JOINT EFFECTS OF PERSONAL AND CONTEXTUAL FACTORS ON ELDERLY MIGRATION IN CANADA: A NESTED LOGIT ANALYSIS

Barry Edmonston and Sharon M. Lee
University of Victoria
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If the elderly were geographically immobile, then population ageing would occur only in "grey" residential areas where there were a large number of adults ageing in place. In fact, the elderly are not immobile and considerable numbers move. Although geographic mobility has long been of great interest to demographers and other social scientists, there have been few recent studies of the mobility and migration of elderly Canadians. In the past, older Canadians were a relatively small proportion of the population. This is changing. In 2011, 14.8 percent of the population were aged 65 years and older, compared to 7.9 percent in 1971 and 11.1 percent in 1991. Population projections prepared by Statistics Canada (2013) forecast that 22.8 percent of the population will be 65 years or older in 2061. The purpose of this paper is to examine trends in elderly migration and to analyze the relationship of personal characteristics and contextual factors with elderly migration, using census data from 1971 to 2011.

Recent findings show that overall elderly mobility decreased from a peak in the late 1960s, when over 30 percent of elderly Canadians reported that they had moved during the previous five years (Northcott and Petruik, 2013; Edmonston and Lee, 2014). 2006 census data reveal that only about 20 percent of elderly Canadians moved during the previous five years. Such a trend may seem counterintuitive because many would assume that elderly Canadians, like

other Canadians, would have become more mobile over time. The empirical evidence, however, is that elderly adults are moving considerably less now than 35 years ago. Edmonston and Lee's (2014) analysis of census data from 1971 to present reports that the decreasing trend in elderly mobility is genuine, and not caused by possible changes in the age distribution or the elderly, nor by unusual declines in selected mobility rates, such as decreases solely in local movers. Multivariate analysis of individual, temporal, and contextual factors tells us that most of the decline in elderly mobility is caused by factors that are not in the statistical model.

Migration of the elderly is an important topic for several reasons. Older Canadians move in large numbers and this movement, coupled with the increasing proportion of the population that is older, has the potential to create large concentrations of the elderly in particular areas of the country. Such concentrations will have higher demand for health care and other social services as well as different demands for housing and retail trade. For this reason, sound policy planning requires that there is information about trends in population ageing and the migration patterns of the older population.

ELDERLY MOBILITY

Elderly mobility involves several types of spatial movement when there is a change of residence. Spatial movement may be temporary (such as the seasonal movement of "snowbirds" from Winnipeg to Arizona) or permanent. Permanent changes of address are often short distance local moves, such as when an elderly person moves from a single-family house to an apartment in the same city. Movers who cross geographic boundaries are called "migrants" whereas movers within the same geographic boundary are referred to as "non-migrant movers". It is important to note that the demographic definition of migration is not based on the length of the move but on whether the movement crosses a geographic boundary. Small movements may

involve relatively short distance but are defined as migratory if there cross a geographic boundary.[1]

Recent Canadian censuses asked a sample of all households about their recent movements. Households are asked about where they lived five years ago and one year ago. Answers to these two questions allow Statistics Canada to distinguish those household members who changed their place of residence and, if so, the geographic movement that was made. Based on data from the censuses of Canada, mobility status can be differed in five mutually exclusive categories:

- Non-movers: persons who did not change their place of residence,
- Local movers: movers who changed their place of residence but stayed in the same municipality or geographic area,
- Intraprovincial migrants: migrants who moved from one municipality or geographic area to another but remained within the same province or territory,
- Interprovincial migrants: migrants who moved from one province or territory to another, and
- External migrants: migrants who moved from outside Canada to a place in Canada.

Note that the sum of the last four categories is the total number of movers, and the sum of last three categories is the total number of proportion of migrants. For discussion in this paper, we concentrate on interprovincial migrants.

A key advantage of census data is that data can be tabulated by socioeconomic characteristics of the population. Because census data includes information on the province of

[1] For example, if someone moves only a few blocks in the adjoining cities of Kitchener and Waterloo, Ontario, they are a non-migrant mover if they remain within the boundaries of one city and a migrant if they move from one city to the other. In this case, it is possible that the non-migrant mover moves a longer distance than the migrant. The crucial distinction is whether the move crosses a geographic boundary.

origin five years prior to the census and residence at time of the census, contextual data on the origin and destination can be linked to the individual.

Almost 50,000 elderly Canadians migrated from one province to another during 2001 to 2006 (see Table 1). During this five-year period, Prince Edward Island, New Brunswick, Alberta, and British Columbia gained elderly residents, and all other areas lost elderly adults. Prince Edward Island and British Columbia has the highest net in-migration rates. Manitoba and Northern Canada has the highest net out-migration rates.

Table 2 presents information on the number and rates for elderly migration from the 1971 to 2006 censuses. It is noticeable that only two coastal provinces – New Brunswick and British Columbia – have consistently received elderly migration during this 35 year period. Several areas – including Newfoundland and Labrador, Quebec, Manitoba, Saskatchewan, and Northern Canada – have consistently lost elderly migrants. There is a mixed picture for Prince Edward Island, Nova Scotia, Ontario, and Alberta, which have experienced both net in-migration and net out-migration of elderly adults.

MIGRATION DETERMINANTS

DATA SOURCES

Census microdata samples

The largest set of data on Canada's elderly population are population censuses, which have been conducted every five years since 1951. Except for 1976, data from the 1971 to 2006 are currently available in census microdata samples, which contain anonymous information on individuals. 2011 census microdata are scheduled be released by the end of 2014. These data are particularly useful for migration analysis because they ask each respondent where they lived

one and five-years ago. Replies to this question provide information on whether the person moved during the previous one or five years as well as origin and destination of their move.

Statistics Canada takes samples of census data and releases them as public-use microdata samples. This paper uses eight census microdata samples for analysis, as shown in this table.

Year	Sampling Rate	Number of Elderly
1971	1 percent	17,330
1981	2 percent	47,206
1986	2 percent	49,903
1991	3 percent	89,196
1996	2.7 percent	90,670
2001	2.7 percent	98,864
2006	2.7 percent	109,864
2011	2.7 percent	NA

Overall, the analysis includes 502,275 elderly Canadians who answered migration questions in the 1971 to 2006 censuses, as well as 2011 data as soon as they become available in 2014.

Contextual data

Data on the place of residence five years prior to the census are limited in Canada's public-use microdata to the province or territory. Census data combine Yukon Territory, Northwest Territory, and Nunuvut in a single category, called Northern Canada. Data on migrant's origin includes 11 categories – 10 provinces and Northern Canada. Data on current residence includes 23 census metropolitan areas (CMA), such as Halifax, Toronto and Calgary. In addition, elderly migrants might move the non-CMA proportion of a province or a province

that does not have a CMA.[2] The destination for an elderly migrant includes 34 places: 23 CMA's, 8 provinces with non-CMA portions, and 3 provinces/territories that do not have CMA's.

In additional to census microdata, we include contextual data obtained from other sources, including: (1) climate data on the number of summer days above 30^0 centigrade, the number of winter days below -203^0 centigrade, the number of days with snow deeper than 30 centimeters on the ground, and, (2) transportation data on mass transit and walking to work, (3) access to medical care data on number of physicians per 1,000 population and proportion of workers in health care, (4) unemployment, employment growth, and median wage data (5) median housing prices, (6) physical attractiveness of the local area (7) presence of professional hockey, football, and baseball terms, and (8) presence of professional theatre or opera, and museums.

METHODS

Several previous researchers have noted the value of a nest logit model for analysis of migration data. The nested logit model recognizes behavioural differences in potential migrants: initially, there a spatial choice that compares the original area to a limited set of alternatives; secondly, there a decision about whether to move; and thirdly, there is selection of a final destination among the set of alternatives. This choice process fits nicely within the framework of a nest logit analysis. But, despite the apparent advantages of nested logit models, there has been relatively little analysis of migration data with this technique. Following the original proposal by Moss (1979) for the use of nested logit models for migration choice data, empirical studies using nested logit models have been limited to Falaris (1987) in Venezuela, Liaw and Ledent (1987) in Canada, and Frey and Liaw (1998) and Knapp et al. (2001) in the United States. Among

[2] Newfoundland and Labrador, Prince Edward Island, and Northern Canada do not have census metropolitan areas.

available studies, only Liaw and Ledent (1988) has focussed on the migration of elderly, using 1981 census data. It is clear that there is a need for additional and more recent studies.

Researchers studying migration has several possible statistical models to consider. Relatively few researchers study binary mover-stayer data because most interest is not whether a person move occurs but where the person moves. For this reason, binary logit models are seldom employed in migration analysis. There are three potential statistical models for the analysis of multiple choice categories such as states, provinces, or cities: multinomial logit, conditional logit, and nested logit.

Multinomial logit model. This model examines the likelihood that a person (or family or household) chooses a specific location based on characteristics of the person. Although personal characteristics such as age, race, or education vary, the model assumes that individual characteristics are constant across locations. For example, a person's age is constant across destinations; however, age may have a different effect on the likelihood of selecting a specific destination relative to other destinations. In other words, the multinomial logit models have regression coefficients that vary for alternative locations. But, the values of the explanatory variables are constant across locations.

The multinomial logit model has deficiencies for migration research about where people move. Each location requires that it is represented by a distinct category of the response variable. This results in a proliferation of parameters when there is large number of destinations. The major disadvantage, however, is that the model can only serve analyze individual characteristics and is, therefore, of limited usefulness to research on characteristics of destination choice.

Conditional logit model. Unlike the multinomial logit model, conditional logit models include estimates for regressors that may have different values for each alternative location. The disadvantage of the conditional logit approach the opposite of the multinomial logit: the conditional logit model does not include regressor estimates for personal characteristics because the variation in the model is limited to attributes of the destination choices. Variables that various with destination choices, such as an individual's age, can be included; however, this is cumbersome because it requires the use of destination-specific interaction terms.

Nested logit model. An assumption of the multinomial and conditional logit models is that destination choices are independent of one another. If choices are perceived by potential migrants as close substitutes, then unobserved factors that affect the choice of one destination may also affect another. This violates the "independence of irrelevant alternatives" (IIA) assumption for multinomial and conditional logit models. If the IIA assumption is not meet, the multinomial and conditional logit models provide inconsistent parameter estimates. If there is concern about meeting the IIA assumption, then the nested logit model is appropriate because IIA can be selectively maintained, as described below.

The multivariate model used for analysis assumes an individual that makes migration decisions to maximize their overall utility or overall preference to move from their current location to a new place. Each individual has a non-deterministic or stochastic utility function U_{ijk} that, written in reduced, form is:

$$U_{ijk} = x_{ijk}\beta_{jk} + y_{ijk}\delta_{jl} + z_i\zeta_k + u_{ijk} \quad (1)$$

where i indexes individuals, j represents the destination choice of the jth place, and k refers to decision to migrate (coded as a binary variable with 0=not migrating and 1=migrating). Thus, each new place of migration is uniquely identified by a double index jk. In equation (1), x, y,

and z are vectors of characteristics of individuals, the destination choice, and the decision to migrate, respectively. The nested logit model assumes that the stochastic term u_{ijk} is distributed according to the generalized extreme value (GEV) distribution.

Let P_{jk} denote the probability of choosing to migrate (j=1) to place k. Since we know that $P_{jk}=P_{j|k}.P_k$ and assuming additive separability of utility, McFadden (1981) derived the nested logit model:

$$P_{j|k}=\frac{\exp\left(\frac{x_{jk}\beta_{jk}+y_{jk}\delta_{jk}}{1-\psi}\right)}{\sum_{m=1}^{M}\exp\left(\frac{x_{mk}\beta_{mk}+y_{mk}\delta_{mk}}{1-\psi}\right)} \quad (2)$$

and

$$P_k=\frac{\exp(z\zeta_k+\theta I_k)}{\sum_{m=1}^{K}\exp(z\zeta_k+\theta I_k)} \quad (3)$$

where

$$I_k=\log\sum_{m=1}^{M}\exp\left(\frac{x_{mk}\beta_{mk}+y_{mk}\delta_{mk}}{1-\psi}\right) \quad (4)$$

is called an inclusive value and $\theta=1-\psi$, where ψ is an index of similarity of the unobserved attributes of deciding to migrate to a new place.

The model to be estimated consists of equations (2) and (3), estimated by the full-information maximum likelihood method, implemented for this analysis by the *nlogit* procedure in Stata 12 statistical software.

Estimates from the nested logit model are interpreted in a similar way to those from other types of logit models (see Long and Freese, 2010).

The inclusive value indicates the attractiveness of other places in Canada by a potential migration in their current residence because the nested logit model characterizes the maximum utility or perceived preference of all potential destinations.

RESULTS

Results in the paper include discussion of in, out, and net migration of the elderly by province. The results include migration to 32 possible destination, which are discussed in terms of the largest migration flows.

The nested logit analysis includes two models. Both models include individual characteristics as contextual variable. The first model dealing with the departure decision. The second model deals with the destination choice.

Because of the potential influence of the proportion of co-ethnics in the origin and destination, this factor receives additional analysis and discussion.

DISCUSSION AND CONCLUSIONS

The paper includes a discussion and conclusions section.

Table 1. In, Out, and Net Migration (number and rates) for the Elderly by Region and Province, 2006.

Region and Province	In-Migrants	Out-Migrants	Net Migrants[a]	Net Migration Rate[b]
Atlantic	6,290	5,920	370	1.2
Newfoundland and Labrador	1,073	1,221	-148	-2.2
Prince Edward Island	666	296	370	20.7
Nova Scotia	2,627	2,849	-222	-1.7
New Brunswick	1,924	1,554	370	3.7
Quebec	3,700	6,252	-2,552	-2.6
Ontario	10,840	13,726	-2,886	-1.9
Prairies	13,800	15,317	-1,517	-2.5
Manitoba	1,850	3,515	-1,665	-11.0
Saskatchewan	2,368	3,663	-1,295	-9.4
Alberta	9,582	8,139	1,443	4.4
British Columbia	15,057	8,102	6,955	12.3
Northern Canada	111	481	-370	-83.4
All Canada	49,798 [c]	49,798 [c]	0 [d]	12.4

[a] Net migrants equals in-migrants minus out-migrants; however, the number may not be exactly equal due to rounding.

[b] The net migration rate for the elderly population, 65 years of age and older, is calculated as the number of net migrants during 2001 to 2006 divided by the total population aged 60 years of age and older in 2001 times 1,000.

[c] The number of migrations for All Canada indicates the number of elderly who changed their province of residence between 2001 and 2006.

[d] The number of net interprovincial migrants for all Canada is zero by definition because the number of in-migrants equals the number of out-migrants.

[e] The net migration rate of all Canada is the number of interprovincial migration per 1,000 elderly residents in 2001.

Table 2. Net Migration (number and rates) for Elderly by Province, 1981 to 2006.

Region and Province	1976-1981	1981-1986	1986-1991	1991-1996	1996-2001	2001-2006	1976-2006 Average
			Number of Net Migrants				
Atlantic	50	1,050	368	-324	1,661	370	529
Newfoundland and Labrador	-300	-250	-32	-432	-28	-148	-198
Prince Edward Island	-800	350	66	-252	151	370	-19
Nova Scotia	400	350	-33	288	1,102	-222	314
New Brunswick	750	600	367	72	436	370	433
Quebec	-9,100	-6,350	-4,334	-4,788	-4,659	-2,552	-5,297
Ontario	3,050	3,550	-3,134	-900	1,320	-2,886	167
Prairies	-2,150	-3,050	-2,933	-1,404	535	-1,517	-1,753
Manitoba	-1,150	-1,350	-2,233	-1,332	-959	-1,665	-1,448
Saskatchewan	-950	-950	-967	-864	-1,742	-1,295	-1,128
Alberta	-50	-750	267	792	3,236	1,443	823
British Columbia	7,300	5,250	9,966	7,632	1,440	6,955	6,424
Northern Canada	850	-450	67	-216	-297	-370	-69
All Canada[b]	39,850	35,950	45,234	42,480	43,565	49,798	42,813
			Net Migration Rate[a]				
Atlantic	0.2	4.5	1.4	-1.2	5.8	1.2	2.0
Newfoundland and Labrador	-6.9	-5.3	-0.6	-8.0	-0.5	-2.2	-3.9
Prince Edward Island	-84.7	23.7	3.7	-16.1	8.9	20.7	-7.3
Nova Scotia	4.4	3.6	-0.3	2.7	9.3	-1.7	3.0
New Brunswick	10.7	8.2	4.4	0.8	4.7	3.7	5.4
Quebec	-16.1	-10.7	-6.3	-6.2	-5.3	-2.6	-7.9
Ontario	3.6	3.9	-2.9	-0.7	1.0	-1.9	0.5
Prairies	-5.4	-7.4	-6.2	-2.7	0.9	-2.5	-3.9
Manitoba	-9.5	-11.0	-16.3	-9.4	-6.6	-11.0	-10.6
Saskatchewan	-8.2	-8.0	-7.4	-6.5	-12.8	-9.4	-8.7
Alberta	-0.3	-4.4	1.3	3.3	11.5	4.4	2.6
British Columbia	25.0	16.4	25.4	17.4	2.9	12.3	16.6
Northern Canada	114.1	-209.3	25.4	-75.0	-76.8	-83.4	-50.8
All Canada[c]	17.1	14.6	15.6	13.2	12.1	12.4	14.2

[a] The net migration rate for the elderly population, 65 years of age and older, is calculated as the number of net migrants during the five-year period divided by the total population aged 60 years of age and older at the beginning of the period times 1,000.

[b] The number of migrations for All Canada indicates the number of elderly who changed their province of residence during the five-year period.

[c] The net migration rate for All Canada is the number of interprovincial migration per 1,000 elderly residents at the beginning of the period.

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