Joint Effects of Ecological and Personal Factors on Elderly Interprovincial Migration in Canada*

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Introduction

According to Lee's (1966) typology of migration factors, a comprehensive explanation of the migration process should incorporate both ecological and personal factors. Ecological factors describe the objective (physical and social) environments that provide information on regional attractiveness or repulsiveness, while personal factors affect the ways in which information is perceived and used to determine the actual level of satisfaction to be achieved by potential migrants.

Until recently, limited access to detailed data on the personal attributes of migrants and non-migrants restricted most explanatory analyses of interregional migration in Canada to the use of ecological factors only (for example, origin and destination wage levels). But, thanks to the so-called Public Use Sample (PUS) micro data files prepared by Statistics Canada from each quinquennial census since 1971, useful information on many personal attributes is now available (despite some inherent limitations) for incorporation, along with ecological factors, into an explanatory or projection migration model.

This paper analyzes the joint effects of ecological and personal factors on elderly migration in Canada in the late 1970s, using information on migration and personal factors extracted from the individual file of the 1981 Public Use Sample. Our focus on elderly Canadians stems from the expectation that the Canadian population will continue to age rapidly over the next three decades and that the elderly's demand for services (for example, health care and income maintenance) will expand rapidly as a consequence. Some of these services are clearly location-specific and should be matched to the changing distribution of the elderly population, which is, of course, affected by geographic mobility.

Although both long- and short-distance movements should be studied, the limited geographical detail in the PUS data restricts our analysis to interprovincial movements. For such an analysis, migration is conceptualized as a two-level decision process: (1) the departure process, whereby a potential migrant chooses to stay or to outmigrate, and (2) the destination choice process, whereby an outmigrant chooses one of the potential destination provinces. The nested logit model, derived from random-utility choice theory (Kanaroglou, Liaw, and Papageorgiou 1986), is used to evaluate the joint effects of ecological and personal factors on the probabilities of these two choices. In applying this model, several ecological variables and three personal factors are utilized. All were selected on the basis of our previous experience in (1) explaining interprovincial migration patterns of the general population (Liaw and Ledent 1987), and (2) examining the impact of various personal factors on the migration process of the elderly (Ledent and Liaw 1986).

After a brief description of the PUS data, the following section shows how the composition of the elderly population at risk of migrating differs markedly among the provinces in terms of each of the three personal factors retained.[1] The departure and destination choice processes are then characterized. Next, in a shift from a univariate to a multivariate perspective, the nested logit model is introduced and the selection of the ecological variables explained. The joint effects of ecological and personal factors are studied in the succeeding sections. Finally our findings are summarized.

The PUS Data and the At-risk Population •

The individual file of the 1981 PUS, released by Statistics Canada on three reels of magnetic tape, contains about 450,000 records included

[1]Each factor will be examined in turn, because it is difficult to visualize patterns by looking at a multidimensional contingency table.

in a 1-in-50 sample of Canadians randomly selected from the 1981 Census. Each record comprises more than 100 variables pertaining to a given person. Among these variables, two are of paramount interest in a study of migration: the 1976 and 1981 places of residence that, if located in Canada, are coded only at the provincial level. The three smallest units—Prince Edward Island, Yukon, and the Northwest Territories—are, however, consolidated into a single region (PEIT).[2] Because it does not have geographical integrity and shares less than 1 percent of the national population, PEIT will be ignored in our multivariate statistical analysis.

Using age 65 (as of 1981) as a threshold, 43,037 records, corresponding to those elderly who indicated a 1976 place of residence within Canada, were extracted from the PUS individual file. The ensuing set of elderly—called here the *at-risk population*—is characterized below in terms of the three personal factors found, in an univariate analysis of elderly migration (Ledent and Liaw 1986), to be relatively good discriminators of mobility differences: birth status, mother tongue, and education. Because of the small number of interprovincial migrants included in the PUS, the simultaneous use of more factors than three would have resulted in too many zero migration streams and thus the underlying pattern would have been hopelessly covered up by a high level of random noise.

Birth Status

Birth status is determined by comparing the place of birth with the 1976 place of residence. An individual born in Canada is said to be a *native* if in 1976 he resided in his province of birth and a *non-native* if in 1976 he resided in a province other than his province of birth. An individual born outside Canada is said to be *foreign-born*. This variable conveys some information about the individual's migration experience up to five years prior to the 1981 census date. Both non-natives and foreign-borns had experienced (at least once) long-distance migration, whereas many of the natives probably had never left their province of birth (only a small fraction had left and subsequently returned). From a cultural viewpoint, the former could be seen as being rootless and the latter as having roots. Indeed, previous migration experience and rootlessness are expected to be conducive to further migration.

Among the 43,037 elderly Canadians in our subsample, the majority (57 percent) were natives and, among those who were not, more were foreign-born (29 percent) than non-natives (14 percent), see Table 1. There were, however, tremendous differences among the

[2]For simplicity, the ten regions used to record the two places of residence are referred to as provinces in the remainder of this paper.

provinces. In particular, the proportion of natives ranged from less than 20 percent in British Columbia to more than 80 percent in the Atlantic provinces and Quebec. While the foreign-borns were scarce in the Atlantic provinces, they represented about one-third or more of the elderly in Ontario and all the western provinces. Finally, non-natives, who were rare in Newfoundland and Quebec (2 and 5 percent, respectively), were quite numerous in Alberta and British Columbia (24 and 39 percent, respectively).

Table 1

PERCENTAGE SHARES OF THE ELDERLY POPULATION BY BIRTH STATUS, MOTHER TONGUE, AND EDUCATION: CANADA AND THE PROVINCES, 1976.

	Nfld.	PEIT	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
Birth Status											
Native	97	74	82	84	81	53	56	49	32	17	57
Foreign-born	1	7	7	6	14	37	33	33	44	44	29
Non-native	2	19	11	11	5	11	11	17	24	39	14
Mother Tongue											
French	0	9	6	29	75	5	6	4	3	2	22
"Minority"	0	8	2	2	9	21	39	42	35	23	19
English	99	83	92	69	16	74	55	55	62	75	58
Education											
Low	62	51	41	61	61	46	52	61	47	38	51
High	38	49	59	39	39	54	48	39	53	62	49

Note: PEIT = Prince Edward Island, Yukon, and the Northwest Territories.

In all, the large cumulative effects of selectivity regarding past migration is revealed quite dramatically by the sharp contrast in birth status in Newfoundland, where 97 percent of the elderly were natives, versus British Columbia, where only 17 percent were natives.

Mother Tongue

The at-risk population is classified into three groups by mother tongue: *English*, *French*, and *"Minority"*. English was the mother tongue for 58 percent of the elderly, while the remaining population was almost equally split between French (22 percent) and other languages (19 percent).

Apart from Quebec, where English was the mother tongue for just 16 percent of the elderly, English was less dominant in the Prairies (55-62 percent) than in the Atlantic provinces (69-99 percent), Ontario

(74 percent), and British Columbia (75 percent). French was important in Quebec (75 percent) and, to a lesser extent, in New Brunswick (29 percent). In the remaining provinces, less than 10 percent of the elderly were of French mother tongue (only 5 percent in Ontario even though this is the most important recipient of migrants out of Quebec). Finally, the "Minority" group, virtually non-existent in the Atlantic provinces, constituted about one-tenth of the elderly in Quebec, about one-fifth in Ontario and British Columbia, and more than one-third in the Prairie provinces.

The geographical pattern of mother tongue just described is mainly the result of immigration history: the early establishment of separate French and British colonies; the large influx of Eastern Europeans and Scandinavians into the Prairies in the first three decades of the twentieth century; the large number of Southern European immigrants in Ontario in the 1950s and 1960s; and the persistent preference of Asian immigrants for Ontario and British Columbia.

Education

Two education groups are considered here: *low education* (with less than nine years of schooling), and *high education* (with at least nine years of schooling). Elderly Canadians were almost equally distributed among the two groups (51 percent versus 49 percent). The relative importance of the two groups, however, varied across provinces. The proportion of elderly with higher education ranged from 38-39 percent in Newfoundland, New Brunswick, Quebec, and Saskatchewan to about 62 percent in British Columbia, with intermediate values of 48 percent in Manitoba, 53 percent in Alberta, 54 percent in Ontario, and 59 percent in Nova Scotia. In general, the provinces that had long experienced net outmigration had a large majority of poorly-educated elderly, whereas those with a long history of net inmigration had a large majority of well-educated elderly. The only exception is Nova Scotia.

Characterization of the Departure Rates

The level of migration out of province i for a group of individuals with personal attribute t can be represented by the following departure rate:

$$q_{i,t} = S_{i,t} / K_{i,t} \tag{1}$$

where $S_{i,t}$ is the relevant numbers of outmigrants and $K_{i,t}$ the corresponding at-risk population.[3] In addition, a range of plausible variations

[3]More aggregated departure rates are computed from the same formula where both the numerator and denominator terms have been summed over the provinces and/or the relevant personal attributes.

for $q_{i,t}$ can be ascertained from the following standard error (shown as Sigma in Table 2):

$$\sigma_{i,t} = [q_{i,t} (1-q_{i,t}) / K_{i,t}]^{0.5} \tag{2}$$

although this formula may understate the true amount of uncertainty, if outmigrations are not independent events.

Overall Pattern

Of the 43,037 individuals in our elderly subsample, 784 changed their province of residence from 1976 to 1981, implying an overall departure rate of 18 per thousand. Thus, the elderly were about one-third as likely to change provinces as the general population, which had a 53 per thousand departure rate.

The elderly's propensity to change provinces varied across provinces, but in a way that differed from the corresponding propensity for the general population. For the latter, three distinct levels of departure rates were registered (see note, Table 2): (1) the two most populous provinces, Quebec and Ontario, had less-than-average rates (34 and 42 per thousand, respectively); (2) British Columbia had an about average rate (53 per thousand); and (3) the Atlantic and Prairie provinces had higher-than-average rates (72 per thousand and over). In the case of the elderly, however, Quebec had a departure rate just above average (21 per thousand), whereas the Atlantic provinces had a less-than-average (rather than a higher-than-average) departure rate, especially in the case of Newfoundland (8 per thousand). Why is the elderly's spatial pattern of outmigration so different from that of the general population? As suggested by Liaw and Kanaroglou (1986) and Cheung and Liaw (1987), the elderly may have a different utility function; for example, they are less affected by labour market factors and are more sensitive to environmental factors. We suspect, however, that a large part of the answer lies in the highly heterogeneous nature of the elderly population with regard to personal factors.

Effects of Personal Factors

Birth Status

The overall departure rate differed significantly among the three birth status groups, assuming a low level (8 per thousand) for the natives, a moderate level (22 per thousand) for the foreign-borns, and a high level (52 per thousand) for the non-natives. With almost no exception, this contrast also appeared in the individual provinces. For example, in the Prairie provinces, which registered higher-than-average departure rates, the outmigration propensity of the foreign-borns took on an

intermediate value of 28-36 per thousand, between those of the natives (17-22 per thousand) and the non-natives (35-73 per thousand).

Mother Tongue

The overall departure rate also differed significantly among the three mother tongue groups. That of the "Minority" group (18 per thousand) fell between the rates of the French (7 per thousand) and English (22 per thousand) groups. This pattern was exacerbated in Quebec, where the French were unwilling to outmigrate (4 per thousand), whereas the "Minority" and, especially, the English groups, had an exceptionally high desire to outmigrate (40 and 87 per thousand, respectively). In the other provinces, however, another pattern was observed, as the French elderly were eager to migrate, especially those in British Columbia (48 per thousand) and Ontario (27 per thousand). As will be shown later on, a large proportion of these migrants naturally went to Quebec.

Education

The overall departure rate of the elderly also differed significantly between the two education groups. People with 8 years or less of schooling were about half as migratory as those with 9 years or more (12 as against 25 per thousand). Except for British Columbia, such a contrast was also seen at the provincial level, in particular in Quebec (10 versus 38 per thousand) and Saskatchewan (16 versus 42 per thousand).

These observations may explain in part why the departure rates of the elderly deviate from those of the general population. For example, the very low departure rate of the elderly in Newfoundland largely stems from the very high proportions of natives and poorly educated among the elderly. In contrast, the unexpectedly high departure rate of the elderly in Quebec mainly follows from the hypermobility of the province's English elderly, although they represented only 16 percent of Quebec's elderly population.

Characterization of the Destination Choice Proportions

Of the group of migrants out of province i with personal attribute t, the proportion $q_{j|i,t}$ that selected province j as destination can be computed from:

$$q_{j|i,t} = S_{j|i,t} / S_{i,t} \tag{3}$$

	Nfld.	PEIT	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
Total											
Migrants	7	11	25	19	221	168	57	56	116	104	784
At-risk pop.	825	316	1723	1294	10608	15716	2260	2166	2880	5249	43037
Dep. rate	8	35	15	15	21	11	25	26	40	20	18
Sigma	3	10	3	3	1	1	3	3	4	2	1
Classified by Birth Status											
Native											
Migrants	4	0	16	9	74	32	21	23	20	4	203
At-risk pop.	802	235	1413	1081	8576	8257	1267	1072	929	897	24529
Dep. rate	5	0	11	8	9	4	17	21	22	4	8
Sigma	2	0	3	3	1	1	4	4	5	2	1
Foreign-born											
Migrants	0	3	2	0	82	66	22	20	46	31	272
At-risk pop.	8	21	125	75	1495	5792	738	718	1263	2324	12559
Dep. rate	0	143	16	0	55	11	30	28	36	13	22
Sigma	0	76	11	0	6	1	6	6	5	2	1
Non-native											
Migrants	3	8	7	10	65	70	14	13	50	69	309
At-risk pop.	15	60	185	138	537	1667	225	376	688	2028	5949
Dep. rate	200	133	38	72	121	42	55	35	73	34	52
Sigma	103	44	14	22	14	5	14	9	10	4	3
Classified by Mother Tongue											
French											
Migrants	1	1	1	3	33	21	1	1	3	5	70
At-risk pop.	3	29	100	380	7938	786	135	78	96	105	9650
Dep. rate	333	34	10	8	4	27	7	13	31	48	7
Sigma	272	34	10	5	1	6	7	13	18	• 21	1
"Minority"											
Migrants	0	1	1	1	37	37	17	16	22	21	153
At-risk pop.	3	25	43	20	925	3300	876	899	1005	1216	8312
Dep. rate	0	40	23	50	40	11	19	18	22	17	18
Sigma	0	39	23	49	6	2	5	4	5	4	1
English											
Migrants	6	9	23	15	151	110	39	39	91	78	561
At-risk pop.	819	262	1580	894	1745	11630	1249	1189	1779	3928	25075
Dep. rate	7	34	15	17	87	9	31	33	51	20	22
Sigma	3	11	3	4	7	1	5	5	5	2	1
Classified by Education											
Less than 9 years of schooling											
Migrants	2	6	9	9	65	53	22	21	34	41	262
At-risk pop.	515	162	714	791	6498	7236	1167	1329	1362	1988	21762
Dep. rate	4	37	13	11	10	7	19	16	25	21	12
Sigma	3	15	4	4	1	1	4	3	4	3	1
At least 9 years of schooling											
Migrants	5	5	16	10	156	115	35	35	82	63	522
At-risk pop.	310	154	1009	503	4110	8480	1093	837	1518	3261	21275
Dep. rate	16	32	16	20	38	14	32	42	54	19	25
Sigma	7	14	4	6	3	1	5	7	6	2	1

Note: Dep. rate (departure rate) and Sigma (standard error of the departure rate) are expressed as the number of outmigrats per
1,000 at-risk persons per five years.

* For comparative purposes, the total departure rates of the general population are: Nfld., 72; PEIT, 236; N.S., 81; N.B., 79;
Quebec, 34; Ontario, 42; Manitoba, 102; Sask., 80; Alberta 80; B.C., 53; and Canada, 53.

where $S_{j|i,t}$ is the number of migrants with personal attribute t who migrated from province i to province j during the 1976-1981 period.[4] Moreover, a rough estimate of the uncertainty attached to $q_{j|i,t}$ can be ascertained from the following standard error:

$$\sigma_{j|i,t} = [q_{j|i,t} (1-q_{j|i,t}) / K_{j|it}]^{0.5} \qquad (4)$$

a formula that is based on the assumption that destination choices made by different elderly migrants are independent events.

Overall Pattern

Table 3 shows the overall destination choice pattern of elderly migrants out of each province. Because of the relatively small numbers of individuals involved, however, the destination choice pattern of the migrants out of the Atlantic provinces is subject to a relatively high level of random noise.

For elderly migrants out of the Maritime provinces and Quebec, Ontario was the most important destination, attracting more than 40 percent of those leaving Nova Scotia and New Brunswick and about 75 percent of those leaving Quebec. By contrast, for elderly migrants out of Ontario and the Prairie provinces, British Columbia was the most important destination, attracting more than 40 percent of those leaving Ontario, Manitoba, and Saskatchewan, and about 80 percent of those leaving Alberta.

Only very small proportions of elderly migrants out of the Atlantic provinces and Quebec moved westward beyond Ontario. Among those doing so, more chose British Columbia over Alberta. Even smaller proportions of elderly migrants out of the western provinces moved eastward beyond Ontario. The east-west division of the migration field is an important feature of Canada's demographic system (Stone 1974).

Among the four provinces that sent out the largest numbers of elderly migrants, Ontario and British Columbia had a much more dispersed destination choice pattern than Quebec and Alberta. The major destinations for elderly migrants out of Ontario were British Columbia (44 percent), Quebec (16 percent), Nova Scotia and Alberta (both 11 percent), whereas the major destinations for elderly migrants out of British Columbia were Alberta (46 percent), Ontario (20 percent), Saskatchewan (14 percent), and Manitoba (11 percent). •

Finally, Newfoundland was by far the destination least selected by the elderly. Combined with our earlier finding that the elderly in Newfoundland had an extremely low propensity to outmigrate, this

[4] Again, more aggregate destination choice proportions can be obtained by summing both the numerator and denominator over i and/or t.

observation means that, as far as the elderly are concerned, Newfoundland—not Quebec, despite the French/English barrier—is the most isolated province.

Table 3

THE DESTINATION CHOICE PROPORTIONS (PERCENT) OF THE ELDERLY MIGRANTS OUT OF EACH PROVINCE, 1976-1981

Destination	Origin									
	Nfld.	PEIT	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
Nfld.	—	0	0	0	0	0.6 (0.6)	0	0	0	0
PEIT	0	—	8.0 (5.4)	5.3 (5.1)	1.4 (0.8)	0	1.8 (1.8)	0	0.9 (0.9)	3.8 (1.9)
N.S.	57.1 (18.7)	0	—	10.5 (7.0)	2.3 (1.0)	11.3 (2.4)	1.8 (1.8)	0	0.9 (0.9)	1.0 (1.0)
N.B.	0	9.1 (8.7)	20.0 (8.0)	—	6.8 (1.7)	7.1 (2.0)	0	1.8 (1.8)	0	0
Quebec	0	9.1 (8.7)	4.0 (1.5)	15.8 (8.4)	—	15.5 (2.8)	1.8 (1.8)	0	1.7 (1.2)	4.8 (2.1)
Ontario	14.3 (13.2)	9.1 (8.7)	48.0 (10.0)	42.1 (11.3)	74.2 (2.9)	—	8.8 (3.8)	8.9 (3.8)	10.3 (2.8)	20.2 (3.9)
Manitoba	0	9.1 (8.7)	4.0 (1.5)	5.3 (5.1)	0.5 (0.5)	7.1 (2.0)	—	8.9 (3.8)	1.7 (1.2)	10.6 (3.0)
Sask.	14.3 (13.2)	0	0	0	0.5 (0.5)	3.6 (1.4)	14.0 (4.6)	—	6.0 (2.2)	13.5 (3.4)
Alberta	14.3 (13.2)	0	8.0 (5.4)	5.3 (5.1)	4.1 (1.3)	10.7 (2.4)	26.3 (5.8)	37.5 (6.5)	—	46.2 (4.9)
B.C.	0	63.6 (15.2)	8.0 (5.4)	15.8 (8.4)	10.4 (2.1)	44.0 (3.8)	45.6 (6.6)	42.9 (6.6)	78.4 (3.8)	—
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of outmigrants	7	11	25	19	221	168	57	56	116	104

Note: PEIT = Prince Edward Island, Yukon, and the Northwest Territories. The figures in parentheses are the standard errors computed according to equation (4).

Effects of Personal Factors

Birth Status

A look at the two most dissimilar groups, natives and non-natives (see Table 4), reveals that Ontario's role as the major destination for elderly migrants out of the Maritime provinces and Quebec was much more pronounced for natives than for non-natives, as was British Columbia's role as the major destination for elderly migrants out of Ontario and the Prairie provinces. In addition, the elderly's destination

choice pattern was less dispersed for natives than for non-natives. For example, among the elderly migrants out of Alberta, 95 percent of the natives and 72 percent of the non-natives went to British Columbia. Such a contrast between natives and non-natives is not surprising, given the large proportion of non-natives who were actually return migrants (Vanderkamp 1968). Since net migration in Canada has been toward Ontario, Alberta, and British Columbia, return migration tends to be eastward and towards provinces with smaller populations.

Table 4
THE DESTINATION CHOICE PROPORTIONS (PERCENT) OF THE ELDERLY MIGRANTS OUT OF EACH PROVINCE, 1976-1981: NATIVES VERSUS NON-NATIVES*

Destination	Nfld.	PEIT	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
						Origin				
Nfld.	—	—	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(1.4)	(0)	(0)	(0)	(0)	(0)	
PEIT	0	—	0	0	1.4	0	0	0	0	25.0
	(0)		(28.6)	(10.0)	(1.5)	(0)	(0)	(0)	(0)	(4.3)
N.S.	50.0	—	—	11.1	0	3.1	0	0	0	0
	(66.7)	(0)		(10.0)	(4.6)	(21.4)	(7.1)	(0)	(2.0)	(1.4)
N.B	0	—	12.5	—	5.4	0	0	4.3	0	0
	(0)	(12.5)	(28.6)		(13.8)	(11.4)	(0)	(0)	(0)	(0)
Quebec	0	—	6.3	11.1	—	18.8	0	0	0	0
	(0)	(12.5)	(0)	(20.0)		(24.3)	(7.1)	(0)	(2.0)	(5.8)
Ontario	25.0	—	56.3	66.7	74.3	—	9.5	8.7	0	0
	(0)	(0)	(28.6)	(20.0)	(67.7)		(7.1)	(15.4)	(12.0)	(18.8)
Manitoba	0	—	6.3	0	0	6.3	—	0	0	10.6
	(0)	(12.5)	(0)	(10.0)	(1.5)	(10.0)		(30.8)	(4.0)	(11.6)
Sask.	0	—	0	0	1.4	0	14.3	—	5.0	0
	(33.3)	(0)	(0)	(0)	(0)	(2.9)	(35.7)		(8.0)	(17.4)
Alberta	25.0	—	6.3	0	5.4	12.5	23.8	30.4	—	75.0
	(0)	(0)	(14.3)	(10.0)	(1.5)	(8.6)	(14.3)	(30.8)		(40.6)
B.C.	0	—	12.5	11.1	12.2	59.4	52.4	56.5	95.0	—
	(0)	(62.5)	(0)	(20.0)	(9.2)	(20.0)	(28.6)	(23.1)	(72.0)	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of	4	0	16	9	74	32	21	23	20	4
outmigrants	(3)	(8)	(7)	(10)	(65)	(70)	(14)	(13)	(50)	(69)

Note: PEIT = Prince Edward Island, Yukon, and the Northwest Territories.   .

* For each destination, the upper row shows the choice percentages for native migrants while the lower row shows those for non-native migrants.

Mother Tongue

A look at the two most dissimilar groups, French and English (see Table 5), reveals that elderly migrants with French mother tongue

were more likely to choose either Quebec or New Brunswick as a destination than those with English mother tongue. For example, among migrants out of Quebec, 24 percent of the French group and only 5 percent of the English group went to New Brunswick, whereas among migrants out of Ontario, 71 percent of the French group but only 7 percent of the English group went to Quebec. By contrast, elderly migrants in the English group were more likely to choose either Ontario or British Columbia. For example, among migrants out of Quebec, 76 percent of the English group and 55 percent of the French group went to Ontario. Among migrants out of Ontario, 50 percent of the English group and only 5 percent of the French group went to British Columbia.

Table 5
THE DESTINATION CHOICE PROPORTIONS (PERCENT) OF THE ELDERLY MIGRANTS OUT OF EACH PROVINCE, 1976-81: FRENCH VERSUS ENGLISH*

Destination	Nfld.	PEIT	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
						Origin				
Nfld	—	0	0	0	0	0	0	0	0	0
		(0)	(0)	(0)	(0.9)	(0)	(0)	(0)	(0)	(0)
PEIT	0	—	0	0	0	0	0	0	0	0
	(0)		(8.7)	(6.7)	(2.0)	(0)	(0)	(0)	(1.1)	(5.1)
N.S.	0	0	—	0	0	4.8	0	0	0	0
	(66.7)	(0)		(13.3)	(2.6)	(13.6)	(2.6)	(0)	(1.1)	(1.3)
N.B.	0	0	100.0	—	24.2	9.5	0	0	0	0
	(0)	(11.1)	(17.4)		(4.6)	(9.1)	(0)	(0)	(0)	(0)
Quebec	0	100.0	0	66.7	—	71.4	100.0	0	33.3	40.0
	(0)	(0)	(4.3)	(6.7)		(7.3)	(0)	(0)	(1.1)	(2.6)
Ontario	0	0	0	0	54.5	—	0	0	0	0
	(16.7)	(0)	(47.8)	(53.3)	(76.2)		(0)	(7.7)	(11.0)	(20.5)
Manitoba	0	0	0	0	3.0	9.5	—	100.0	0	0
	(0)	(11.1)	(4.3)	(0)	(0)	(4.5)		(7.7)	(2.2)	(14.1)
Sask.	100.0	0	0	0	3.0	0	0	—	0	20.0
	(0)	(0)	(0)	(0)	(0)	(4.5)	(17.9)		(6.6)	(15.4)
Alberta	0	0	0	0	9.1	0	0	0	—	40.0
	(16.7)	(0)	(8.7)	(6.7)	(3.3)	(10.0)	(35.9)	(33.3)		(41.0)
B.C.	0	0	0	33.3	6.1	4.8	0	0	66.7	—
	(0)	(77.8)	(8.7)	(13.3)	(11.3)	(50.0)	(43.6)	(51.3)	(76.9)	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of	1	1	1	3	33	21	1	1	3	5
outmigrants	(6)	(9)	(23)	(15)	(151)	(110)	(39)	(39)	(91)	(78)

Note: PEIT = Prince Edward Island, Yukon and the Northwest Territories.

* For each destination, the upper row shows the choice percentages of the French migrants, while the lower row shows those of the English migrants.

Education

In general, Ontario and British Columbia were more attractive to the well-educated than to the poorly educated (see Table 6) and, naturally, the well-educated from Ontario strongly favoured British Columbia as a destination and vice versa. As for the large migration flow out of Quebec, the attraction of British Columbia was significantly higher for the well-educated, while Ontario held a slightly stronger attraction for the poorly educated.

Table 6

THE DESTINATION CHOICE PROPORTIONS (PERCENT) OF THE ELDERLY MIGRANTS OUT OF EACH PROVINCE, 1976-1981: POORLY EDUCATED VERSUS WELL-EDUCATED*

Destination	Origin									
	Nfld.	PEIT	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
Nfld.	—	0	0	0	0	1.9	0	0	0	0
		(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
PEIT	0	—	11.1	11.1	0	0	0	0	2.9	2.4
	(0)		(6.3)	(0)	(1.9)	(0)	(2.9)	(0)	(0)	(4.8)
N.S.	50.0	0	—	11.1	0	9.4	0	0	2.9	0
	(60.0)	(0)		(10.0)	(3.2)	(12.2)	(2.9)	(0)	(0)	(1.6)
N.B.	0	0	22.2	—	9.2	11.3	0	0	0	0
	(0)	(20.0)	(18.8)		(5.8)	(5.2)	(0)	(2.9)	(0)	(0)
Quebec	0	0	0	22.2	—	20.8	0	0	0	4.9
	(0)	(20.0)	(6.3)	(10.0)		(13.0)	(2.9)	(0)	(2.4)	(4.8)
Ontario	0	0	44.4	22.2	76.9	—	9.1	4.8	2.9	7.3
	(20.0)	(20.0)	(50.0)	(60.0)	(73.1)		(8.6)	(11.4)	(13.4)	(28.6)
Manitoba	0	0	0	0	0	9.4	—	4.8	0	12.2
	(0)	(20.0)	(6.3)	(10.0)	(0.6)	(6.1)		(11.4)	(2.4)	(9.5)
Sask.	0	0	0	0	0	3.8	27.3	—	5.9	14.6
	(20.0)	(0)	(0)	(0)	(0.6)	(3.5)	(5.7)		(6.1)	(12.7)
Alberta	50.0	0	0	1.11	6.2	5.7	22.7	47.6	—	58.5
	(0)	(0)	(12.5)	(0)	(3.2)	(13.0)	(28.6)	(31.4)		(38.1)
B.C.	0	100.0	22.2	22.2	7.7	37.7	40.9	42.9	85.3	—
	(0)	(20.0)	(0)	(10.0)	(11.5)	(47.0)	(48.6)	(42.9)	(75.6)	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of outmigrants	2	6	9	9	65	53	22	21	34	41
	(5)	(5)	(16)	(10)	(156)	(115)	(35)	(35)	(82)	(63)

Note: PEIT = Prince Edward Island, Yukon, and the Northwest Territories.

* For each destination, the upper row shows the choice percentages of the migrants with less than 9 years of education, while the lower row shows the migrants with at least 9 years of education.

The Nested Logit Model

The nested logit model was selected for analyzing the joint effects of ecological and personal factors on the destination choice and departure processes of elderly Canadians; for a justification, see Liaw and Ledent (1987). Briefly, this model consists of the following two submodels:

1. *The Destination Choice Model.* For an elderly migrant out of province i with personal attribute t, the probability of choosing province j as the destination is:

$$p_{j|i,t} = \exp(\beta' Y_{ij,t}) \, / \, {}_k\Sigma \, \exp(\beta' Y_{ik,t}) \qquad (5)$$

where $Y_{ij,t}$ is a column vector of explanatory variables; β' is a row vector of unknown coefficients; and the summation in the denominator is over all possible destinations.

2. *The Departure Model.* For an elderly migrant with personal attribute t residing in province i, the probability of migrating to some other province is:

$$p_{i,t} = \exp(\alpha_o + \alpha' X_{i,t} + \mu \, I_{i,t}) \, / \, [1 + \exp(\alpha_o + \alpha' X_{i,t} + \mu \, I_{i,t})] \qquad (6)$$

where $X_{i,t}$ is a column vector of explanatory variables; α_o, α', and μ are unknown parameters; and $I_{i,t}$ is the natural logarithm of the denominator of the destination choice model, or the so-called inclusive variable, which represents the drawing power of the rest of the system on the potential migrant out of province i.

Implementation of the above models follows from the assumption that the destination choice proportions and the departure rates are linked to the explanatory variables through the following:

$$E(q_{i,t}) = p_{i,t} \qquad (7)$$

and

$$E(q_{j|i,t}) = p_{j|i,t} \qquad (8)$$

where E is the expectation operator.

The explanatory variables in $Y_{ij,t}$ and $X_{i,t}$ may represent ecological factors, personal factors (up to g-1 dummy variables can be used to reflect a personal factor that yields g distinct groups), and their interactions. The latter can be accounted for by forming independent variables as products of an ecological factor and a relevant set of dummy variables.

Both models can be estimated using a maximum quasi-likelihood method performed by means of the 3R routine of the BMDP program (see Liaw and Ledent 1987). T-ratios, computed by dividing each esti-

mated parameter by the corresponding asymptotic standard error, are used to evaluate the relative importance of the explanatory variables in terms of the likelihood criterion.[5] In addition, a weighted coefficient of determination, computed as 1.0 minus the quotient of the weighted residual mean square of the maximum quasi-likelihood solution by the weighted total mean square,[6] is used to assess the model's goodness of fit. This measure approaches 1.0 for a very good fit and zero for a very poor fit.

Choice of the Explanatory Variables

In a previous study (Ledent and Liaw 1986), the above nested logit model was applied to interprovincial migration of the elderly disaggregated by sex, age, and birth status. In addition to showing that such migration is not very selective with respect to sex and age, this study uncovered a set of ecological factors that turned out to be statistically significant explanatory variables. All of these ecological factors (except one which will be replaced by a more suitable factor in relation to our stratification by mother tongue) are retained here, along with a few new variables (in the case of the departure model). The data sources of all ecological variables can be found in Liaw and Ledent (1986).

The Destination Choice Model

Of the six ecological factors, five are inherited from our previous study (Ledent and Liaw 1986):

1. Distance (the natural logarithm of highway distance in kilometres) between provinces i and j. This factor is hypothesized to have a negative effect.
2. Relative coldness at the destination (the number of degree-days below 18°C at the destination divided by the corresponding value at the origin, with both values averaged over the 1951-1980 period). This factor is expected to have a negative effect.
3. Relative sunshine at the destination (the number of bright sunshine-hours at the destination divided by the corresponding value at the origin, with both values averaged over the 1951-1980 period). This factor is hypothesized to have a positive effect.

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[5]For a very large sample size and under the null hypothesis that an explanatory variable's coefficient is zero, the t-ratio becomes similar to the standard normal variate.

[6]The weighted total mean square is the residual mean square under the null hypothesis that the coefficients of all substantive explanatory variables are zero.

4. Relative housing growth at the destination (the annual number of housing starts per thousand residents at destination, averaged over the five years from 1976 to 1980, minus the corresponding number at the origin). This factor is expected to have a positive effect.
5. Destination proportional share of the national population in 1976. This factor is hypothesized to have a positive effect.

The sixth variable, intended to replace the index of ethnic dissimilarity between provinces i and j that was used before, is:

6. Matching ethnic size at destination. This independent variable results from matching the three mother tongue groups (English, French, and "Minority") with the corresponding three groups measured for 1976. More specifically, the value of this variable for each mother tongue group is the percentage of the destination population belonging to the corresponding ethnic group. This factor is expected to have a positive effect.

The Departure Model

Of the six ecological factors retained in this model, three are inherited from our earlier work:

1. Proportional share of the origin population in the 1976 national population. This factor is hypothesized to have a negative effect on the departure rate.
2. An index of cultural attachment to the origin, computed as the percentage of the origin population in the British and French ethnic groups. This index is expected to have a negative effect.[7]
3. Bright sunshine at the origin (the number of bright sunshine hours in thousands per year averaged over the 1951-1980 period). This factor is hypothesized to have a negative effect.

The three other factors are:

4. Coldness at the origin (the number of degree-days below 18°C in thousands per year, averaged over the 1951-1980 period). This factor is expected to have a positive effect.
5. Housing growth at the origin (the annual number of housing starts per thousand residents at the origin, averaged over the 1976-1980 period). This factor is hypothesized to have a negative effect.
6. Government transfers to persons at the origin (the per capita government transfer to persons, net of unemployment benefits, in

[7]A province with a high percentage of its population in these ethnic groups has a longer settlement history and a stronger cultural attachment.

1976 expressed in thousands of 1961 dollars). This factor is expected to have a negative effect.

Data sources for all these variables can be found in Liaw and Ledent (1986).

The Joint Effects of Ecological and Personal Factors on the Destination Choice Pattern

Table 7 reports on three of the nine trials undertaken to fit the destination choice model with various combinations of the ecological factors as well as their interactions with personal factors. The results appear under specifications 1 to 3.

Specification 1 shows that, ignoring all personal factors, all six ecological factors are significant explanatory variables, with coefficients having the hypothesized signs: the destination choice probability is negatively affected by distance and coldness, and positively by sunshine, housing growth, matching ethnic size, and population share at destination. The weighted coefficient of determination takes on a moderate value of 0.57.

Specifications 2 and 3 show the consequences of adding the interactions between the ecological and personal factors to the set of explanatory variables. Many more interaction terms, other than the ones reported in these two specifications, were examined in our trials and turned out to be statistically insignificant. The following results were obtained from Specification 2:
- The negative effect of distance seems to be slightly weaker for the well-educated.
- The positive effect of *sunshine* at the destination is significantly *weaker* but remains positive (8.386-6.607 = 1.779) for migrants with *"Minority"* mother tongue.
- The positive effect of *housing growth* at the destination is significantly *weaker* but remains positive (1.394-0.912 = 0.482) for *non-native* migrants.
- The positive effect of the *destination population share* is significantly *weaker* and becomes slightly negative (0.521 0.563 = -0.042) for *non-native* migrants.
- The positive effect of the *destination population share* is significantly *weaker* but remains positive (0.521-0.457 = 0.064) for migrants with *French* mother tongue.
- The positive effect of the *destination population share* is significantly *stronger* for *well-educated* migrants.

The addition of the six interaction terms causes the weighted coefficient of determination to increase moderately to 0.639. Finally, the

results of Specification 3 show that the deletion of the least important interaction term has little effect on the relative importance of the remaining explanatory variables and the model's overall goodness of fit.

Table 7

ESTIMATION RESULTS OF THE DESTINATION CHOICE MODEL: ELDERLY INTERPROVINCIAL MIGRANTS, 1976-1981

Explanatory variables	Spec. 1	Spec. 2	Spec. 3
Coefficients			
Ecological factors			
(1) Distance (log of)	-1.291	-1.411	-1.274
(2) Relative coldness	-6.127	-5.345	-5.343
(3) Relative sunshine	8.775	8.386	8.358
(4) Relative housing growth	0.939	1.394	1.393
(5) Matching ethnic size	0.029	0.037	0.037
(6) Population share	0.384	0.521	0.527
Interactions between ecological and personal factors			
(7) Distance (log of) * Well-educated		0.207	
(8) Relative sunshine * Minority		-6.607	-6.469
(9) Relative housing growth * Non-native		-0.912	-0.902
(10) Population share * Non-native		-0.563	-0.562
(11) Population share * French		-0.457	-0.449
(12) Population share * Well-educated		0.287	0.275
T-ratios			
Ecological factors			
(1) Distance (log of)	-15.2	-12.0	-16.1
(2) Relative coldness	-10.9	-11.0	-10.8
(3) Relative sunshine	6.0	6.4	6.3
(4) Relative housing growth	6.1	7.9	7.8
(5) Matching ethnic size	7.8	9.2	9.1
(6) Population share	4.8	4.2	4.2
Interactions between ecological and personal factors			
(7) Distance (log of) * Well-educated		1.6	
(8) Relative sunshine * Minority		-3.9	-3.8
(9) Relative housing growth * Non-native		-3.9	-3.8
(10) Population share * Non-native		-4.8	-4.7
(11) Population share * French		-2.6	-2.5
(12) Population share * Well-educated		2.3	2.2
Weighted coefficient of determination	0.573	0.639	0.628
Degrees of freedom	680	674	675

Note: The t-ratios are analogous to the t-statistics in linear regression analysis. The weighted coefficient of determination is 1.0 minus the ratio of the weighted residual mean square to the weighted total mean square.

The Joint Effects of Ecological and Personal Factors on the Departure Pattern

Table 8 reports on three of the thirteen runs of fitting the departure model, referred to as Specifications 1 to 3. The general conclusion of all the runs is that, in sharp contrast to the findings for the destination choice model, most of the ecological factors here are either statistically insignificant or of the wrong sign. In light of the numerous empirical findings of ecological models that origin ecological factors are either much less important than destination ecological factors or simply unimportant, this finding is hardly surprising.[8]

Specification 1 shows the results of a run with the six ecological factors retained, the inclusive variable, five dummy variables (representing various effects of three personal factors), and an interaction term (reflecting the effect of being a native and being a resident of Quebec in 1976). Although the goodness of fit is moderately high (0.718), most of the ecological factors are either insignificant or somewhat significant but with a wrong sign. Most personal factors, however are significant within the multivariate context. The coefficients and t-ratios relating to the dummy variables show that:

- *Non-natives* and *foreign-borns* tend to be more migratory than *natives*, with the non-natives having the highest propensity to become interprovincial migrants.
- Those with *French* mother tongue are less migratory than those with *English* mother tongue but, in opposition to the result obtained from our univariate analysis, those in the *"Minority"* group appear to be more migratory than those in the *English* group.
- The *well-educated* are clearly more migratory than the *poorly educated*.

The t-ratio associated with the interaction term seems to suggest that, in the context of the above factors, the propensity to become an interprovincial migrant is, in the case of elderly residents of Quebec, not affected by being a native. The interpretation of this interaction term is, however, more complicated. Since the reference group is English and poorly educated, our result means in fact that, among poorly-educated elderly Quebecers with English mother tongue, those who are natives are not less likely than non-natives to be interprovincial migrants.

Specification 2 is a modification of Specification 1 involving deletion of all ecological factors except for the origin population share. Although the goodness of fit is decreased slightly, the signs of all coef-

[8]Since our ecological variables in the destination choice model are mostly defined as ratios or differences between destination and origin variables, we do not infer that origin ecological attributes are not important in determining the destination choice pattern. The puzzle is with the explanation of the departure pattern.

ficients remain unchanged and most of the t-ratios experience an increase in magnitude.

Table 8
ESTIMATION RESULTS OF THE DEPARTURE MODEL: ELDERLY CANADIANS, 1976-1981

Explanatory variables	Spec. 1	Spec. 2	Spec. 3
Ecological factors			
(1) Origin population share	-1.510 (-1.3)	-1.294 (-2.0)	-3.215 (-5.8)
(2) Cultural attachment to origin	0.049 (2.5)		
(3) Sunshine at origin	6.724 (2.5)		
(4) Coldness at origin	-1.119 (-2.0)		
(5) Housing growth at origin	0.659 (1.7)		
(6) Government transfers to origin	0.690 (0.5)		
Inclusive variable (7)	0.448 (1.9)	0.276 (4.7)	0.113 (2.9)
Personal factors			
(8) Non-native	1.282 (3.5)	1.824 (7.5)	1.152 (5.1)
(9) Foreign-born	1.006 (3.8)	1.320 (4.9)	0.918 (5.5)
(10) French	-0.954 (-2.6)	-0.954 (-2.5)	0.499 (1.7)
(11) Minority	2.914 (1.8)	1.757 (3.8)	0.758 (2.4)
(12) High education	0.882 (3.9)	0.804 (4.2)	0.660 (5.1)
Interactions			
(13) Origin population * Non-native			1.989 (2.1)
(14) Native * Quebec	0.013 (0.0)	0.983 (2.1)	
(15) English * Quebec			1.687 (9.3)
(16) Minority * Quebec			1.049 (3.4)
(17) French * Quebec			-1.010 (-2.6)
Weighted coefficient of determination	0.718	0.682	0.858
Degrees of freedom	84	89	86

Note: The t-ratios in parenthese are analogous to the t-statistics in linear regression analysis. The weighted coefficient of determination is 1.0 minus the ratio of the weighted residual mean square to the weighted total mean square.

As for the nonpersonal factors, it can now be inferred that the propensity to become an interprovincial migrant is negatively affected by the *origin population share* and positively affected by the *inclusive variable*. The t-ratio of 2.1 for the interaction term indicates that among poorly-educated elderly Quebecers with English mother tongue, those who are natives are actually more migratory. This result suggests that a truly important interaction term should be a combination of English mother tongue and being a resident of Quebec.

Specification 3 replaces the native*Quebec interaction term by four others: one for testing the hypothesis that non-natives are less likely to be retained by a large population size, and the other three for

testing the hypothesis that the effect of mother tongue on a potential migrant is particularly strong in Quebec (Quebec is strongly able to retain the French and to repel the English and the "Minority"). With a weighted coefficient of determination of 0.858 and t-ratios that are large in magnitude, this specification is clearly superior to the previous two.

The inferences about personal and nonpersonal factors from the first two specifications are strongly supported by the results of Specification 3, with only one important modification: it is not quite true that, among the elderly, the French in all parts of Canada tend to be less migratory than the English. From the interaction terms, it can be inferred that:

- *Non-natives* are less affected by the retaining power of the *origin population share.*
- The *repelling power of Quebec* is extremely strong for the elderly with *English* mother tongue and moderately strong on the elderly with a *"Minority"* mother tongue.
- The *retaining power of Quebec* is strong for the elderly with *French* mother tongue.

Conclusion

We have characterized the interprovincial migration pattern of elderly Canadians based on micro data from the individual file of the 1981 Public Use Sample. The elderly were about one-third as migratory as the general population. The interprovincial contrast in departure rates of the elderly differed from that of the general population in two important respects. First, when compared with the departure rate of Ontario, that of Quebec was much too high for the elderly and slightly too low for the general population. Second, when compared with the departure rates of the Prairie provinces, those of the Atlantic provinces were much too low for the elderly and nearly the same for the general population. In addition, it was found that the propensity of an elderly person to become an interprovincial migrant varied substantially with personal attributes. For example, the elderly who were nonnative, of English mother tongue, and well-educated were much more migratory than the elderly who were native, French in Quebec, and poorly educated.

The destination choice pattern of the elderly Canadians revealed a division of the national migration field into two parts. Only very small proportions of elderly migrants out of the Atlantic provinces and Quebec went westward beyond Ontario; even smaller proportions of elderly migrants out of the western provinces moved eastward beyond Ontario. The two most important destinations were Ontario in the

east and British Columbia in the west. The westward bias in the destination choice pattern was evident for both the elderly and the general population.

The destination choice pattern of elderly outmigrants also varied with personal attributes. It was more dispersed for non-natives than for natives. Interprovincial migrants with French mother tongue were much more likely to choose Quebec and New Brunswick than those with other mother tongues. The well-educated were more likely than the poorly educated to choose Ontario and British Columbia.

To analyze the combined effects of ecological and personal factors on the interprovincial migration patterns of the elderly in a multivariate framework, we applied our data to the two submodels of the nested logit model: the destination choice model at the lower level; and the departure model at the upper level.

For the destination choice model it was found, with a high degree of significance, that the destination choice probability was negatively affected by distance and coldness and was positively affected by matching ethnic size, housing growth, sunshine, and population share at destination. Several significant interactions between ecological and personal factors were also substantiated. For example, the attraction of destination population share was relatively stronger for the well-educated and relatively weak for the non-natives and those with French mother tongue.

Finally, for the departure model it was found that the propensity to outmigrate was negatively affected by origin population share and positively affected by the drawing power of the rest of the country (that is, the inclusive variable). More important, the variation in the departure rate was shown to be well explained by personal factors. Most of the inferences made before in a univariate framework were validated: the propensity to become an interprovincial migrant was relatively high if the elderly person was (1) non-native or foreign-born, (2) well-educated, or (3) non-French living in Quebec. In addition, it was also shown that, although the French elderly in Quebec had a low propensity to outmigrate, the French elderly in the rest of the country appeared to be relatively migratory.

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