THE SPATIAL ASPECTS AND REGULARITIES OF MULTIPLE INTERREGIONAL MIGRATION WITHIN CANADA: EVIDENCE AND IMPLICATIONS*

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Introduction

This study constitutes an extension of the work by Grant and Vanderkamp [7; 8] concerning multiple (repeat) migration behaviour among 44 economic regions of Canada in the period 1969-71. Specifically, it attempts to more fully document and analyze the spatial variability of rates of various types of multiple migration and to speculate upon the implication of revealed regularities for the modelling of migration behaviour. To our knowledge spatial analysis of multiple migration within a subprovincial framework is unique, although spatial distributions of more aggregate migration rates for provincial and urban-centered regions have been documented elsewhere (see Stone [13], Simmons [12], and Courchene [3]).

We utilize Grant and Vanderkamp's [7] definitions of migration types. A *primary migrant* is a person who moved interregionally in 1969-70 and who stayed in the destination region in 1971. A *return migrant* is someone who moved from region i to region j in

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1969-70 and who returned to region i in 1970-71. An *onward migrant* is someone who moved in 1969-70 and who moved again to a region other than the 1969 origin region in 1970-71. In all cases, no interregional moves were observed in the preceding year (1968-69). This restriction does not preclude the possibility that any of these individuals had moved interregionally prior to 1968; hence to the extent that such moves had occurred, their definitions of the various migration types are misclassified. The reader will note that in each case the repeat move occurs the year after the initial move.

Grant and Vanderkamp's descriptive study [7] made no attempt to document spatial patterns of the three types of moves in 1969-70, either by the region of origin or by the destination region of the initial move; this is undertaken in this paper. By spatial patterns, we refer to differences in migration rates by origin (destination) regions.

A further study by Grant and Vanderkamp [8] involved a full-scale econometric study of the determinants of repeat migration using approximately 3,500 individual records. Their empirical specification was a logit regression analysis which tested for two probability odds equations involving persons who moved initially in 1969-70: the odds of a return move 1970-71 to staying in the 1970 region of destination; and the odds of an onward move 1970-71 to staying in the 1970 region of destination. Their descriptive study [7] suggested a number of important influences on repeat migration, so they included 26 independent variables reflecting certain personal characteristics (age, sex, marital status, etc.), various labour market factors (changes in occupation), and migratory experience prior to 1968. Certain locational and spatial factors (distance, origin region, and rural-urban dummy variables) were also included, but no theoretical justification was given.

Two features of Grant and Vanderkamp's [8] results are particularly worth noting in light of the thrust of this study. First, their analysis of locational and spatial variables suggests significant differences in migration propensities by the type of migration and by the region of origin. They found, for instance, that the odds of an onward move were positively influenced by the distance of the initial move, but that the distance of the initial move had no statistically significant effect on return moves vis-à-vis primary moves. This result suggests that onward migration was more geographically dispersed than primary or return migration. In addition, they partially controlled for the region of origin by including five (one excluded to avoid multicollinearity) broad geographical designations. The probability of a return move (relative to a primary move) was observed to be highest for migrants whose origin region was in the Atlantic provinces or western Canada (Alberta, British Columbia, and northern Canada) and lowest for Quebec regions. On the other hand, the probability of an onward move was highest for those originating from a region in Manitoba or Saskatchewan, with no other probabilities being statistically significant. We consider these observations to be important because they suggest that spatial factors by themselves (since 20 other variables were controlled for) contribute to the explanation of various migration types and, furthermore, that they impact differently on primary, return, and onward migration.

Second, Grant and Vanderkamp's [8] results clearly indicate that a large amount of the variance in the odds equations is unexplained; their R^2 values were generally less than 4 percent. Although R^2 values for individual record experiments tend to be lower than for aggregate data studies, their results indicate nonetheless that many unobserved determinants have been excluded from their specifications. Given the nature of their data, they were unable to control for individual characteristics such as language, cultural and social background, and motivation. To the extent that locational variables reflect these underlying unobservable aspects of the population of a particular region, we suggest that a more detailed specification of the spatial dimension might increase the explained variance in migration equations. In addition, we suggest in a later section that spatial regularities may violate some of the assumptions of a logit specification, which is the most commonly used framework for econometric studies of migration behaviour.

The Study

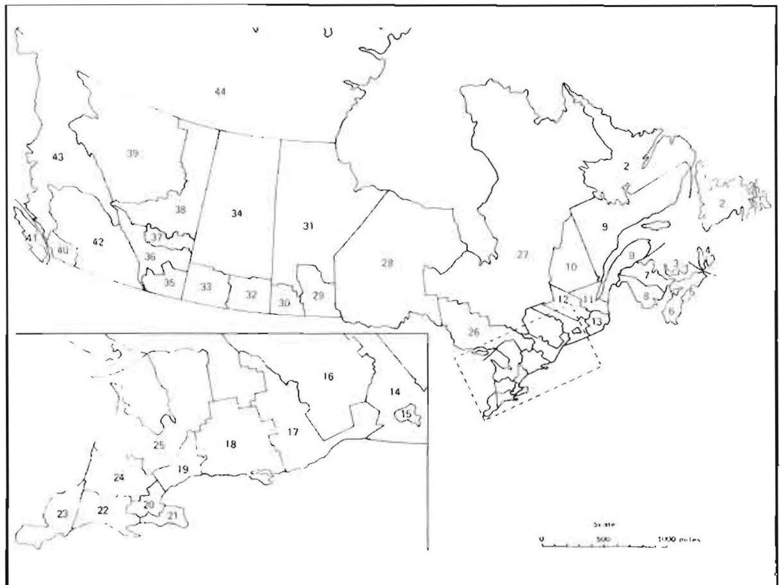
Recall that the purpose of this work is twofold: to measure and describe the spatial regularity in overall rates of in-migration and out-migration and in propensities for designated types of multiple move behaviour; *and* to discuss the implication of observed regularities for the modelling and interpretation of interregional migration. Two aspects of spatial regularity are investigated. First, are the national regularities in overall rates of in-migration and out-migration commonly observed at the provincial scale evident at lower levels of aggregation, both for the overall rates and for propensities for multiple moves? Second, what degree of regional homogeneity underlies national regularities? Is it the case that migration propensity (total out-migration, total in-migration, primary, return or onward) for a particular region is similar to that of other regions that are close geographically, or are subnational groupings of regions structured in a more complex way?

The data for this study are derived from what has been called the *UIC Data Base*, and is described in detail in Grant and Vanderkamp [6; 7; 8]. The population at risk (about 3,500 observations) is those who moved interregionally in 1969-70. For this study we have grouped individual records in order to obtain aggregate values for the 44 economic regions defined by Grant and Vanderkamp [6] and illustrated in Figure 1. We are interested in three migration sequences for the period 1969-71; return moves (i, j, i), onward moves (i, j, k) and primary moves (i, j, j). Two years is a very short time span in which to measure subsequent migration activity. However, there is some evidence [4;7] that over half of return migration occurs within one year after an initial move.

The data indicate that the overall interregional migration rate was 3.18 percent in 1969-70. We estimate that approximately 19 percent of those who moved in 1969-70 moved again in 1970-71. This translates into an 11.4 percent propensity for return migration and one of 7.5 percent for onward migration. As a comparison, it is interesting to note that the interprovincial migration propensity for 1969-70 was 1.24 percent and that approximately 14.7 percent of these persons returned to the 1969 province and 3.6 percent made a move to another province in 1970-71. The difference in the distribution of multiple migration between interregional and interprovincial is as anticipated. That is, the larger the geographical unit, the greater the probability that a multiple move is of the return variety.

Overall Spatial Patterns of Interregional Migration

Before we formally analyze the spatial regularity of various types of interregional flows, it is useful to present some general impressions. Figures 2 and 3 indicate the migration rate per thousand into the region of destination in 1970 and out of the origin region in 1969. With respect to overall out-migration rates, Figure 3 indicates that the spatial pattern conforms in a general way with the national pattern of interprovincial out-migration rates described in detail by Grant and Vanderkamp [6]. That is, propensities are high for western Canadian regions, low for regions in Ontario and Quebec, and somewhat high for certain Atlantic regions. However, one is impressed with the very high variation within provincial boundaries. Moreover, there is a wide variation of *net* migration rates within provincial boundaries. Thus, in Ontario (a net gainer of labour in this period), approximately half of the regions were net losers of labour, including the major metropolitan regions of Toronto (Region 19), Hamilton (Region 20), and Windsor-Sarnia (Region 23). In addition, a very mixed pattern of net migration is observed for Atlantic Canada regions.



Key

1. St. John's
2. Other Newfoundland regions
3. Prince Edward Island
4. Cape Breton Island
5. Greater Halifax
6. Other Nova Scotia regions
7. Moncton and Northern New Brunswick
8. Saint John and Southern New Brunswick
9. Gaspé region
10. Lac Saint-Jean
11. Quebec metropolitan region
12. Trois-Rivières region
13. Eastern Townships
14. Montreal environs
15. Montreal
16. Ottawa-Hull
17. Eastern Ontario
18. Central Lake Ontario
19. Toronto metropolitan region
20. Hamilton region
21. Niagara Peninsula
22. London region
23. Windsor-Sarnia
24. Kitchener-Midlands
25. Georgian Bay
26. Sudbury region
27. Timiskaming area
28. Thunder Bay region
29. Winnipeg and Eastern Manitoba
30. Brandon and Western Manitoba
31. Northern Manitoba
32. Regina and Eastern Saskatchewan
33. Moose Jaw and Western Saskatchewan
34. Saskatoon and Northern Saskatchewan
35. Southern Alberta
36. Calgary and South Central Alberta
37. Red Deer and Central Alberta
38. Edmonton and Northern Alberta
39. Peace River
40. Vancouver region
41. Vancouver Island
42. Southern British Columbia interior
43. Northern British Columbia
44. Northern Canada

*After Grant and Vanderkamp [6].

Figure 1

ECONOMIC REGIONS OF CANADA

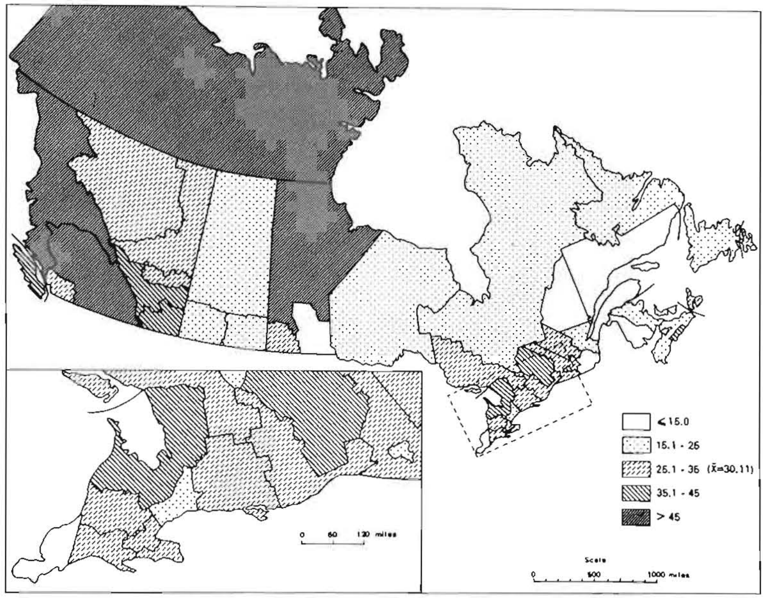


Figure 2

IN-MIGRATION PER THOUSAND (Case 8)

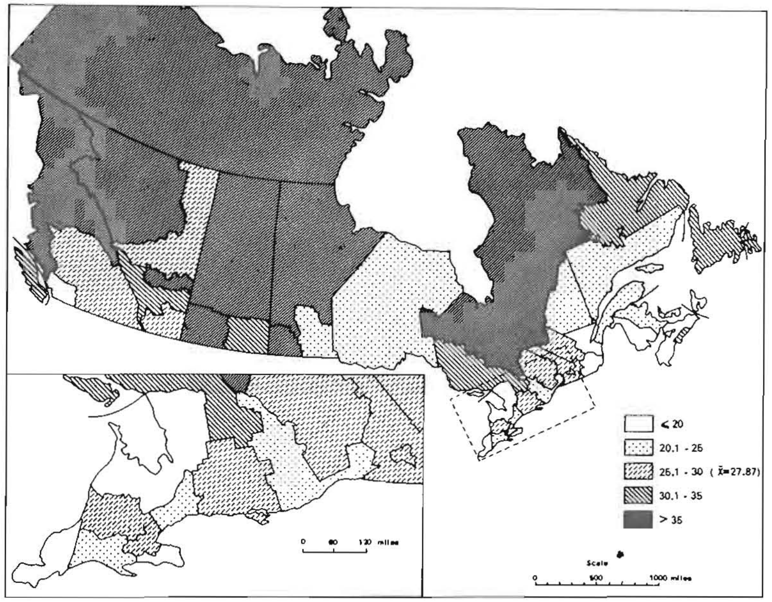


Figure 3

OUT-MIGRATION PER THOUSAND (Case 7)

Our main focus in this paper is the spatial distribution of the underlying migration propensities which comprise the overall flows. Migration rates defined as the percentage of total out-migration from a particular region are mapped in Figure 4 for return movers (those who moved from i in 1969-70 and returned in 1970-71) and in Figure 5 for onward movers (first move in 1969-70 to j, second move in 1970-71 to k). As can be seen from Figure 4, the spatial pattern of return migration resembles somewhat the spatial pattern of out-migration (Figure 3); western Canada regions, as well as certain Atlantic regions, have high return migration propensities. Thus, five of the eight Atlantic regions have above average return migration rates, as do several of the western Canada regions, particularly those in Alberta and British Columbia.

The propensity for onward migration (Figure 5) is, on average, lower than that for return migration. Highest propensities are observed for regions in western Canada. However, higher than average propensities are found in certain Ontario regions, including Georgian Bay (Region 25), Niagara (Region 21), and Eastern Ontario (Region 17). It is also interesting that the odds of making an onward move to a return move is much higher on average for Ontario and Quebec regions than for regions in other parts of Canada.

Origin regions that had high return-move propensities did not necessarily have high onward-move propensities. A simple correlation analysis of the two propensities by origin region suggests that the association is positive but weak (r = .091) and provides a first indication that spatial patterns are quite different for the two types of multiple migration.

Much of the return migration involved movement *within* broad areas, as can be seen in Table 1. For example, about 70 percent of persons who left an Ontario region and moved to another Ontario region returned. However, the allocation of migrants from Atlantic Canada regions and regions in the Prairies is more dispersed. Excepting moves within the same broad areas, Ontario regions are the most popular destination of the original move, but they are much less attractive as destinations for persons originally located in regions west of Ontario than for those originally located in regions to the east. Quebec and prairie regions appear to receive the smallest numbers of return and onward movers. In the case of Quebec, language considerations most likely generate this result. The distribution of onward moves is considerably more dispersed than for return moves. Ontario regions are quite pronounced as intermediate destinations for onward moves for migrants from other areas of Canada.

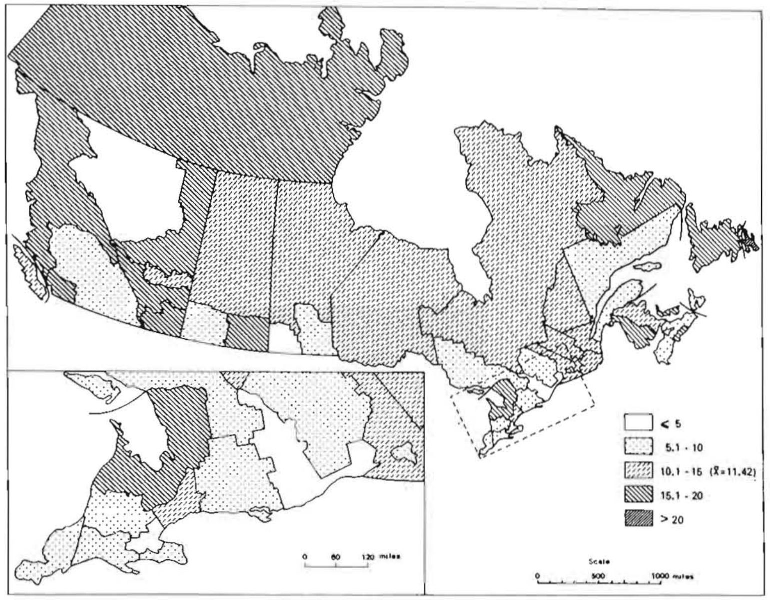


Figure 4

PERCENT FROM I WHO RETURN TO I (Case 5)

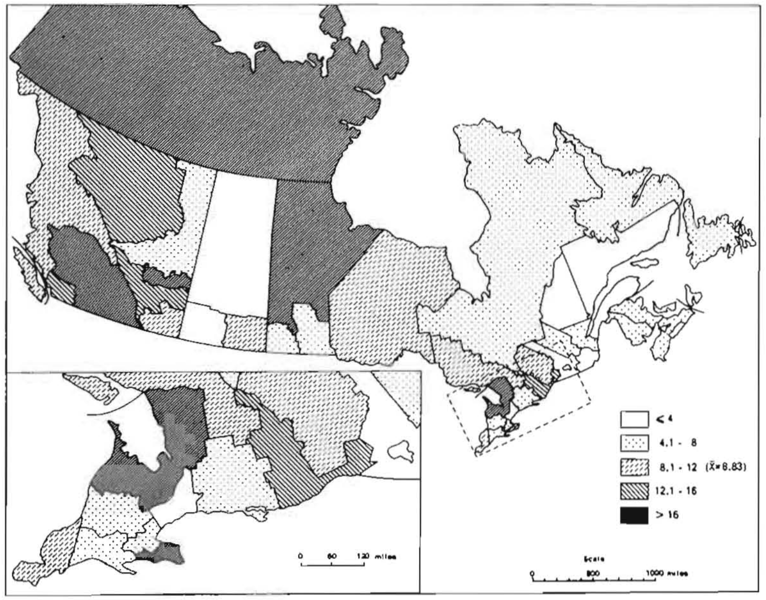


Figure 5

PERCENT FROM I WHO GO ON TO K (Case 6)

Table 1

ALLOCATION BY ORIGIN AREA OF REPEAT MIGRANTS
WHO MADE THEIR INITIAL MOVE 1969-70[1]

	Destination 1970					
Origin 1969	Atlantic %	Quebec %	Ontario %	Prairies[2] %	West[3] %	North Canada %
Atlantic	54.5(37.5)	2.3(8.3)	40.9(33.3)	0.0(12.5)	2.3(8.3)	0.0(0.0)
Quebec	5.3(12.8)	73.7(56.4)	15.8(20.5)	0.0(5.1)	3.9(2.6)	1.3(2.6)
Ontario	9.8(9.2)	6.8(4.1)	69.8(70.4)	3.0(6.1)	10.6(8.2)	0.0(2.0)
Prairies	0.0(0.0)	0.0(2.4)	18.2(22.0)	40.9(46.3)	40.9(26.8)	0.0(2.4)
West	0.9(4.8)	1.8(1.6)	7.1(22.6)	3.6(6.5)	83.9(56.5)	2.7(8.1)
North Canada	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	100.0(100.0)[4]	0.0(0.0)

[1]The unbracketed number refers to persons who returned 1970-71 and the bracketed number refers to individuals who made an onward move, 1970-71. Percentages may not sum to 100.0 for each origin area because of rounding. Percentages less than 10 percent are often based on less than 20 observations.

[2]Regions in Manitoba and Saskatchewan.

[3]Regions in Alberta and British Columbia.

[4]Based on a very small sample.

These observations on return and onward migration within the context of the six broad areas suggest that the distance of the initial move was greater for onward movers than for return movers. Using the distance between the population centroids of the 44 regions, we confirmed this general impression. The average distance of the initial move was approximately 600 miles for onward movers, 530 for return movers, and just over 500 for primary movers.

The migration matrices for return and onward moves are displayed in Table 2. As can be seen by inspecting the row totals, return migration propensities are highest for Atlantic origin regions and origin regions in Alberta and British Columbia, whereas the highest onward migration rate is for persons originating from Manitoba and Saskatchewan. The data indicate, for example, that 15.1 percent of all persons who moved from an Atlantic region to any other region in 1969-70 returned to that Atlantic region in 1970-71. Furthermore, we estimate that about 18 percent of migrants from an Atlantic region who went to an Ontario region (in many cases, Toronto) returned to that Atlantic region in 1970-71. And, in another context, a significant number of persons who moved to Atlantic regions in 1969-70 left within one year. Note, for instance, that 17.3 percent of migrants from an Ontario region who moved to an Atlantic region returned to the Ontario region in 1970-71. These observations demonstrate a constant flux of population change for Atlantic Canada during the late 1960s and early 1970s.

Our explanation of why regions in Atlantic and western Canada had high return migration propensities (illustrated in Figure 4) is somewhat speculative. It might be argued that in this time period economic opportunities in these areas of Canada were limited (perhaps particularly for Atlantic regions), and therefore forced individuals to seek opportunities in different areas of Canada. For example, the data in Table 1 indicate that approximately 50 percent of all return migrants from Atlantic and Prairie regions moved initially to regions outside their respective broad geographical areas. Information about job openings is likely to be less accurate for long distance moves, and hence a significant number of those who undertake such moves are likely to have disappointing income and employment experiences in terms of their initial move. Grant and Vanderkamp [8] have tested this hypothesis and found reasonably strong support for it. It is, however, worth repeating that their locational variables (representing origin regions) were also statistically significant, indicating to us that location plays an independent role in determining return migration rates. It is also important to note that they included the income level of the individual in the origin region, hence their

Table 2

MIGRATION RATE FOR REPEAT MIGRANTS WHO MADE AN INITIAL MOVE 1969-70[1]

	Destination 1970						
Origin 1969	Atlantic %	Quebec %	Ontario %	Prairies[2] %	West[3] %	North Canada %	Total %
Atlantic	15.8(5.9)	6.7(13.3)	17.6(7.8)	0.0(42.9)	6.7(13.3)	0.0(0.0)	15.1(8.2)
Quebec	14.8(18.5)	10.2(4.0)	7.8(5.2)	- (20.0)	11.1(3.7)	20.0(20.0)	9.8(5.0)
Ontario	17.3(12.0)	11.8(5.3)	8.8(6.6)	12.1(18.2)	10.8(6.2)	0.0(20.0)	9.7(7.2)
Prairies	0.0(0.0)	0.0(16.7)	12.9(14.5)	11.3(11.9)	9.9(6.1)	0.0(50.0)	10.6(9.9)
West	7.1(21.4)	13.3(6.7)	10.5(18.4)	10.5(10.5)	17.2(6.4)	13.0(21.7)	15.7(8.7)
North Canada	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	22.2(11.1)	0.0(0.0)	16.7(8.3)
Total	15.4(9.6)	10.3(4.5)	9.6(7.5)	10.7(13.7)	14.5(6.3)	11.4(25.7)	

[1]The unbracketed number is the percentage of 1969-70 migrants from a specific region within a broad area who returned to that region in 1970-71. The bracketed value is the equivalent percentage for onward migrants.

[2]Regions in Manitoba and Saskatchewan.

[3]Regions in Alberta and British Columbia.

origin-location dummy variables were not simply capturing the fact that low-income regions tend to have high return propensities.

The economies of both Atlantic Canada and regions in prairie and western Canada are highly concentrated in primary industrial activity. It is therefore possible that persons who move to take advantage of the opportunities in various primary industries find (or expect) the duration of employment in the destination region to be short. In these circumstances they return to a region of former employment or perhaps move to a resource site in another region. It is interesting to note in Table 2 that the return migration rates for moves within the Atlantic, Prairie, and Western regions are high in comparison to other values in the table.

Why onward migration rates are extremely high for regions in Manitoba and Saskatchewan (and to a lesser extent for those in Alberta and British Columbia), while so low for Quebec region, is an unresolved puzzle at this stage of our work. Clearly, a disappointing experience for the first move may trigger another move to a completely different region (an onward move), although Grant and Vanderkamp [8] found the relationship between disappointment and the probability of an onward move to be weaker than that for return migration and disappointment. Locational ties to specific regions in western Canada may be less than those for Quebec and Atlantic Canada regions, although we have no supporting evidence on this score. If this is a reasonably plausible contention, it can be argued that individuals from Atlantic and Quebec regions who have had a disappointing first move are more likely to return than to move to another region, while migrants from western regions are more likely to move onward than return.

Spatial Regularities in Interregional Flows

We have presented some general impressions of the spatial patterns in each of the migration cases. In this section, we conduct formal tests for the degree of spatial regularity in the various migration cases. We focus on two important aspects of regularity in our data. First, is there regularity across the country? For example, is a certain type of migration important in the west of Canada, but increasingly less so as one moves eastward? Or, is the pattern much more spatially complex, with several troughs and peaks occurring across the country? Second, is there homogeneity within regional groupings? For instance, do Atlantic regions exhibit similar levels of a particular type of migration because in some sense common economic and social conditions prevail in these regions? Separate methods of anlaysis are used to assess each type of regularity: trend surface for regularity across

the country (national regularity), and spatial autocorrelation for regularity within regional groupings (regional regularity).

We have eight cases. Cases 1 to 3 refer to primary, return, and onward moves with respect to the region of destination (j), whereas Cases 4 to 6 refer to the origin region (i). Cases 7 and 8 are overall migration rates per thousand.

Trend Surface Analysis

Trend surface analysis has its origins in attempts by geologists to generalize surfaces [9] and has been used by geographers to examine spatial trends in a diverse set of phenomena [1; 15]. An overview of the model and its applications is provided by Unwin [16].

The aim of trend surface analysis is to separate regional, or systematic, variation in mapped data from local, or non-systematic, variation [17]. Thus, it is assumed that the observed value for the variable of interest, Z (some migration rate), at any point, i, has two components, the systematic (trend) and the non-systematic (residual). More formally:

$$Z_i = f(x_i, y_i) + u_i$$

where x_i = Coordinate of the x-axis for observation i.

y_i = Coordinate of the y-axis for observation i.

u_i = Residual at the i^{th} data point.

There are a number of ways of representing the function of x_i and y_i, that is, the form of the trend, but the most common is to fit a non-orthogonal polynomial by ordinary least squares [15]. In this form, trend surface analysis is a multiple regression model in which the mapped variable is the dependent variable and location coordinates, or their transformations, serve as the independent variables. Each inflexion in the surface requires an expansion in the polynomial, and although this expansion can be infinite, the fitting of trend surfaces is commonly of orders one through three - the linear, quadratic and cubic surfaces. In each case, the slopes of the fitted surface are given by the partial regression coefficients.

If, in the unusual case, migration rates were equal for all regions, the national (trend) surface should be linear and flat. On the other hand, if migration rates were completely random in terms of location, we should expect to obtain no significant surface.

Trend surface results can be presented and used in a variety of ways. It is possible, for instance, to examine and interpret residual surfaces or to interpolate values for interstitial regions. Given that the problem under consideration in this study is to gauge the degree of systematic variation in each of the national patterns, the focus here is upon the statistical significance (F) and the coefficient of multiple determination (R^2) of the trend surfaces (Table 3). The R^2 values are interpreted in the conventional manner, but it should be noted that the F values refer not to the surfaces in isolation but to the significance of the additional explanation afforded by an expansion of the model [16].

Significant surfaces were obtained for both aggregate patterns (Cases 7 and 8). In the case of in-migration, the quadratic surface accounts for nearly 70 percent of the variation in the map. The high point is in the extreme northwest; the bottom of the trough is along the northern Ontario-St. Lawrence axis, with a secondary high ridge along the southern Ontario and Atlantic fringes. The linear surface for out-migration has its high point in the northwest and its low point along the southern Ontario and Atlantic fringes.

The results for the remaining six cases reveal that greater regularity is evident when behaviour is defined in terms of the origin (Cases 4-6) as opposed to the destination (Cases 1-3). This might well reflect the relative homogeneity of out-migrants from a region as opposed to the pronounced heterogeneity of migrants into a region, such that individuals leaving a region like Metropolitan Toronto (No. 19) are likely to demonstrate less socioeconomic diversity than those arriving.

The trend surface results for Cases 4-6 are interesting not only because of the degree of regularity evident (the R^2 values range from .157 to .577) but also because the spatial regularity differs for each. For primary movers (Case 4), a significant cubic surface is obtained, while return migration yields a linear surface, and onward migration a quadratic surface. For the cubic surface (Case 4), there are highs on the north Pacific Coast and along the Ontario-Quebec axis and lows in the centre-north and northeast. For the linear surface (Case 5), the high is along the northern rim and the low in southern Ontario. Lastly, for the quadratic surface (Case 6), the peak is in the extreme northwest, with a pronounced trough in Atlantic Canada and a secondary, weak peak in southern Ontario. This diversity evident in national regularity in the spatial patterns of propensities for multiple moves suggests that a focus on aggregate out-migration rates might well mask important differences between particular types of migration behaviour.

Spatial Autocorrelation

Spatial autocorrelation has long been of interest to geographers and ecologists, but has recently become important in other disciplines, notably economics and geology [2]. The basic premise of

Table 3

TREND SURFACE RESULTS

	Linear Surface		Quadratic Surface		Cubic Surface	
	F†	R^2††	F	R^2	F	R^2
1. % to j who stay in j	4.94*	.190	1.03	-	2.19	-
2. % to j who return to i	2.69	-	.93	-	.78	-
3. % to j who go on to k	1.30	-	2.75	-	5.44*	.521
4. % from i who stay in j	9.46*	.310	3.09*	.443	2.77*	.577
5. % from i who return to i	3.93*	.157	2.02	-	1.34	-
6. % from i who go on to k	8.89*	.297	6.96*	.542	1.46	-
7. out-migration per 1,000	14.98*	.416	1.53	-	1.69	-
8. in-migration per 1,000	11.00*	.344	14.34*	.688	1.60	-

†The F statistic reported results from an analysis of variance of the incremental explanation offered by the surface.

††Coefficients of determination are reported only for significant surfaces.

*Denotes statistical significance at the .05 level.

spatial autocorrelation is that the presence of some quality in a region makes its presence in neighbouring regions more or less likely. In other words, spatial autocorrelation refers to a situation in which values of a mapped variable at specific locations are collinear with those at nearby locations. Spatial autocorrelation is, of course, the cross-sectional equivalent of temporal autocorrelation and gives rise to similar model-building and model calibration problems [14]. Cliff and Ord [2] provide an exhaustive discussion of spatial autocorrelation techniques and applications.

In this study, two measures of spatial autocorrelation are used, both of which use the product moment correlation coefficient as a measure of association. The first measure is the simpler to calculate and focuses upon the correlation between pairs of neighbours. Given values for points in space (in this case, the population centroids of the 44 regions) and the distance between all pairs of points, the first order nearest autocorrelation coefficient, NNr_1, measures the degree of association between the n observed values and values for nearest neighbours. This nearest-neighbour coefficient can be calculated n-1 times, where NNr_i is the measure on the degree of association between i^{th} nearest neighbours. In this study we calculate NNr_i for the first to third nearest neighbours. This vector of three correlation coefficients reflects the sensitivity of spatial autocorrelation to increasing separation (distance), which partly compensates for the oversimplification in this measure arising from the consideration only of relationships between pairs of region, rather than between each region and all nearby regions.

The second measure of spatial autocorrelation used is similar to that developed by Cliff and Ord [2], and complements the nearest neighbour measure by focusing upon the correlation between mapped values and those in *all* neighbouring regions. A correlation coefficient is calculated between the observed value for each economic region, Z_i, and an estimated value, $\hat{Z}$, calculated as follows:

$$\hat{Z}_i = \sum_j Z_j w_{ij}$$

where: $\hat{Z}_i$ = Estimated value of Z in region i.

Z_j = Observed value of Z in contiguous region j.

w_{ij} = Proportion of boundary of i that is shared with j.

We exclude from the boundary of each region the portions which are coincident with the U.S.-Canadian border or with large bodies of water. Region 23, for example, is considered to share borders only with Regions 22 and 24. Thus, the sum of all w_{ij} equals unity

for each region. Note that this measure of spatial autocorrelation produces only a single correlation coefficient for each case.

Both spatial autocorrelation measures were calculated for each of the eight cases (Table 4). As in the case of the trend surface analysis, there is a degree of spatial regularity evident for the two aggregate rates, although in this case it is between neighbours as opposed to across the whole map. The greater degree of regional regularity for out-migration (Case 7) as opposed to in-migration (Case 8) may again reflect the greater homogeneity of outmigrants as opposed to in-migrants. Indeed, the results for Case 7 are most consistent; the nearest neighbour correlation coefficient decreases in magnitude as more distant pairs of neighbours are considered and the value for the contiguous neighbour measure is almost identical to that for first nearest neighbours.

Table 4

SPATIAL AUTOCORRELATION RESULTS

Case	Nearest Neighbour Measure 1st	2nd	3rd	Contiguous Neighbour Measure
1. % to j who stay in j	-.087	.254	.195	.151
2. % to j who return to i	.058	.024	.173	.128
3. % to j who go on to k	-.136	.221	.110	.114
4. % from i who stay in j	.281	.237	.218	.242
5. % from i who return to i	.166	-.128	.210	-.003
6. % from i who go on to k	.278	.217	.305*	.337*
7. out-migration per 1,000	.582*	.245	.149	.575*
8. in-migration per 1,000	.056	.570*	.055	.348*

*Denotes significance at the .05 level using a 2-tailed t-test.

The regularity evident in the spatial patterns of Cases 4-6 at the national scale is absent at the regional level, with the exception of a relatively weak spatial autocorrelation for Case 6. However, this result is not conclusive because the spatial autocorrelation analysis was performed on all regions, so the failure to produce a significant result does not preclude the possibility that regional regularity exists in some parts of the country but not in others. For instance, examination of Figure 5 reveals a group of contiguous regions with similar onward migration propensities running from northern Saskatchewan to the St. Lawrence, but reveals less regional regularity elsewhere. Additionally, it is possible that regional structures are more complex than has been suggested here. There is evidence, for example, that migration behaviour might differ systematically between metropolitan cores and rural peripheries. Although our data are not consistently fine enough to properly test such a core-periphery hypothesis, Figures 2 through 5 suggest that it has some credibility. Note, for instance, that although the propensity for return migration is relatively uniform across southern Ontario (Figure 4), the rate for Metropolitan Toronto (Region 19) is above average. Conversely, the metropolitan region's propensity for onward migration is below average. This implies a different behaviour pattern on the part of Metropolitan Toronto migrants (as reflected in the mix of onward and return moves) relative to that of their counterparts from the remainder of southern Ontario.

Summary and Implications

We have demonstrated that various types of interregional migration rates differed significantly across the country in the period 1969-70. The average propensity of those who moved in 1969-70 to return was 11.5 percent and this constituted about 60 percent of the multiple moves that occurred in 1969-71. The largest repeat migration rates were observed for moves originating from Atlantic regions and regions in Alberta and British Columbia. However, those regions having high onward-migration rates did not necessarily have high return-migration rates.

A large degree of return migration occurred between regions within broad areas. For example, migrants originating from regions in the West who moved to another western region in 1969-70 were more prone to make a return move than those individuals who chose a region outside of the West as the destination of their 1969-70 move. The exceptional case was for Atlantic region migrants who moved to Ontario; about 18 percent of them returned after one year's absence. By way of contrast, our data indicated that the destination of the 1969-70 move was much more geographically dispersed for those individuals who made another, non-return move in 1970-71. Our trend surface analysis confirmed these different spatial regularities for the two types of multiple moves.

Regions in Ontario were the most popular initial destinations for repeat migrants originating from regions in Atlantic Canada and Quebec. The original destinations of return migrants originating from regions in the prairies and western Canada were heavily concentrated in regions on the Ontario-Manitoba border. However, 22.6 percent of the onward migrants from Alberta and British Columbia regions chose regions in Ontario as the destination of their first move.

The statistical analysis of national and regional spatial regularities in our data set reveals such regularities to be relatively strong for traditional aggregate measures such as in- and out-migration rates per thousand and only a little less so for percentages of primary, return, and onward migrants defined in terms of the origin region. No pronounced regularity was established for the special types of in-migration.

We offer as a suggestion the possibility that some of the unobservable factors in migration data sets that importantly determine multiple migration behaviour may lie hidden in the spatial dimension. This notion is not new, but we offer some further elaboration on this matter in light of our findings as well as the Grant and Vanderkamp [8] results (which indicate that locational factors play a statistically significant role over and above observable factors such as personal and economic considerations).

Econometric migration studies such as that of Grant and Vanderkamp [8] make two key assumptions which may not hold. First, they assume that there is no "selectivity bias" among migrant categories. That is to say, unobservable factors such as tastes, motivation, family ties, language and cultural factors, and locational attachments are identically distributed for primary, return, and onward movers. To the extent that they are differently distributed, migration propensities among these groups will differ. Locational and other spatial characteristics may well capture some of the influence of these differences in unobservable factors. It is well known that out-migration rates from Atlantic regions are high relative to other parts of Canada. But, as we have shown, return migration propensities are also high for Atlantic regions, and this suggests that unique cultural and social factors play an important role in drawing back persons who left regions in Atlantic Canada. Typically, these as well as other influences are unmeasurable and unobservable, and yet it is possible that spatial factors capture some of their influence.

Additionally, logit specifications of multiple-choice behaviour assume that the specific choices (locations) are perceived by the individual to be totally distinct from one another [5]. The analogy that is used is that an individual can make a choice between a red and a blue car but not between two seemingly identical red cars. In the latter case, the logit model is unlikely to explain why an individual chose one of the two red cars unless it was possible to discern a uniquely distinct feature of the chosen car. Alternative destinations in a migration model may also have common characteristics and therefore are spatially autocorrelated. Such common characteristics as environment, culture, industrial structure, and language have often been cited by students of migration. Thus, the logit migration model may be unable to explain locational choice decisions if spatial autocorrelation is present. However, our results for Cases 1 to 3 (destinations) and for Cases 4 to 6 (origins) suggest that there is not a problem, at least not on an overall basis. Our results do not preclude "pockets" of spatial autocorrelation for certain geographical areas in Canada, and this is clearly a topic worth further investigation.

Although the above comments are speculative, we offer some suggestions for those concerned with modelling migration behaviour. First, our trend surface evidence suggests the possibility that various migration types (return, onward, and primary) may have different coefficients with respect to spatial and locational variables in a full-scale econometric model, and tests should be conducted to ascertain if these differences are statistically different. If differences are significant, this implies that space itself plays an independent role (perhaps due to information flow factors and/or unobservable locational characteristics) and that representative variables should be sought. Some thought should also be given to testing different functional forms for each of the migration categories, particularly if there is some indication that spatial variables impact differently. In addition, it would be interesting to include a measure of spatial autocorrelation (for perhaps both the origin and destination region) as an independent variable in a full-scale econometric model. This would test the proposition that the choice of a given destination was influenced (negatively or positively) by the region's association with its close neighbours.

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