A MIXED LOGIT MODEL ANALYSIS OF RETIREES' RESIDENTIAL CHOICES IN THE MONTREAL METROPOLITAN AREA

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Abstract

The residential preferences of the elderly are an important issue to be considered in both social sciences and during urban planning. In this study, we attempted to identify the characteristics of the dwellings and neighborhoods that influence the residential choices of the population aged 65 to 74 in the Montreal metropolitan area. We employed a statistical approach combining data from the 2011 National Household Survey and geospatial references to develop a joint form of mixed logit models in order to assess the net impact of selected characteristics. Our results revealed that, the general characteristics of an ideal home of retirees are 3 to 4 rooms, high-rise building, and low-density neighbourhood. We noted that the geographical location of the previous dwelling is an important determinant of the geographical location of the new one, suggesting a strong territorial attachment among the elderly. By stratifying the model with income quintile, we noted that the preferences varied widely as per the socioeconomic profile. Thus, for the lower-class elderly, housing costs are a predominant factor, while condominiums are the preferred tenure mode of the upper class, who also sought to live in a wealthy neighborhood. This segregation dynamic may lead to territorial segmentation, where the upper class seeks to live apart from the rest of the population.

Introduction

In the past decades, most studies on the residential location were concerned with families, because they were the most likely to move and also because they formed a large part of the population in the Western world in the second half of the XXth century, following the Baby Boom (Karsten, 2007, Michielin and Mulder, 2008, Turcotte and Vézina, 2010). Thus, a large part of the housing market has been customized for their needs. As most of developed societies, Canada faces important demographic changes. The increase in the life expectancy and the low fertility level recorded in the last 40 years, suggest an important increase in the proportion of elderly population (Girard et al., 2013). The population ageing is especially important in the province of Quebec, because the Baby Boom of the 50's was most prevalent here. As this cohort approaches the retirement age, the Baby Boom is likely to change to a Papy Boom in the forthcoming years.

According to the life cycle theory, the different cycles of life, such as marriage, childbirth, divorce, departure of children, or decease of the partner, determine needs in housing and residential location (Rossi, 1955, Landale and Guest, 1985, Speare et al., 1975, South and

Crowder, 1997, Kim et al., 2005, Michielin and Mulder, 2008, Æro, 2006). A change in this cycle can lead to the dissatisfaction of the current housing scheme and indicate the need for a change. Retirement brings an important change in a person's life and affects the needs in housing, because commutation is no longer an issue and also because this event is often concomitant with the departure of children. Although empirical studies show that the odds to move around 65 years of age are moderate (Marois and Bélanger, 2014, Marois et al., 2015), the number of movers is likely to grow following the increase in the size of the cohort reaching the retirement age. The study of the residential preferences of the elderly is therefore important in social sciences and for urban planning (Kim, 2011, De Jong and Brouwer, 2012).

The objective of this study was to analyse the residential preferences of the retirees in the Montreal metropolitan region (Canada). More specifically, we aimed to identify the impact of the characteristics of the dwelling and the neighborhood on the residential choices and the variation in the impact of these characteristics with the socioeconomic status of the elderly. For this purpose, we employed a statistical approach by performing mixed logit regressions on movers aged 65–74 years by using the 2011 National Household Survey (2011 NHS) and geospatial data. Following the age-effect perspective of the life cycle theory, for policy concerns, we assume that the succeeding cohort, the first Baby Boomers born between 1946 and 1955, will have similar preferences when they reach this age group. From a fundamental perspective, the present study is expected to bring new insights on a changing population. From an applied perspective, our results may help city planners to adapt the new needs of the changing real-estate customers.

Theoretical and empirical background

Although the life cycle approach mentioned above can explain why people seek to move in regards to certain life events, other theories help understand their residential needs. Litwak and Longino (1987) classified the movements of the elderly into three types, coinciding with different life cycles: i) the retirement move following the retirement mainly for gaining desired amenities; ii) the comfort move to deal with the health deterioration, as people seek to be closer to family members who can help for daily cares; and iii) the care move encompassing the move to an institution when the family is no longer available to help. According to this typology, the move considered in our study mainly belongs to the retirement category.

Theoretical frameworks concerning mobility at old age distinguished the forced mobility from the voluntary one. The voluntary mobility (*mobilité choisie*) from the conceptualization of Caradec (2010) corresponds to the classical mobility toward seeking a better living environment or better accessibility to amenities, while the forced mobility (*mobilité contrainte*) is of two types, that imposed by a tierce and that for health/economic obligations. Pope and Kang (2010) made a similar distinction with the proactive and the reactive mobility on the basis of psychological literatures. The proactive movers are those who move in preparation of future needs, while the reactive movers react to the present or past stressful encounters, such as the deterioration of their health or economic status or decease of the partner. Using this distinction, the authors noted that the proactive movers were the least vulnerable elderly, i.e., the youngest, the most educated, and the wealthiest, while the reactive mobility occurs in reaction to an event that urges people to move. Supporting this theoretical framework, Marois et al. (2015) observed that the mobility was much higher for the 65–69-year-old population than for older people under similar conditions; but, the probability increased when some vulnerable characteristics were encountered, such as disability or low income.

The typology of elderly migration of Wiseman (1980) classifies the reasons to make a local move into three types: i) the local amenity moves—such as those motivated by the desire to have a leisure-oriented lifestyle. Pull-factors that are external to the original home are thus extremely important in this type of move. ii) the environmental move is the move toward a similar dwelling and neighbourhood as previous, only to change a stressful condition. iii) the involuntary move as a result of deterioration of the health. The two first types of moves can be considered as voluntary or proactive mobility. According to Oswald et al. (2002), people move when they encountered several push–pull factors. On retirement, the needs change. The professional reasons for the residential location gets eliminated, and the needs related to the characteristics of the dwelling takes priority (Angelini and Laferrère, 2012).

According to this theoretical framework, the retirement move, which is the most frequent move of the studied age group, can be considered as a voluntary or a proactive mobility, although a sudden decrease in the income following the retirement can force some people to change home. Although we studied retirees, disabilities were found to be low for the 65–74-year-old population group. Numerous studies revealed that, before the age of 80 years, mobility toward an institution is rare (Christel, 2006, Renaut, 2007). Furthermore, the voluntary mobility generally occurs few times after the retirement (Bonvalet and Ogg, 2011, Nowik and Thalineau, 2010).

Some empirical studies have analysed the residential mobility of elderly and their location choices. Using a discrete-choice model, Duncombe et al. (2001) reported that the 65–74-years-aged people seek to avoid high taxes and housing costs and put importance on while recreational activities and security. Physical and climatic amenities are also considered in the housing location. Similar interregional perspectives were shared by other studies (Cebula, 1974, Dresher, 1994, Conway and Houtenville, 2001).

As the accessibility to services is usually better in the central parts of a city, one can expect that people leave suburbs for the central area when they get older (Paez et al., 2010). However, empirical studies does not support this expectation because such a case has not been observed in the American metropolitan areas (Frey, 2006, Engelhardt, 2006). In the Montreal metropolitan area, Patterson et al. (2014) analyzed the flow between the urban core area and the suburbs and noted a decreasing propensity to move toward the urban core area in last decades for elderly. Moreover, the frequency of movement to the suburbs increased faster for the elderly than for all other age groups. Following a similar approach, Marois et al. (2015) analyzed the choice of the urban type of neighborhood for the elderly who move in some regions of the province of Quebec, including Montreal. The authors observed that people of approximately 65–69 years of age without any vulnerabilities are more attracted to suburban areas predominated by single housing schemes. The oldest elderly and those with disability preferred sectors with high-rise buildings, while the population with low income preferred mixed sectors with old apartments. Moreover, the propensity to move differed widely among the elderly. Thus, individual characteristics were found to have a great impact on the residential location. These former studies however focused on the neighborhood type from an urbanistic perspective and didn't consider characteristics of the dwelling and other neighborhood characteristics such as the presence of facilities and services.

Several dimensions concerning the preferences of retirees in housing remain to be investigated. Laferrère (2006) reported that, because the dwelling size increases with increase in the number of family members, it should reduce following the departure of children; however, this point is debatable. Angelini and Laferrère (2012) reported that the preference among elderly movers for smaller dwellings and apartments rather than houses increases with age. However, because the mobility is low, the dwelling of the previous life cycles is generally adequate for most of them. Clark and White (1990) asserted that the financial situation is more important that the dwelling size and quality for seniors in the USA, and the income and housing costs are therefore important factors for consideration.

Our research proposes to combine both the dwelling and neighborhood characteristics into a single model to determine the net effect of each of them in the elderly preferences for residential choice. Instead of evaluating answers to intention or preference surveys as performed by previous studies, we analyzed the behaviors of the studied population. This approach seemed more appropriate, considering that the intentions to move are not always accompanied by actual movement.

Methodological issue

Following the random utility approach, the probability P of selecting a location can be expressed by Equation 1, as follows:

$$P_l = \frac{e^{U_l}}{\sum_j e^{U_j}} \qquad (1)$$

The numerator represents the natural exponent of the utility U of location l, and the denominator is the summation of the natural exponent of the utility of j possible locations. The standard conditional logit model defines the utility by a vector X_l of alternative characteristics, multiplied by a vector of fixed parameters β and an error component ε_l, as expressed by Equation 2 below:

$$U_l = \beta X_l + \varepsilon_l \qquad (2)$$

However, conditional logit model assumes the property of independence of irrelative alternatives (IIA) (McFadden, 1974). Although several researches are based on this model for the analyses of residential location (Duncombe et al., 2001, Friedman, 1981, Bayoh et al., 2006, Waddell, 2005), many concerns have been expressed by others, because this assumption has often not met and thus the estimated parameters may be biased (McFadden, 1978, Dahlberg et al., 2012, Walker and Ben-Akiva, 2002). To relax this assumption, some researchers used the nested logit model, where similar alternatives are regrouped in nests to capture the correlation between alternatives (McFadden, 1978). In studies using nested models to analyse the residential location, the alternatives were partitioned between stayers and movers (Kim et al., 2005, Lee and Waddell, 2010). This kind of model requires information about both the old and new housing locations, which is not always available. Because nested models assume that the correlation within each nest is the same, difficulties can be encountered for the specification of the model when setting the appropriate nests (Munizaga and Alvarez, 2001), especially when relevant variables are missing (Afsa Essafi, 2003).

Another random utility model that allows relaxing of the IIA is the mixed logit models (McFadden and Train, 2000, Munizaga and Alvarez, 2001, Train, 2003, Bhat and Guo, 2004), also called random coefficient logit model, in which a random effect can be set for parameters instead of a fix an effect. The probabilities are weighted averages of the logit formula evaluated at different values of β (Ng, 2008). Mixed logit models estimate parameters with the maximum simulated likelihood method, which produces (after a sufficient number of repetitions), similar parameters compared to that with the maximum likelihood method (McConnell and Tseng, 1999). The mixed logit model adds an error component μZ_l to the equation, which induces heteroscedasticity and correlation across alternatives. Thus, the marginal utility of attributes is allowed to vary among individuals. The utility function U for the location l becomes the following:

$$U_l = \beta X_l + \mu Z_l + \varepsilon_l \tag{3}$$

Where, the vector Z_l can contain all or some variables of the vector X_l, and μ is a random vector with 0 mean for which the standard deviation is calculated. Thus, μZ_l and ε_l are the stochastic components of the model, while βX_l is the deterministic components. When the standard deviation of μ is not statistically different from 0, we can accept the IIA, and the mixed logit would give the same parameters β than the conditional logit. Larger standard deviation of μ indicated a correlation among alternatives and the IIA has to be relaxed. Parameters β estimated with mixed logit model can then be more adapted for the situation. Although these had been developed several decades earlier, their application is much more recent as they need highly advanced computers for processing the simulation method used to estimate the parameters (Train, 2003).

Specification of the model

The available data supported that the mixed logit model seems an appropriate choice for the analysis of the residential location in the Montreal metropolitan region. The only recent and exhaustive database, where internal mobility can be estimated at a small geographical level is the 2011 National Household Survey (2011 NHS) (Statistics Canada, 2011), which contains numerous variables related to the housings and a quite precise geographical location, the dissemination area (DA), which counts between 400 and 700 persons. Although some can have large superficies in the rural sectors, most of them are extremely small in a metropolitan region such as Montreal. Indeed, the mean size of the DA in the MMR is 0.63 km^2, while 89% have an area smaller than 0.50 km^2. This variable thus provides a precise geographical position of households and can be used as a proxy of the address, which allows computing data on the neighborhood. The 2011 NHS also provides a question on the place of residence five years ago, which allows selection of individuals who move. However, no information is known about the previous dwelling, except the locality. Thus, the analysis has to focus on the location choice of movers in regard with the characteristics of the new home, which could be mainly classified as pull factors according to the typology of elderly migration of Wiseman (1980).

Some studies on the modeling of residential location are at individual level (Duncombe et al., 2001, Dahlberg et al., 2012), while other are at the household level (Ben-Akiva and Bowman, 1998, Bayoh et al., 2006, Lee and Waddell, 2010). Because our analysis concerns dwellings, the household level seems more appropriate for our purpose. We defined the studied population as the households of the Montreal metropolitan region, where the main support was aged 65 to 74 years at the moment of the survey and had moved within the last 5 years, which represents a sample of 6560 households. Some elderly living in a household where the main support doesn't have these characteristics could thus be missing, while the location choice of some who are selected could be influenced by the needs of other people living in the same household.

Following the literature on this topic, many variables have an influence on the residential choice. These variables can be regrouped into two sets of characteristics: i) the dwelling attributes such as the number of rooms, the dwelling type, the tenure mode, and the year of construction and ii) the neighborhood attributes such as urban morphology, sociodemographic composition, and accessibility to amenities (Wang and Li, 2004). In the case of the specific geographical configuration of Montreal, where the inner city and most of the central neighborhoods are located on an island, the choice between the island and the rest of the metropolitan region constitute an important issue for the residential location as well as for the construction of the public policies (Patterson et al., 2014, Marois and Bélanger, 2015a). Residential choices are also constrained by the household budget, which was incorporated in the model (Lee and Waddell, 2010). Moreover, all things being equal, households seek to maximise their remaining income and the housing costs are thus a key factor taken into account for the residential choice. Finally, the dwelling and neighborhood attributes could have divergent effects with regard to the household characteristics, which can be implemented by interaction terms. Thus, we can decompose the components of βx_l into the subsets of observed variables and interaction terms:

$$\beta X_l = \alpha D_l + \phi N_l + \varphi G_l + \chi(I_n - C_l) + \lambda H_n(D_l + N_l + G_l) \qquad (4)$$

Where,

D_l = a vector of characteristics related to the dwelling of the location l

N_l = a vector of characteristics related to the neighborhood of the location l

G_l = geographical position of location l

I_n - C_l = the budget constraint, which is defined by the monthly income of the household (I_n) minus the monthly housing costs (C_l)

H_n = a vector of characteristics of the household n

α, ϕ, φ, χ, and λ are the vectors of parameters to be estimated

The utility function thus takes the form of a joint model, where the dwelling and neighborhood characteristics are considered on the same scale. We used the SAS Software for the modeling and the Halton sequences for the simulation processes instead of the standard random numbers for reducing the number of repetitions necessary to stabilize the parameters (Munizaga and Alvarez, 2001). After performing some tests, we noticed no more significant differences after 100 simulations and therefore retained this number.

In a theoretical mixed logit model as well as in the conditional or in the nested logit model, the chosen alternative is compared to all possible alternatives. However, considering the very large and indeterminate number of alternatives in the housing market of a metropolitan region, this was not feasible. For this situation, McFadden (1978) showed that a random sample of alternatives could produce similar results than the full set for conditional logit models, while McConnell and Tseng (1999) showed that this method is also adequate for mixed models. In our study, we built a sample of alternatives from the 2011 NHS using the location attributes of all households who moved in the Montreal metropolitan region between 2006 and 2011. Because of the simulation method used to estimate parameters, the computation length of the model could be high. Thus, we preferred keeping the sample of alternatives to as low as possible. We tested the different numbers of selected alternatives for the sample and saw no significant difference in the estimated parameters when the sample was 30 or higher, namely one chosen and 29 unchosen locations.

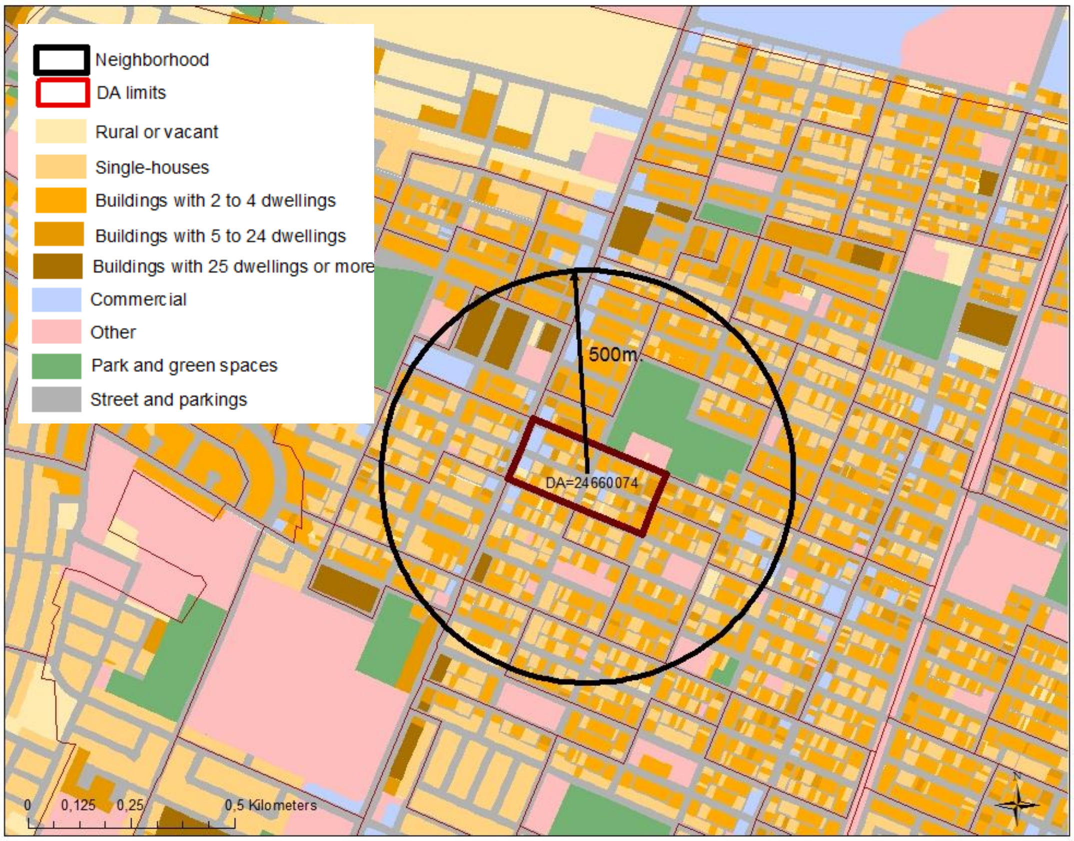
Table 1. List of independent variables

Components	Variables	Description	Source
Dwelling' characteristics	DWELTYP1	House (any type, any tenure)	1
	DWELTYP2	Owner of a duplex or a building that has fewer than five storeys	1
	DWELTYP3	Condominium in a duplex or in a building that has fewer than five storeys	1
	DWELTYP4	Renter in a duplex or in a building that has fewer than five storeys	1
	DWELTYP5	Condominium in a building that has five or more storeys	1
	DWELTYP6	Renter in a building that has five or more storeys	1
	NEW_BUIL	New building (after 2000)	1
	ROOM1_2	Number of rooms: 1 or 2	1
	ROOM3_4	Number of rooms: 3 or 4	1
	ROOM5_6	Number of rooms: 5 or 6	1
	ROOM7	Number of room: 7 or more	1
	RPAIR	Repairs needed	1
Neighborhood's characteristics	|NINC-HHINC|	Absolute difference between the mean income of the neighborhood and the mean income of the household	1
	P_PARK	Proportion of the land used as parks or green spaces	2
	DEN_SHOP	Shopping opportunities density	3
	DEN_LEIS	Leisure and recreation opportunities density	3
	DEN_HEALTH	Health care services density	3
	URBMOR1	Predominant urban morphology: Rural or vacant space	2
	URBMOR2	Predominant urban morphology: Single houses	2
	URBMOR3	Predominant urban morphology: Buildings with 2 to 4 dwellings	2
	URBMOR4	Predominant urban morphology: Buildings with 5 to 24 dwellings	2
	URBMOR5	Predominant urban morphology: Buildings with 25 dwellings or more	2
Geographical location	LOCAL	Previous dwelling located in the same census division	1
Budget constraint	HHINC-HCOST	(Household income – Housing costs) / 12	1
Household characteristics	INCQ1-INCQ5	Income quintiles	1
	CORE	Origin: urban core (Census division of Montreal)	1
	COUPLE	Family structure: couple	1

1. 2011 National Household Survey
2. Montreal metropolitan community 2012
3. 2013 Origin-Destination Survey

The independent variables included in models are listed in Table 1. The housing costs included all kind of cost related to the housings that are rented or mortgage payments, condominium fees, taxes, electricity, and public services. We built the budget constraint variable by subtracting the monthly housing costs to the monthly household income, which then represents the amount remaining for other expenses once the housing costs are paid. Variables related to the neighborhood are provides from two kinds of sources: geospatial references and the 2011 NHS, and thus, the definition of the neighborhood are not identical. For the data aggregated from the 2011 NHS, being the absolute difference between the household income and the mean income of the neighborhood, the neighborhood is defined by a sector consisting of the DA and all the adjacent ones. For data collected from geospatial references, the neighborhood can be defined from a radius of 500 m from the center point of the DA, which is the walkable distance of retirees according to the literature (Banister and Bowling, 2004). The variables using this definition are the presence of a healthcare service, the proportion of the land used for parks and green spaces, the services density, and the predominant urban morphology, which is defined according to the main residential shape of the neighborhood, either rural or vacant, single houses, buildings with 2 to 4 dwellings, buildings with 5 to 24 dwelling or buildings with 25 dwellings or more, from georeferenced data on land use of the Montreal metropolitan community (2012). Figure 1 depicts an example of the delimitation of a neighborhood (represented by the black circle) of someone living in the DA #24660074. We can see that the proportion of park and green spaces is 6.3%, and the predominant urban morphology is buildings with 2 to 4 dwellings.

Figure 1. Example of delimitation of a neighborhood with the geospatial references



Because services density is assumed to be an important factor in the residential location choice, we computed density indicators for three purposes: shopping opportunities, leisure, and recreation opportunities and health services. These indexes were computed with the 2013 Origin-Destination Survey, from which we mapped the number of the elderly destinations for the selected purposes. The indexes were calculated summing the weighted destinations in a radius of 500 m from the center of the DA. Table 2 presents the descriptive statistics of the alternatives' characteristics.

Table 2. Description of the alternatives' characteristics

	All dwellings	Sampled dwellings	Chosen dwellings
DWELTYP1	26.5%	26.6%	17.7%
DWELTYP2	4.7%	4.7%	3.8%
DWELTYP3	7.8%	7.6%	9.6%
DWELTYP4	50.3%	50.5%	45.0%
DWELTYP5	2.5%	2.4%	7.3%
DWELTYP6	8.2%	8.1%	16.5%
NEW_BUIL	19.5%	19.4%	23.1%
ROOM1_2	7.0%	7.1%	5.7%
ROOM3_4	47.4%	47.3%	59.8%
ROOM5_6	25.9%	25.9%	23.9%
ROOM7	19.7%	19.8%	10.6%
RPAIR	32.4%	32.4%	18.1%
NINC (mean)	CAD 66,701	CAD 66,791	CAD 67,790
P_PARK	3.6%	3.6%	3.6%
DEN_SHOP	163	162	166
DEN_LEAS	89	89	82
DEN_HEALTH	34	34	30
URBMOR1	13.0%	12.9%	14.5%
URBMOR2	42.7%	42.8%	48.5%
URBMOR3	31.8%	32.1%	25.5%
URBMOR4	6.2%	6.1%	4.8%
URBMOR5	6.3%	6.0%	6.7%
HCOST (mean)	CAD 12,253	CAD 12,227	CAD 10,053

Results

For the studied population, we built separate models for dwelling (model 1) and neighborhood (model 2) characteristics to examine their net impact and a general joint model (model 3) that combines both the kinds of variables. We tested several interaction terms and retained the most empirically relevant ones. Table 3 presents the mean parameters and their error components for these mixed logit models. Parameters represent the average effect, while the error component indicates whether the effect varies or not in the population. Following a Monte Carlo process, this third model predicts correctly about 30% of the chosen alternatives.

Regarding the dwelling characteristics, our results showed that, on an average, the preferred dwelling for people aged 65 to 74 years was a newly built unit in a building with five or more storeys that does not need repairs; this observation is consistent with the findings of Angelini and Laferrère (2012). Owned and rented dwellings have similar effect. Overall, the only type of dwelling that is significantly less preferred than single-house is a locative unit in a duplex or in a building that has fewer than five storeys. The optimal size of the dwelling is 3 or 4 rooms, although the interaction between the size and the family status indicated that couples had a preference for dwellings with 5 or 6 rooms.

Table 3. Parameters of the general mixed logit model on the residential location of the population aged 65–74 years in the Montreal metropolitan community, 2011

	Model 1: Dwelling characteristics				Model 2: Neighborhood characteristics				Model 3: Joint model			
Variables	Mean of parameters		Error component		Mean of parameters		Error component		Mean of parameters		Error component	
DWELTYP2	0.033		-0.067						-0.413		-1.379	***
DWELTYP3	0.271	**	0.079						0.360	***	-0.075	
DWELTYP4	-0.252	***	-0.043						-0.143	**	0.069	
DWELTYP5	0.799	**	-1.143	**					1.390	***	-0.086	
DWELTYP6	0.750	***	0.401						1.029	***	0.014	
NEW_BUIL	0.212	***	-0.208						0.163	**	-0.244	
ROOM1_2	-0.537	*	-0.538						-0.360	***	-0.031	
ROOM1_2*COUPLE	-1.497	**	0.254						-1.362	**	0.138	
ROOM5_6	-0.403	***	0.033						-0.389	***	-0.264	
ROOM5_6*COUPLE	0.996	***	-0.057						0.989	***	-0.216	
ROOM7	-1.136	***	0.273						-1.215	***	0.849	***
ROOM7*COUPLE	1.547	***	0.509						1.547	***	-0.314	
RPAIR	-0.672	**	0.296						-0.648	**	-0.064	
|NINC-HHINC|					-1.100E-05	***	1.420E-05	***	-9.586E-06	***	-1.100E-05	***
P_PARK					1.052	***	0.064		0.927	***	-0.026	
DEN_SHOP					-9.600E-05		-7.500E-04	***	-5.100E-05		4.400E-04	**
DEN_LEIS					-4.230E-04	*	-7.560E-04	*	-5.330E-04	**	6.020E-04	
DEN_HEALTH					-1.188E-03	**	-4.500E-05		-1.549E-03	**	-1.120E-04	
URBMOR1					0.059		0.046		-0.102	*	-0.190	
URBMOR3					-0.642	**	-0.037		-0.489	***	0.012	
URBMOR4					-0.698	***	-0.121		-0.601	***	0.056	
URBMOR5					-0.190		-0.551		-0.550	***	-0.029	
LOCAL					4.270	**	-1.680	***	4.059	***	1.080	***
LOCAL*CORE					-1.775	**	-0.151		-2.041	***	0.298	
(HHINC-HCOST)/12	1.226E-03	***	1.021E-03	***	9.850E-04	***	-9.060E-04	***	1.105E-03	***	-9.240E-04	***

*p<0.05; **p<0.01; ***p<0.0001

For the neighborhood characteristics, the negative value of the mean parameter associated to absolute difference between the mean income of the neighborhood and the mean income of the household indicates that the residential location choices follows a segregation logic. However, because the error component is strong and significant, the importance of living with people of the same economic class varies widely among elderly.

The neighborhood-oriented model (model 2) revealed that the preferred environment for elderly are either neighborhoods where the predominant urban morphology is single-houses or those predominated by building with 25 dwellings or more. However, when both the dwelling and neighborhood characteristics are considered (model 3), the mean parameter for that category becomes significantly negative. Thus, this probably means that elderly want to live in a high-rise building in a low-density neighborhood, which is rare in the real-estate market.

The indicators related to the services density are either not statistically significant, either slightly negative. Because this result was not expected, we attempted several formulations of these variables, such as enlarging of the radius of the area, transposing variables in tierces, or using their natural logarithm. In each case, the conclusion was similar. This could mean either that these variables are wrong proxy of neighborhood amenities, either that services within a walkable distance is not important factor for the residential choice of elderly. However, considering the significant error component for the shopping index, this variable had a positive effect for about 30% of the population, under the assumption of a normal distribution of the parameter.

Concerning the geographical location, dwelling located in the same census division (county-like entity) than the previous one are much more likely to be selected by elderly. This territorial attachment in however lower for those living in the urban core, but is still important. Thus, the very high parameter suggests that inter-county moves are very rare, specifically those toward the inner city.

The income appears to be an important individual characteristic that affect residential preferences, because the error component is very important for the remaining money after housings payment and for the mean income of the neighborhood. Following this result and as per Clark and White's findings (1990) about the importance of the financial situation for the residential choice, we built a second model that stratified the population into three types according to the household income:(i) the lower class—being those in the poorest income quintile, (2) the middle class—being those in the second, third, and fourth income quintiles, and (3) the upper class—being those in the wealthiest income quintile. Results of the stratified model are presented in Table 4.

Table 4. Parameters of the mixed logit model stratified by income quintile on the residential location of the population aged 65–74 years in the Montreal metropolitan community, 2011

	INCQ1				INCQ2-INCQ4				INCQ5			
Variable	**M**		**EC**		**M**		**EC**		**M**		**EC**	
DWELTYP2	-2.744		-3.502	**	-0.263		-1.532	**	0.008		-0.116	
DWELTYP3	-0.541		0.708		0.420	***	-0.006		0.614	***	0.115	
DWELTYP4	0.259		0.435		-0.012		0.067		-0.835	**	-0.929	
DWELTYP5	-0.481		-1.917	*	1.018	***	-0.687		2.194	***	-0.102	
DWELTYP6	1.498	***	-0.336		1.023	***	-0.074		0.974	***	0.123	
NEW_BUIL	-0.206		-1.273	**	0.210	**	0.137		0.151		-0.258	
ROOM1_2	-0.158		0.030		-0.691	***	0.110		-1.033		0.843	
ROOM1_2*COUPLE	-0.296		0.222		-1.191	*	-0.232		-1.295		0.522	
ROOM5_6	-1.676	***	1.383	**	-0.340	**	-0.713	*	0.594	***	0.050	
ROOM5_6*COUPLE	1.086	*	-0.066		0.626	***	0.496		0.372	*	-0.573	
ROOM7	-3.273	***	1.009	*	-1.453	***	-1.032	**	0.721	**	-0.372	
ROOM7*COUPLE	1.802		2.452		0.798	**	-0.713		0.352		0.810	*
RPAIR	-0.614	***	-0.246		-0.737	**	0.246		-0.529	***	0.327	
|NINC-HHINC|	-2.936E-07		-4.441E-06		3.353E-07		4.480E-09		-1.500E-05	***	1.610E-05	***
P_PARK	0.118		-0.053		0.923	**	0.114		0.510		-0.417	
DEN_SHOP	-1.520E-04		2.780E-04		-3.814E-06		-5.630E-04	**	1.680E-04		-4.760E-04	
DEN_LEIS	3.290E-04		-1.000E-04		-9.680E-04	***	-3.320E-04		-7.190E-04		-8.480E-04	
DEN_HEALTH	-2.687E-03	**	-1.048E-03		-1.532E-03	*	4.590E-04		-5.720E-04		3.224E-03	
URBMOR1	0.052		-0.459		-0.068		-0.090		-0.324	**	0.198	
URBMOR3	-0.293	**	-0.164		-0.454	***	-0.112		-0.240	*	-0.162	
URBMOR4	-0.455		-0.466		-0.606	**	-0.493		-0.815		0.802	
URBMOR5	-0.889	***	-0.277		-0.435	***	-0.028		-0.400		0.664	
LOCAL	5.784	***	2.610	**	4.289	***	1.440	***	3.999	***	1.693	***
LOCAL*CORE	-1.841	**	0.285		-2.128	***	-0.132		-1.697	***	0.409	
(HHINC-HCOST)/12	3.207E-03	***	2.221E-03	**	1.222E-03	***	7.400E-04	**	3.910E-04	***	5.700E-04	***

*p<0.05; **p<0.01; ***p<0.0001

In the three income groups, the elderly preferred residing in a building with five storeys or more. However, the preferred–or constrain–tenure mode differed. Although locative unit in high-rise building is also preferred over single houses by the upper class, the condominium is most preferred. On the other hand, the lower class prefer the locative category in a high-rise building, while the locative and condominium have similar values for the middle class. Compared to a single house, a condominium in a building that has fewer than five storeys finds greater preferences by the middle and upper class, while a locative unit in that kind of building is much less appreciated by the upper class.

The weight accorded to the size of the dwelling in the residential choice varies with the income class. In general, the preferred size of the dwelling increases with the increase in financial capability. Thus, the preferred dwelling size for the upper class is 7 rooms or more, while it is 3 or 4 rooms for the middle and lower class.

Concerning the neighborhood characteristics, the stratified model first showed that the preference for sectors of the same economic class is only significant for the upper class, with a significant heterogeneity. Because the economic dimension of a neighborhood is not important in residential choices for the other classes, our results suggest that mobility for elderly follows a segregation dynamic that may lead to territorial segmentation, where the upper class seeks to live apart from the rest of the population.

Finally, the stratified model revealed that the remaining income after housing payments has much more importance in the residential choice for low-income households. Indeed, for the lower class, the (mean) parameter is very high with a strong heterogeneity, while it is about ten times lower for the upper class. This difference in the weight attributed to the remaining income between different economic classes is extremely important for consideration, because all parameters of the model are relative to each other. Thus, because the parameter is high for the lower class, the relative importance of other variables is reduced, and the housing costs become the main consideration. By contrast, because housing costs have much less importance for the upper class, the other variables, especially the dwelling type and the neighborhood income, become the main factors of their residential choice.

Discussion

The first finding of our study concerns a methodological issue. Mixed logit models allows use of random parameters and induces heteroscedasticity and correlation across alternatives. In our study, because the error component of several variables in the developed models were statistically significant, we can conclude that the parameters of mixed logit models are better estimators than those of conditional logit models for studying residential location preferences. Our study is thus an additional empirical verification of the conclusion that has already been expressed theoretically (McFadden and Train, 2000) and empirically (Bhat and Guo, 2004, Dahlberg et al., 2012) in other contexts. In addition to a better estimate of parameters, mixed logit model provides information on their heterogeneity, which is a relevant empirical issue.

Our next important finding concerns the duality between the dwelling and neighborhood characteristics. The results of this joint model revealed an evident preference of elderly to live in a building with five storeys or more, but with a neighborhood where the predominant urban morphology is single-houses. Indeed, they found neighborhoods predominated by large buildings as repulsive. We thus observed competitive characteristics in the residential choice, because most of the high-rise buildings were obviously located in high-density neighborhoods. Elderly have to make arbitration between their preferred dwelling types and their preferred environment, because the ideal residential location combining all attractive factors is probably very rare on the residential market.

Moreover, because the descriptive statistics (Table 2) showed that elderly are slightly overrepresented in dwellings located in the neighborhood where the main urban morphology is buildings with 25 dwellings or more (7.2% of elderly live in such an environment vs. 6.3% of the available dwellings), this result of the regression argues in favor of joint models taking into consideration both the dwelling and neighborhood characteristics for analysing residential choices rather than using individual factors in the analysis. Thus, this overrepresentation of the elderly in high-density sectors can be attributed to their preference for the dwelling type rather than a preference for that kind of urban environment.

From a fundamental perspective, our models also suggested that the density of amenities in a walkable distance is probably not a decisive factor in residential choice making for elderly in a metropolitan context. This finding was unexpected from a theoretical perspective (Paez et al., 2010), however, it is supported by other empirical studies reporting that a large proportion of seniors choose to live in low-density sectors (Marois et al., 2015), that elderly tend to retire in place (Rosenbloom and Morris, 1998), and that no massive mobility of the elderly from the suburb toward the inner city, where the accessibility is assumed to be better, is observed (Patterson et al., 2014). Duncombe et al. (2003) found similar results regarding public expenses in recreation services as well as in healthcare services, which are not positively associated with the location choice of elderly. In most cases, we can assume that the mobility concerned in our study was a voluntary one. Our study population including 65–74-year old individuals can be qualified as “young elderly”. For most of them, their abilities to drive, use stairs, and perform their daily tasks were not significantly reduced yet (Arim, 2015) and they did not suffer from substantial losses in mobility (Rosenbloom, 2003). For several reasons, most elderly used car (Alsnih and Hensher, 2003), which may explain the previously mentioned results. Overall, our results agree with those of De Jong et al.’s (1995), who stated that the decline of health precedes the mobility and, therefore, as long as an elderly has no disability, the presences of services in a walkable distance is not a concern in the residential choice.

In the near future, as this cohort would age further, a large part will probably continue to live in low-density sectors, where most inhabitants are car-dependant (Rosenbloom and Morris, 1998). The risk for accidents increases for aging drivers (Stamatiadis and Deacon, 1995), which is particularly important because elderly do not seek to live in a walkable distance from stores and services. In addition, because a large proportion of the 65–74-year-olds choose to live in suburbs with no services, we can either expect an increase in their reactive moves in the forthcoming years (Pope and Kang, 2010), either an increase of social isolation, and loss of quality of life if the elderly diminish their frequencies of daily moves and travels (Negron-Poblete et al., 2014). While the aging of population is spatially very heterogenic in different demographic dynamics (Marois and Bélanger, 2015b), a local response is required to adapt to the new needs of the changing population. Moreover, in the suburbs, Moreover, in the suburb, public transit services are generally planned to meet workers’ needs, and consequently are less adapted to meet the mobility needs of seniors (Alsnih and Hensher, 2003). In this view, the conclusion of Négron-Poblete et al. (2014) is clearly relevant, that, “[u]rban planners will have to find the balance point between local accessibility in proximity, by foot and by public transit, and regional accessibility organized more around car travel or around train and subway networks”.

Many studies have noted strong territorial attachment among elderly, particularly those belonging to rural areas (Berger et al., 2010, Caradec, 2010, Marois et al., 2015, Rosenbloom and Morris, 1998). Because we found that the inter-county moves are extremely rare, this attachment is also important for smaller geographical levels in an urban context, following the territorial logical of the mobility (Caradec, 2010). The stratified model moreover showed that this attachment exists for all economic classes. In fact, the moderate overall mobility of elderly conjugated with very low inter-county mobility suggests that localities will face a strong aging-in-place of their population. Although the survey used in this study does not provides finer geographical location and details of the previous dwellings other than the locality, there is a need for data combining both the actual and previous dwelling and neighborhood characteristics to better understand the dynamics of the mobility in question.

From an applied perspective, our findings could be a policy-concern on urban planning and housing market. Our study models revealed a strong attractiveness for locative units (in high-rise buildings) for all socioeconomic classes. However, locative units of any kind count only for a very small proportion, that is about 10% of new housings in the Montreal agglomeration (Ville de Montréal, 2014). Indeed, most of the new constructions are condominiums. With the aging of the baby boomers, the population of individuals aged between 65 and 74 years is actually increasing sharply. Because many boomers are not economically prepared for their retirement (Mo, 2010, Mo and Légaré, 2005), we may expect that an increase in the demands for locative units in high-rise building and the actual housing market cannot be adapted. This policy concern is particularly worrying with regards to the lower class, because they are much more vulnerable to housing costs and are limited in their residential choices.

On a different note, the issue of social diversity of elderly in a residential context is also important. The models revealed that the mean income of the neighborhood is an extremely important factor of the residential location for the upper class. The strong heterogeneity observed also suggested that polarisation occurs among the wealthiest. Conventionally, many retirees were concentrated in poor and old sectors of the inner city; but, with an improvement in their economic situation in the last decades, they are no longer confined into specific sectors (Séguin et al., 2013). Although the segregation is probably overall low, the specific case of geographical isolation of the richest among the upper class is interesting, suggesting that neighborhoods similar to gated communities in their social composition would be in expansion as the boomers, which have a better socioeconomic status than the previous generation (Mo, 2010), will reach the retirement age. Clearly, the issue of the residential isolation of the upper class needs to be explored in future studies.

Conclusion

In this study, we attempted to understand the dwelling and neighborhood characteristics that influence the residential choice in the Montreal metropolitan area for the population aged 65–74 years. This age group is assumed to increase sharply in the coming years as the baby boomers reach this age range. Using a statistical approach that combined data from the 2011

NHS and geospatial references, we developed a joint form of mixed logit models to assess the net impact of individual selected characteristic. From the methodological perspective, we can conclude that this kind of model appears more adequate than conditional logit model, as the random parameters considers the correlation across alternatives, which allows relaxing the assumption of independence of irrelevant alternatives. Moreover, it allows observation of the heterogeneity of the effects in the studied population.

The results of our models revealed that, on an average, the ideal home of an elderly has 4 or 5 rooms, is in a high-rise building, and is located in a low-density neighborhood with parks and green spaces. However, the preferences of the population vary widely following the socioeconomic profile. Condominiums were the preferred tenure mode of the upper-class, who also sought to live in a wealthy neighborhood. For the lower class, housing costs were a predominant factor.

As the large cohort of the Baby Boom reaches the retirement age, the question of residential location of elderly will have important political and social issues. All along their life cycles, this cohort had several different behaviors compared to the other generations. A comparative study about their residential preferences is warranted in the future for a better understanding of the results of this study.

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