] = (1-\pi_j)\, V(q_j,\, \omega_j,\, I_{ij};\, G_j,\, A_{ij})$$
$$+ \pi_j\, [\delta_j V^R(q_j,\, \omega_j,\, \bar{I}_{ij};\, G_j,\, A_{ij},\, T\text{-}\bar{L}_j)$$

$$+ (1-\delta_j)V^R(q_j,\ \omega_j,\ I_{ij};\ G_j,\ A_{ij},\ T-\bar{L}_j)]\ ,$$

where V^R is a rationed indirect utility function, defined by

$$V^R(q_j,\ \omega_j,\ I_{ij};\ G_j,\ A_{ij},\ T-\bar{L}_j) = \max\ \{U(X_j,\ T-L_j;\ G_j,\ A_{ij}):\ \text{subject to (2.2) and } L_j = \bar{L}_j\}. \tag{2.12}$$

$\bar{L}_j$ is the rationed level of labour supply, and $\bar{I}_{ij}$ is non-wage income including UI benefits. The individual would then choose to live in the province k such that

$$E[u_{ik}] > E[u_{ij}],\ \forall\ j \neq k\ . \tag{2.13}$$

It must be noted that this version of the model assumes that all unemployment is involuntary; the individual is constrained to work less than his or her desired number of weeks per year. One possible method of incorporating voluntary unemployment would be to add an extra step to the decision-making process: prior to choosing among provinces, the individual could choose the strategy (work or no work) that would maximize utility in each province. However, when dealing with aggregate data the one-stage model is probably adequate, since a representative consumer would not choose to be unemployed for an entire year unless the entire population had done so.

Finally, at this point it is worthwhile to consider what other variables could be added to the vector A_{ij}, which thus far contains only two variables related to moving costs. Other variables which might affect migration decisions yet do not belong in any of the other categories of variables discussed thus far are climate, the proportion of the destination population that speaks French, and the average level of education in the province of origin. Whether or not these variables are actually included in the estimating equation will depend on the availability of the necessary data.

B. Estimation Procedure

The multinomial logit model developed by McFadden (1974) was designed for use with microdata. Microdata sets contain information on the characteristics of individuals and their choice of destination, but individuals' probabilities of migrating, P_{ij}, $j=1,\ldots, J$, are unobservable. Only the actual choices made by individuals are known. In this case the objective of the researcher is to estimate a model that can be used to predict the probabilities of migrating for any individual drawn at random from the population, given only the characteristics of the individual and the characteristics of the alternative destinations. Under the assumptions that each observation is a drawing from a multinomial distribution and that the μ_{ij} have identical independent extreme value distributions, one can derive a likelihood function for the model. In this likelihood function the unobservable P_{ij}'s are replaced by the expression on the right-hand side of (2.8), and maximization of the likelihood function produces estimates of the parameters of the indirect utility function. These estimates can then be combined with the data to provide estimates of the P_{ij}. The only random error in this version of the model is μ_{ij}, which represents individual differences in tastes for different alternatives; measurement error, specification error, and randomness in the world are ignored.

The multinomial logit model's disregard for the usual sources of error in economic models becomes a problem when one wishes to apply the model to aggregate data. In this case the P_{ij} are not unobservable; estimates of aggregate migration rates, subject to measurement error, are readily obtainable. The problem is that though the observed aggregate rate of migration is a random variable, P_{ij} in equation (2.8) is not. Thus before one can use equation (2.8) as the basis for a model of aggregate migration rates, one must first add a random error to it.

Several authors have proposed methods of introducing random errors into the multinomial logit model so that it can be estimated using aggregate data. Theil (1970) began by transforming equation (2.8) by taking the log of the odds of choosing alternative j over alternative k. He then added and subtracted the observed log-odds ratio to the equation, and re-arranged it to obtain the following estimating equation:

$$(2.14) \qquad \ln(M_{ij} / M_{ik}) = V_{ij} - V_{ik} + \ln(M_{ij} / M_{ik}) - \ln(P_{ij} / P_{ik}) ,$$

where M_{ij} is the observed relative frequency with which individuals in cell i choose alternative j. Using the result that M_{ij} is asymptotically normally distributed with mean P_{ij} and variance $P_{ij}(1-P_{ij})/N_i$, where N_i is the size of cell i, he shows that the approximation error $[\ln(M_{ij} / M_{ik}) - \ln(P_{ij} / P_{ik})]$ will also be asymptotically normally distributed.

However, Theil's approximation error fails to account for other sources of error, such as measurement error or the effect of omitted variables. As the cell size increases, the approximation error will approach zero, and these other sources of error will become relatively more important. To deal with this problem, Amemiya and Nold (1975) propose the addition of an error term to the representative individual's indirect utility function. Amemiya and Nold deal only with the binomial logit model, but Parks (1980) extends their methodology to the multinomial case.

The derivation of Parks' estimation method also begins with the multinomial logit equation for the probability of choosing alternative k, equation (2.8). In a slight modification of Parks' model, it will be assumed that random error terms capturing the effects of errors in optimization, measurement errors, and randomness in the data can be added to the equation in the following manner:[30]

$$(2.15) \qquad P_{ik} = \exp\,[V_{ik} + \theta_{ik}] \;/\; \sum_{j=1}^{J} \exp\,[V_{ij} + \theta_{ij}] \;;\; i=1,\ldots, I;\; j=1,\ldots, J;$$

where I is the number of cells in the data set. Taking the log of the ratio of the probabilities of choosing alternatives j and k yields the equation

$$(2.16) \qquad \ln(P_{ij} \;/\; P_{ik}) = V_{ij} - V_{ik} + (\theta_{ij} - \theta_{ik}) \;;\; j=1,\ldots, J;\; j\neq k.$$

But in this expression, P_{ij} and P_{ik} are the true probabilities of choosing alternatives j and k respectively, not the sample probabilities. Following Theil (1970), Parks replaces P_{ij} and P_{ik} with M_{ij} and M_{ik}, the sample probabilities, and adds the resulting approximation error to the right-hand side of the equation. The final estimating equation is thus

$$(2.17) \qquad \ln \frac{M_{ij}}{M_{ik}} = V_{ij} - V_{ik} + (\theta_{ij} - \theta_{ik}) + \ln \frac{M_{ij}}{M_{ik}} - \ln \frac{P_{ij}}{P_{ik}} \;;\; j=1,\ldots, J;\; j\neq k.$$

In order to estimate the model assumptions must be made about the distributions of the various error terms attached to equation (2.17). The θ_{ij}, $i=1,\ldots,I$, $j=1,\ldots,J$, are assumed to be normally distributed with a zero mean. However, because of the restriction

[30]Parks first transforms equation (2.8) by dividing both the top and bottom by exp (V_{ik}). He then adds an error term to each of the differences $(V_{ij}-V_{ik})$, rather than to the individual V_{ij}'s. Parks' treatment of the θ_j will be equivalent to that in the text if the same alternative k is chosen to be in the denominator of the log-odds ratio for all cells of data. Thus the model outlined in the text is a slight generalization of that of Parks.

$$\sum_{j=1}^{J} P_{ij} = 1 , \tag{2.18}$$

it would be unreasonable to assume that the θ_{ij} were independent of each other. Therefore it will be assumed that

$$E(\theta_{ij}\theta_{ik}) = \begin{cases} \sigma_j^2 & \text{if } j=k; \\ \sigma_{jk} & \text{if } j\neq k. \end{cases} \tag{2.19}$$

For simplicity it has been assumed that the variances and covariances of the θ_{ij} are independent of the cell i. The joint distribution of the differences $(\theta_{ij}-\theta_{ik})$, i=1,...., I, j=1,...., J, j≠k, can be derived from these assumptions. With respect to the approximation error, Theil (1970) demonstrated that if the M_{ij} were generated by independent random drawings from a multinomial distribution, the approximation errors would be normally distributed with a zero mean and the following variance-covariance matrix:

$$\Omega_i = \frac{1}{N_i} \begin{bmatrix} \frac{1}{P_{i1}} + \frac{1}{P_{ik}} & \frac{1}{P_{ik}} & \cdots & \frac{1}{P_{ik}} \\ \frac{1}{P_{ik}} & \frac{1}{P_{i2}} + \frac{1}{P_{ik}} & \cdots & \frac{1}{P_{ik}} \\ \vdots & & & \vdots \\ \frac{1}{P_{ik}} & & & \frac{1}{P_{iJ}} + \frac{1}{P_{ik}} \end{bmatrix} . \tag{2.20}$$

To derive the variance-covariance matrix of the composite error term ε_{ij}, where

$$\varepsilon_{ij} = (\theta_{ij} - \theta_{ik}) + \ln(M_{ij} / M_{ik}) - \ln(P_{ij} / P_{ik}) \ ; \ i=1,...., I; \ j=1,...., J; \ j\neq k;$$

let $\varepsilon_i = (\varepsilon_{i1}, \ldots, \varepsilon_{i(k-1)}, \varepsilon_{i(k+1)}, \ldots, \varepsilon_{iJ})$ and define Σ to be the variance-covariance matrix of the errors $(\theta_{ij} - \theta_{ik})$, $i=1, \ldots, I$, $j=1, \ldots, J$, $j \neq k$. Then the variance-covariance matrix of the vector ε_i will be

$$V = \Omega + (I \otimes \Sigma), \tag{2.21}$$

where

$$\Omega = \begin{bmatrix} \Omega_1 & 0 & & & 0 \\ 0 & \Omega_2 & & & \\ \cdot & & \cdot & & \cdot \\ \cdot & & & \cdot & \cdot \\ \cdot & & & \cdot & \cdot \\ 0 & & \cdot & \cdot & \Omega_I \end{bmatrix} .$$

This matrix will be block-diagonal with I blocks of dimension (J-1)x(J-1) along the main diagonal. Since V is a non-scalar, heteroskedastic matrix, equation (2.17) must be estimated using GLS. Parks suggests the following step-by-step procedure:

(1) Apply OLS to equation (2.17) to obtain consistent estimates of the parameters and the residuals. Let the residual vector be $e = [e_1, \ldots, e_I]$, where each e_i has (J-1) elements.

(2) Use the elements of e to construct an estimate of what Parks calls the "unadjusted residual matrix":

$$S = \frac{1}{I} \sum_{i=1}^{I} e_i e_i' .$$

(3) Using the relative frequency data construct $\hat{\Omega}$, an estimate of Ω.

(4) A consistent estimate of Σ can be obtained using the formula

$$\hat{\Sigma} = S - \frac{1}{I} \sum_{i=1}^{I} \hat{\Omega}_i \ .$$

(5) Finally,

$$\hat{V} = \hat{\Omega} + (I \otimes \hat{\Sigma}) \ .$$

Using $\hat{V}$, GLS can be applied to equation (2.17) to produce asymptotically efficient estimates of the unknown parameters.

Here time-series and cross-section data will be pooled, so that each "cell" will consist of one province in year t. The total number of cells will therefore be equal to ten times the number of years in the data set. For simplicity, autocorrelation will be assumed to be nonexistent. Though it might be more realistic to introduce correlations between the error terms for different years, to do so would complicate the estimation procedure. As a further simplification, it will also be assumed that the matrix Σ is the same not only for each province of origin, but also for all t, t=1,....,T, where T is the number of years in the sample. The matrices Ω_i will vary with t since their elements depend on the migration rates, which vary over time as economic conditions change.

It should be noted that this estimation method has not been applied in other Canadian migration studies that use aggregate data. Grant and Vanderkamp (1976) use OLS to estimate an equation similar to (2.17), as does Shaw (1985, 1986). MacNevin (1984) tries both OLS with dummy variables for sending and receiving regions and a variance-components method. Winer and Gauthier (1982a) do include an approximation error in their equation, but ignore the off-diagonal elements of the Ω_i in their estimation process. This may not be a serious omission, though; as they note in chapter 4 of their study, the off-diagonal elements are in their case about 100 times smaller than the diagonal elements. However, like the other authors they have in effect ignored the constraint implied by (2.18). In chapter IV both the OLS and GLS estimates of equation (2.17) will be examined in order to determine the effect of implementing Parks' procedure.

One last estimation issue that must be dealt with before moving on to a discussion of the functional form of the estimating equation is which alternative k should appear in the denominator of the log-odds ratio. Previous studies have set k=i, the province of origin, which leads to a straightforward intuitive interpretation of the expression V_{ij}-V_{ik}. When k equals i, this difference becomes the difference between the characteristics of the origin and the characteristics of the destination. However, in principle k can be any alternative, as long as the variance-covariance matrix is constructed accordingly.

One disadvantage of setting k equal to the province of origin is that programming the variance-covariance matrix becomes slightly more complicated. If k is the same for all provinces of origin, there is one less parameter to be varied as the Ω_i are constructed. For this reason, it was decided to set k equal to alternative six, the province of Ontario, rather than the province of origin. The effect on the results of this assumption about k will be examined in chapter IV.

C. A Functional Form for the Indirect Utility Function

To complete the specification of this empirical model of migration, all that remains is to choose a functional form for the indirect utility function. The generalized least squares estimation procedure described in the previous section is most easily implemented when the expression (V_{ij} - V_{ik}) is linear in the parameters to be estimated, so a simple log-linear Cobb-Douglas utility function was chosen. When maximized subject to the budget constraint (2.2), it leads to the indirect utility function

(2.22) $$V_{ij} = v + (\alpha_1 + \alpha_2)\ln(\omega_j T + I_{ij}) - \alpha_1 \ln q_j - \alpha_2 \ln\omega_j + \sum_{h=1}^{H} \alpha_{3h}\ln G_{hj} + \sum_{n=1}^{N} \alpha_{4n}\ln A_{nij} ,$$

where

$$v = \alpha_1 \ln\alpha_1 + \alpha_2 \ln\alpha_2 - (\alpha_1+\alpha_2)\ln(\alpha_1+\alpha_2) ,$$

and H and N are the number of elements in the vectors G_j and A_{ij} respectively.[31] Note that the nonlinear constant v will disappear from the estimating equation when the difference $(V_{ij} - V_{ik})$ is taken.

Equation (2.22) defines the indirect utility function for what can be described as the "perfect certainty" version of the model. It is also possible to derive an expected indirect utility function that is consistent with (2.22). First, the rationed indirect utility function corresponding to the direct utility function underlying (2.22), with $\bar{L}_j=0$, is

(2.23) $$V^R_{ij} = \alpha_1(\ln I_{ij} - \ln q_j) + \alpha_2 \ln T + \sum_{h=1}^{H} \alpha_{3h}\ln G_{hj} + \sum_{n=1}^{N} \alpha_{4n}\ln A_{nij} .$$

Substituting (2.22) and (2.23) into (2.11) yields the following expression for expected indirect utility:

(2.24) $$E[u_{ij}] = (1-\pi_j)v + \alpha_1[(1-\pi_j)\ln(\omega_j T + I_{ij})$$

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[31]Each variable in equation (2.22) should have a subscript t added to it, but this additional subscript has been omitted in order to simplify the notation.

$$- \ln q_j + \pi_j\delta_j\ln\bar{I}_{ij} + \pi_j(1-\delta_j)\ln I_{ij}]$$

$$+ \alpha_2[(1-\pi_j)\ln(\omega_jT + I_{ij}) - (1-\pi_j)\ln\omega_j$$

$$+ \pi_j\ln T] + \sum_{h=1}^{H} \alpha_{3h}\ln G_{hj} + \sum_{n=1}^{N} \alpha_{4n}\ln A_{nij} .$$

There is, however, one problem with (2.24): because the constant v is multiplied by $(1-\pi_j)$, it will not disappear from the equation when the difference $\{E[u_{ij}]-E[u_{ik}]\}$ is taken. This means that the estimating equation will no longer be linear in the parameters α_1 and α_2. When nonlinear estimation of this version of the model was attempted, the results were not very satisfactory. Though convergence was achieved after about sixty iterations, the resulting estimates of α_1 and α_2 were always large and negative with very large standard errors. When different starting values were used the estimates of α_1 and α_2 sometimes changed considerably, though the values of the remaining parameters were unaffected. Because equation (2.24) did not seem to function well, it was arbitrarily decided to drop the constant term v from equation (2.22). Thus the expression for the indirect utility function that was actually used to produce the estimates in the next chapter is

(2.22′)
$$V_{ij} = (\alpha_1+\alpha_2)\ln(\omega_jT + I_{ij}) - \alpha_1\ln q_j$$

$$- \alpha_2\ln\omega_j + \sum_{h=1}^{H} \alpha_{3h}\ln G_{hj} + \sum_{n=1}^{N} \alpha_{4n}\ln A_{nij} .$$

The corresponding expected indirect utility function is

(2.24′)
$$E[u_{ij}] = \alpha_1[(1-\pi_j)\ln(\omega_jT + I_{ij}) - \ln q_j$$

$$+ \pi_j\delta_j\ln\bar{I}_{ij} + \pi_j(1-\delta_j)\ln I_{ij}]$$

$$+ \alpha_2[(1-\pi_j)\ln(\omega_jT + I_{ij}) - (1-\pi_j)\ln\omega_j$$

$$+ \pi_j \ln T] + \sum_{h=1}^{H} \alpha_{3h} \ln G_{hj} + \sum_{n=1}^{N} \alpha_{4n} \ln A_{nij} \, .$$

Though this modification greatly eased the estimation procedure, its adoption was not without cost; the elimination of the constant term v in equation (2.22) means that (2.22′) and (2.23) can no longer be derived from exactly the same direct utility function.

Now that a functional form has been chosen for the indirect utility function, it is easier to see how this study's treatment of fiscal variables differs from that of most other studies. First, rather than being replaced by revenue variables such as intergovernmental transfer payments, government expenditures have been allowed to remain in the estimating equation. Second, other fiscal variables such as income tax rates, provincial government transfer payments, unemployment insurance benefits, and the probability of being covered by UI do not enter the equation independently, as in other studies. Instead, they are components of the of the composite wage and price variables multiplying the parameters α_1 and α_2. This treatment of these variables is suggested by the underlying theoretical model. In order to justify the inclusion of these variables in any other manner, say as components of A_{ij}, one would need an alternative theoretical model explaining why they might do so. For example, if one wished to treat UI benefits and provincial government transfers as separate explanatory variables, it would be necessary to explain why individuals might respond differently to different sources of income. In the absence of a theoretical model that does so, equation (2.24′)'s treatment of these variables is more appropriate.

Two other features of the functional form also deserve attention. First, both equations (2.22′) and (2.24′) satisfy the restriction that the indirect utility function be homogeneous of degree zero in prices and incomes. This restriction was imposed during estimation, although it could have been tested by allowing the coefficient of full income to differ from $(\alpha_1+\alpha_2)$. Second, the log-linear Cobb-Douglas utility function implies that the degree of relative risk aversion is constant and equal to one. However, one could easily modify the function to allow a greater degree of risk aversion by adding π_j, the probability of unemployment in region j, to the vector A_{ij}. If individuals tend to be highly risk-averse, then the coefficient of $\ln \pi_j$ should be negative.

To conclude this chapter, it is helpful to present the exact estimating equations used. For the perfect certainty version of the model, the log-odds estimating equation is

$$(2.25) \quad \ln(M_{ij} / M_{i6}) = \alpha_1 [\ln(\omega_j T + I_{ij}) - \ln(\omega_6 T + I_{i6}) - \ln q_j + \ln q_6]$$
$$+ \alpha_2 [\ln(\omega_j T + I_{ij}) - \ln(\omega_6 T + I_{i6}) - \ln\omega_j + \ln\omega_6] + \sum_{h=1}^{H} \alpha_{3h} [\ln G_{hj} - \ln G_{h6}]$$
$$+ \alpha_4 [\ln DEG_j - \ln DEG_6] + \alpha_5 [\ln D_{ij} - \ln D_{i6}] + \alpha_6 [DUM_{ij} - DUM_{i6}] ,$$

where the subscript 6 indicates the province of Ontario, DEG_j is a measure of climate, D_{ij} is the distance between i and j, and DUM_{ij} is the move/stay dummy variable. These three variables, unlike the others in the equation, do not vary over time. The estimating equation for the expected utility model is

$$(2.26) \quad \ln(M_{ij} / M_{i6}) = \alpha_1 [(1-\pi_j)\ln(\omega_j T + I_{ij}) - (1-\pi_6)\ln(\omega_6 T + I_{i6})$$
$$+ \pi_j \delta_j \ln\bar{I}_{ij} - \pi_6 \delta_6 \ln\bar{I}_{i6} + \pi_j(1-\delta_j)\ln I_{ij} - \pi_6(1-\delta_6)\ln I_{i6} - \ln q_j + \ln q_6]$$
$$+ \alpha_2 [(1-\pi_j)\ln(\omega_j T + I_{ij}) - (1-\pi_6)\ln(\omega_6 T + I_{i6}) + (\pi_j - \pi_6)\ln T$$
$$- (1-\pi_j)\ln\omega_j + (1-\pi_6)\ln\omega_6]$$
$$+ \sum_{h=1}^{H} \alpha_{3h} [\ln G_{hj} - \ln G_{h6}] + \alpha_4 [\ln DEG_j - \ln DEG_6] + \alpha_5 [\ln D_{ij} - \ln D_{i6}]$$
$$+ \alpha_6 [DUM_{ij} - DUM_{i6}] + \alpha_7 [\ln\pi_j - \ln\pi_6] .$$

As can be seen from these equations, the terms multiplying α_1 and α_2 are functions of many variables. In the discussion of the results in chapter IV these two terms will frequently be referred to as the "price variable" and the "wage variable" respectively, and readers may find it helpful to refer back to these two equations to see exactly how they are defined.

CHAPTER III

DATA

Since a detailed list of data sources is available in appendix 2, this chapter will focus mainly on the problems encountered in assembling the data set. The equations were estimated using annual data for the period 1962-1981. The dependent variables, the migration rates, were calculated using data on gross flows of migrants and provincial populations as of June 1st. The migration flow data are estimates prepared by Winer and Gauthier (1982b) and Statistics Canada. The estimates are based on the movements of family allowance recipients between provinces. Because only children are eligible to receive family allowance benefits, Winer and Gauthier adjusted the raw data on movements of family allowance recipients using such factors as the average number of children per family eligible to receive family allowance benefits, and the ratio of adult to child migration rates, in order to obtain estimates of the number of moves made by the total population.[32]

These moves do not all take place at a single point in time; they are the cumulative total of all moves that took place between January 1st and December 31st in a given year. For this reason it was decided to use the population as of June 1st in the calculation of migration rates, rather than the January 1st population. The June 1st population estimates are the official Statistics Canada population series, and were also used by Winer and Gauthier (1982) to calculate

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[32]See Winer and Gauthier (1982b) for a more detailed description of the method used to create the migration series.

migration rates.

The data for most of the components of income were obtained from readily available sources. The wage rate w_j is the annual average value of average weekly wages and salaries in province j. To obtain an estimate of the labour income component of full income, this wage variable was multiplied by the number of weeks per year, 52. Also required in the calculation of full income were provincial government transfer payments and nonwage income excluding provincial government transfers.[33] These data were obtained from the Provincial Economic Accounts and converted to per capita terms using provincial population as of June 1st. The Provincial Economic Accounts also supplied the data needed to calculate average tax rates for each province. They were constructed by subtracting the ratio of disposable income to personal income in each province from one. They thus measure the combined impact of both the federal and provincial income tax systems.

Two variables had to be constructed using data from several sources. The first of these was the provincial price level, q_j. Regional city consumer price indices (CPIs) are inadequate, since they are all set to 100 in the same base year; thus they reflect only regional differences in inflation rates, not price levels. Similarly, inter-city price indices published by Statistics Canada measure only regional differences in price levels in a given year, and do not capture regional differences in inflation rates. Moreover, the inter-city indices exclude some important items in the CPI reference basket, such as housing, and were not

[33]Nonwage income excluding provincial government transfers consists of interest, dividend, and miscellaneous investment income plus federal transfers to persons (excluding Canada Pension Plan benefits and UI benefits). Provincial government transfer payments to persons include direct relief, old age and blind pensions, mothers' and disabled persons' allowances, workmen's compensation benefits, pensions to government employees, grants to post-secondary institutions, grants to benevolent associations, and other miscellaneous transfers.

available throughout the sample period. A compromise was achieved by combining regional city consumer price indices with data from the 1978 Consumer Expenditure Survey. Average yearly expenditures by households in the major city in each region in 1978 were deflated using the regional city CPIs to obtain a time-series of expenditure levels that were comparable across provinces.[34] The main drawbacks of this procedure are twofold: first, it does not fully account for changes in consumer spending habits over time; and second, it ignores differences in the quality of goods purchased in each region. Though these problems are typical of most index number series, the problem is perhaps more severe when regional rather than intertemporal comparisons are of interest. Regional differences in the prices of nontraded goods such as housing, which are likely to be important determinants of migration decisions, are not adequately measured by this procedure. However, an attempt to deal with these problems was beyond the scope of this project.

The second variable that had to be constructed was the cost of moving. No specific data exist on the cost of moving from one province to another, or on the amount of time required to do so. In fact, there is likely to be a great deal of variation in the cost of moving between two provinces, depending on the distance between the origin and the destination. For example, a move from Ontario to Quebec could entail travelling only a few miles (from Ottawa to Hull), or as many as 1200 (from Thunder Bay to Quebec City). It was arbitrarily assumed that the distance travelled could be approximated by the distance

[34]The new data series produced are expenditure levels, measured in constant 1971 dollars, rather than index numbers. The series can be thought of as the price of one unit of a fixed bundle of goods. They could, however, have been converted to index numbers by choosing a base province and year, and dividing the elements of all ten series of expenditure levels by the value for that province in that year.

between provincial capitals, while a linear function related time spent moving and distance. The maximum amount of time required to move was assumed to be one month and the minimum one week. This linear function was assumed to be constant throughout the sample period. It was then combined with the average wage rate in the province of origin to construct an estimate of the foregone wage cost of moving. Travel costs for a single person were assumed to equal the distance travelled multiplied by the average revenue per person-mile earned by railways in Canada. The average amount of belongings moved was arbitrarily assumed to be half a ton, at a cost equal to half the average railway revenue per ton-mile multiplied by the distance travelled. The sum of these three components equals total moving costs. Thus the monetary costs of moving are approximated by a linear function of distance, which varies over time as wage and rail rates change.

Rail rates for both passengers and freight were chosen to measure moving costs because these data were the most readily available. Also, though many migrants probably choose other modes of transportation, there is no data available on their choices. The use of average rail rates for freight may understate actual moving costs to some extent, because some types of freight receive special discounts that would not be available for the shipment of household goods. An example would be the Crow rates that apply to the shipment of grain.

Given the hypotheses being tested, the variables chosen to represent the supply of government services are particularly important. One possible measure is current expenditures on goods and services by provincial governments, local governments, and hospitals, available in the <u>Provincial Economic Accounts</u>. Since current expenditures do not include intergovernmental transfers, this measure involves no double-counting. It was deflated by the implicit price deflator for government spending from the National Income and Expenditure Accounts, and divided by the provincial population as of June 1st in order to obtain an estimate of spending per capita. Per capita expenditures provide a better measure of the generosity of local public services than total expenditures, since there are in fact very few pure public goods, and jurisdictions with larger populations must of necessity spend more than smaller ones in order to provide the same level of services. However, the data do not control for the quality of services provided by different governments or the efficiency with which they are provided.

One problem with this measure of provincial government services is that it does not include services derived from governments' capital stocks. While data on investment by each level of government are available, capital stock measures are available only for the whole government sector in each province, including the federal government. Even if the appropriate capital stock measure were available, it would still be difficult to determine the rate at which its services were consumed by the public. Investment expenditures could perhaps be considered indicators of future levels of government services, but it is not clear what the exact relationship between current investment and future services is. Also, to include investment expenditures as a proxy for expected future government services would be inconsistent, since expected values have not been constructed for other variables. Therefore, it seemed best to include only current government expenditures as a measure of provincial government services. Implicit in this choice of variables is the assumption that services flowing from the government capital stock are proportional to current government expenditure.

Individual migration decisions are likely to be affected not just by the level of government spending, but also by its composition. Testing of this hypothesis requires data on provincial government spending by function. Unfortunately, the

Provincial Economic Accounts do not include a breakdown of government expenditures by function. Therefore, it was necessary to turn to an alternative source to obtain data on the amount of government expenditures devoted to particular functions. This source was the Statistics Canada publication Consolidated Government Finance. From this publication government expenditures on education, health, and social services were obtained for provincial and local governments and hospitals in each province. As with the earlier data, they were transformed to per capita values by dividing by population as of June 1st. However, there are two problems with these data. First, the data are collected on a fiscal year rather than a calendar year basis. Spending during the fiscal year ending nearest to December 31st of a given year was attributed to that year. Second, there is a major break in the series in 1970, when Statistics Canada began using a different method of constructing the data. No attempt was made to link the two series. Third, unlike the Provincial Economic Accounts, Consolidated Government Finance does not list current and capital expenditures separately. Therefore, these measures of the components of government spending are not comparable to the data obtained from the Provincial Economic Accounts. In order to get some idea of the importance of the differences between the two series, migration functions were estimated using the composite government expenditure variables from both sources.

In order to estimate the expected utility model it was necessary to collect data on three additional variables peculiar to that model: the unemployment rate, the probability of being covered by UI, and the average UI benefit. Average annual unemployment rates were obtained from the Labour Force Survey, while Benefit Periods Established and Terminated Under the Unemployment Insurance Act provided a measure of average regular benefits paid. Obtaining an estimate of the probability of being covered by UI was more problematic. What was needed was an estimate of the proportion of the working population that was covered by the programme. The 1971 revisions to the UI Act extended coverage to virtually all paid workers, and thus the number of paid workers provides a good approximation to the covered population for the post-1971 period. Prior to 1972, the covered population was defined to be coverage as measured in Benefit Periods Established and Terminated Under the Unemployment Insurance Act, less the annual number of claimants reporting to local offices at month-end. The coverage series thus obtained for the 1962-81 period was then divided by employment in each province to obtain an estimate of the proportion of the working population that was covered by UI.

Another factor that had to be taken into account when constructing the nonwage income variables I_{ij} and $\bar{I}_{ij}$ was changes in the tax treatment of some of their components. Prior to the 1971 revision of the tax system, unemployment insurance benefits were tax-free and moving costs were not tax deductible. The 1971 revisions, which took effect in 1972, made UI benefits taxable and moving costs tax-deductible. Thus prior to 1972,

$$I_{ij} = (B_i + R_j - C2_{ij})(1 - \tau_j) - C1_{ij}\ ,$$

and

$$\bar{I}_{ij} = (B_i + R_j - C2_{ij})(1 - \tau_j) - C1_{ij} + AUI_j\ \ ;$$

while after 1972,

$$I_{ij} = (B_i + R_j - C1_{ij} - C2_{ij})(1 - \tau_j),$$

and

$$\bar{I}_{ij} = (B_i + R_j + AUI_j - C1_{ij} - C2_{ij})(1 - \tau_j) ,$$

where B_i is interest income plus federal government transfers excluding UI benefits in province i, R_j is transfer payments from the provincial government in province j, $C1_{ij}$ is the cost of moving oneself and one's belongings from i to j, $C2_{ij}$ is the foregone wage cost of moving from i to j, τ_j is the average rate of income tax in province j, and AUI_j is the average regular UI benefit in province j.

Finally, four variables were included in the vector A_{ij}. Three of these were discussed in some detail in chapter II: the distance between i and j, a dummy variable that was set equal to one if i=j and zero otherwise, and the unemployment rate in region j. The fourth variable included was a measure of climate, the number of degree days above 0°C. The greater the number of degree days above 0°C, the warmer the climate. The data for this variable were obtained from Canadian Climate Normals, 1951-1980, an Environment Canada publication, and are averages for the major city in each province over the period 1951-1980. Thus like distance and the dummy variable, this variable does not vary over time. Though annual data on degree days above 0°C are available, it was decided to use the averages on the grounds that people are more likely to be influenced by the average climate of a region than by year-to-year variations.[35] Other climate variables, such as amounts of sunshine, snow, and rainfall were also available, but were found to be too highly collinear with degree days and each other to include them in the model.

[35]Of course, the degree of variability of the climate might also be a factor. If so, its influence is not captured here.

CHAPTER IV

EMPIRICAL RESULTS

In this chapter the model of migration developed in chapter II will be confronted with the data to see how well it can explain interprovincial migration in Canada. Of particular interest will be the implications of the results with respect to fiscally-induced migration, one of the key issues which the model was intended to address. As was noted in chapter I, the evidence to date on this issue has been inconclusive.

In total, eight different versions of the model were estimated. The estimation results can be found in tables I to IV. These tables contain the perfect certainty and expected utility versions of four basic equations: (i) an equation with one composite provincial government expenditure variable from Consolidated Government Finance; (ii) an equation with four provincial government expenditure variables from Consolidated Government Finance; (iii) an equation with one composite provincial government expenditure variable from the Provincial Economic Accounts; and (iv) an equation in which all the explanatory variables, including one composite provincial government expenditure variable from the Provincial Economic Accounts, are lagged one period. Although GLS is the proper estimation technique for the model, both the OLS and GLS estimates for these equations have been presented so that the two can be compared. Tables I and III contain the OLS estimates of the parameters for the perfect certainty and expected utility models respectively, while the corresponding GLS estimates can be found in tables II and IV.

TABLE I

PERFECT CERTAINTY MODEL: OLS RESULTS

	1	2	3	4
Prices	-0.795 (-2.788)	0.823 (2.875)	0.833 (2.934)	1.019 (3.637)
Wages	7.900 (4.014)	9.082 (4.954)	10.999 (5.407)	13.763 (6.869)
Government spending	3.259 (19.396)		2.365 (15.503)	2.503 (16.848)
Health		2.422 (15.663)		
Social services		-0.677 (-7.297)		
Education		1.706 (9.404)		
Other spending		-0.438 (-2.975)		
Degree days	6.173 (49.290)	5.099 (36.734)	5.579 (36.962)	5.454 (36.717)
Distance	-0.699 (-11.609)	-0.617 (-11.191)	-0.553 (-8.910)	-0.478 (-7.775)
Move/stay dummy	0.272 (0.660)	0.8081 (2.144)	1.237 (2.911)	1.705 (4.048)
R^2	0.884	0.906	0.877	0.880
F-statistic	2285.0	1912.0	2123.0	2198.0

TABLE II

PERFECT CERTAINTY MODEL: GLS RESULTS

	1	2	3	4
Prices	-0.936 (-8.443)	0.661 (4.567)	0.609 (5.220)	0.717 (5.865)
Wages	9.460 (8.352)	10.886 (9.158)	11.499 (10.982)	14.010 (12.711)
Government spending	2.675 (35.026)		1.683 (19.069)	1.740 (19.946)
Health		1.136 (11.716)		
Social services		-0.367 (-7.464)		
Education		1.045 (9.571)		
Other spending		0.001 (0.008)		
Degree days	6.165 (79.631)	5.523 (61.521)	5.877 (70.387)	5.778 (69.446)
Distance	-0.599 (-19.606)	-0.571 (-17.238)	-0.529 (-18.797)	-0.468 (-15.767)
Move/stay dummy	1.184 (5.823)	1.301 (5.836)	1.580 (8.470)	1.930 (9.828)
R^2	0.967	0.963	0.969	0.967
F-statistic	8809.0	5184.0	9416.0	8692.0

TABLE III

EXPECTED UTILITY MODEL: OLS RESULTS

	5	6	7	8
Prices	0.474	0.762	0.811	0.827
	(2.508)	(4.155)	(4.548)	(4.855)
Wages	10.668	10.582	9.832	10.783
	(4.778)	(4.883)	(4.379)	(4.700)
Government spending	1.024		-0.210	0.081
	(5.112)		(-1.113)	(0.421)
Health		1.840		
	(11.684)			
Social services		-0.460		
		(-5.082)		
Education		1.121		
		(6.405)		
Other spending		-0.693		
		(-4.978)		
Degree days	5.577	4.804	5.630	5.489
	(46.729)	(34.940)	(41.461)	(39.965)
Distance	-0.584	-0.552	-0.572	-0.533
	(-9.824)	(-9.754)	(-9.560)	(-8.771)
Move/stay dummy	1.029	1.262	1.129	1.391
	(2.555)	(3.300)	(2.787)	(3.389)
Unemployment rate	-1.116	-0.669	-1.346	-1.212
	(-15.850)	(-9.218)	(-16.640	(-14.613)
R^2	0.901	0.913	0.899	0.899
F-statistic	2323.0	1869.0	2288.0	2273.0

TABLE IV

EXPECTED UTILITY MODEL: GLS RESULTS

	5	6	7	8
Prices	0.215 (2.300)	0.361 (3.394)	0.578 (5.867)	0.553 (5.885)
Wages	12.157 (9.138)	12.984 (9.525)	11.620 (9.086)	12.756 (9.703)
Government spending	0.810 (9.953)		0.126 (1.176)	0.240 (2.238)
Health		0.895 (9.760)		
Social services	(-6.233)	-0.286		
Education		0.498 (4.755)		
Other spending		-0.321 (-4.547)		
Degree days	5.521 (68.253)	5.236 (63.551)	5.460 (61.557)	5.418 (61.817)
Distance	-0.526 (-16.959)	-0.503 (-15.666)	-0.518 (-17.468)	-0.478 (-15.710)
Move/stay dummy	1.622 (8.000)	1.774 (8.392)	1.679 (8.707)	1.934 (9.804)
Unemployment rate	-0.939 (-21.535)	-0.852 (-15.307)	-1.058 (-20.460)	-0.994 (-19.510)
R^2	0.965	0.966	0.964	0.964
F-statistic	7088.0	5120.0	6860.0	6949.0

In all four tables, t-statistics are shown in parentheses beneath the coefficient estimates. Because the pooled sample is very large (1800 observations) the normal distribution can be used to evaluate the t-tests. The critical value at the .05 level of significance is 1.960. In addition, a measure of goodness of fit, R^2, and an F-statistic are reported for each equation. Because the equations do not contain a constant term, R^2 is computed using the following formula:

$$R^2 = 1 - \frac{e'e}{y'y},$$

where e is the OLS residuals vector and y is a vector containing the independent variable. In the case of the GLS estimates, e and y are the residuals vector and dependent variable from a model that has been premultiplied by the matrix P such that $P'P=V^{-1}$, where V is an estimate of the variance-covariance matrix of the model.[36] The F-statistic reported in the tables is constructed using this measure of R^2.

A. Highlights of the Results

One of the most interesting features of the results in tables I to IV is that virtually all of the parameter estimates are highly significant at the 5% level, except for the coefficient of the composite government expenditure variable in equation 7. This result is probably due to the large sample size. Furthermore, most of the coefficient estimates have plausible signs. The coefficients of prices and wages are positive and significant in all the equations, except for the coefficient of prices in equation 1. These results are consistent with economic theory, in that positive coefficients imply that both goods and leisure are "goods"

[36]Buse (1973) shows that this is an appropriate definition of R^2 for an equation with no constant term that is estimated using GLS.

rather than "bads."[37] As in other studies of migration the coefficient of distance is consistently negative, a result which suggests that on average, people prefer to move short distances if at all. In addition, the positive coefficient of the move/stay dummy variable indicates that people are more likely to stay than move, which confirms the hypothesis that there are large fixed costs associated with moving. However, these fixed costs are not large enough to prohibit all moves. The positive coefficient of degree days above 0°C indicates that other things being equal, most people prefer warmer climates to colder ones.

B. A Comparison of OLS and GLS Estimation Results

With the exception of Winer and Gauthier (1982a) and MacNevin (1984), other authors have estimated their multinomial logit models of interprovincial migration in Canada using OLS. Though unbiased, OLS estimates are often less efficient than feasible GLS estimates, in that their covariance matrix may be larger than that of the feasible GLS estimates. A comparison of the results in tables I and III with those in tables II and IV indicates that in this case GLS estimation does increase the efficiency of the parameter estimates. GLS estimation reduces the standard errors of all the parameter estimates, in some cases by almost fifty percent.[38] Furthermore, the change in estimation techniques leads to a change in the interpretation of the results with respect to at least two parameters. The coefficient of other government spending in equation 2 is significant at the 5% level after OLS estimation but insignificant after GLS estimation, while the reverse

[37]A negative coefficient for either of these variables would imply that the marginal utility of the corresponding variable in the direct utility function was negative.

[38]Though the standard errors are not reported in the tables, their movements can be inferred from the changes in the t-statistics.

happens to the coefficient of the move/stay dummy variable in equation 1. Thus the use of a less efficient estimation technique (OLS) might lead one to draw incorrect conclusions about the effects of certain variables on interprovincial migration. In the remainder of the chapter the discussion will focus on the GLS estimates.

C. Implications for Fiscally-Induced Migration

With respect to fiscally-induced migration, the first question that must be asked is whether the provision of local public goods has any effect on migration decisions. In most of the equations that include a single composite local public good, the estimated coefficient of the public good has the expected positive sign in addition to being significantly different from zero. The only exception is equation 7. On the basis of these results it seems safe to conclude that the supply of local public goods does affect individuals' migration decisions. Further support for this hypothesis can be gained from equations 2 and 6, which contain four separate government spending variables: government expenditures on health, social services, education, and all other functions. The coefficients of spending on health and education are positive and statistically significant in both equations, indicating that individuals are attracted to regions with higher levels of health and educational services. However, the coefficient of spending on social services is negative, suggesting that migrants are actually repelled by a more generous system of social services. This result persists even in the expected utility model where the probability of unemployment is explicitly taken into account, which means that spending on social services is not simply acting as a proxy for the unemployment rate.

With respect to social services, a similar result was obtained by Cebula

(1979b) for the United States. He found that black migrants (who generally have lower incomes) were attracted to regions with more social services, while white migrants were more likely to move to regions with a lower level of social services. He hypothesized that high-income white migrants associated a more generous social welfare system with higher tax rates, and therefore preferred to avoid such areas. Since differences in regional tax rates have already been taken into account in the construction of the income variables used here, it is not clear whether this explanation is applicable in this case as well. It would be interesting to re-estimate the model using data that could be disaggregated by income class to see if high- and low-income migrants respond differently to government expenditures on social services.

The estimated coefficient of the fourth public good variable, a composite variable that includes all government expenditures other than those on health, education, and social services, is statistically significant only in the expected utility version of the model. In both cases its sign is negative, which seems to imply that other types of public goods have a negative influence on migration decisions. This government expenditure variable includes spending on such functions as recreation and culture, protection, and transportation and communications. It seems plausible that some individuals would be affected by spending on some of these functions; in the absence of contradictory empirical evidence, it seems safest to interpret the estimate of this coefficient as an indication that on balance, the direct effects of other types of local public goods on migration are negative. Some of these public goods may also have an indirect effect on migration through their effects on variables such as prices and wages, but a general equilibrium model would be required to isolate such effects.

Though the results clearly indicate that spending on local public goods influences interprovincial migration, it has yet to be established which government expenditure variable best captures that effect. Considering first the composite government spending variable, a comparison of equations 1 and 5 with equations 3 and 7 indicates that the change in the definition of the composite government spending variable has very little effect on the qualitative results. The major difference seems to be that when total government spending from Consolidated Government Finance in equations 1 and 5 is replaced in equations 3 and 7 by current expenditures on goods and services from the Provincial Economic Accounts, the coefficient of prices rises while that of government spending falls. Since neither definition is ideal, the robustness of the results with respect to changes in the definition of government expenditures only serves to strengthen the results.

A more interesting issue is whether the composition of government spending matters to migrants. The use of a composite government expenditure variable involves the implicit assumption that individuals consider all government spending to be alike; i.e., that the marginal utility of a ten dollar increase in per capita spending on health is the same as the marginal utility of a ten dollar increase in spending on social services. The results for equations 2 and 6 suggest that this assumption is incorrect. If so, then the effect on migration of a given increase in government spending in one province will depend on how the money is spent.

A specification test that compares an equation with one composite government expenditure variable to an equation in which government spending has been divided into four components would help to settle this issue. Although the two hypotheses are not nested, the equations are linear in parameters. One can therefore create an artificial model which contains both, and use F-tests to distinguish between them. In the perfect certainty case, the artificial model will consist of equation 2 with the composite government spending variable added to it. After estimating the artificial model, one can carry out F-tests of the following two hypotheses: (i) that the coefficients of the four components of government spending are jointly zero; and (ii) that the coefficient of the composite government spending variable is zero. Rejection of the first null hypothesis would imply that the composition of government spending is important, as would the failure to reject the second.

The results of these tests, which were applied to both the perfect certainty and expected utility versions of the model, are shown in table V. In the case of the perfect certainty model the results are inconclusive, as neither null hypothesis can be rejected. The rejection does seem to be a little stronger in the case of the first hypothesis, though. In the case of the expected utility model, the results tend to support the hypothesis that the composition of government spending matters. It is impossible to reject the hypothesis that the coefficient of the composite government spending variable is zero, while hypothesis (i) is decisively rejected. Together with the estimates of the parameters of the components of government expenditures in equations 2 and 6, these results suggest that the marginal utility of government spending is not the same for all components. The implication of this finding is that interprovincial flows of migrants will be influenced not only by the level of government spending in each province, but also by its composition.

TABLE V

F-TESTS OF THE IMPORTANCE OF THE COMPOSITION OF LOCAL PUBLIC SPENDING

Null Hypothesis	Critical Value	Model: Perfect Certainty	Model: Expected Utility
The marginal utilities of different local public goods are different.	3.84	30.01	3.17
The marginal utilities of all local public goods are the same.	2.37	77.00	36.04

What do the results imply with respect to the other fiscal variables that are included in the model, namely tax rates, provincial government transfer payments, UI benefits, and the probability of being covered by UI? Because they do not enter the estimating equations independently of other variables, the implications of the results with respect to these variables are less obvious. However, the fact that these variables do not have their own coefficients does not make them any less important as determinants of migration decisions. In all versions of the model, these variables will have a significant impact on migration decisions as long as the parameters α_1 and α_2 of the indirect utility function are significantly different from zero. These two parameters are identified in the tables as the coefficients of prices and wages respectively. In all the equations both these coefficients pass a test of significance at the 5% level. Therefore, tax rates, provincial government transfer payments, and the probability of being covered by UI do have a significant impact on migration decisions in this model.

D. Unemployment and Migration

The impact of unemployment on migration is another issue that remains unsettled in the empirical literature. The expected utility model of migration described in chapter II allows the unemployment rate to enter the estimating equation in two ways: as a multiplicative factor that modifies the composite wage and price variables, and as a separate explanatory variable. Thus even if the coefficient of the unemployment rate should prove to be insignificant, the unemployment rate would still have an impact on migration as long as the coefficients of the price and wage variables were significantly different from zero.

As can be seen in table IV, the coefficients of prices and wages are always statistically significant with the expected positive sign in the expected utility version of the model. Furthermore, the coefficient of the unemployment rate itself is also statistically significant in all four versions of the expected utility model. The negative sign of this coefficient implies that individuals are, on average, more risk-averse than the simple log-linear utility function would imply. These results provide strong support for the hypothesis that individuals will be less likely to move to a province where the chance of being unemployed is higher, other things being equal.

The fact that the coefficient of the unemployment rate is statistically significant tends to support the expected utility model, but it does not answer the question of which version of the model is best able to explain interprovincial migration in Canada. Although the perfect certainty model and the expected utility models are nonnested, it is once again possible to nest them artificially within a composite model and use F-tests to distinguish between them. Tests of this type were applied to two different pairs of models: equations 1 and 5, which contain only one government expenditure variable, and equations 2 and 6, which contain four government expenditure variables.[39] The results, displayed in table VI, show that when there is only one government expenditure variable in the equation the hypothesis that the expected utility model is the true model cannot be rejected. At the same time, the hypothesis that the perfect certainty model is the true model is overwhelmingly rejected. But when government expenditures are disaggregated, the results are less conclusive. In this case both null hypotheses

TABLE VI

F-TESTS TO COMPARE THE PERFECT CERTAINTY MODEL WITH THE EXPECTED UTILITY MODEL

Null Hypothesis	Critical Value	No. of Government Expenditure Variables: One	Four
The perfect certainty model is the true model.	2.60	214.30	141.90
The expected utility model is the true model.	3.00	2.30	16.19

are rejected. However, the fact that the margin of rejection is much smaller in the case of the expected utility model suggests that it is closer to the true model than is the perfect certainty model. On the basis of these results and those discussed

[39]The exact procedure followed was to estimate two new versions of equations 5 and 6, with the composite wage and price variables from the perfect certainty model added to each. Then two F-tests were applied to each equation. The first tested the null hypothesis that the coefficients of all the variables not belonging to the perfect certainty model -- i.e., the unemployment rate and the composite wage and price variables from the expected utility model -- were zero. This hypothesis is equivalent to the hypothesis that the perfect certainty model is correct. The second test was of the null hypothesis that all variables not belonging to the expected utility model have zero coefficients; in other words, that the expected utility model is correct.

above, then, one can conclude that the expected utility model does a better job of explaining migration behaviour than does the perfect certainty model, and that consequently unemployment rates do influence migration.

E. Migration and Expectations

One implicit assumption underlying equations 1 to 3 and 5 to 7 is that individuals have perfect information about wages, prices, and other variables in all provinces. In fact, since the data on these variables are published with a time lag, this may be an excessively strong assumption. Equations 4 and 8 represent a crude attempt to test an alternative hypothesis about the information available to potential migrants, namely, that migrants' expectations are based on the previous period's values of the independent variables.[40] All the independent variables were lagged one period in these equations. However, a comparison of equations 3 and 7 with equations 4 and 8 reveals little difference in the parameter values. Two alternative explanations can be given for this result: first, that individuals have fairly accurate information about conditions in other regions, perhaps obtained from friends and relatives; and second, that using lagged independent variables has no discernible effect on the parameter estimates because the relative attractiveness of the different regions does not change much from year to year. If the latter explanation is correct, it would be impossible to determine whether or not current values of the explanatory variables are the most appropriate indicators of the conditions in different regions. In the absence of a more sophisticated mechanism describing the formation of individuals'

[40]Note that equations 4 and 8, like equations 3 and 7, use data from the Provincial Economic Accounts to measure government spending in each province. The effect of lagging the independent variables could have not been examined using data from the alternative source without changing the sample period of the estimating equation, since those data are not available prior to 1962.

expectations, current values might as well be used. One of the advantages of this choice is that it maintains the simultaneity between migration and wages; equations 4 and 8 imply that the relationship between migration and wages is recursive.

F. The Effect of Varying the Denominator of the Log-Odds Ratio

As was noted earlier, this study differs from others which estimate log-odds models of interprovincial migration in Canada in that it does not put the province of origin in the denominator of the log-odds ratio. Instead, Ontario was the alternative that was placed in the denominator of the ratio. Ontario was chosen because it is a large province that has generally been one of the more popular destinations of interprovincial migrants, and because using the same province k in the denominator of the log-odds ratio for all observations at time t simplifies the programming of the variance-covariance matrix. Since this choice represents a departure from the previous literature, it is important to determine its effect, if any, on the results.

If the model had been estimated using maximum likelihood methods, it would not matter which alternative k appeared in the denominator of the log-odds ratio. But this model was estimated using GLS, and GLS is only asymptotically equivalent to maximum likelihood estimation. In order to obtain maximum likelihood estimates of the parameters, one must iterate the GLS procedure.

However, in this particular model the structure of the variance-covariance matrix makes it unlikely that iterated GLS estimation will converge. In fact, Oberhofer and Kmenta (1974) have shown that iterated Aitken estimators will not converge if the variance-covariance matrix contains elements of the parameter vector. Here the variance-covariance matrix depends on the expected values of the migration rates, which in turn depend on the unknown parameters of the model. Though the observed migration rates are used in place of the expected values to obtain a first estimate of the variance-covariance matrix, it would be more appropriate to use the predicted values of the model in subsequent iterations. Since this step would introduce elements of the parameter vector into the variance-covariance matrix, iterating GLS will not lead to maximum likelihood estimates in this model. If this link between the parameters of the migration rate equation and the elements of the variance-covariance matrix did not exist, one would expect iterated GLS estimation to converge to the same vector of parameter estimates regardless of the choice of denominator for the log-odds ratio.

Since the parameter estimates will be affected by the choice of denominator, and since this study's choice differs from that of all others, it is important to examine how the parameter estimates are affected. Parameter estimates for the expected utility model with seven different choices of denominator are presented in table VII. The qualitative results regarding prices, degree days, distance and government spending on health are unchanged, although the exact magnitude of the estimates does depend on the choice of k. The qualitative results with respect to the probability of unemployment are also fairly robust -- the coefficient of this variable is negative and significant in all equations except that with Saskatchewan in the denominator of the log-odds ratio. Similarly, the coefficient of other government spending is positive and significant except when Ontario is in the denominator of the log-odds ratio.

However, for the remaining coefficients the results are quite mixed. The coefficient of the wage variable is positive and significant only when Newfoundland, Ontario, and Saskatchewan appear in the denominator of the log-odds ratio.

TABLE VII

EFFECT OF VARYING THE DENOMINATOR OF THE LOG-ODDS RATIO

	NFLD	QUE	ONT	SASK
Prices	0.827	1.799	0.361	0.743
	(8.584)	(15.886)	(3.394)	(7.336)
Wages	7.944	-7.738	12.984	7.112
	(6.356)	(-5.086)	(9.525)	(5.891)
Government spending				
Health	0.682	0.633	0.895	0.246
	(7.198)	(6.327)	(9.760)	(3.587)
Social services	-0.152	-0.366	-0.286	-0.084
	(-3.261)	(-6.540)	(-6.233)	(-1.622)
Education	0.021	-0.161	0.498	0.103
	(0.206)	(-1.307)	(4.755)	(1.002)
Other spending	0.245	0.287	-0.321	0.594
	(3.392)	(3.126)	(4.547)	(7.950)
Degree days	2.986	2.732	5.236	4.053
	(32.776)	(25.054)	(63.551)	(46.562)
Distance	-0.695	-0.974	-0.503	-0.870
	(-23.320)	(-25.536)	(-15.666)	(-29.659)
Move/stay dummy	0.892	-0.604	1.774	-0.267
	(4.547)	(-2.451)	(8.392)	(-1.397)
Unemployment rate	-0.303	-0.444	-0.852	0.014
	(-5.836)	(-6.502)	(-15.307)	(0.310)
R^2	0.967	0.955	0.966	0.974
F-statistic	5269.0	3823.0	5120.0	6623.0

TABLE VII

(CONTINUED)

	ALTA	BC	ORIGIN
Prices	0.919	1.032	0.928
	(9.029)	(10.198)	(9.257)
Wages	-3.169	2.543	0.271
	(-2.160)	(1.827)	(0.193)
Government spending			
Health	0.941	0.721	0.618
	(8.212)	(6.921)	(8.167)
Social services	-0.57	-0.290	0.020
	(-0.847)	(-5.063)	(0.415)
Education	0.714	0.313	0.411
	(6.470)	(2.599)	(4.727)
Other spending	1.133	0.480	0.165
	(15.506)	(6.946)	(2.743)
Degree days	1.739	3.524	2.145
	(18.892)	(47.679)	(22.774)
Distance	-0.902	-0.708	-0.679
	(-23.550)	(-19.833)	(-19.535)
Move/stay dummy	-0.768	0.436	1.257
	(-3.008)	(1.843)	(5.566)
Unemployment rate	-0.514	-0.285	-0.234
	(-8.024)	(-4.730)	(-6.126)
R^2	0.953	0.959	0.982
F-statistic	3599.0	4167.0	9861.0

When k is set equal to the province of origin or British Columbia the coefficient is insignificant, and in the remaining two cases it is significant but negative. Similarly mixed results are obtained for the coefficients of government spending on social services and education and the dummy variable.

Given the importance to the model of the wage and government spending variables, these mixed results are worrisome. One way to eliminate the confusion would be to apply maximum likelihood estimation directly to the migration rate equation implicit in equation (2.17), which is

$$M_{ij} = \left[\exp\left(V_{ij} + \theta_{ij}\right) \Big/ \sum_{k=1}^{J} \exp\left(V_{ik} + \theta_{ik}\right) \right] \cdot \left(M_{ij} \,/\, P_{ij}\right) . \tag{4.1}$$

The problem with this option is that M_{ij} is a very nonlinear function of the random variables $\theta_{i1}, \ldots, \theta_{iJ}$ and the approximation error (M_{ij} / P_{ij}), and deriving the model's likelihood function would be a difficult task. A more fruitful approach would probably be to modify the error structure of the model before attempting maximum likelihood estimation. In the meantime, the dependence of the parameter estimates on the choice of a denominator for the log-odds ratio must be kept in mind when evaluating the estimation results. For those parameters for which the qualitative results were unchanged when k was altered, one can be reasonably sure of the results. However, for the remaining parameters, some of which were the coefficients of particularly important explanatory variables, the results must be interpreted with caution.

G. The Stability of the Parameter Estimates over Time

It is an implicit assumption in many econometric models that the values of the parameters to be estimated remain constant over time. Here too this assumption has been made. But in fact, like the structural parameters of other models, the parameters of the representative consumer's utility function may change over time, and therefore the assumption of time-invariant parameters should be treated as a hypothesis to be verified by the data.

In the interprovincial migration context, Shaw (1986) specifically sets out to test the hypothesis that

> the influence of traditional market variables has diminished over time because of a crowding-out process whereby (i) higher standards of living and the pursuit of leisure may have dampened the response of migrants to labour market forces, (ii) growth of social security programs has cushioned the effect of, say, unemployment and thus motivation to migrate for work, and (iii) fiscal policies have exerted unintended effects.[41]

To test this hypothesis, Shaw uses four sets of census estimates of migration during the periods 1956-61, 1966-71, 1971-76, and 1976-81. He estimates each version of his model using the pooled data set (1956-81), and the pre-1971 and post-1971 subsamples. The year 1971 is viewed as a logical point for a break in the sample because it is the year in which the unemployment insurance program was expanded and equalization payments to the less wealthy provinces were increased. His test of the hypothesis of parameter change consists of comparing the parameter values and their significance levels and the behaviour of the explanatory variables pre- and post-1971.[42] He concludes that the evidence supports his hypothesis, though as was indicated in chapter I there are some ambiguities in the interpretation of his results. It would be interesting to see whether his hypothesis would be accepted or rejected by the continuous time series data on migration used here.

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[41]Shaw (1986), p. 650.

[42]Shaw does not seem to carry out any formal statistical tests of the equality of the two sets of regression coefficients.

Shaw's crowding-out hypothesis can be divided into two parts: (i) that the parameters of the utility function have shifted over time in such a manner as to increase the relative importance of public goods in the utility function; and (ii) that fiscal variables have grown much faster than traditional market variables during the sample period, and thus their effects on migration have increased relative to those of traditional market variables such as wages and unemployment rates. Here the discussion will focus on the first part of the hypothesis. As a first step, it was decided to gradually increase the data set from one to twenty years to see if the resulting parameter estimates showed any kind of trend. This procedure can also help to identify outlying data points, as such points will cause large shifts in the parameter values as they are added to the data set. The expected utility model with four government expenditure variables was chosen for this experiment. First OLS estimation was applied to the complete data set, and the residuals were used to obtain an estimate of the model's variance-covariance matrix. This estimate of the covariance matrix was then used to transform the data. Finally, OLS estimation was applied to the transformed data, beginning with one year's worth of data. New parameter estimates were obtained as the data set was gradually increased by one year at a time. This procedure was carried out with both Ontario and the province of origin in the denominator of the log-odds ratio.

The variables in equation (2.26) which correspond most closely to Shaw's traditional labour market variables are the price variable, the wage variable, and the unemployment rate. The parameter estimates for these three variables and the four provincial government expenditure variables have been plotted in figures 1 to 7, with the labels "Ontario" and "Origin" indicating which province appears in the denominator of the log-odds ratio.[43] If Shaw's hypothesis were correct, one would expect to see a downward trend in the magnitude of the coefficients of prices, wages, and the unemployment rate, and an upward trend in the magnitude of those of the government expenditure variables. While the behaviour of some of the coefficients seems to conform to this pattern, that of others does not. Turning first to figure 1, one can see that regardless of the choice of denominator for the log-odds ratio, the behaviour of the coefficient of the wage rate tends to support Shaw's hypothesis. The value of this coefficient clearly falls as the sample period is extended, from a peak of 22.209 in 1964 to a low of 12.984 in 1981 when Ontario is in the denominator of the log-odds ratio.[44] However, the coefficients of the price and unemployment rate variables behave somewhat differently. The coefficient of the price variable, shown in figure 2, rises initially but then declines during the latter part of the sample period. The decline begins in 1969 when the province of origin is in the denominator of the log-odds ratio, and in 1973 when Ontario is in the denominator. Both the timing and direction of this change tend to support Shaw's core hypothesis.

The coefficient of the unemployment rate, shown in figure 3, behaves in a fashion similar to that of the coefficient of the price variable: it rises during the early part of the sample period, and then declines. But because the coefficient is negative, the interpretation of this behaviour is different. As the coefficient falls after 1973 it increases in absolute value, implying that the influence of unemployment rates on migration is increasing.

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[43]The regression results are presented in tables XVII and XVIII in appendix 3, along with plots of the estimates of the other three parameters.

[44]Though the coefficient of the wage rate is always significantly different from zero when Ontario is in the denominator of the log-odds ratio, it is never significant when the province of origin is in the denominator.

FIGURE 1
COEFFICIENT OF WAGE VARIABLE
FORWARD REGRESSIONS

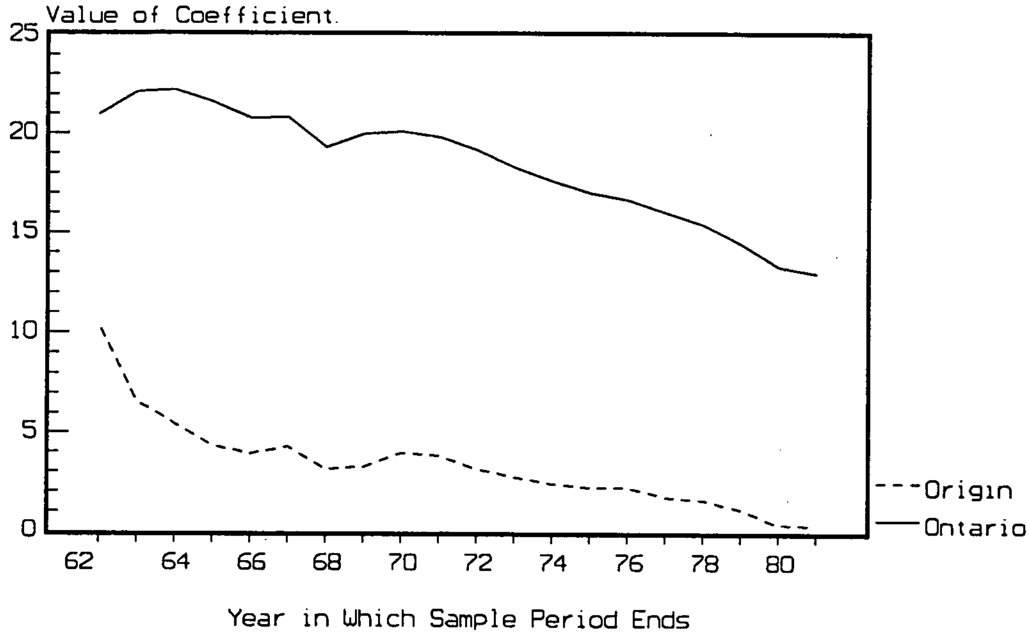


FIGURE 2
COEFFICIENT OF PRICE VARIABLE
FORWARD REGRESSIONS

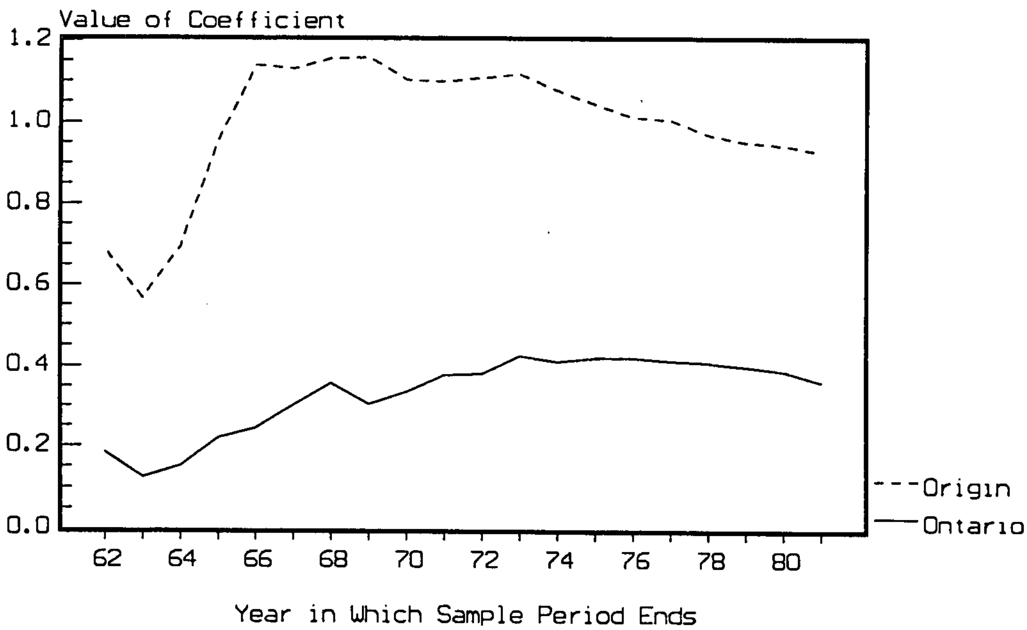


FIGURE 3
COEFFICIENT OF UNEMPLOYMENT RATE
FORWARD REGRESSIONS

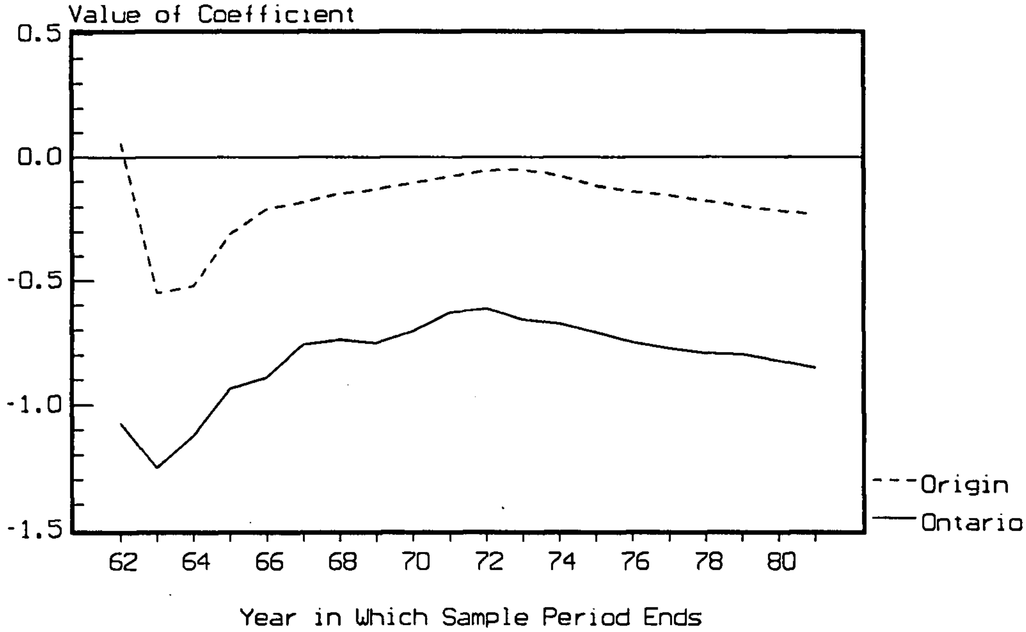


FIGURE 4
COEFFICIENT OF LOCAL PUBLIC
EXPENDITURES ON HEALTH
FORWARD REGRESSIONS

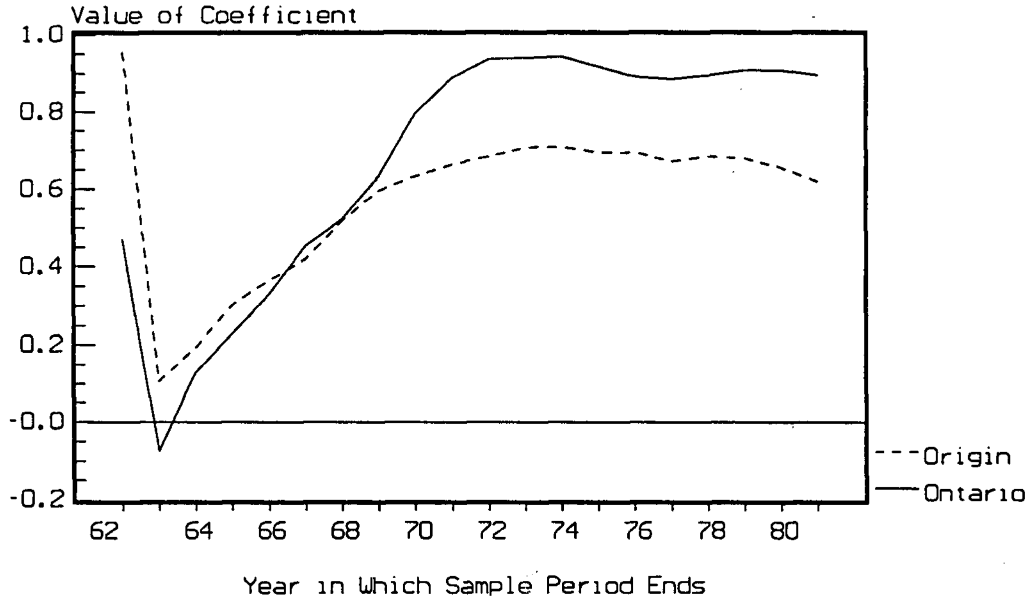


FIGURE 5
COEFFICIENT OF LOCAL PUBLIC
EXPENDITURES ON EDUCATION
FORWARD REGRESSIONS

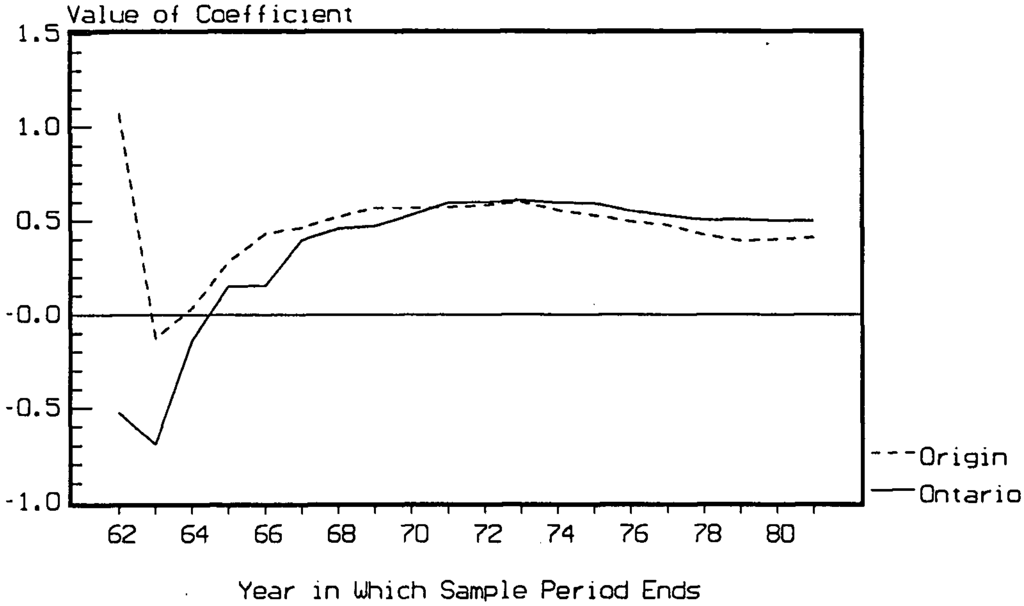


FIGURE 6
COEFFICIENT OF LOCAL PUBLIC
EXPENDITURES ON SOCIAL SERVICES
FORWARD REGRESSIONS

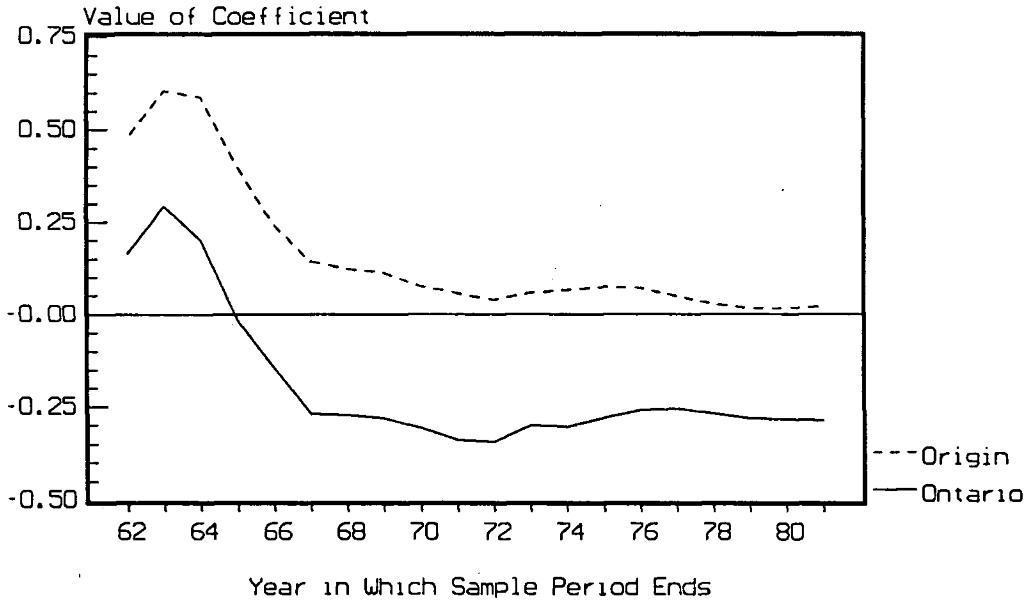
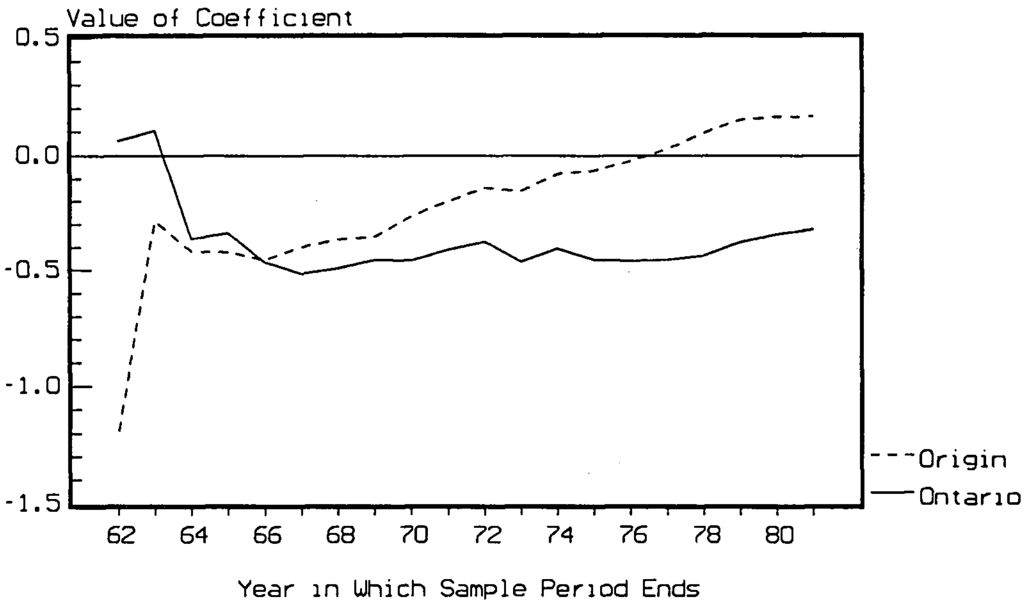


FIGURE 7
COEFFICIENT OF LOCAL PUBLIC
EXPENDITURES ON ALL OTHER GOODS
FORWARD REGRESSIONS



The coefficients of the four government expenditure variables are plotted in figures 4 to 7. The coefficients of local public expenditures on health and education behave in a very similar fashion: they rise through most of the sixties and early seventies, and then level off, with a slight decline in the latter part of the sample period.[45] With the exception of the slight decline in the last few years, this behaviour is consistent with Shaw's hypothesis. The coefficient of government spending on social services becomes significantly different from zero in 1967 when Ontario is in the denominator of the log-odds ratio, but does not display much of a trend thereafter. When the province of origin is placed in the denominator of the log-odds ratio the coefficient appears to be getting smaller in magnitude as the sample period increases, and in fact it is not significant after 1966. It is also difficult to interpret the changes in the coefficient of other government spending, since it seems to move in opposite directions depending on which province appears in the denominator of the log-odds ratio. In general, the behaviour of the coefficients of these last two components of provincial government spending neither supports nor contradicts Shaw's core hypothesis.

Thus on balance, the forward regression results provide partial support for the hypothesis that there has been a shift in tastes from private to public goods during the sample period. The behaviour of the coefficients of the price variable, the wage variable, government spending on health, and government spending on education does tend to support the hypothesis. However, the behaviour of the coefficients of the unemployment rate and the other two government spending variables does not. Furthermore, the forward regression estimates do not support Shaw's contention that this change in preferences took place largely after 1971.

[45]Prior to 1967, these coefficients are generally not significantly different from zero.

Instead, they indicate that the coefficient of the wage rate declined fairly steadily from 1963, while most of the increase in the coefficients of government spending on education and health took place prior to 1971. These observations suggest that the post-1971 changes in the UI Act and equalization payments could not have been responsible for the shift in preferences.

In another attempt to identify trends in the coefficient estimates, the model was re-estimated using one year of data at a time. Each annual subset of the data set contains ninety observations, which is a sufficiently large sample size to obtain reasonable estimates of the parameters. GLS estimation was applied to each subset, with Ontario in the denominator of the log-odds ratio, and the results for the traditional labour market variables and the fiscal variables are plotted in figures 8 to 11.[46] The main feature of these results is the extreme volatility of the parameter estimates. For some of the coefficients -- those of prices, wages, and government spending on health, social services, and education -- this volatility is particularly marked during the latter half of the sample period.

With the exception of the coefficient of the wage variable, it is difficult to discern a trend in the annual estimates of any of the parameters. As in the forward regressions, the coefficient of the wage variable does seem to be decreasing over time. It remains positive until 1976, but then negative values begin to appear. However, these negative values are both large and significant

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[46]The results of the annual regressions are also presented in tabular form in appendix 3. There was some difficulty in carrying out GLS estimation for two of the years in the sample, 1968 and 1975. In both these years, the estimate of the variance-covariance matrix of the random error μ was not positive definite. Parks (1980) suggests two options in the event that this situation should arise: to replace the observed migration rates with their predicted values based on the OLS parameter estimates, or to subtract from S a multiple δ of the mean of the covariance matrices of the approximation errors. In the second case the second option was followed by setting δ equal to zero. In the first case, nothing was done since the sum of the two covariance matrices was positive definite.

FIGURE 8
COEFFICIENT OF WAGE VARIABLE
ANNUAL REGRESSIONS

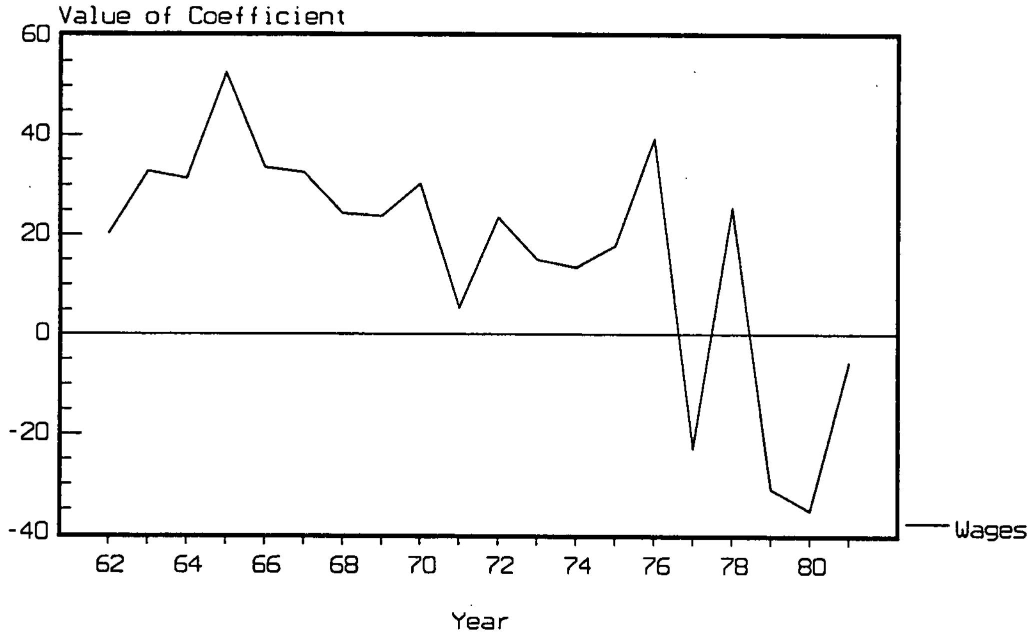


FIGURE 9
COEFFICIENT OF PRICE VARIABLE
ANNUAL REGRESSIONS

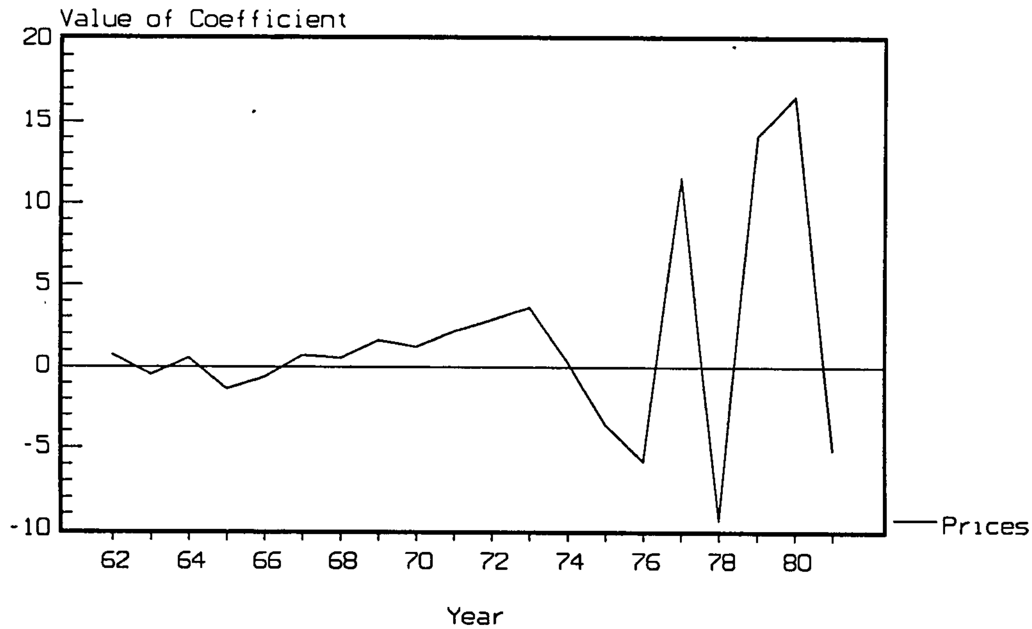
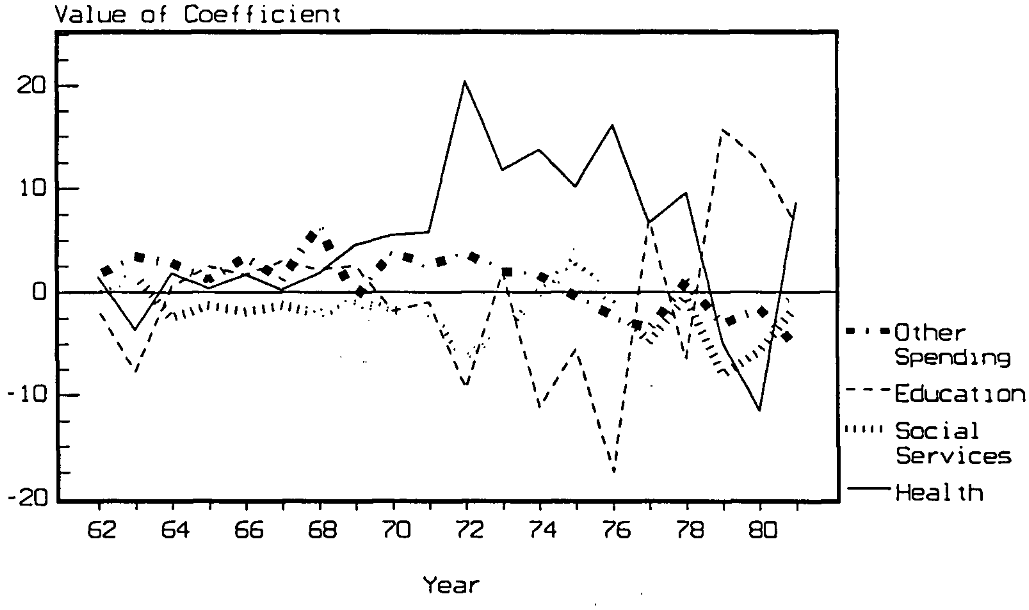


FIGURE 10
COEFFICIENT OF UNEMPLOYMENT RATE
ANNUAL REGRESSIONS

FIGURE 11
COEFFICIENTS OF GOVERNMENT
EXPENDITURE VARIABLES
ANNUAL REGRESSIONS



(except in 1981), so one cannot infer much about the size of the wage rate's impact on migration from these changes. In 1980, for example, the coefficient of the wage rate was larger in absolute value than in any other year except 1965 and 1976.

Finally, it was decided to carry out a formal statistical test of the hypothesis that a structural break occurred in 1971. The procedure for doing so consisted of several steps: first, OLS estimation was carried out using the entire sample; second, the residuals from the OLS regression were used to construct an estimate of the variance-covariance matrix of the model; third, the matrix P such that P'P equals the inverse of the estimate of the variance-covariance matrix was used to transform the entire data set; and fourth, OLS was applied to two subsets of the transformed data set -- 1962-1971 and 1972-1981 -- and a Chow test was performed.[47]

The result of the test, displayed in table VIII along with the pre- and post-1971 parameter estimates, indicates that the hypothesis that the two sets of parameter estimates are different cannot be rejected.[48] As for the changes in the parameter estimates, there is not a great deal of support for the hypothesis that preferences have changed so as to favour fiscal variables. The coefficient of the wage variable falls dramatically, from 25.869 to an insignificant 0.726, the coefficient of government spending on health rises from 1.188 to 2.07, and the coefficient of other government spending increases in absolute value from 0.610 to 0.899. But the changes in the other coefficients tend to contradict the

[47]Ontario was placed in the denominator of the log-odds ratio.

[48]The parameter estimates that appear in table VIII are not those that were produced by the procedure described in the previous paragraph. Instead, they were produced by dividing the untransformed data set into two parts and applying GLS to each part.

TABLE VIII

PRE- AND POST-1971 PARAMETER ESTIMATES

	1962-1971	1972-1981	1962-1981
Prices	0.192	0.534	0.361
	(1.253)	(2.104)	(3.394)
Wages	25.869	0.726	12.984
	(11.114)	(0.461)	(9.525)
Government spending			
Health	1.188	2.074	0.895
	(12.018)	(9.059)	(9.760)
Social services	-0.973	-0.719	-0.286
	(-13.947)	(-6.102)	(-6.233)
Education	1.737	1.185	0.498
	(14.468)	(5.733)	(4.755)
Other spending	0.610	-0.899	-0.321
	(4.381)	(-8.370)	(-4.547)
Degree days	4.464	4.315	5.236
	(39.127)	(32.588)	(63.551)
Distance	-0.216	-0.779	-0.503
	(-3.905)	(-20.915)	(-15.666)
Move/stay dummy	3.460	0.153	1.774
	(9.667)	(0.618)	(8.392)
Unemployment rate	0.240	-1.118	-0.852
	(2.722)	(-15.568)	(-15.307)
R^2	0.968	0.972	0.966

Chow test: $F(10, 1780) = 5.97$

hypothesis rather than support it. For example, the coefficient of government spending on social services declines in absolute value from 0.973 to 0.719, while the coefficient of prices rises from 0.192 to 0.534.

Together with the results of the forward and annual regressions, the results in table VIII tend to support the hypothesis that the parameters of the migration function have not been stable over time. However, though the results do indicate a decline in the importance of leisure in the utility function, there is not enough evidence to support the hypothesis that there has been a shift in preferences from private to public goods since 1971. If a crowding-out effect does exist, as Shaw (1986) suggests, the effect is largely due to the rapid growth of fiscal variables since 1971, rather than a shift in individual preferences.

H. The Within-Sample Predictive Power of the Model

The values of R^2 that appear in tables II and IV range between 0.963 and 0.969, suggesting that the model does a good job of explaining the variation in the data. However, because the model in fact consists of ninety equations whose parameters have been constrained to be identical, it would be wise to look a little more closely at the fit of the model. Some of the ninety equations may actually fit quite poorly, but have little effect on the aggregate R^2 because they account for only a small proportion of the total variation of the dependent variable. Furthermore, R^2 has been calculated using the transformed data, not the actual data. Since the model's covariance matrix must be estimated, the model may not fit the untransformed data as well as it fits the transformed data. In any case, it would be a good idea to check the fit of the individual equations to see which, if any, do not fit well.

For this exercise it was decided to calculate the coefficient of correlation between actual and fitted values, which is defined by

$$r_{XY} = \sigma_{XY} / (\sigma_X \sigma_Y) ,$$

where σ_{XY} is the covariance between the random variables X and Y, σ_X is the standard deviation of X, and σ_Y is the standard deviation of Y. This measure was chosen because it always lies in the interval [-1, 1], whereas the value of R^2 for the individual equations does not have a lower bound. Correlation coefficients were calculated for gross migration rates and flows, as well as for net migration. If there are errors in the prediction of the gross flows, these errors may be compounded when they are aggregated to obtain estimates of net migration.

Table IX contains the correlation coefficients for the 100 gross migration rates, while table X contains the correlation coefficients for the corresponding gross migration flows. The parameter estimates used were those for equation 6, the expected utility model with four government expenditure variables and Ontario in the denominator of the log-odds ratio. For purposes of comparison an overall correlation coefficient for each set of data was also computed. Like the R^2 values in tables II and IV, the overall correlation coefficients for the gross migration rates and flows are high, in excess of .99.[49] However, the values for the individual equations are much lower. Only for the flows of stayers (rather than the rates) are the correlation coefficients greater than 0.9. For some destinations, in particular Newfoundland, Prince Edward Island, Alberta, and British Columbia, migration flows seem to be predicted better than migration rates. The same is true of outflows from Ontario, Alberta, and British Columbia. The difference between the correlation coefficients for the migration rates and flows can be

[49]To be directly comparable to R^2, the correlation coefficients in table IX would have to be squared. They have not been squared here because to do so would mask undesirable negative values.

TABLE IX

CORRELATIONS BETWEEN ACTUAL AND FITTED VALUES
OF GROSS MIGRATION RATES -- EQUATION 6

	Destination				
Origin	NFLD	PEI	NS	NB	QUE
NFLD	-0.29	0.01	-0.06	-0.27	0.19
PEI	-0.20	0.52	0.05	0.12	0.34
NS	0.05	0.04	0.09	-0.24	-0.22
NB	0.02	-0.14	0.00	0.06	-0.22
QUE	-0.36	-0.04	0.27	-0.04	0.30
ONT	0.73	0.09	-0.06	0.02	-0.70
MAN	0.17	0.22	0.12	0.31	-0.03
SASK	0.50	0.68	0.57	0.52	-0.65
ALTA	0.10	0.56	0.26	-0.06	-0.40
BC	0.43	0.03	-0.22	0.52	0.02

	Destination				
Origin	ONT	MAN	SASK	ALTA	BC
NFLD	0.14	-0.08	-0.12	-0.04	-0.05
PEI	0.73	0.04	0.01	-0.22	0.24
NS	0.72	0.10	0.21	0.51	0.04
NB	0.55	0.34	-0.18	0.35	-0.07
QUE	0.40	0.13	0.64	0.30	-0.15
ONT	0.55	-0.23	0.70	0.80	0.47
MAN	0.72	0.34	0.62	0.10	0.11
SASK	0.46	-0.23	0.14	0.07	-0.08
ALTA	-0.10	0.28	0.57	0.20	0.03
BC	0.69	0.27	0.54	0.36	0.55

Overall correlation coefficient: 0.9992

TABLE X

CORRELATIONS BETWEEN ACTUAL AND FITTED VALUES
OF GROSS MIGRATION FLOWS -- EQUATION 6

	Destination				
Origin	NFLD	PEI	NS	NB	QUE
NFLD	0.95	-0.01	-0.35	-0.34	-0.08
PEI	-0.16	0.98	-0.15	-0.04	0.19
NS	0.33	0.20	1.00	-0.49	-0.43
NB	0.17	0.01	-0.12	0.96	-0.36
QUE	-0.39	0.01	0.09	-0.20	1.00
ONT	0.80	0.43	0.47	0.40	-0.66
MAN	0.24	0.23	0.17	0.31	-0.15
SASK	0.48	0.68	0.56	0.51	-0.65
ALTA	0.35	0.72	0.50	0.26	0.00
BC	0.60	0.33	0.21	0.63	0.30

	Destination				
Origin	ONT	MAN	SASK	ALTA	BC
NFLD	-0.01	0.03	-0.19	0.13	0.13
PEI	0.67	-0.04	-0.07	-0.09	0.29
NS	0.61	0.21	0.15	0.65	0.23
NB	0.43	0.34	-0.13	0.47	0.15
QUE	0.29	-0.04	0.54	0.51	0.07
ONT	1.00	0.27	0.70	0.85	0.71
MAN	0.67	0.99	0.47	0.23	0.12
SASK	0.46	-0.25	0.91	0.10	-0.08
ALTA	-0.09	0.57	0.15	1.00	0.67
BC	0.55	0.42	0.22	0.74	1.00

Overall correlation coefficient: 0.9999

explained by the changes in population during the sample period.

In light of the low correlation coefficients for most gross flows of migrants, it is not surprising that the model predicts net migration poorly as well. The overall correlation coefficient for net migration is only 0.36, and the highest coefficient for an individual flow is 0.77 for Ontario. The latter is comparable to an R^2 value of 0.59. In general, it seems that the model does a very poor job of predicting migration rates and flows during the sample period.

Why does the model have so little predictive power even during the sample period? The first possibility is that the model's poor fit is a result of the fact that the parameter estimates are not maximum likelihood estimates. The GLS estimation technique minimizes the sum of squared errors of an equation that has been transformed using an estimate of the model's variance-covariance matrix, not the sum of squared errors of the original estimating equation. Thus the transformed dependent variable may be predicted better than its untransformed counterpart. However, table XI shows that this is not the case. Of the ninety untransformed log-odds ratios that make up the model, forty-five had correlation coefficients in excess of 0.5, while only thirty-two of the transformed log-odds ratios had correlation coefficients greater than 0.5.

Another possibility is that the model may be misspecified. One possible source of misspecification is the assumption that the parameters of the utility function are the same for all provinces of origin. This assumption derives from the hypothesis that an individual's utility function will not change when he or she moves. However, it may be less valid in aggregate. All individuals have different utility functions, and it is possible that the aggregate representation of the preferences of the population of province i may differ from that of the population of province j.

TABLE XI

SUMMARY OF CORRELATIONS BETWEEN ACTUAL AND FITTED VALUES OF LOG-ODDS RATIO -- EQUATION 6

Value of correlation coefficient	Frequency	
	Transformed	Untransformed
0.8-1.0	7	12
0.7-0.8	9	13
0.6-0.7	7	12
0.5-0.6	9	8
0.4-0.5	12	9
0.3-0.4	7	12
0.2-0.3	6	7
0.1-0.2	9	6
0-0.1	3	9
< 0	21	21
> 0.5	32	45

The null hypothesis that the parameters of the indirect utility function are the same for all provinces of origin can easily be tested by means of a Chow test. The test was carried out in much the same manner as the test for a structural break in 1971. First, an OLS estimate of the error vector for the pooled data set was obtained and used to create an estimate of the variance-covariance matrix. Then the data were transformed, and OLS was applied to ten subsets of the transformed data set, one for each province of origin. The resulting F-value, with 90 and 1700 degrees of freedom, was 118.025, which indicates that the null hypothesis must be rejected.

Since the null hypothesis of identical parameters for each province of origin was rejected, the model was re-estimated with the restriction removed. A separate migration function was estimated using GLS for each province of origin, thereby increasing the number of parameters in the model from ten to one hundred. New fitted values were generated, and the resulting new correlation coefficients are presented in table XII.[50]

Normally one would expect that an increase of this magnitude in the number of parameters would improve the within-sample predictive power of the model. However, in this case there is no obvious improvement in the correlation coefficients. Though some do improve, others deteriorate. These results indicate that restricting the coefficient estimates to be the same for all provinces of origin is not responsible for the model's poor fit.

Yet another possibility is that the assumption that the parameter estimates do not vary over time is too restrictive. In fact, in the previous section the parameter estimates were shown to be quite unstable over time. To see if allowing the parameter estimates to vary over time would improve the fit, the annual

[50]The new parameter estimates will be discussed in the next section.

TABLE XII

CORRELATIONS BETWEEN ACTUAL AND FITTED VALUES OF GROSS MIGRATION RATES -- PROVINCE OF ORIGIN REGRESSIONS

	Destination				
Origin	NFLD	PEI	NS	NB	QUE
NFLD	-0.23	0.00	-0.02	-0.28	0.28
PEI	0.24	0.55	0.20	0.12	-0.02
NS	-0.02	-0.08	0.29	0.39	-0.68
NB	-0.02	-0.25	-0.43	-0.33	-0.58
QUE	0.21	0.20	-0.52	-0.46	-0.31
ONT	0.05	0.21	-0.64	-0.35	-0.58
MAN	0.25	0.01	-0.02	0.02	0.00
SASK	0.49	0.59	0.56	0.57	-0.66
ALTA	0.33	0.74	0.31	0.26	0.04
BC	0.39	0.38	0.57	-0.15	0.59
	Destination				
Origin	ONT	MAN	SASK	ALTA	BC
NFLD	0.13	-0.16	-0.15	-0.23	-0.18
PEI	0.67	0.32	0.16	-0.21	-0.23
NS	0.71	-0.19	-0.12	0.19	0.01
NB	0.51	0.16	0.13	0.24	-0.24
QUE	-0.20	-0.37	0.59	0.56	-0.04
ONT	0.49	-0.17	0.33	0.88	0.53
MAN	0.73	0.45	0.64	0.35	0.12
SASK	0.39	-0.29	-0.06	-0.09	-0.23
ALTA	0.04	0.20	0.42	0.50	0.21
BC	0.35	0.23	0.33	-0.23	0.10

Overall correlation coefficient: 0.9999

parameter estimates from appendix 3 were used to generate new predicted values. The resulting correlation coefficients are presented in table XIII. However, they too do not appear to be much better than those in tables IX and XI. Therefore the assumption of parameter stability over time cannot be the source of the problem either.

Thus far three possible explanations for the poor predictive power of the model have been considered and found to be inadequate. Table XIV provides a convenient summary of tables IX, XII, and XIII that aids in drawing comparisons between the ten parameter, one hundred parameter, and two hundred parameter versions of the model. It shows that equation 6 from table IV, with only ten parameters, performs as well or better than versions of the model with ten or twenty times as many parameters. Equation 6 is able to predict twenty-one of the one hundred migration rates with a correlation between actual and fitted values that is greater than 0.5. Increasing the number of parameters by allowing them to vary with the province of origin or the year does not improve this number.

No doubt the omission of some important explanatory variables is partly to blame for the model's poor fit. No attempt was made to model expectations, and variables such as age, level of education, and language, which have been shown to influence migration in other studies, were not included here. However, the data themselves may also contribute to the problem. Unless the data exhibit sufficient variation both across migration flows and over time, the estimated model will not be able to predict individual migration rates very well. Though each individual migration rate varies over time, when the data are pooled the intertemporal variation may be overwhelmed by the cross-section differences.

The analysis of variance provides a useful method of dividing the variation

TABLE XIII

CORRELATIONS BETWEEN ACTUAL AND FITTED VALUES OF GROSS MIGRATION RATES -- ANNUAL REGRESSIONS

	Destination				
Origin	NFLD	PEI	NS	NB	QUE
NFLD	0.23	0.17	-0.29	0.12	0.06
PEI	0.18	-0.26	0.19	-0.09	-0.02
NS	0.45	0.14	0.26	0.46	0.31
NB	0.09	0.16	-0.58	-0.29	-0.03
QUE	-0.17	-0.05	-0.25	0.38	0.41
ONT	0.42	0.10	0.20	0.42	0.16
MAN	0.22	0.40	0.67	0.27	0.23
SASK	0.03	0.20	0.22	0.22	-0.31
ALTA	-0.07	-0.01	0.20	-0.29	0.22
BC	0.45	0.51	-0.46	0.68	0.03

	Destination				
Origin	ONT	MAN	SASK	ALTA	BC
NFLD	0.57	0.32	0.11	0.76	0.32
PEI	0.30	-0.38	0.07	0.76	0.45
NS	0.55	-0.21	-0.05	0.79	0.23
NB	0.24	-0.34	0.46	0.86	0.13
QUE	0.47	-0.45	0.44	0.88	0.22
ONT	0.53	0.05	0.37	0.86	0.38
MAN	0.62	0.56	0.44	0.22	0.61
SASK	0.26	-0.29	0.14	0.16	0.61
ALTA	-0.13	0.35	0.35	0.00	0.08
BC	0.13	-0.05	0.47	0.62	0.38

Overall correlation coefficient: 0.9984

TABLE XIV

SUMMARY OF TABLES IX, XII, AND XII

Value of correlation coefficient	Frequency		
	Equation 6 (Table IV)	Province of origin regressions	Annual regressions
0 .8-1.0		1	3
0.7-0.8	6	3	3
0.6-0.7	4	2	6
0.5-0.6	11	10	5
0.4-0.5	5	5	12
0.3-0.4	7	11	11
0.2-0.3	8	11	15
0.1-0.2	12	10	13
0-0.1	16	7	8
< 0	31	40	24
> 0.5	21	16	17

in a pooled data set into its time-series and cross-section components. Given a set of T observations of K variables, the total variation in the data (SST) can be measured by the sum of squared deviations from the mean (μ) of the data set; i.e.,

$$SST = \sum_{k=1}^{K} \sum_{t=1}^{T} (y_{kt} - \mu)^2 ,$$

where y_{tk} is element tk of the data set. This sum of squared deviations can be divided into two parts: the between-group variation (SSH), and the within-group variation (SSE). These two components are defined as follows:

$$SSH = \sum_{k=1}^{K} T(\mu_k - \mu)^2 ,$$

and

$$SSE = \sum_{k=1}^{K} \sum_{t=1}^{T} (y_{kt} - \mu_k)^2 ,$$

where

$$\mu_k = \frac{1}{T} \sum_{t=1}^{T} y_{kt} .$$

The usual problem in analysis of variance is to test whether the group means μ_k, k=1,..., K, are identical. Here, however, it is simply the shares of cross-section (SSH) and time-series (SSE) variation in the total variation (SST) that are of interest. First the decomposition was applied to the data used to estimate the expected utility model with four government expenditure variables, with both

Ontario and the province of origin in the denominator of the log-odds ratio. The results can be found in table XV. They show that intertemporal variation accounts for less than 5% of the total variation in the dependent variable, the log-odds ratio. The small amount of intertemporal variation in this variable is a consequence of the even smaller amount of intertemporal variation in the migration rates. When a similar decomposition was applied to the migration rate data, it was found that intertemporal variation accounts for less than 0.01% of the total variation. The failure of the province of origin regressions to perform any better can be attributed to the same cause, as the cross-section variation between out-migration rates from each province of origin also overwhelms the intertemporal variation. For each of the ten provinces of origin, the cross section variation accounted for 95% of the total variation in the migration data.

Not only does the dependent variable exhibit relatively little variation over time, half of the explanatory variables do as well. Three of these variables, degree days, distance, and the move/stay dummy variable, were defined to be constant over time. The small proportion of intertemporal variation in the other two, the wage and unemployment rate variables, reflects the fact that regional disparities in wages and unemployment rates in Canada have been fairly constant over time.

The price and government expenditure variables, on the other hand, display a much higher proportion of intertemporal variation, ranging from 68 to 33 per cent. The importance of intertemporal variation in these variables seems to decrease somewhat when the province of origin is substituted for Ontario in the denominator, but it still remains quite a bit greater than that of the other variables. The relatively high degree of intertemporal variation of these variables explains the volatility of the parameter estimates from the annual equations; if the dependent variable does not change much from year to year but some of the

TABLE XV

DECOMPOSITION OF SUMS OF SQUARED ERRORS OF VARIABLES IN EQUATION 6 INTO CROSS-SECTION AND TIME-SERIES VARIATION

	Per Cent of Total Variation			
	k = Ontario		k = Origin	
Variable	Cross-Section	Time-Series	Cross-Section	Time-Series
Log-odds ratio	99	1	96	4
Prices	52	48	67	33
Wages	97	3	94	6
Government spending				
Health	40	60	52	48
Social services	33	67	51	49
Education	32	68	53	47
Other spending	33	67	56	44
Degree Days	100	0	100	0
Distance	100	0	100	0
Move/no move dummy	100	0	0	0
Unemployment rate	78	22	87	13

explanatory variables do, then the parameter estimates will have to change as well.

Given the lack of intertemporal variation in the data, one might have expected the annual estimates to do a better job of predicting net migration than they did. But choosing a new set of parameter values for each year actually increases the influence of the cross-section variation, since each set of parameter estimates is fitted to the cross-section variation in a particular year. A more likely way to improve the fit of the model would have been to estimate a separate set of parameters for each migration flow, but this approach would be difficult to justify theoretically. It would also lead to violations of the adding-up constraint unless cross-equation restrictions were imposed on the parameters.

To summarize, it seems that the inability of the model to predict migration flows within the sample period can be traced to the relative lack of intertemporal variation in the pooled migration rate data set. This observation suggests that in order to improve the model's fit one would have to add to it more variables capable of explaining the cross-section differences between migration flows. Variables representing sociological and cultural factors, as well as the quality of life in each province, would be good candidates for inclusion. It is clear from the results that interprovincial differences in economic variables alone are not capable of explaining aggregate interprovincial migration in Canada.

I. Migration Functions for Each Province of Origin

In the previous section the fit of a model in which the parameter estimates varied with the province of origin was discussed. Here the parameter estimates for that model, which appear in table XVI, will be discussed. As one might expect, they reveal considerable differences between the provinces in both the sign

TABLE XVI

MIGRATION FUNCTIONS FOR EACH PROVINCE OF ORIGIN

	NFLD	PEI	NS	NB
Prices	0.906	-4.030	-1.524	-0.226
	(2.539)	(-13.258)	(-6.766)	(-0.765)
Wages	27.660	27.834	41.670	44.291
	(6.565)	(7.334)	(13.893)	(16.916)
Government spending				
Health	1.425	-0.064	0.867	0.766
	(6.992)	(-0.407)	(6.849)	(5.292)
Social services	-0.673	-0.914	-1.280	-0.634
	(-5.238)	(-8.104)	(-13.049)	(-7.762)
Education	0.788	0.588	0.368	0.788
	(3.178)	(3.074)	(2.417)	(4.538)
Other spending	-1.151	0.642	0.251	-0.093
	(-6.677)	(5.362)	(2.197)	(-0.836)
Degree days	7.369	5.037	5.848	6.374
	(33.864)	(43.319)	(46.832)	(45.097)
Distance	0.0854	-0.193	0.688	0.617
	(0.408)	(-2.827)	(10.167)	(10.315)
Move/stay dummy	8.558	3.277	9.090	9.990
	(5.922)	(8.699)	(21.625)	(25.256)
Unemployment rate	-1.427	-0.888	-0.232	-0.496
	(-9.970)	(-10.850)	(-2.534)	(-5.006)
R^2	0.982	0.993	0.996	0.995

TABLE XVI

(CONTINUED)

	QUE	ONT	MAN	SASK
Prices	2.392	1.884	0.553	0.260
	(8.713)	(13.162)	(2.732)	(1.282)
Wages	-99.262	-45.906	-25.530	-1.927
	(-28.009)	(-19.544)	(-4.174)	(-0.284)
Government spending				
Health	0.218	0.153	0.992	1.110
	(1.674)	(1.826)	(6.056)	(6.345)
Social services	0.114	-0.232	-0.293	-0.221
	(0.995)	(-3.445)	(-2.874)	(-2.001)
Education	0.536	0.022	1.277	0.506
	(3.388)	(0.242)	(6.329)	(2.835)
Other spending	0.882	0.480	-0.264	-0.254
	(6.263)	(5.793)	(-2.123)	(-1.821)
Degree days	-0.992	-0.236	4.729	4.706
	(-5.435)	(-2.078)	(23.775)	(23.155)
Distance	-3.572	-1.467	-1.575	-1.589
	(-40.925)	(-19.386)	(-10.489)	(-9.720)
Move/stay dummy	-16.295	-3.294	-5.506	-6.125
	(-30.721)	(-6.233)	(-5.439)	(-6.122)
Unemployment rate	0.571	0.203	-0.790	-1.104
	(4.671)	(3.113)	(-5.222)	(-8.525)
R^2	0.997	0.997	0.993	0.976

TABLE XVI

(CONTINUED)

	ALTA	BC	POOLED
Prices	1.155	0.405	0.361
	(10.024)	(2.125)	(3.394)
Wages	7.647	-17.742	12.984
	(3.098)	(-3.966)	(9.525)
Government spending			
Health	1.199	0.893	0.895
	(9.944)	(5.511)	(9.760)
Social services	-0.678	-0.374	-0.286
	(-8.893)	(-3.794)	(-6.233)
Education	-0.476	0.668	0.498
	(-4.004)	(3.404)	(4.755)
Other spending	-0.803	-0.495	-0.321
	(-9.016)	(-3.223)	(-4.547)
Degree days	6.508	7.342	5.236
	(54.357)	(27.556)	(63.551)
Distance	-0.489	-2.690	-0.503
	(-5.491)	(-12.655)	(-15.666)
Move/stay dummy	3.189	-16.776	1.774
	(5.252)	(-10.312)	(8.392)
Unemployment rate	-0.682	-0.315	-0.852
	(-11.499)	(-2.543)	(-15.307)
R^2	0.997	0.995	0.966

and magnitude of some of the parameters. For example, the coefficient of the wage variable proves to be positive and significantly different from zero in only five provinces: the four Atlantic provinces and Alberta. The coefficient of the price variable also fails to be positive and significant in the equations for Prince Edward Island, Nova Scotia, and New Brunswick. The negative signs of these coefficients suggests that goods and leisure are not normal goods in some provinces. Both the price and wage coefficients are insignificant in the Saskatchewan equation, which means that in Saskatchewan income tax rates, provincial government transfers to persons, UI benefits, and the percentage of the labour force covered by UI have no significant impact on migration either.

Another coefficient that does not behave as expected is that of distance. In all the equations estimated using the pooled data set for the 1962-81 period, the coefficient of distance was negative and significant. This is not the case in the equations for Newfoundland, Nova Scotia, and New Brunswick. In fact, the results indicate that the residents of Nova Scotia and New Brunswick are more likely to move to regions that are farther away, other things being equal. Though economic theory does not dictate that the coefficient of distance should be negative, most studies have found that it is. However, Winer and Gauthier (1982) do report several equations for out-migration from the Atlantic provinces in which the coefficient of distance is not significantly different from zero.[51]

The equations for Ontario and Quebec share a number of differences from the equation estimated using the pooled data set, some of which are unique to those two provinces. For example, they are the only two provinces whose residents seem to prefer colder climates and higher unemployment rates. In addition, the coefficient of the wage variable is negative in both equations, and

[51]See tables 4-2 and 4-4 on pages 44 and 45 of Winer and Gauthier (1982a).

neither province's residents seem to be interested in government expenditures on health care. Ontario residents also seem to be oblivious to educational expenditures, while in Quebec expenditures on social services are unimportant. In the case of Quebec the failure to account for the language barrier could be responsible for some of these anomalous results, but it is difficult to explain why the behaviour of Ontario residents should differ so greatly from the Canadian average.

One feature which all the equations have in common is that in every equation at least two of the government expenditure variables have coefficients that are significantly different from zero. This finding can only serve to strengthen the earlier conclusion that both the level of government spending and its composition influence migration. On this important point the results for the pooled data set and the ten province of origin subsets do not disagree.

CHAPTER V

CONCLUSIONS

The objective of this thesis was to resolve some of the confusion in the empirical literature regarding fiscally-induced migration and the influence of unemployment rates on migration. To a certain extent this goal has been achieved. The results in chapter IV have demonstrated that fiscally-induced migration does exist and that high unemployment rates do tend to reduce in-migration to a region. This success in obtaining unambiguous results can be attributed to two principal factors: the specification of the model and the large size of the pooled time-series cross-section data set.

As far as specification is concerned, this study differed from previous ones in a number of ways. First of all, measures of net fiscal benefit and intergovernmental transfer payments were excluded from the model on theoretical grounds. It was argued in chapters I and II that individuals would be more directly affected by the supply of provincial government services, tax rates, and transfer payments to persons from provincial governments, and therefore these were the fiscal variables included in the model. Second, other studies have implicitly assumed that all local public goods have the same marginal utility. Here this assumption was tested by allowing four different components of government spending to enter the utility function separately. Third, a number of explanatory variables, such as nonwage income, UI benefits, income tax rates, provincial government transfer payments, wage rates, and the probability of being covered by UI were constrained by theoretical considerations to enter the estimating equation through two composite variables, rather than as separate explanatory variables. Finally, unemployment rates were incorporated into the model by applying the expected utility hypothesis to migration decisions.

The estimation results in tables II and IV seem to be quite robust with respect to small changes in the specification of the estimating equation. Nearly all of the parameter estimates were significantly different from zero with the expected sign. The results in table IV show that the unemployment rate affects migration both through the composite wage and price variables and as a separate explanatory variable. But it is the results with respect to the fiscal variables that are the most interesting. A number of these variables -- provincial government transfer payments, the average income tax rate, average regular UI benefits, and the probability of being covered by UI -- appear only in the composite wage and price variables. The positive and significant coefficients of these variables indicate that increases in provincial government transfers, UI benefits, or the proportion of the population that is covered by UI in province j will tend to reduce out-migration from and increase in-migration to province j. Increases in income tax rates in province j will tend to have the opposite effect. These empirical results confirm the predictions of theoretical models regarding the effects of these variables on interprovincial migration.

The other fiscal variables included in the estimating equations were the government expenditure variables. First, total expenditures per person by provincial and local governments and hospitals proved to have a positive and significant coefficient. When government expenditures were divided into four components -- health, social services, education, and other spending -- the coefficients of the first three of these variables were significantly different from zero in both the perfect certainty and expected utility versions of the model. These findings imply that not only the level but also the composition of local public goods affects migration, as the theory of local public goods predicts.

The implications of these results for the debate on fiscally-induced migration are twofold. First, the ambiguous results of earlier studies are probably the result of specification problems rather than an indication that fiscally-induced migration does not exist. Several of these studies implicitly or explicitly assumed that consumers have rational expectations regarding the behaviour of provincial governments -- in other words, that they are aware of the provincial government budget constraint and incorporate it in their behaviour. This assumption allowed the authors to replace the government expenditure variables that would otherwise have appeared in their estimating equations with variables such as intergovernmental transfer payments. The fact that intergovernmental transfer payments often proved to have insignificant coefficients in these studies, while here the coefficients of the government expenditure variables were significant, suggests that individuals do not have rational expectations with respect to provincial government budget constraints.

Second, the results clearly support the hypothesis that fiscally-induced migration exists. Furthermore, as long as migration decisions are influenced by provincial government tax, transfer, and expenditure policies, they will also be influenced by intergovernmental transfer payments and the magnitude of natural resource revenues, albeit indirectly. However, the empirical results obtained here indicate that the effects of changes in intergovernmental transfer payments on migration will be by no means as clear-cut as those in theoretical models. Instead, the effect of an increase in intergovernmental transfer payments to province j (or an increase in province j's natural resource revenues) would depend on how the government of province j decided to use that increase in revenues. If it decided to cut income taxes by an equal amount, net in-migration to j would increase. However, if instead it decided to devote the increase in revenues entirely to an increase in spending on social services, net in-migration to province j would decrease. If spending on all functions was raised, the impact on in-migration to province j would depend on the relative magnitudes of the increases in spending on the different functions. Thus without a model of provincial government behaviour, it would be impossible to predict exactly how a change in intergovernmental transfer payments would affect migration.

But despite the model's success in demonstrating that unemployment rates and fiscal variables do influence migration, in other respects it has shown itself to be inadequate. Many important questions about migration and regional disparities can only be answered by carrying out simulations of a model in which migration, wages, and employment are jointly determined. For example, one might wish to know how an increase in equalization payments to the Atlantic region would affect regional disparities in wage rates. In order to answer this question one would need a model of provincial labour markets that includes a migration function and a government sector. The migration function developed here would certainly be a candidate for inclusion in such a model, since it has a number of properties that are desirable: predicted migration rates will always lie between zero and one; the characteristics of all ten provinces affect the rate of migration from i to j; and the model satisfies the constraint that the rates of out-migration from a particular province of origin must sum to one. But in addition to possessing these desirable properties, a model that is to be used for simulation purposes must show that it does a good job of explaining the data. In particular, its ability to predict the dependent variable both within and outside the sample period must be examined. Here only the within-sample predictive power was examined, but it was found to be extremely poor. In general, a model will be better able to predict the dependent variable within the sample period than outside it, since the parameter estimates are chosen so as to reproduce as closely as possible variations in the sample data. An equation that is unable to predict accurately within its own sample period is highly unlikely to be able to forecast accurately outside the sample period, or to produce reliable counterfactual simulations.

The multinomial logit model of migration estimated here is in many respects similar to those estimated by several other researchers who use Canadian data. The poor fit of the model thus raises the question of why other researchers have not also reported problems with the fit of their models. In some cases the answer is that because they used different data sets the problem did not arise. Grant and Vanderkamp (1976) used a data set provided by the Unemployment Insurance Commission that allowed them to examine moves in 1968-69 and 1969-70. Thus they were not working with time-series data. Similarly, Shaw (1985, 1986) uses census data and does not have a continuous time-series of migration rates. Winer and Gauthier (1982a) use a 10% federal income tax sample for 1967 to 1977, from which they obtained data not only on migration rates but also on various income variables. They were also able to exclude from their data set several categories of tax filers who are less likely to be motivated by economic considerations related to income when making migration decisions: tax filers under the age of twenty, tax filers over the age of fifty-five, students, tax filers with incomes below $100, women with low incomes, and tax filers whose major source of income was from investments or rentals. Furthermore, the data set allowed them to take account of various socioeconomic differences by dividing the observations into four income classes. These features of their data set are no doubt at least partially responsible for their model's good fit. It would be interesting to re-estimate the present model using a similar data set to see if its performance improved.

The only other study which uses the family allowance migration data to estimate a multinomial logit model of migration is that of MacNevin (1984). Since he does not investigate his model's predictive power, no comparisons can be drawn with the results obtained here. However, it seems likely that the problems encountered here are largely the result of the limitations of the data set used. In general, models that have been estimated using more disaggregated data seem to produce better results, suggesting that migration is a complex process in which socioeconomic and cultural factors and individual differences play and important role. If so, then aggregate models of migration may never be able to fully explain changes in aggregate migration flows over time.

In the future, studies based on micro data are likely to make a greater contribution to our understanding of the determinants of migration than new studies based on aggregate data. However, models of aggregate migration flows are still needed for some purposes. In particular, models of regional disparities are usually aggregate models. But any aggregate model of migration that is to be included in a model of regional disparities would have to fit better than the model estimated here.

The analysis of this study's results suggests several ways in which the model could perhaps be improved. First, there is a need for more explanatory variables capable of explaining the cross-section differences between migration flows. Variables measuring sociological and cultural factors or the quality of life in the different provinces, such as average level of education, the percentage of the population that speaks French, and pollution levels, might fill this need. Like the migration rate data, such variables are likely to exhibit more cross-section than time-series variation. Second, an attempt should be made to account for return migration. Many return migrants may be individuals for whom interregional differentials in wages and unemployment rates are inversely related to the average differentials. In any given year, migration from i to j will be the sum of return migration and other migration. Following Vanderkamp (1971), one could hypothesize that return migration was proportional to past migration flows from j to i. If other migration was assumed to be explained by a multinomial logit model, this would lead to a migration rate equation with the following form:

$$M_{ijt} = \beta\ (F_{ji(t-1)}\ /\ POP_{it}) + \{\exp\ (V_{ijt})\ /\ \sum_{k=1}^{K} \exp\ (V_{ikt})\} + \varepsilon_{ijt}\ ,$$

where M_{ijt} is the rate of migration from i to j in year t, $F_{ji(t-1)}$ is the flow of migrants from j to i in year t-1, POP_{it} is the population of province i in year t, V_{ijt} is the utility associated with moving from i to j in year t, and ε_{ijt} is a random error term. Though this equation is nonlinear, it should be possible to estimate it. Third, it would be desirable to add a dynamic element (other than the variable $F_{ij(t-1)}$) to the model. Finally, a data set based on income tax returns rather than the movements of family allowance recipients might produce better results.

Though the model of migration that was estimated here is clearly incapable of explaining intertemporal movements in interprovincial migration rates in Canada, this does not necessarily mean that the results regarding fiscal variables and unemployment rates are invalid. In fact, in comparison with other models in the literature, the model has proved to be remarkably successful in detecting the existence of a relationship between these variables and migration. However, the poor fit of the model does mean that it would be unwise to place too much weight on the actual values of the parameter estimates. Instead, the best way to interpret the results is to conclude that fiscal variables and unemployment rates do influence migration, but that the parameter estimates discussed in chapter IV are severely biased due to misspecification of the model. If the modifications suggested above do turn out to improve the model's fit, then it may one day serve as a useful component of an aggregate model of regional disparities in Canada.

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APPENDIX 1

THE DISTRIBUTIONS OF μ^n AND $\bar{\mu}$

In Chapter II it was asserted that the exact distribution of the μ_{ij} in equation (2.11) could be approximated to the first order by an extreme value distribution similar to that of the μ^n_{ij}. The validity of this assertion will be examined in this appendix. For simplicity the subscripts i and j will be omitted from the variables throughout the discussion.

In the derivation of the multinomial logit model, it is assumed that the error term μ^n, where the superscript n indexes individuals, is independently and identically distributed over the population with an extreme value distribution. The general form of the probability density function for this distribution is

$$f(\mu^n) = \frac{1}{\beta} \exp\left[-\frac{(\mu^n-\alpha)}{\beta} - \exp\left(-\frac{(\mu^n-\alpha)}{\beta} \right) \right], \tag{A1.1}$$

where $-\infty<\mu^n<\infty$, $-\infty<\alpha<\infty$, and $\beta>0$. In most derivations of the multinomial logit model, such as McFadden (1974), it is assumed that $\alpha=0$ and $\beta=1$.

Since it is difficult to derive the exact distribution of $\bar{\mu}$, where

$$\bar{\mu} = \frac{1}{N} \sum_{n=1}^{N} \mu^n , \tag{A1.2}$$

the moment-generating functions of μ^n and $\bar{\mu}$ will be examined instead to see how closely they resemble each other. The moment generating function of μ^n is

(A1.3) $$M_1(t) = \int_{-\infty}^{\infty} \exp(t\mu^n)\ f(\mu^n)\ d\mu^n$$

$$= e^{\alpha t}\ \Gamma(1-\beta t),\quad t < \frac{1}{\beta}\ ,$$

where

$$\Gamma(a) = \int_{-\infty}^{\infty} x^{a-1}\ e^{-x}\ dx\ ,\quad a > 0.$$

Similarly, the moment-generating function of $\bar{\mu}$ is given by

(A1.4) $$M_2(t) = \int_{-\infty}^{\infty}\cdots\int_{-\infty}^{\infty} \exp\ \frac{t}{N} \sum_{n=1}^{N} \mu^n \quad \prod_{n=1}^{N} f(\mu^n)\ d\mu^1 \ldots d\mu^N$$

$$= \exp\ \frac{\alpha t}{N}\ \ \Gamma\ 1-\frac{\beta t}{N}\ .$$

The relationship between the distributions of μ^n and $\bar{\mu}$ can now be determined by examining the moments of the two distributions. The first moments of the two distributions are the same:

$$M_1'(0) = M_2'(0) = \alpha + \beta c\ ,$$

where c is Euler's constant (0.5772...). The second and subsequent moments of the two distributions are, however, different though related. The second moments of the two distributions are as follows:

$$M_1''(0) = (\alpha+\beta c)^2 + \beta^2\ \ 1 + \sum_{i=1}^{\infty} \frac{1}{(1+i)^2}\ ,$$

and

$$M_2''(0) = (\alpha+\beta c)^2 + \frac{\beta^2}{N} \quad 1 + \sum_{i=1}^{\infty} \frac{1}{(1+i)^2} \quad .$$

Thus while the two distributions have the same mean, the variance of $\bar{\mu}$ is smaller than that of μ^n. Because of this close relationship between the two distributions, the use of the simpler extreme value distribution in place of the exact distribution of $\bar{\mu}$ can be regarded as a first order approximation to the true distribution of $\bar{\mu}$.

An alternative justification for the assumption that $\bar{\mu}$ has an extreme value distribution makes use of the original justification for assuming that the μ^n have an extreme value distribution. In most economic applications random variables are assumed to have a normal distribution, and there is no theoretical reason why discrete choice models should be exempted from this general rule. In fact, applying the normality assumption to the μ^n results in the standard multinomial probit model. The problem is that the probit model does not yield a closed form expression for the P_{ij}, and thus the multinomial probit model quickly becomes intractable as the number of alternatives increases. The use of the extreme value distribution in place of the normal distribution became popular because it both leads to a closed form expression for the P_{ij} and resembles a slightly skewed normal distribution. Thus in cases where there is no reason to believe that preferences have an extreme value distribution rather than a normal distribution, the multinomial logit model can be regarded as an approximation to the multinomial probit model.

In the case at hand, the Central Limit Theorem implies that the distribution of $\bar{\mu}$ will converge to a normal distribution as N approaches infinity, regardless of the distribution of the μ^n, n=1,..., N. Since N in the data set to be used here is the population of a Canadian province, it will be quite large. Thus in principle (2.11) gives rise to a multinomial probit model. However, as in the case of microdata the multinomial probit model is intractable when the number of alternatives exceeds four or five. To make estimation of the model feasible, the true normal distribution of $\bar{\mu}$ can be approximated by an extreme value distribution, as is the case with microdata.

APPENDIX 2

DATA SOURCES AND VARIABLE DEFINITIONS

The following Statistics Canada publications are referred to below:

Catalogue Number	Title
13-201	National Income and Expenditure Accounts
13-213	Provincial Economic Accounts
13-531	National Income and Expenditure Accounts, Vol. 1
52-003	Railway Operating Statistics
62-550	Family Expenditure in Canada, Vol. 2, 1978
62-010	Consumer Prices and Price Indexes
68-202	Consolidated Government Finance
71-001	The Labour Force
71-201	Historical Labour Force Statistics
72-002	Employment, Earnings and Hours
73-001	Statistical Report on the Operation of the Unemployment Insurance Act
73-201	Benefit Periods Established and Terminated Under the Unemployment Insurance Act
91-201	Estimates of Population for Canada and the Provinces

Variable	Definition	Source
w_j	Annual average value of average weekly wages and salaries	CANSIM (D1496-D1505); Statistics Canada catalogue 72-002
B_j	Non-wage income excluding provincial government transfers $=(INT_j+FT_j-UI_j)/POP_j$	
INT_j	Interest, dividend and miscellaneous investment income	CANSIM (D30378-D30387); Statistics Canada catalogues 13-531 and 13-201

FT_j	Federal transfers to persons (excluding CPP)	Statistics Canada catalogue 13-213. Note: For 1961 and 1962 this publication includes the Yukon and Northwest Territories with B.C.. It was assumed that in 1961 and 1962 federal transfers to the Territories amounted to $2 million a year (the value of federal transfers to the provinces in each year from 1963-63), and this amount was subtracted from the published figures to obtain estimates for B.C..
UI_j	Unemployment Insurance benefits	1962-1981: Statistics Canada catalogue 13-213. 1961: Statistics Canada catalogue 73-001 (Oct.-Dec. 1982). <u>Note</u>: In 1961 and 1962, the Yukon and Northwest Territories were included with B.C.. UI benefits for the Territories were assumed to be zero in those years, as in 1963-1965.
POP_j	Population of province j as of June 1st	Statistics Canada catalogue 91-201
R_j	Provincial government transfers to persons $=(PT_j+LT_j)/POP_j$	
PT_j	Provincial government transfers to persons	Statistics Canada catalogue 13-213
LT_j	Local government transfers to persons	Statistics Canada catalogue 13-213
t_j	Combined federal-provincial average tax rate $=1.0-((PDY_j/POP_j)/PY_j)$	
PDY_j	Personal disposable income	CANSIM (D30328-D30337); Statistics Canada catalogues 13-531 and 13-201
PY_j	Personal income per person	CANSIM (D30316-D30325); Statistics Canada catalogues 13-531 and 13-201

G_j	Real per capita supply of local public services (1) $G_j=(GP_j+GL_j+GH_j)*100/(POP_j*DEF)$ (2) $G_j=(G2_j*100)/(POP_j*DEF)$	
GP_j	Provincial government current expenditure on goods and services	Statistics Canada catalogue 13-213
GL_j	Local government current expenditure on goods and services	Statistics Canada catalogue 13-213
GH_j	Hosptitals' current expenditure on goods and services	Statistics Canada catalogue 13-213
$G2_j$	Total consolidated expenditures of provincial and local governments and hospitals, excluding debt service payments. This variable was decomposed into four categories: spending on health, education, social services, and all other functions.	Statistics Canada catalogue 68-202.
DEF	Implicit price index for government current expenditures on goods and services, 1971=100	CANSIM (D40674): Statistics Canada catalogue 13-531
E_j	Degree-days above 0°C for the major city in province j (St John's, Charlottetown, Saint John, Halifax, Montreal, Toronto, Winnipeg, Regina, Edmonton, and Vancouver)	Environment Canada, <u>Canadian Climate Normals, 1951-1980</u>, Vol. 4, (Degree Days), 1982. This number is the average over all measuring stations of total annual degree-days above 0°C.
q_j	Expenditure level in province j $=(CPI_j(t)/CPI_j(78))*LEV_j$	
CPI_j	Unrevised all-items CPI for regional cities, 1971=100. Cities used were St. John's, Charlottetown, Halifax, Saint John, Montreal, Toronto, Winnepeg, Regina, Edmonton, and Vancouver. Since the Charlottetown series begins in 1974, the Halifax CPI was used for the period 1961-1973.	Tables supplied by Statistics Canada, except in the case of Charlottetown. Only the revised series is available for this city. It was obtained from CANSIM (D130671). (Statistics Canada catalogue 62-010)

LEV_j	Average family expenditure level in 1978	"Total current consumption" from Table 3 of Statistics Canada catalogue 62-550
P_{ij}	Rate of migration from i to j $= M_{ij}/POP_i$	
M_{ij}	Flow of migrants from province i to province j	1961-1978: Winer and Gauthier (1982b), pp.64-69 1979-1981: Tables provided by Statistics Canada
C_{ij}	Cost of moving from i to j $=[0.5*D1+D2+0.00087*w_i]* D_{ij}$	
D1	Average rail revenue per ton-mile of freight =R1/R2	
R1	Railway operating revenue, freight	CANSIM (D4014); Statistics Canada catalogue 52-003
R2	Revenue ton-miles	CANSIM (D4019); Statistics Canada catalogue 52-003
D2	Average rail revenue per passenger-mile =R3/R4	
R3	Railway operating revenue, passenger	CANSIM (D4015); Statistics Canada catalogue 52-003
R4	Revenue passenger-miles	CANSIM (D4021); Statistics Canada catalogue 52-003
D_{ij}	Distance between i and j	Distances in kilometres were obtained from Canada: Pocket Road Atlas, Rolph-McNally, 1977, and divided by 1.6 to convert them to miles. D_{ii} was set equal to 0.001.
I_{ij}	Non-wage income including UI benefits $=(B_i+R_j+AUI_j)(1-\tau_j)-C_{ij}$	Negative values were set equal to 0.001 before taking logs.
AUI_j	Average regular UI benefit $=TUI_j/BP_j$	
TUI_j	Total amount of regular UI benefit paid	Statistics Canada catalogue 73-201

BP_j	Number of regular benefit periods terminated	Statistics Canada catalogue 73-201
π_j	Annual average unemployment rate (probability of unemployment)	1961-1965: (a) NFLD, PEI, NS, NB, SASK, ALTA: "Provincial Seasonally Adjusted Labour Force Statistics, January 1953-December 1965," Working Paper No.2, Labour Force Survey Division, Statistics Canada, August 1973 (b) ONT, QUE, BC: Statistics Canada catalogue 71-201 1966-1981: CANSIM (D767902, D768040, D768178, D768316, D768478, D768648, D768794, D768932, D769070, D769233); Statistics Canada catalogue 71-001 Note: In some cases unemployment rate data were not available, so they were calculated using the corresponding labour force and employment series.
δ_j	Probability of being covered by UI $=COV_j/EMP_j$	
COV_j	1961-1971: Coverage less the average annual number of UI claimants reporting to local offices at month end 1972-1981: Number of paid workers	1961-1971: Statistics Canada catalogue 73-201 1972-1981: Statistics Canada catalogue 71-001

EMP_j	Annual average employment	1961-1965: (a) NFLD, PEI, NS,NB, MAN, SASK, ALTA: "Provincial Seasonally Adjusted Labour Force Statistics, January 1953-December 1965," Working Paper No. 2, Labour Force Survey Division, Statistics Canada, August 1973 (b) QUE, ONT, BC: Statistics Canada catalogue 71-201 1966-1981:CANSIM (D767900, D768038, D768176, D768314, D768476, D768646, D768792, D768930, D769068, D769231); Statistics Canada catalogue 71-001
DUM_j	Stay/move dummy variable =1 if alternative is staying, 0 otherwise	

APPENDIX 3

SUPPLEMENTARY TABLES AND FIGURES

This appendix contains some additional figures and tables that complement material included in the text. First, tables containing the parameter estimates for the forward and annual regressions are presented. These are followed by plots of the estimates of those coefficients that were not discussed in the text.

TABLE XVII

FORWARD REGRESSION RESULTS WITH ONTARIO IN THE DENOMINATOR OF THE LOG-ODDS RATIO

	Year in which sample period ends			
	1962	1963	1964	1965
Prices	0.185 (0.437)	0.124 (0.417)	0.152 (0.618)	0.220 (1.024)
Wages	20.982 (2.817)	22.120 (4.179)	22.209 (5.141)	21.591 (5.935)
Government spending				
Health	0.469 (1.007)	-0.075 (-0.259)	0.129 (0.664)	0.228 (1.478)
Social services	0.164 (0.496)	0.293 (1.418)	0.200 (1.225)	-0.016 (-0.143)
Education	-0.522 (-0.486)	-0.695 (-1.105)	-0.142 (-0.432)	0.152 (0.674)
Other spending	0.062 (0.081)	0.106 (0.264)	-0.362 (-1.317)	-0.338 (-1.574)
Degree days	4.604 (9.801)	4.979 (14.820)	5.274 (17.674)	5.069 (21.035)
Distance	-0.439 (-2.585)	-0.397 (-3.307)	-0.375 (-3.845)	-0.354 (-4.261)
Move/stay dummy	2.055 (1.880)	2.329 (3.015)	2.482 (3.944)	2.623 (4.885)
Unemployment rate	-1.073 (-2.301)	-1.251 (-4.107)	-1.123 (-6.077)	-0.935 (-6.639)
R^2	0.973	0.971	0.970	0.970
# of observations	90	180	270	360

TABLE XVII

(CONTINUED)

	Year in which sample period ends			
	1966	1967	1968	1969
Prices	0.244 (1.225)	0.301 (1.592)	0.357 (2.014)	0.304 (1.795)
Wages	20.779 (6.498)	20.812 (7.132)	19.310 (7.197)	19.971 (7.984)
Government spending				
Health	0.328 (2.252)	0.452 (3.336)	0.522 (4.133)	0.631 (5.322)
Social services	-0.143 (-1.379)	-0.269 (-3.060)	-0.272 (-3.320)	-0.281 (-3.597)
Education	0.156 (0.774)	0.399 (2.131)	0.458 (2.661)	0.474 (2.936)
Other spending	-0.467 (-2.449)	-0.516 (-3.012)	-0.491 (-2.942)	-0.456 (-2.803)
Degree days	5.428 (25.075)	5.410 (26.885)	5.382 (29.100)	5.422 (31.396)
Distance	-0.346 (-4.724)	-0.336 (-5.061)	-0.377 (-6.169)	-0.365 (-6.426)
Move/stay dummy	2.664 (5.610)	2.737 (6.361)	2.483 (6.262)	2.549 (6.903)
Unemployment rate	-0.890 (-6.755)	-0.758 (-6.236)	-0.738 (-6.310)	-0.751 (-6.769)
R^2	0.967	0.967	0.967	0.967
# of observations	450	540	630	720

TABLE XVII

(CONTINUED)

	Year in which sample period ends			
	1970	1971	1972	1973
Prices	0.336	0.378	0.381	0.424
	(2.119)	(2.516)	(2.626)	(3.069)
Wages	20.123	19.830	19.165	18.288
	(8.571)	(8.979)	(9.170)	(9.284)
Government spending				
Health	0.794	0.888	0.937	0.940
	(7.144)	(8.357)	(8.977)	(9.022)
Social services	-0.306	-0.339	-0.343	-0.300
	(-4.120)	(-4.803)	(-5.005)	(-4.685)
Education	0.531	0.596	0.598	0.609
	(3.519)	(4.218)	(4.470)	(4.738)
Other spending	-0.458	-0.411	-0.377	-0.463
	(-2.973)	(-2.952)	(-2.838)	(-3.789)
Degree days	5.474	5.449	5.463	5.471
	(35.016)	(37.980)	(40.673)	(44.347)
Distance	-0.357	-0.359	-0.380	-0.391
	(-6.703)	(-7.178)	(-8.061)	(-8.728)
Move/stay dummy	2.609	2.599	2.478	2.411
	(7.542)	(7.989)	(8.073)	(8.256)
Unemployment rate	-0.704	-0.631	-0.615	-0.659
	(-6.683)	(-6.489)	(-6.733)	(-7.804)
R^2	0.967	0.967	0.967	0.967
# of observations	810	900	990	1080

TABLE XVII

(CONTINUED)

	Year in which sample period ends			
	1974	1975	1976	1977
Prices	0.410	0.419	0.419	0.412
	(3.090)	(3.289)	(3.372)	(3.442)
Wages	17.612	17.042	16.675	16.039
	(9.365)	(9.469)	(9.643)	(9.629)
Government spending				
Health	0.944	0.918	0.891	0.885
	(9.177)	(9.160)	(9.074)	(9.244)
Social services	-0.303	-0.279	-0.258	-0.255
	(-5.034)	(-4.977)	(-4.923)	(-5.103)
Education	0.597	0.593	0.550	0.526
	(4.884)	(5.006)	(4.822)	(4.731)
Other spending	-0.408	-0.456	-0.462	-0.457
	(-3.562)	(-4.378)	(-4.787)	(-5.003)
Degree days	5.432	5.423	5.416	5.403
	(47.788)	(51.567)	(54.715)	(57.353)
Distance	-0.404	-0.418	-0.428	-0.441
	(-9.448)	(-10.239)	(-10.926)	(-11.722)
Move/stay dummy	2.332	2.247	2.192	2.125
	(8.351)	(8.413)	(8.554)	(8.618)
Unemployment rate	-0.673	-0.711	-0.750	-0.776
	(-8.777)	(-9.803)	(-11.128)	(-12.085)
R^2	0.967	0.967	0.967	0.967
# of observations	1170	1260	1350	1440

TABLE XVII

(CONTINUED)

	Year in which sample period ends			
	1978	1979	1980	1981
Prices	0.407 (3.506)	0.398 (3.549)	0.387 (3.551)	0.361 (3.394)
Wages	15.395 (9.597)	14.479 (9.631)	13.309 (9.395)	12.984 (9.525)
Government spending				
Health	0.894 (9.411)	0.907 (9.647)	0.907 (9.737)	0.895 (9.760)
Social services	-0.266 (-5.527)	-0.280 (-5.927)	-0.282 (-6.062)	-0.286 (-6.233)
Education	0.503 (4.577)	0.506 (4.683)	0.499 (4.686)	0.498 (4.755)
Other spending	-0.436 (-5.215)	-0.380 (-4.843)	-0.345 (-4.648)	-0.321 (-4.547)
Degree days	5.366 (58.951)	5.317 (60.807)	5.275 (62.312)	5.236 (63.551)
Distance	-0.456 (-12.579)	-0.471 (-13.565)	-0.495 (-14.857)	-0.503 (-15.666)
Move/stay dummy	2.047 (8.615)	1.957 (8.575)	1.815 (8.277)	1.774 (8.392)
Unemployment rate	-0.793 (-12.788)	-0.799 (-13.511)	-0.825 (-14.365)	-0.852 (-15.307)
R^2	0.967	0.967	0.966	0.966
# of observations	1530	1620	1710	1800

TABLE XVIII

FORWARD REGRESSION RESULTS WITH PROVINCE OF ORIGIN IN THE DENOMINATOR OF THE LOG-ODDS RATIO

	Year in which sample period ends			
	1962	1963	1964	1965
Prices	0.687 (1.544)	0.566 (1.860)	0.695 (2.729)	0.956 (4.444)
Wages	10.347 (1.528)	6.562 (1.305)	5.442 (1.290)	4.307 (1.188)
Government spending				
Health	0.966 (1.778)	0.106 (0.429)	0.193 (1.203)	0.303 (2.632)
Social services	0.480 (1.856)	0.605 (3.575)	0.588 (4.044)	0.399 (3.541)
Education	1.096 (0.873)	-0.126 (-0.204)	0.033 (0.103)	0.284 (1.411)
Other spending	-1.204 (-1.312)	-0.286 (-0.719)	-0.421 (-1.834)	-0.422 (-2.398)
Degree days	2.875 (6.015)	2.528 (8.330)	2.622 (10.264)	2.464 (11.371)
Distance	-0.592 (-3.302)	-0.643 (-5.010)	-0.661 (-6.222)	-0.647 (-7.100)
Move/stay dummy	1.440 (1.226)	1.308 (1.569)	1.210 (1.755)	1.307 (2.210)
Unemployment rate	0.074 (0.157)	-0.550 (-2.129)	-0.521 (-3.249)	-0.310 (-2.754)
R^2	0.985	0.983	0.984	0.984
# of observations	90	180	270	360

TABLE XVIII

(CONTINUED)

	Year in which sample period ends			
	1966	1967	1968	1969
Prices	1.139 (6.079)	1.131 (6.533)	1.156 (7.168)	1.158 (7.564)
Wages	3.916 (1.231)	4.261 (1.470)	3.118 (1.163)	3.245 (1.292)
Government spending				
Health	0.363 (3.266)	0.419 (3.896)	0.517 (5.003)	0.595 (6.012)
Social services	0.241 (2.539)	0.142 (1.727)	0.122 (1.601)	0.112 (1.537)
Education	0.430 (2.669)	0.464 (3.283)	0.520 (3.963)	0.567 (4.589)
Other spending	-0.456 (-2.948)	-0.400 (-2.911)	-0.367 (-2.823)	-0.355 (-2.820)
Degree days	2.557 (13.462)	2.611 (15.008)	2.623 (16.175)	2.624 (17.220)
Distance	-0.618 (-7.704)	-0.614 (-8.511)	-0.647 (-9.750)	-0.644 (-10.406)
Move/stay dummy	1.488 (2.860)	1.505 (3.230)	1.306 (3.047)	1.343 (3.368)
Unemployment rate	-0.207 (-2.251)	-0.182 (-2.203)	-0.148 (-1.890)	-0.130 (-1.733)
R^2	0.983	0.983	0.983	0.983
# of observations	450	540	630	720

TABLE XVIII

(CONTINUED)

	Year in which sample period ends			
	1970	1971	1972	1973
Prices	1.104	1.100	1.109	1.118
	(7.747)	(8.134)	(8.478)	8.940
Wages	3.946	3.820	3.123	2.722
	(1.679)	(1.717)	(1.474)	(1.356)
Government spending				
Health	0.633	0.663	0.683	0.706
	(6.699)	(7.296)	(7.684)	(8.062)
Social services	0.075	0.056	0.038	0.057
	(1.063)	(0.825)	(0.582)	(0.934)
Education	0.567	0.571	0.581	0.598
	(4.757)	(4.988)	(5.246)	(5.544)
Other spending	-0.266	-0.199	-0.143	-0.155
	(-2.236)	(-1.796)	(-1.368)	(-1.581)
Degree days	2.640	2.608	2.578	2.533
	(18.526)	(19.319)	(19.881)	(20.592)
Distance	-0.621	-0.617	-0.638	-0.641
	(-10.762)	(-11.393)	(-12.459)	(-13.092)
Move/stay dummy	1.500	1.536	1.419	(1.410)
	(4.034)	(4.402)	(4.301)	(4.467)
Unemployment rate	-0.106	-0.080	-0.055	-0.051
	(-1.492)	(-1.206)	(-0.874)	(-0.878)
R^2	0.983	0.983	0.983	0.983
# of observations	810	900	990	1080

TABLE XVIII

(CONTINUED)

	Year in which sample period ends			
	1974	1975	1976	1977
Prices	1.078	1.044	1.013	1.006
	(8.967)	(8.940)	(8.882)	(9.068)
Wages	2.402	2.190	2.195	1.716
	(1.250)	(1.190)	(1.243)	(1.013)
Government spending				
Health	0.709	0.693	0.694	0.670
	(8.253)	(8.310)	(8.520)	(8.384)
Social services	0.064	0.072	0.070	0.048
	(1.075)	(1.252)	(1.275)	(0.916)
Education	0.556	0.527	0.495	0.476
	(5.384)	(5.283)	(5.194)	(5.122)
Other spending	-0.079	-0.066	-0.022	0.027
	(-0.844)	(-0.752)	(-0.273)	(0.354)
Degree days	2.472	2.419	2.363	2.296
	(20.976)	(21.546)	(21.829)	(21.919)
Distance	-0.651	-0.659	-0.658	-0.662
	(-13.926)	(-14.796)	(-15.455)	(-16.240)
Move/stay dummy	1.353	1.311	1.322	1.309
	(4.490)	(4.565)	(4.805)	(4.962)
Unemployment rate	-0.076	-0.116	-0.139	-0.156
	(-1.432)	(-2.408)	(-3.046)	(-3.575)
R^2	0.983	0.983	0.983	0.983
# of observations	1170	1260	1350	1440

TABLE XVIII

(CONTINUED)

	Year in which sample period ends			
	1978	1979	1980	1981
Prices	0.969 (8.942)	0.951 (9.071)	0.943 (9.242)	0.928 (9.257)
Wages	1.576 (0.967)	1.082 (0.708)	0.347 (0.240)	0.271 (0.193)
Government spending				
Health	0.684 (8.655)	0.678 (8.717)	0.654 (8.534)	0.618 (8.167)
Social services	0.027 (0.530)	0.014 (0.286)	0.015 (0.307)	0.020 (0.415)
Education	0.424 (4.630)	0.394 (4.371)	0.400 (4.539)	0.411 (4.727)
Other spending	0.096 (1.339)	0.151 (2.241)	0.164 (2.581)	0.165 (2.743)
Degree days	2.263 (22.128)	2.224 (22.496)	2.179 (22.620)	2.145 (22.774)
Distance	-0.664 (-16.978)	-0.671 (-17.945)	-0.684 (-19.010)	-0.679 (-19.535)
Move/stay dummy	1.313 (5.187)	1.281 (5.278)	1.215 (5.197)	1.257 (5.566)
Unemployment rate	-0.176 (-4.182)	-0.198 (-4.887)	-0.215 (-5.479)	-0.234 (-6.126)
R^2	0.983	0.983	0.982	0.982
# of observations	1530	1620	1710	1800

TABLE XIX

ANNUAL REGRESSION RESULTS

	1962	1963	1964	1965
Prices	0.735	-0.456	0.535	-1.358
	(4.171)	(-1.982)	(1.525)	(-6.110)
Wages	20.333	32.711	31.353	52.748
	(4.429)	(5.237)	(5.478)	(13.447)
Government spending				
Health	1.468	-3.607	1.884	0.393
	(4.152)	(-11.354)	(7.907)	(1.231)
Social services	-0.129	1.649	-2.452	-1.241
	(-0.499)	(4.965)	(-8.526)	(-5.064)
Education	-1.655	-7.674	0.563	2.496
	(-1.814)	(-7.660)	(1.973)	(8.512)
Other spending	1.710	3.461	2.828	1.217
	(2.363)	(8.096)	(6.379)	(2.006)
Degree days	4.091	4.086	3.604	0.529
	(11.983)	(13.446)	(8.345)	(11.431)
Distance	-0.339	-0.203	-0.095	0.243
	(-3.569)	(-1.890)	(-0.863)	(3.428)
Move/stay dummy	2.638	3.299	4.216	6.073
	(4.467)	(5.020)	(6.138)	(13.784)
Unemployment rate	-0.458	-4.568	0.969	0.635
	(-1.540)	(-8.480)	(4.375)	(5.230)
R^2	0.995	0.993	0.993	0.996

TABLE XIX

(CONTINUED)

	1966	1967	1968	1969
Prices	-0.607	0.706	0.532	1.614
	(-1.295)	(1.188)	(1.704)	(2.679)
Wages	33.501	32.421	24.299	23.764
	(9.176)	(5.627)	(7.704)	(4.236)
Government spending				
Health	1.701	0.248	1.882	4.568
	(2.183)	(0.403)	(8.945)	(15.107)
Social services	-1.853	-1.234	-2.066	-0.918
	(-10.920)	(-10.830)	(-6.684)	(-3.362)
Education	1.692	3.018	2.221	2.553
	(9.306)	(12.828)	(8.010)	(6.242)
Other spending	3.406	1.293	6.344	-0.554
	(5.998)	(1.661)	(5.391)	(-0.843)
Degree days	5.181	3.634	3.748	3.611
	(22.069)	(8.883)	(16.913)	(12.414)
Distance	-0.150	-0.025	-0.372	-0.183
	(-1.712)	(-0.195)	(-5.377)	(-1.694)
Move/stay dummy	3.527	4.573	2.317	3.723
	(6.024)	(5.558)	(5.351)	(5.620)
Unemployment rate	0.660	0.552	2.626	1.467
	(3.507)	(2.070)	(6.666)	(5.083)
R^2	0.998	0.987	0.997	0.994

TABLE XIX

(CONTINUED)

	1970	1971	1972	1973
Prices	1.246	2.180	2.848	3.598
	(2.517)	(4.153)	(5.181)	(5.620)
Wages	30.205	5.401	23.615	15.002
	(5.207)	(1.257)	(4.933)	(4.291)
Government spending				
Health	5.531	5.736	20.422	11.786
	(8.519)	(4.065)	(12.271)	(17.366)
Social services	-1.704	-1.729	-6.286	-4.024
	(-4.239)	(-4.953)	(-13.937)	(-8.126)
Education	-1.747	-0.937	-9.386	1.977
	(-2.145)	(-0.721)	(-8.267)	(1.656)
Other spending	3.890	2.603	3.730	2.013
	(7.091)	(5.276)	(6.557)	(4.151)
Degree days	3.794	2.623	-2.728	1.888
	(15.312)	(5.843)	(-5.457)	(6.567)
Distance	-0.081	-0.673	-0.325	-0.409
	(-0.620)	(-7.744)	(-3.015)	(-4.636)
Move/stay dummy	4.217	0.419	2.750	2.121
	(4.980)	(0.745)	(3.941)	(3.626)
Unemployment rate	0.739	0.428	2.825	0.451
	(1.585)	(2.000)	(6.845)	(1.841)
R^2	0.994	0.992	0.987	0.992

TABLE XIX

(CONTINUED)

	1974	1975	1976	1977
Prices	0.298	-3.580	-5.791	11.543
	(0.578)	(-5.341)	(-6.178)	(10.669)
Wages	13.554	17.834	39.331	-22.745
	(3.738)	(5.692)	(6.363)	(-5.124)
Government spending				
Health	13.724	10.152	16.120	6.608
	(11.385)	(9.154)	(13.841)	(-16.661)
Social services	-0.012	3.200	-1.052	-4.753
	(-0.022)	(5.212)	(-2.188)	(-10.080)
Education	-11.133	-5.472	-17.373	6.957
	(-7.146)	(-4.531)	(-14.003)	(9.328)
Other spending	1.644	-0.411	-2.223	-3.548
	(2.498)	(-1.249)	(-5.302)	(-10.974)
Degree days	0.240	-0.983	3.034	5.431
	(0.441)	(-1.217)	(6.486)	(17.339)
Distance	-0.582	-0.626	-0.110	-0.939
	(-7.690)	(-9.593)	(-0.882)	(-9.680)
Move/stay dummy	0.941	0.815	4.221	-0.977
	(1.925)	(1.938)	(5.339)	(-1.512)
Unemployment rate	-0.642	-0.315	0.283	-3.500
	(-3.727)	(-1.570)	(0.946)	(-15.945)
R^2	0.994	0.997	0.983	0.989

TABLE XIX

(CONTINUED)

	1978	1979	1980	1981
Prices	-9.428	14.101	16.517	-5.089
	(-6.183)	(13.049)	(11.992)	(-2.794)
Wages	25.471	-30.965	-35.275	-5.672
	(4.389)	(-7.473)	(-8.544)	(-1.214)
Government spending				
Health	9.561	-4.903	-11.474	8.573
	(6.990)	(-4.127)	(-6.986)	(4.989)
Social services	-0.419	-7.965	-5.723	-1.400
	(-0.793)	(-19.308)	(-10.054)	(2.017)
Education	-6.413	15.698	12.683	6.482
	(-7.589)	(11.182)	(13.291)	(7.186)
Other spending	1.000	-3.021	-1.562	-5.132
	(2.963)	(-5.126)	(-2.269)	(-8.405)
Degree days	4.192	7.026	8.034	-0.461
	(7.629)	(10.030)	(7.719)	(-0.563)
Distance	-0.577	-1.034	-1.074	-0.966
	(-5.200)	(-11.176)	(-16.014)	(-11.873)
Move/stay dummy	1.321	-1.499	-1.749	-0.980
	(1.835)	(-2.447)	(-3.943)	(-1.856)
Unemployment rate	-0.877	-1.879	-2.744	-2.397
	(-4.637)	(-10.305)	(-14.094)	(-13.506)
R^2	0.989	0.988	0.992	0.994

FIGURE 12
COEFFICIENT OF DEGREE DAYS
FORWARD REGRESSIONS

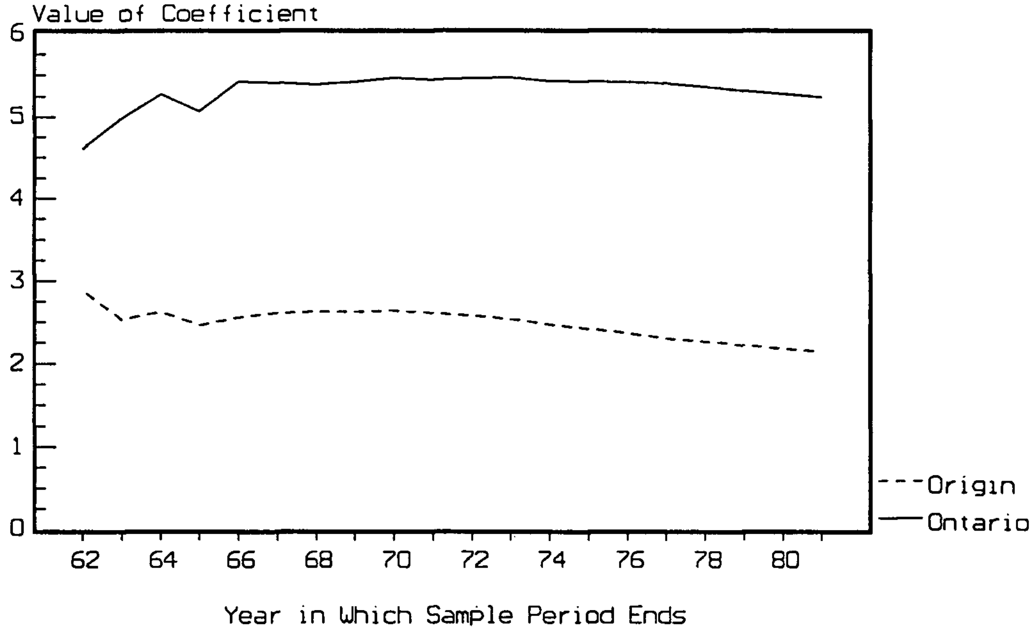

FIGURE 13
COEFFICIENT OF DISTANCE
FORWARD REGRESSIONS

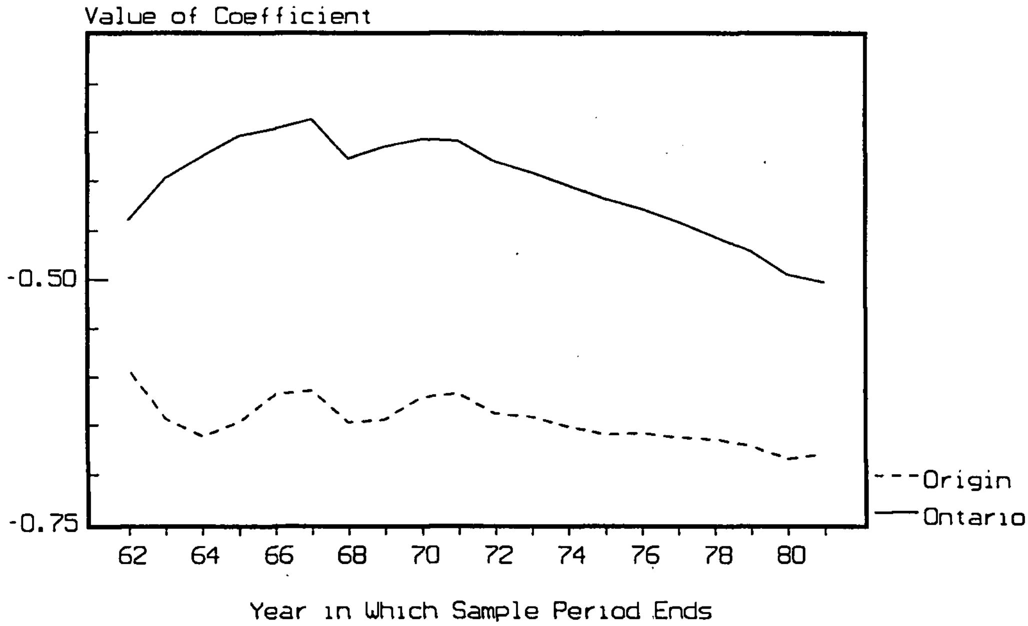

FIGURE 14
COEFFICIENT OF MOVE/STAY DUMMY VARIABLE
FORWARD REGRESSIONS

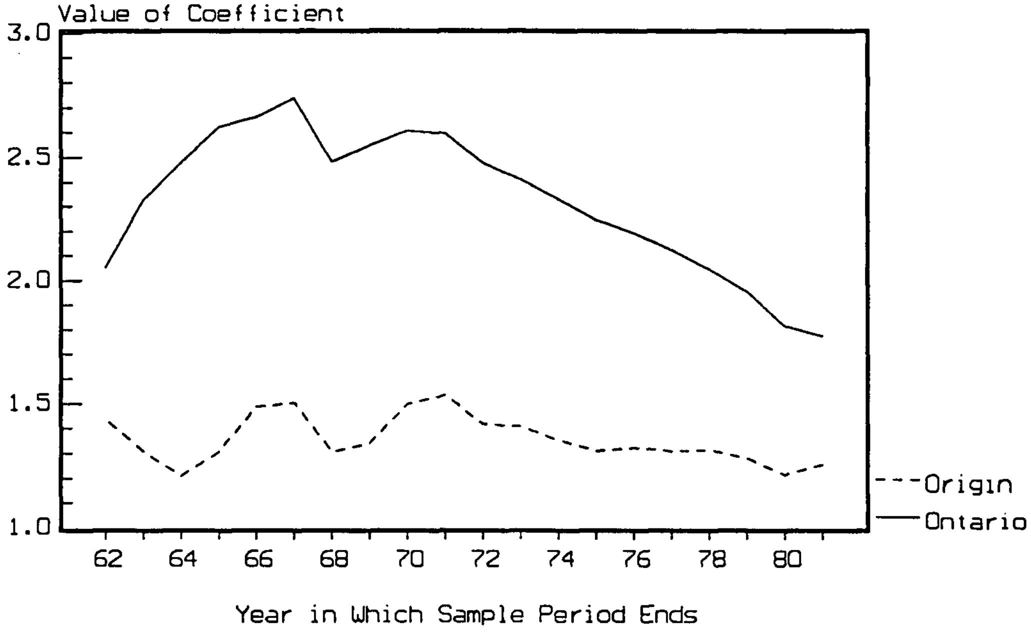

FIGURE 15
COEFFICIENTS OF DEGREE DAYS AND THE
MOVE/STAY DUMMY VARIABLE
ANNUAL REGRESSIONS

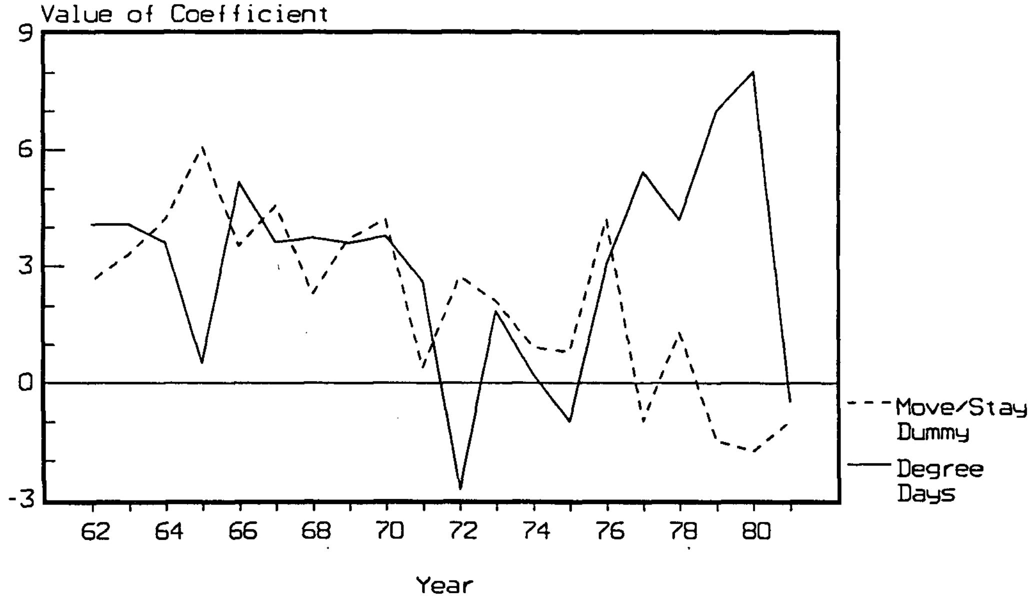

FIGURE 16
COEFFICIENT OF DISTANCE
ANNUAL REGRESSIONS