

CANADIAN JOURNAL of URBAN RESEARCH

REVUE CANADIENNE de RECHERCHE URBAINE

Family residential choices in Montreal metropolitan area: A community-based analysis

Jean-Philippe Meloche
École d'urbanisme et d'architecture de paysage
Université de Montréal

Abstract

Whether families with children choose to live in the suburbs to benefit from cheap land or do so to avoid decaying socio-economic conditions of central neighbourhoods remains a central question for public policy. To explore that question, this article investigates the characteristics of communities within the Montreal metropolitan area where families with children have chosen to live (108 communities). Three different analyses are undertaken. The first analysis is a community-based estimation of the Alonso model. It shows that the average price of a single-family house within a community varies with distance to the Central Business District (CBD), and that space per household for housing grows in relation with distance. The second analysis is inspired by life-cycle arguments. It shows that housing space is not as significant as new housing development or poverty to explain the proportion of families with children in communities of the metropolitan area. The third analysis, using data pertaining to families with children only, shows that communities closer to the CBD have a higher proportion of low-income families as well as high-income ones. These communities also have a higher proportion of families with parents that are immigrants, have university degrees, are single (divorced), and are under 35 years old. Mothers are also more likely to be active in these communities. We conclude that developing homogenous neighbourhoods designed for upper-middle-class households and knowledge-based workers may better contribute to the attraction of families with children in Montreal's central neighbourhoods than building affordable housing.

Keywords: Family, children, residential choice, suburbs, central neighbourhoods, Montreal

Résumé

Les familles avec enfants choisissent-elles de vivre en banlieue simplement pour bénéficier de terrains bon marché ou le font-elles plutôt pour éviter les conditions socio-économiques des quartiers centraux ? Cette question est centrale pour les politiques publiques. Pour y répondre, cet article examine les caractéristiques des communautés de la région métropolitaine de Montréal où les familles avec enfants ont choisi de vivre (108 communautés). Trois analyses sont proposées. La première fait l'estimation du modèle classique d'Alonso basée sur des données à l'échelle des communautés locales. Il en ressort que le prix moyen d'une maison unifamiliale au sein d'une communauté varie en fonction de la distance qui sépare celle-ci du centre-ville et que l'espace par ménage pour le logement augmente en fonction de la distance. La deuxième analyse s'inspire des arguments de cycle de vie. Il en ressort que l'espace consacré au logement n'est pas une variable aussi significative que la construction de nouveaux logements ou la pauvreté pour expliquer la proportion de familles avec enfants dans les communautés de la région métropolitaine de Montréal. La troisième analyse, qui utilise des données relatives aux familles avec enfants uniquement, montre que les communautés plus proches du centre-ville ont une proportion plus élevée de familles à faible revenu ainsi que de familles

Canadian Journal of Urban Research, Winter 2020, Volume 29, Issue 2, pages 70–86.

Copyright © 2020 by the Institute of Urban Studies.

All rights of reproduction in any form reserved.

ISSN: 2371-0292

à revenu élevé. Ces communautés ont également une proportion plus élevée de familles dont les parents sont des immigrants, des diplômés universitaires, vivent seuls (divorcés) et ont moins de 35 ans. Les mères sont également plus susceptibles d'être actives dans ces communautés. Nous concluons que le développement de quartiers homogènes conçus pour les ménages de la classe moyenne supérieure et les travailleurs du savoir peut contribuer davantage à attirer des familles avec enfants dans les quartiers centraux de Montréal que la construction de logements abordables.

Mots-clés: Famille, enfants, choix résidentiel, banlieue, quartiers centraux, Montréal

Introduction

The residential choices of families may depend on a variety of factors: life cycle, household size, age of children, employment location, consumption, housing stock, residential development, urban environment, transport infrastructure, etc. In his classic model, Alonso (1964) reduces this complex decision of household residential location to a few elements: income, preferences, distance, and price¹. Household location is determined by a compromise between land prices and transportation costs. However, Alonso's analysis does not include household size as an independent variable, particularly the presence of children in the household. Adding an assumption regarding the presence of children, we find a rational explanation as to why families instinctively choose to live in the suburbs (at least in North America). Nevertheless, families are not exclusively sensitive to land prices and transportation costs. As Mieszkowski and Mills (1993) argue, the decision to live in the suburbs is also conditioned by the natural evolution of cities and families. As cities grow, the need for space pushes housing development further away from previously built central locations. Since buying a house is often linked with the decision to have children (Mulder 2006), new suburban developments also tend to be better adapted to the modern needs of young families. As families leave, the housing stock in central districts depreciates and attracts poorer households. The downgrading of socio-economic conditions then stimulates additional out-migration of families with children to the suburbs. This phenomenon affects all type of families but is particularly pronounced among middle-income households (Jean 2016; Kartsen, Lubi, and de Stigter-Speksnijder 2013; Dowling and Power 2012).

Whether families with children choose to live in the suburbs to benefit from cheap land or do so to avoid decaying socio-economic conditions remains a central question for public policy. In Montreal, Canada, for instance, many strategies have been put in place by the City in the past years to attract or retain families with young children in central neighbourhoods, with a strong emphasis on affordability (City of Montreal 2013). These policies suppose that families with children are sensitive to Alonso's (1964) arguments and that social housing may give them a better access to central places. On the other hand, if families are primarily affected by the life-cycle factors such as those identified by Mieszkowski and Mills (1993), social housing may have unexpected impact on their residential choice. The presence of social housing in central neighbourhoods may contribute to raise the concentration of low-income population there, and consequently lead to the migration of more families with children to the suburbs.

To explore that question, this article seeks a better understanding of the residential choices of families with children from a community perspective. It investigates the characteristics of communities within the Montreal metropolitan area where families with children have chosen to live. The main advantage of working in Montreal is that the central city is divided into 19 boroughs and surrounded by 89 suburban municipalities. This fragmented metropolitan organization provides accessible census data for a wide range of geographical subdivisions. Our analysis is based on two datasets extracted from a special compilation from the 2006 Canadian Census. One set is constituted of aggregate data at the community level and is used to test if the Alonso hypothesis and the flight from blight arguments can be observed in the socio-economic characteristics of local communities. The second dataset is constituted of aggregate data pertaining to families with children only. It is used to identify the factors associated with the presence of families with children in relation with communities' distance to city centre.

Data aggregation at the community level gives a better access to some information (like distance or housing assessment). It allows special compilation from census data and provides output at a suitable level for policy implementation. On the other hand, this level of aggregation reduces volatility and may reduce the significance of some estimations as compared to household-level analysis. Since we work with a special data compilation from the 2006 census, our analysis also relies on cross-sectional static estimations at the community level. Keeping in mind that residential choice is a dynamic process initiated at the household level, and not a static phenomenon occurring at the community level, we should not interpret our estimations as a replication of Alonso (1964) or Mieszkowski and Mills

(1993). The main assumption of our study is that household decisions should be observable in the socio-economic characteristics of their community. Spatial correlation found at this level may enlighten the debate on family-oriented municipal policies, but cannot be generalized as determinant of family residential choices.

The article is divided as follows. The first section presents the Alonso (1964) model with the hypothesis of higher land consumption for families with children. The second section presents the analysis of family location with community data for the Montreal metropolitan area. The third section presents some of the factors associated with the presence of families with children in communities in relation with their distance to city centre. Conclusions and comments are presented in the last section.

Alonso and family residential choice in urban space

In the world of Alonso (1964), the city is structured around a central point, the central business district (CBD), where everyone works and consumes. There is a cost for every household to live far from that point. This cost corresponds to a transport cost function $K(t)$ that rises with distance t to the CBD. The model is a standard consumer problem where a representative household seeks to maximize its utility U under budget constraint Y . In mathematical terms, Alonso (1964) stated the problem as:

$$\text{Max } U = u(z, q, t) \quad (1)$$

$$\text{u.c. } Y = P_z z + P(t)q + K(t) \quad (2)$$

Utility of the household U increases with land consumption q and the consumption of all other goods z , but decreases with distance t to the CBD. Land consumption is not necessarily correlated with housing size. In high-density areas, for instance, households may have a small consumption of land for a large housing unit, as many housing units are often built upwards on the same parcel. The household budget is constrained by household revenues Y , land price $P(t)$, the price of all other goods P_z and transport costs $K(t)$. Land price and transport costs are both functions of distance to the CBD.

Solving the problem gives the following optimality conditions:

$$u_q / u_z = P(t) / P_z \quad (3)$$

and

$$u / u_z = (q \, dP/dt + dK/dt) / P_z \quad (4)$$

Using the budget constraint, we have a system of three Equations (2, 3, and 4) and three variables that yield the optimal quantities of z , q , and t chosen by the representative household.

Alonso (1964) recognizes that all households do not have the same preferences. Even if the optimal equilibrium requires that all marginal utility ratios be equal to price ratios, the model allows different households to choose different combinations of z , q , and t . Thus, the price offered by each one may vary differently in relation to distance to the CBD. The concept of a bid rent curve is used by Alonso (1964) to determine the relation between land price and distance. This bid rent curve for a specific household i can be deduced from the optimality conditions and defined by:

$$\frac{dP_i}{dt} = \frac{P_z}{q} \frac{u_t}{u_z} - \frac{1}{q} \frac{dk}{dt} \quad (5)$$

where both elements on the right-hand side contribute to a negative slope². We can imagine two different types of households with equal budgets and transport costs willing to pay the same price P^* for land at a distance t_0 from the CBD. If one of these households has children (a), while the other one does not (b), we can assume that the preference for land will be higher, all else being equal, for the household with children. This assumption is derived from the literature on family life course events and housing choices, where childbirth is usually associated with the consumption of larger housing units (Gambaro, Joshi, and Lupton 2017; Wagner and Mulder 2015; Mulder 2013).

As underlined by Mulder (2013), families with children do not only show a particular preference for single-family homes, but also for properties with private yards where children can play. This means that families have a higher preference for low-density residential developments and consequently for more land. In this case, optimal conditions will yield a solution where $q_a > q_b$ in Alonso's (1964) model. Applying this inequality to the bid rent curve (Equation 5) leads to a curve with a slope that should be flatter for families with children (at equal transport costs). This is illustrated in Figure 1.

Even if both households are willing to pay the same price P^* at the distance t_o from the CBD, the slope of the bid rent curve indicates that households without children will offer higher prices for land closer to the CBD ($P_b > P_a$ for all locations between t_o and the CBD). This is observable in Figure 1 where the portion of the curve bb is above the curve aa . On the other hand, for all land farther than t_o , families with children will offer higher rents than other households. This means that $P_a > P_b$ for all land above t_o (where the curve aa is above bb on Figure 1). This is the rational economic explanation of why families with children choose to live in the suburbs.

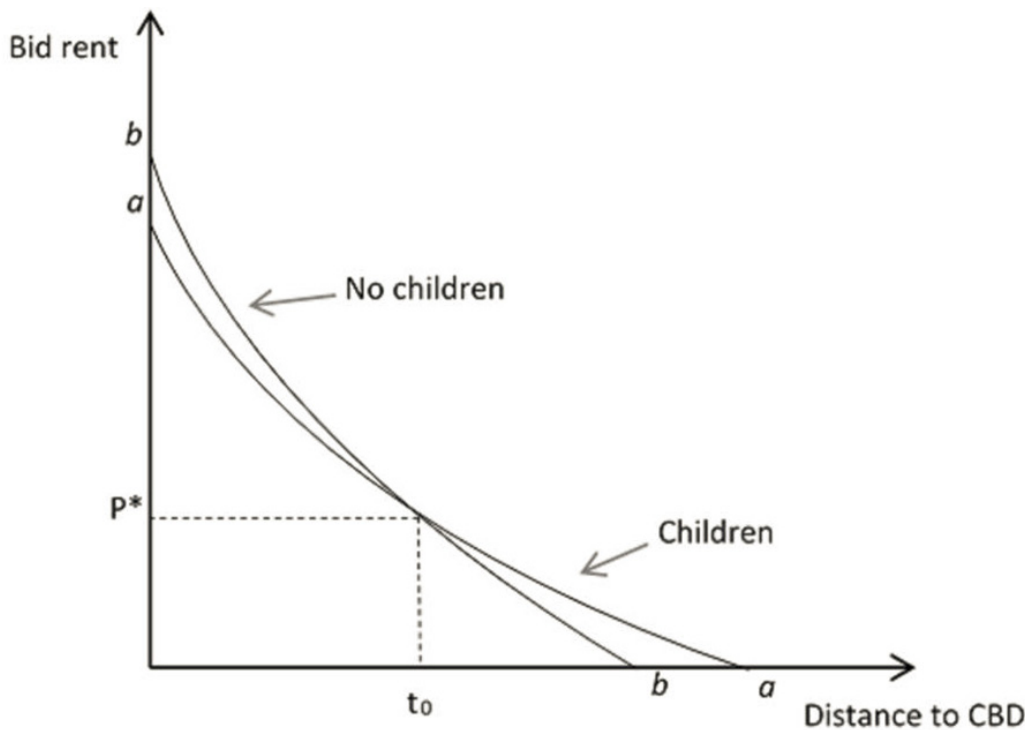


Figure 1
Bid rent functions for households with children and without children
Source: J-P Meloche

The Alonso (1964) model is widely used in the urban economics literature to study the determinants of urban sprawl. We find examples in the work of Paulsen (2012), Spivay (2008), Wassmer (2008), McGrath (2005) or Brueckner and Fansler (1983). Despite the simplicity of the model, it explains quite well the sprawling patterns of North American cities. The model has also been used in studies concerning the influence of income on residential choice (Glaeser, Khan, and Rappaport 2008; Wheaton 1977) as well as the influence of amenities on the choice of living in central urban locations (Glaeser, Kalko, and Saiz 2001; Kern 1981). With the exception of LaSalvia (2014), the influence of children on the location choices of families remains largely unexplored in urban economics.

Shlay (1986) provides insights into the housing preferences of households. Even if all households are considered as having a preference for detached single-family houses, households with higher incomes and children show the strongest preference for that type of housing. Lower income households are more open to compromise on the single-family detached house, but will be stricter with the number of bedrooms per unit. Households with children also have a higher preference for homogenous environments and low-density neighbourhoods (Shlay 1986). Following Rossi (1955), there has also been research undertaken in the field of life course analysis (Gambaro, Joshi, and

Lupton 2017; Wagner and Mulder 2015; Mulder 2013). This field of research provides interesting insights about the motivations of family residential choices. These provide good empirical support for our hypothesis of higher land consumption by families with children (the hypothesis of $q_a > q_b$).

Family-friendly communities in Montreal

Our goal with this research is to have a better understanding of where families with children choose to live on the territory of the Montreal metropolitan area. Although most studies on residential choice are based on household data and focus on factors that influence location choices, our study looks at the problem from a community perspective. Relying on community data, we investigate the characteristics of communities where families with children have chosen to live. In other words, we try to identify which communities have been most attractive for families and why. To do so, we assume that communities with the highest ratios of households with children have amenities that are preferred by households with children.

We use the term “community” to refer to a mix of municipalities and boroughs. The Montreal metropolitan area, as defined by Statistics Canada (in 2006), is composed of 89 municipalities. We add three other municipalities in our definition of the metropolitan area, since they are included in the Montreal Metropolitan Community (an administrative entity that oversees metropolitan governance but whose territory, defined by the Government of Quebec, does not match exactly the census metropolitan area of 2006). Two municipalities are removed since their population was too small to compute any statistical data. This gives us a total of 90 municipalities. However, the central city of Montreal is considered in our study as a collection of boroughs. These boroughs are idiosyncratic to the governance structure of the City. They have their own mayors and share many local responsibilities with the City³. Decomposing

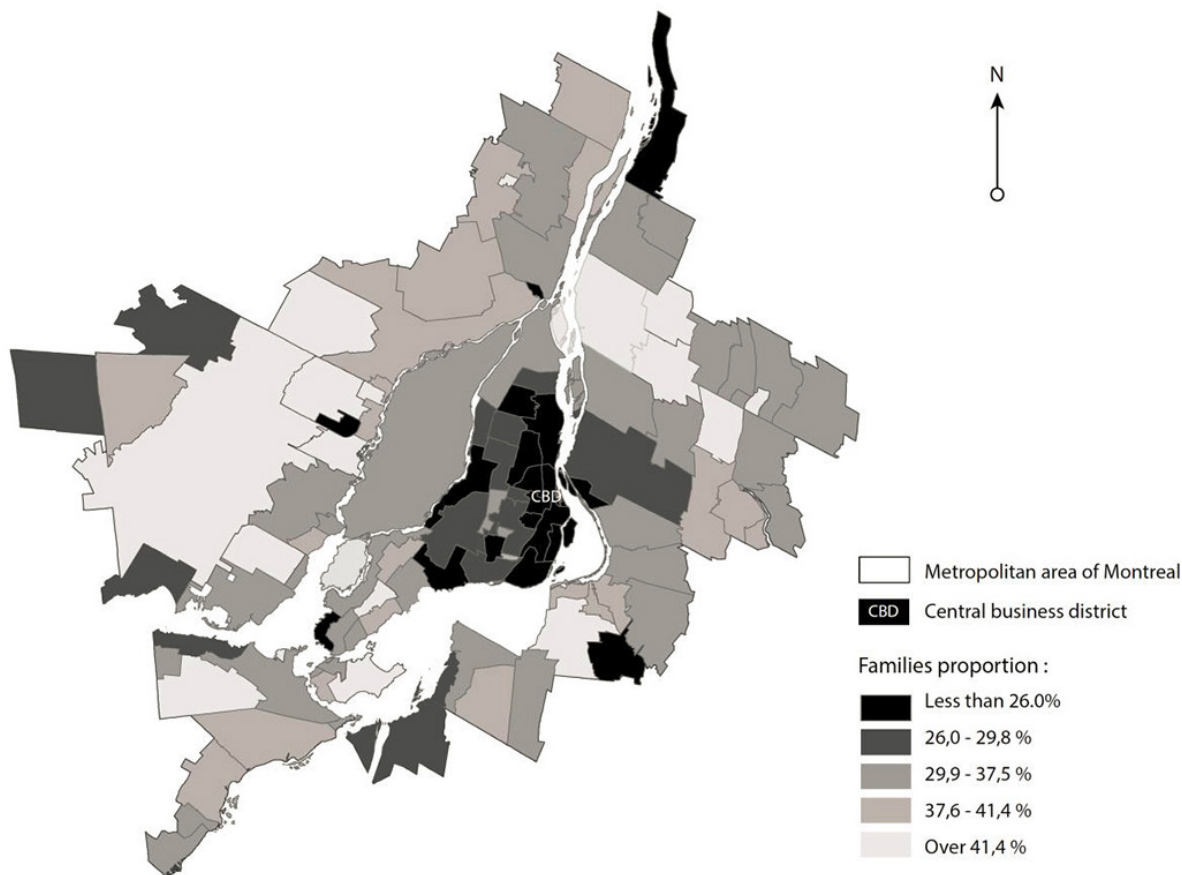


Figure 2

Proportion of household with children (under 18 years old) in the communities of the Montreal metropolitan area

Source: J-P Meloche with data from Statistics Canada, 2006 Census

the municipality of Montreal in 19 boroughs gives us a cross-section of 108 communities. Thus, we use the word “communities” here to underline the fact that all localities concerned are not necessarily independent municipalities.

How are families distributed among the communities of the Montreal metropolitan area? Figure 2 provides an overview of the spatial distribution of these families in 2006. Communities in black on the map are those with the lowest proportion of households with children (less than 26.0 %, which correspond to less than one standard deviation from the mean). In light grey, we find communities with the highest proportion of households with children (more than 41.4 %, which correspond to one standard deviation over the mean). As expected according to Alonso’s (1964) model, most of the communities with a high proportion of children are located in the suburbs (light grey areas on the map), while communities with lower proportions of families with children are located around the CBD. Some exceptions are observed though. Dark areas are noticeable in the suburbs, as well as some grey areas among central communities. What explains these variations? Is the Alonso (1964) model sufficient to explain the distribution of families with children in the metropolitan space? Or could factors underlined by the life-cycle model of Mieszkowski and Mills (1993) also be relevant?

The Alonso (1964) model of the residential location of families with children implies two key empirical observations. First, the proportion of families with children must be higher in communities farther from the CBD. Figure 2 gives some evidence of this. Second, families with children must live in locations where the density of housing is lower, which means that they consume more land ($q_a > q_b$). Another important aspect of the model is that the CBD must be a strong enough anchor so that the monocentric hypothesis of urban form be credible. In our case, although job dispersion has occurred in past decades in the Montreal metropolitan area, the monocentric model still characterizes job density patterns (Sweet, Bullivant, and Kanaroglou 2017). That is why we work here with the assumption of a monocentric city for the Montreal metropolitan area.

The two key factors of the Alonso (1964) model are estimated with single regressions and plotted in Graphs 1 and 2 of Figure 3. The measure of the proportion of families with children is based on the ratio of population under 15 years old on total population. The relation with distance is estimated in Graph 1 of Figure 3. It follows a logarithmic function, which means that the relation is nonlinear. The regression equation and the R^2 are presented in the graphs. The R^2 of the regression indicates that the distance of the community to the CBD explains nearly 20% of the difference in the proportion of children under 15 years old between communities. Distance is measured as the shortest driving distance between a central point (Place Ville-Marie, downtown Montreal) and the geographical centre of the community.

Following Alonso (1964), the main explanation for the positive relation between residential location of families with children and distance to the CBD is a higher preference for land. To measure land space consumption on a community basis, we use a ratio of residential space to population. Residential space is the total community area

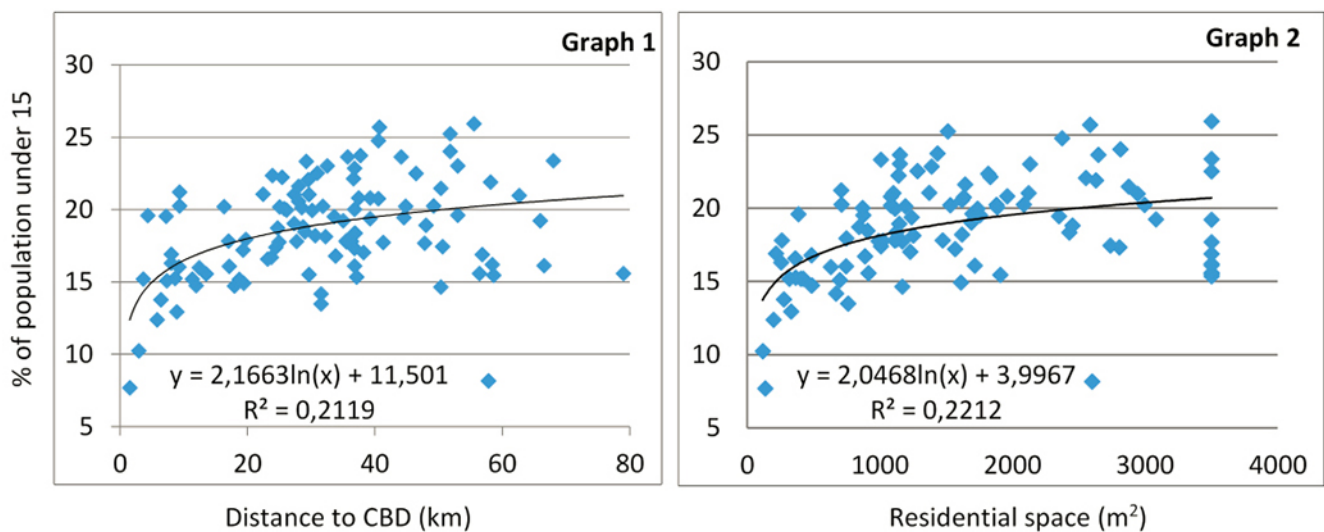


Figure 3

Proportion of population under 15 years old in relation with distance to CBD and residential space

Source: J-P Meloche with data sources detailed in Table 1

from which agricultural (rural) space was subtracted. This number is multiplied by the ratio of residential properties assessment to all assessed land and divided by the total number of households in the community. The computed measure refers to the average amount of square metres of land available in the municipality for every housing unit. It is not a measure of average private land area for every assessed housing unit. Public space such as roads, parks and forests are distributed among all households living in the community. Since some peripheral municipalities have large wooded areas with no development, our measure yields extreme values for some communities. To avoid these extreme values, residential space is capped at 3,500 m² per household. Graph 2 of Figure 3 presents the relation between this variable and the proportion of children under 15 years old in communities. The regression equation and R² appears in the graph. The relation between the two variables is nonlinear. The R² indicates that residential space has the same effect on the proportion of the population under 15 years old than distance to the CBD. This is an indication that the hypotheses of the Alonso (1964) model are observed in our data for the Montreal metropolitan area.

To make sure that all assumptions of the Alonso (1964) model can stand when estimated with community data in the Montreal metropolitan region, we can estimate a standard model such as:

$$\log Price_i = a + b_1 \log Income_i + b_2 \log Distance_i + b_3 \log Space_i + \varepsilon_i \quad (6)$$

where *Price* refers to *P* in the model presented in the previous section, *Income* to *Y* (or *Y - P_z*), *Distance* to *t* and *Space* to *g*. Communities of the metropolitan area refers to *i* and the terms ε_i is a random error.

The *Price* variable is measured with the average assessed value of a single-family house, excluding condo apartments. It is not a direct measure of land price since land is hardly distinguishable from buildings on property value assessments. However, since we control the type of housing unit, we expect that land size will not vary as much between single-family housing units than it does for average housing unit (since density is higher in central communities). The *Income* variable refers to the average household income for the community, while *Distance* and *Space* are the two variables used in Figure 3 and described previously (see Table 1 for details and sources).

The coefficients of the model (b_1 , b_2 , and b_3) have been estimated with ordinary least squares (OLS) using the cross-section of 108 communities. The results are presented in Table 2. The model as a whole fits quite well with our data. This is an indication that the Alonso (1964) model may be appropriate for a community-based analysis of residential choice. The R² of the model is high, suggesting that the model can explain more than 80% of the price differential between communities. Partial effects of *Income* and *Distance* are both significant at a 99% confidence level. *Income* has a positive influence on prices, while prices are decreasing with *Distance*. The partial effect of *Space* is significant, but only if we allow a level of confidence of 90%. This means we have a weaker fit for this variable.

After Alonso (1964), many authors have suggested other variables to explain the residential choices of families. As argued in our introduction, Mieszkowski and Mills (1993) have suggested that families may be seeking new houses, built where space is available (mainly in suburbs) or that they may be escaping decaying neighbourhoods in central locations. Since Figure 2 shows low ratios of families with children in some suburbs as well as high ratio in some central locations, variables other than space and price must be explored to better understand the location patterns of families in the Montreal metropolitan region. Brueckner and Rosenthal (2009) also point to new housing or aging housing stock to explain household residential choice.

Moving one step away from the Alonso model, we estimate a model of family residential choice based on three key arguments retrieved from Alonso (1964) and Mieszkowski and Mills (1993). This model can be specified as follows:

$$Children_i = a + b_1 \log Space_i + b_2 NewHousing_i + b_3 LowIncome_i + BX_i + \varepsilon_i \quad (7)$$

where *Children* refers to the proportion of the population under 15 years old in community *i*. The coefficient b_1 specifies the relation of *Children* with *Space*, as defined in the previous model. As shown in Figure 3, we expect this relation to be positive. The coefficient b_2 refers to the relation of *Children* with *NewHousing*, which is the proportion of housing stock that is less than 10 years old as declared by the occupant in the census questionnaire. Following Mieszkowski and Mills (1993) and Brueckner and Rosenthal (2009), we expect this relation to be positive. The coefficient b_3 gets to the relation between *Children* and *LowIncome*. This third variable refers to the ratio of the population living in low-income households as defined in the Canadian census. Since families with children are said

Table 1
Variable definitions and data sources of Alonso (1964) analysis

	Definitions	Sources	Min	Max	Mean	Stand. Dev.
<i>Distance</i>	Driving distance (km) between the geographical center of a community and Place Ville-Marie in the CBD ¹	Shortest distance calculated with Google Maps	1.5	79.0	32.2	16.7
<i>Pop0-15</i>	Percentage (%) of population under 15 years old in the community	2006 Census, Statistic Canada	7.7	25.9	18.6	3.5
<i>Space</i>	Residential area (m ²) divided by population. Residential area is obtained by subtracting agricultural space from total community area and multiplying by the share of residential assessment value in total assessed value for the community.	Population and total area taken from 2006 Census of Statistics Canada. Agricultural land and assessed value are from Government of Quebec: Agricultural Land Protection Commission (CPTAQ) and Ministry of Municipal Affairs (MAMROT).	117	3,500	1,613	1,015
<i>Price</i>	Average assessed value (\$) of a single family housing unit, excluding condo apartments.	Government of Quebec, Ministry of Municipal Affairs (MAMROT)	128,015	1,024,129	245,649	143,357
<i>NewHousing</i>	Proportion (%) of housing units of 10 years old or less in the community.	2006 Census, Statistics Canada	0.9	43.3	15.5	9.7
<i>Income</i>	Average household income before taxes (\$).	2006 Census, Statistics Canada	40,152	188,985	74,951	28,545
<i>LowIncome</i>	Proportion (%) of population living in low income households after taxes ²	2006 Census, Statistics Canada	1.2	38.4	10.1	7.4

Note: Variables computed for 108 communities constituting the Montreal metropolitan region.

(1) Distance of the central community where stands Place Ville-Marie is 1.5 km, which represents the average distance of all points in the community to Place Ville-Marie.

(2) Low income household are defined by Statistics Canada. Low-income line varies with the number of people in the household.

Table 2
Community-based estimation of the Alonso (1964) model for the Montreal metropolitan region

	Dependent variable: log of average single-family house assessment (excluding apartments)
<i>Log Income</i>	0,874 (0,000)
<i>Log Distance</i>	-0,264 (0,000)
<i>Log Space</i>	-0,084 (0,061)
Constant	4,020 (0,000)
R ²	0,81
Number of observations	108

Note: Estimations made with ordinary least square (OLS). Homoscedasticity hypothesis not rejected. P-values in parenthesis.

to be escaping decaying communities, we expect this relation to be negative. This argument is supported empirically by Gambaro, Joshi and Lupton (2017), Jean (2016), and Rabe and Taylor (2010).

One can argue that the choice of having children may be linked, in some ways, to income. Families with children, for instance, may have more stable income, which will cause a problem of endogeneity in the relation between *Children* and *LowIncome*. Figure 4 lowers the expectation of endogenous bias. Since age groups representing families with children usually have higher proportions of persons living in low-income households (population under 18 years old in Figure 4), a negative relation between *Children* and *LowIncome* will signify that families with children avoid communities with more poverty.

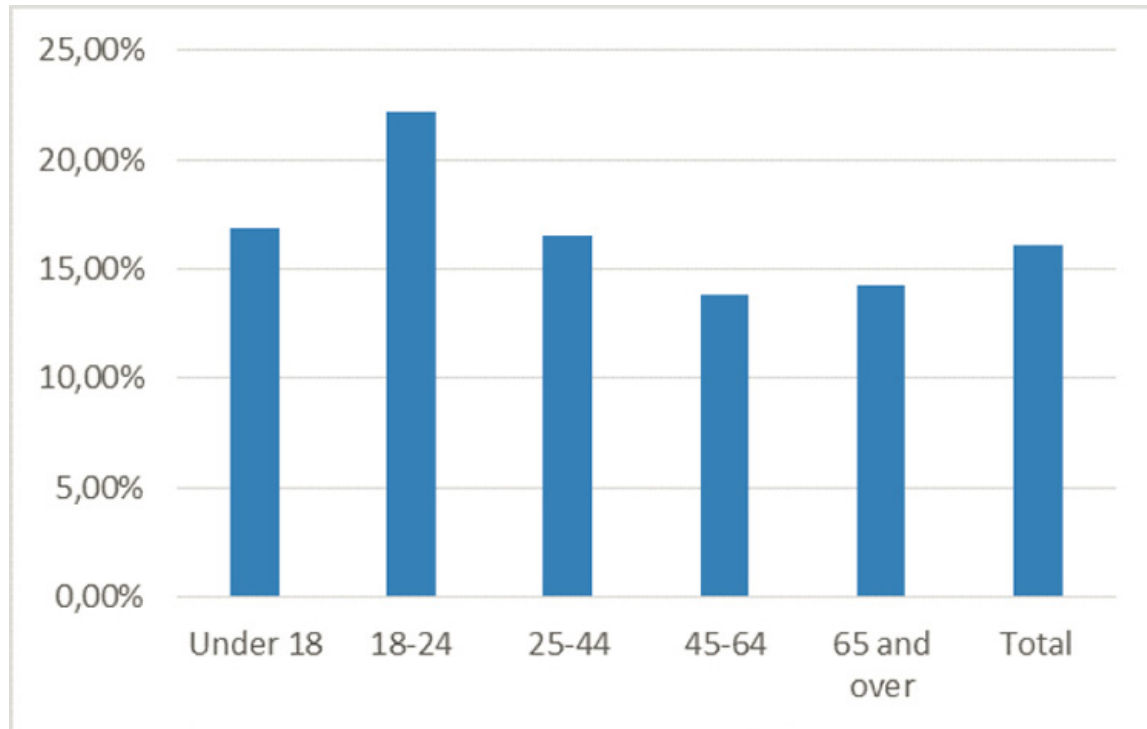


Figure 4

Ratio of population living in low-income households by age group in the Montreal metropolitan census area in 2006

Source: Data from 2006 Census, Statistics Canada. Low-income line is based on revenue after tax, as defined by Statistics Canada.

The vector B and the matrix X are added to Equation (7) to account for two control variables. The first is the price of single-family houses (*Price*) as described in the previous model. The other is the driving distance to the CBD (*Distance*). The reason for the first variable to be added is to verify whether families with children are really locating in communities where single-family houses are more affordable. Since we expect all households to seek the most affordable housing, we have no reason to believe that families with children will happen to live more frequently in communities with low prices for single-family housing units. The second variable (*Distance*) is added to verify the model's sensitivity to distance. Since we have already included all key variables explaining why families with children live further away from the CBD, we do not expect this variable to be significant. All these variables and data sources are described in Table 1.

The estimated results of Equation 7 appear in Table 3. Unexpectedly, the partial effect of *Space* has the wrong sign and is not significant. This means that when arguments of life-cycle and flight from blight are taken into consideration, land space loses its significance at the community level. This does not mean that families with children do not have a higher preference for land. It only means that when new housing stock and low-income ratio are fixed, communities with more space do not have more children in their population. This is an indication that factors of life-cycle and flight from blight may be more important for families than Alonso's (1964) classical arguments of space and price.

Table 3

Estimation results for regressions explaining the share of population under 15 years old in communities of the Montreal metropolitan region

	Dependent variable: Share of population under 15 years old		
<i>Log Space</i>	-0,192 (0,735)	-0,034 (0,954)	-0,638 (0,365)
<i>NewHousing</i>	0,104 (0,002)	0,117 (0,001)	0,118 (0,001)
<i>LowIncome</i>	-0,211 (0,001)	-0,202 (0,001)	-0,177 (0,006)
<i>Price</i>		0,869 (0,247)	1,805 (0,063)
<i>Distance</i>			1,280 (0,129)
Constant	20,484 (0,000)	8,358 (0,462)	-3,307 (0,808)
R ²	0,38	0,39	0,41
Number of observations	108	108	108

Note: Estimations made with ordinary least square (OLS). Homoscedasticity hypothesis not rejected. P-values in parenthesis.

On the other hand, the coefficient of the partial effect of *NewHousing* has the expected sign and is significant at a level of confidence of 99%. This is coherent with the life-cycle theory and with Brueckner and Rosenthal's (2009) previous results. It also gives credit to the argument that the return of families with children in central districts, when observed, is usually the result of major urban renovation policies (Carroll, Witten, and Kearns 2011; Boterman, Karsten and Musterd 2010). Since families with children appear to live in communities with a higher proportion of new housing units, it is plausible that new housing construction in central locations attracts new families there.

The argument of the flight from blight, measured here with *LowIncome*, is also significant at a level of confidence of 99%. Even if families with children have a higher proportion of persons living in low-income conditions (Figure 4), they happened to be more often located in communities with lower proportions of low-income households. This means that families probably avoid locations with high poverty rates. This is something that has been observed previously by Shlay (1986) and Bayoh, Irwin, and Haab (2006). It is also coherent with the findings of Gambaro, Joshi, and Lupton (2017), Jean (2016), and Rabe and Taylor (2010). The choice of families to live in the suburb may be explained by of the gap in the living conditions of populations in central communities and suburban localities. As pointed by Bischoff and Reardon (2013), this is probably due to the fact that neighbourhood conditions are more consequential for children, while adults generally work and socialize at a larger geographical scale.

Control variables added to the regression are not significant. The coefficient of *Price* may be considered significant though if the confidence level is 90%. However, the sign of the coefficient is positive. This is, in some way, a counterintuitive result. Since we can think about families with children as households looking for affordable housing, we do not expect to find them in communities where single-family houses are more expensive. The control variable of *Distance*, on the other hand, has the right sign but is not significant. This may be an indication that the relation between distance and families with children expressed by the Graph 1 of Figure 3 is mainly explained by the key arguments of Mieskowski and Mills (1993) in the Montreal metropolitan area whether than Alonso's (1964) argument.

What family characteristics are found close and far from the central district?

The conclusions of Alonso's (1964) model expressed in Figure 1 suffer from a lack of nuance. Figure 1 suggests that all locations near the CBD should be occupied by households without children, while all locations farther from the point t_0 should be occupied by families with children. A look at the empirical observations mapped in Figure 2 suggests that the real world provides more diversity. Some families with children live in central districts, while many

households without children live in the suburbs. What are the characteristics of these communities that host families with children close or away from city centre?

This section of our research relies on a different set of data. A purpose-built database made from 2006 Census data was ordered from Statistics Canada to compute community-level indicators based on the characteristics of families with children. Our definition of families with children include all households with at least one member aged below 18 years old and living with one or both of their parents or a relative. The data collected concerns the number and age of children, the revenue of households, the age of parents, the language spoken at home by the parents, the immigration status of the parents, the education attainment of the parents, the proportion of single parents and the activity rate of the parents (Table 4).

Table 4
Variable definitions of the family with children analysis

	Definitions	Min	Max	Mean	Stand. Dev.
<i>Children6</i>	Proportion of families with children where all children are under 6 years old	13.0	36.6	23.7	4.6
<i>LowIncome</i>	Proportion of families with children with income less than 30,000\$ for year 2005	0.0	41.2	13.4	8.9
<i>MiddleIncome</i>	Proportion of families with children with income of \$50,000 or more, but less than 80,000\$ for year 2005	0.0	52.8	27.6	9.0
<i>HighIncome</i>	Proportion of families with children with income of \$125,000 or more for year 2005	0.0	55.8	15.3	13.5
<i>Immigrants</i>	Proportion of parents born outside Canada	0.0	71.7	16.7	18.5
<i>English</i>	Proportion of parents mostly speaking English at home	0.0	80.5	16.9	21.0
<i>French</i>	Proportion of parents mostly speaking French at home	11.7	100.0	73.4	27.7
<i>OtherLanguages</i>	Proportion of parents mostly speaking another language than French or English at home	0.0	45.2	7.2	10.5
<i>University</i>	Proportion of parents with a university degree	4.2	80.0	27.4	17.6
<i>SingleParents</i>	Proportion of single-parent families	7.8	41.3	20.6	7.2
<i>MotherActivity</i>	Difference between the activity rate of men and the activity rate of women among parents	0.0	33.3	14.9	4.7
<i>Parents35</i>	Proportion of parents under 35 years old	7.9	35.6	23.6	6.6

Source: Special order from the 2006 Census of Statistics Canada. Families with children are defined as households with at least one child less than 18 years old living with one or both of its parents or a relative. Parents are defined as individuals having at least one child less than 18 years old at home.

Note: Variables computed for 108 communities constituting the Montreal metropolitan region.

Our goal is to identify the characteristics of families with children that have chosen to live in communities closer or farther to the CBD in Montreal. To do so, we use a correlation analysis at the community level with the characteristics of families with children in relation to the distance of their community to the CBD. The distance refers to the same *Distance* variable presented in the previous section. Table 5 presents the correlation statistics of all variables with *Distance*. It presents the Pearson correlation coefficient, the simple regression coefficients (estimated with OLS) and the R^2 of these simple regressions. All variables and sources are presented in Table 4. A look at Table 5 gives an idea of what type of families with children dominates in central communities (negatively correlated with distance), and what type can be associated with the suburbs (positively correlated with distance).

Communities with the most important share of parents' population that are immigrants and that speak languages other than French and English at home are communities that are located closer to Montreal's CBD. These correlations show the highest coefficient in Table 5. This reflects the residential choice of immigrant population that happen to prefer central neighbourhoods in Montreal. Geographic concentration of immigrant population in central

Table 5

Correlation analysis of the characteristics of families with children in a community and the distance of this community to CBD

	Dependent variable: Log of distance from CBD		
	Pearson correlation coefficient	Simple regression coefficients (OLS)	R ² of simple regressions (OLS)
Share of families where all children are under 6 years old	-0,163	-0,026 (0,092)	0,03
Share of low-income families	-0,509	-0,042 (0,000)	0,26
Share of middle-income families	0,566	0,046 (0,000)	0,32
Share of high-income families	-0,283	-0,015 (0,003)	0,08
Share of parents that are immigrants	-0,686	-0,027 (0,000)	0,47
Share of parents speaking English	-0,215	-0,007 (0,025)	0,05
Share of parents speaking French	0,462	0,012 (0,000)	0,21
Share of parents speaking other languages	-0,661	-0,046 (0,000)	0,44
Share of parents with a university degree	-0,543	-0,023 (0,000)	0,29
Share of single parent families	-0,395	-0,040 (0,000)	0,16
Activity gap between men and women	-0,189	-0,029 (0,050)	0,04
Share of parents under 35 years old	0,197	0,022 (0,041)	0,04

Note: Single regressions estimated with ordinary least square (OLS). P-values in parenthesis.

neighbourhoods of Canadian cities has been studied before by Thomas (2013), Agrawal (2010), and Qadeer and Kumar (2006). It is explained by economic constraint and cultural preferences. Our data show that the majority of children growing in central neighbourhoods of Montreal in 2006 have immigrant parents.

In the 2006 Census, 70% of Montreal metropolitan population was speaking French at home, 17% English and 13% another language. By definition, a higher proportion of families that speaks other languages than French and English at home in a community leads to a lower proportion of families that speak French or English at home in that same community. Considering the location pattern of immigrant population, it is not surprising then to find a positive correlation between the proportion of parents speaking French at home and the distance of the community from the CBD. As already observed by Marois and Bélanger (2014), language is a determinant of migration to the suburbs in Montreal, mostly for families speaking French at home. As Table 5 shows, the proportion of families speaking English is only weakly correlated with community's distance to the CBD. This may reflect the fact that English speaking suburbs are distributed more equally along the way from the CBD to the periphery while French suburbs happen to be further away.

Communities located closer to the CBD have a higher proportion of low-income families. This may seem counterintuitive since the Alonso (1964) argument states that land is more expensive in central districts. Although

land is expensive, high-density housing amortizes its cost on a large number of units. Considering that central neighbourhoods also have older buildings, not necessarily corresponding to actual tastes of families with children, it may explain why we find a higher proportion of low-income families there. As already observed in the literature, these families benefit from affordable and older housing units in high-density complexes (Brueckner and Rosenthal 2009) that provide better access to public transit (Glaeser, Khan, and Rappoport 2008). Middle-income families, on the other hand, seems to prefer suburban communities. This is in line with previous studies on residential choice by Jean (2016), Kartsen, Lubi, and de Stigter-Speksnijder (2013) and Dowling and Power (2012).

Communities closer to the CBD also have a higher proportion of high-income families. This may be surprising since flight from blight should push rich households far from the poor ones located in central districts. This may result from the fact that wealthy households in Montreal have been able to build homogenous enclaves near the CBD (the city of Westmount and the borough of Outremont for instance), where low-income and middle-class households are unable to afford the cost of housing. With limited resources, middle-class families can only recreate these types of homogenous communities for themselves if they do so in the suburbs (where land is cheaper). They generally use zoning regulations to prevent the poor from also migrating there. Consequently, poor households get trapped in older and decaying central neighbourhoods. This type of zoning exclusions and its consequences on economic segregation were previously observed by Lens and Monkkonen (2016), Rothwell and Massey (2010), and Ihlanfeldt (2004).

Central communities also have a higher proportion of parents with university diplomas, a higher proportion of single-parent households and younger parents on average. As shown by Jean (2016) and Kartsen, Lubi, and de Stigter-Speksnijder (2013), younger dual-income families with higher education revealed preference for central neighbourhoods in the recent past by arguing that it eases the conciliation of work with other activities, including family activities. University diploma may also be associated with the type of job found in the CBD. Some knowledge workers do have a preference for central urban neighbourhoods (Frenkel, Bendit, and Kaplan 2013). For the remaining variables, we find that the share of families where all children are under six years old and the activity gap between men and women are not significantly correlated with the communities' distance to the CBD.

Most simple correlations presented in Table 5 are significant. We know, however, that many of the variables in the table are correlated with each other. The share of low-income families, for instance, is correlated with the share of parents that are immigrants, the share of parents speaking other languages than French and English and to the share of single-parent families. The share of middle-income families is correlated with the share of parents speaking French, and the share of high-income families is correlated with the share of parents with university degrees. To have a better understanding of our simple correlations, we have computed a multiple regression model to partial out all effects reported in Table 5. To do so, we use a regression model defined as follows:

$$\begin{aligned} \log Distance_i = & a + b_1 Children6_i + b_2 LowIncome_i + b_3 MiddleIncome_i + b_4 HighIncome_i + \\ & b_5 Immigrants_i + b_6 English_i + b_7 French_i + b_8 OtherLanguage_i + b_9 University_i + \\ & b_{10} SingleParent_i + b_{11} MotherActive_i + b_{12} Parent35_i + \varepsilon_i \end{aligned} \quad (8)$$

All variables included in the model are the same as in Table 5. All definitions and sources appear in Table 4. Our estimations of Equation (8) should be considered as explorative. The estimated model is not theory-driven. It is used only to partial out cross-correlation effects in Table 5. The results of these estimations are presented in Table 6.

When all variables are taken into consideration, Table 6 shows that language indicators lose their significance (left column). This means that linguistic characteristics are unrelated to communities distance to the CBD. The same thing happens with the share of parents that are immigrants and the share of middle-income and high-income families. Among income variables, the only one that remains significant in Table 6 is the share of low-income families. This variable appears as the most effective to explain divergence in family characteristics among communities in relation with distance to CBD, overshadowing variables like immigration, spoken language at home or middle-class belonging. This is coherent with the model that we have estimated in the first section. Low-income families are often trapped in central communities. Low income may explain in part the presence of immigrant families in these communities and—as a consequence of inverse proportion—the predominance of middle-income families speaking French in the suburbs.

Table 6

Regression results of the community characteristics of families with children on distance of this community to CBD

	Dependent variable : log of distance to CBD	
<i>Children0</i>	0,018 (0,106)	0,019 (0,065)
<i>LowIncome</i>	-0,026 (0,007)	-0,029 (0,005)
<i>MiddleIncome</i>	-0,009 (0,332)	-0,007 (0,415)
<i>HighIncome</i>	-0,018 (0,083)	-0,018 (0,048)
<i>Immigrants</i>	-0,015 (0,291)	-0,011 (0,003)
<i>English</i>	-0,019 (0,599)	
<i>French</i>	-0,023 (0,535)	
<i>OtherLanguage</i>	-0,024 (0,547)	
<i>University</i>	-0,028 (0,000)	-0,028 (0,000)
<i>SingleParent</i>	-0,030 (0,001)	-0,030 (0,000)
<i>MotherActive</i>	0,022 (0,004)	0,023 (0,004)
<i>Parents35</i>	-0,040 (0,001)	-0,048 (0,000)
Constant	8,189 (0,035)	6,048 (0,000)
R ²	0,76	0,76
Number of observations	108	108

Note: Estimations made with ordinary least square (OLS). Homoskedasticity hypothesis not rejected. P-values in parenthesis.

Four other variables are also significant in our multiple regression analysis: the share of parents with university degree, the share of single-parent families, the activity gap between men and women in the work market and the share of parents under 35 years old. This confirms that families in central neighbourhoods usually have younger parents, which are more educated and more often single (divorced). The positive and significant coefficient associated with the gap in activity rate between men and women means that communities closer to the CBD have a lower gap. This is an indication that considering all other variables, mothers in central districts have a higher activity rate, suggesting that families in these communities may have more often double income parents or stricter working-family constraints.

Setting aside all language variables, we have reestimated Equation (8). The results of that estimation appear in the right column of Table 6 (right column). They are nearly the same as in the previous estimation, except that coefficients associated to the share of parents who are immigrants and the share of high-income families become significant. Not considering language variables, these results confirm that the proportion of families with immigrant parents is higher in central communities, and that proportion of high income is also more important there.

Conclusion

In this article, we have undertaken three different analyses of the location of families with children in the Montreal metropolitan area. The first analysis is a community-based estimation of the Alonso (1964) model. It shows that the average price of a single-family house within a community varies with distance to the CBD and that space per household for housing grows in relation with distance. Notwithstanding, the second analysis, inspired by Mieskowski and Mills (1993) and their life-cycle arguments, shows that housing space is not as significant as new housing development or poverty to explain proportion of families with children in communities of the metropolitan area. Our third analysis shows that communities closer to the CBD have higher proportion of low-income families as well as high-income ones. These communities also have a higher proportion of families with parents that are immigrants, that have university degrees, that are single (divorced) and that are under 35 years old. Mothers are also more likely to be active on the employment market in these communities.

As we have mentioned in the introduction, many strategies have been put in place in the past years by the City of Montreal to attract or retain families with children in central neighbourhoods, with a strong emphasis on affordability (City of Montreal 2013). Nevertheless, our results suggest that affordability may not be the main obstacle for families with children willing to stay in Montreal's central neighbourhoods.

Families with children are actually found in higher proportion in communities with new housing development and where the rate of low-income household is low. On the other hand, families actually living in central locations are already part of low-income group in a higher proportion than what is observed in the rest of the metropolitan area. If the City wants to attract families with children, one of its major goals, our results suggest that it is probably better to use urban renovation opportunities to build homogenous neighbourhoods designed for upper-middle-class households than affordable housing for low income ones.

Many observations on Census data of 2006 are also quite positive for those wishing for the growth of the proportion of families with children in Montreal's central neighbourhoods. Many factors associated with families actually living in central communities may expand in the future. Even if our analysis remains static and exposed to endogeneity bias, we have observed that central locations were hosting families characterized by a higher proportion of parents that are immigrants and that have university degrees. Economic transformation toward an economy increasingly dependent on knowledge and a population growth increasingly dependant on international immigration will increase the proportion of immigrants among parents as well as university graduates (Simmons and Bourne 2018). As Frankel, Bendit, and Kaplan (2013) have argued, there is no guarantee that knowledge-based workers or future immigrants will chose to locate in central neighbourhoods, but it may be the case if they replicate residential choices as they were observed in the 2006 Census. Following the same argument, a growing trend in mothers' participation to employment, stimulated by generous parental policies as the one offered by the Quebec government, may also push for an increasing demand for housing in central neighbourhoods by families with children in the future.

Notes

¹ Our work is mainly based on the model developed by Alonso (1964). In urban economics, however, the model is often called "Alonso-Mills-Muth" in order to account for the contribution of Mills (1967) and Muth (1969) to the theoretical framework used in Alonso (1964).

² Since utility function U is decreasing with transport t , u_t has a negative sign.

³ See Meloche and Vaillancourt (2015) for details on the governance structure of the City of Montreal.

References

- Agrawal, S. K. 2010. *Neighbourhood patterns and housing choices of immigrants*. Region of Peel, Human Services, Immigration discussion paper.
- Alonso, W. 1965. *Location and land use: Toward a general theory of land rent*. Harvard University Press.
- Bayoh, I., E. G. Irwin, and T. Haab. 2006. Determinants of residential location choice: How important are local public goods in attracting homeowners to central city locations? *Journal of Regional Science* 46(1): 97–120.
- Bischoff, K., and S. F. Reardon. 2013. Residential segregation by income, 1970–2009. *Diversity and disparities: America enters a new century*. New York, NY: The Russell Sage Foundation.

- Boterman, W. R., L. Karsten, and S. Musterd. 2010. Gentrifiers settling down? Patterns and trends of residential location of middle-class families in Amsterdam. *Housing Studies* 25(5): 693–714.
- Brueckner, J., and D. Fansler. 1983. The economics of urban sprawl: Theory and evidence on the spatial size of cities. *The Review of Economics and Statistics* 55: 479–482.
- Brueckner, J. K. and S. S. Rosenthal. 2009. Gentrification and neighborhood housing cycles: Will America's future downtowns be rich? *The Review of Economics and Statistics* 91(4): 725–743.
- Carroll, P., K. Witten, and R. Kearns. 2011. Housing intensification in Auckland, New Zealand: Implications for children and families. *Housing Studies* 26(3): 353–367.
- City of Montreal. 2013. *Plan de fidélisation des familles 2014–2017* [Plan to keep families in Montreal 2014–2017].
- Dowling, R., and E. Power. 2012. Sizing home, doing family in Sydney, Australia. *Housing Studies* 27(5): 605–619.
- Frenkel, A., E. Bendit, and S. Kaplan. 2013. Residential location choice of knowledge-workers: The role of amenities, workplace and lifestyle. *Cities* 35: 33–41.
- Gambaro, L., H. Joshi, and R. Lupton. 2017. Moving to a better place? Residential mobility among families with young children in the Millennium Cohort Study. *Population, Space and Place* 23(8): e2072.
- Glaeser, E., M. Khan, and J. Rappaport. 2008. Why do the poor live in cities? The role of public transportation. *Journal of Urban Economics* 63: 1–24.
- Glaeser, E., J. Kolko, and A. Saiz. 2001. Consumer city. *Journal of Economic Geography* 1(1): 27–50.
- Ihlanfeldt, K. R. 2004. Exclusionary land-use regulations within suburban communities: A review of the evidence and policy prescriptions. *Urban Studies* 41(2): 261–283.
- Jean, S. 2016. Neighbourhood attachment revisited: Middle-class families in the Montreal metropolitan region. *Urban Studies* 53(12): 2567–2583.
- Karsten, L., T. Lupi, and M. de Stigter-Speksnijder. 2013. The middle classes and the remaking of the suburban family community: Evidence from the Netherlands. *Journal of Housing and the Built Environment* 28(2): 257–271.
- Kern, C. R. 1981. Upper-income renaissance in the city: Its sources and implications for the city's future. *Journal of Urban Economics* 9: 106–124.
- LaSalvia, T. P. 2014. Essays on intra-urban residential choice. State University of New York at Binghamton.
- Lens, M. C., and P. Monkkonen. 2016. Do strict land use regulations make metropolitan areas more segregated by income?. *Journal of the American Planning Association* 82(1): 6–21.
- Marois, G., and A. Bélanger. 2014. Déterminants de la migration résidentielle de la ville centre vers la banlieue dans la région métropolitaine de Montréal: Clivage linguistique et fuite des francophones. *Canadian Geographer/ Géographe canadien* 58(2): 141–159.
- McGrath, D. 2005. More evidence on the spatial scale of cities. *Journal of Urban Economics* 58: 1–10.
- Meloche, J.-P. and F. Vaillancourt. 2015. Designing proper fiscal arrangements for sub-local decentralization in Montreal. *Journal of Urban Affairs* 37(5): 530–547.
- Mieszkowski, P. and E. Mills. 1993. The causes of metropolitan suburbanization. *The Journal of Economic Perspectives* 7(3): 135–147.
- Mills, E. 1967. An aggregative model of resource allocation in a metropolitan area. *American Economic Review* 57(2): 197–210.
- Mulder, C. H. 2013. Family dynamics and housing: Conceptual issues and empirical findings. *Demographic Research* 29: 355–377.
- . 2006. Home-ownership and family formation. *Journal of Housing and the Built Environment* 21(3): 281–298.
- Muth, R. 1969. *Cities and housing*. Chicago, IL: University of Chicago Press.
- Paulsen K. 2012. Yet even more evidence on the spatial size of cities: Urban spatial expansion in the US, 1980–2000. *Regional Science and Urban Economics* 42: 561–568.
- Qadeer, M., and S. Kumar. 2006. Ethnic enclaves and social cohesion. *Canadian Journal of Urban Research* 15(2): 1–17.
- Rabe, B., and M. Taylor. 2010. Residential mobility, quality of neighbourhood and life course events. *Journal of the Royal Statistical Society: Series A* 173(3): 531–555.
- Rossi, P. H. 1955. *Why families move*. Glencoe: The Free Press.
- Rothwell, J. T., and D. S. Massey. 2010. Density zoning and class segregation in US metropolitan areas. *Social Science Quarterly* 91(5): 1123–1143.

- Shlay, A. B. 1986. Taking apart the American dream: The influence of income and family composition on residential evaluations. *Urban Studies* 23: 253–270.
- Simmons, J., and L. S. Bourne. 2018. The Canadian urban system: Urban Canada goes global. In *International and transnational perspectives on urban systems*. Springer: 99–115.
- Spivay, C. 2008. The Mills-Muth Model of urban spatial structure: Surviving the test of time? *Urban Studies* 45(2): 295–312.
- Sweet, M. N., B. Bullivant, and P. S. Kanaroglou. 2017. Are major Canadian city-regions monocentric, polycentric, or dispersed? *Urban Geography* 38(3): 445–471.
- Thomas, R. 2013. Viewing immigrants' neighbourhood and housing choices through the lens of community resilience. *SAPIENS* 6(1): 1–10.
- Wagner, M., and C. H. Mulder. 2015. Spatial mobility, family dynamics, and housing transitions. *Kölner Zeitschrift für Soziologie und Sozialpsychologie* 67(1): 111–135.
- Wassmer, R. 2006. The influence of local urban containment policies and statewide growth management on the size of United States urban areas. *Journal of Regional Science* 46(1): 25–65.
- Wheaton, W. C. 1977. Income and urban residence: An analysis of consumer demand for location. *The American Economic Review* 67(4): 620–631.