S E D A P

A PROGRAM FOR RESEARCH ON

SOCIAL AND ECONOMIC DIMENSIONS OF AN AGING POPULATION

Car Driving and Public Transit Use in Canadian Metropolitan Areas: Focus on Elderly and Role of Health and Social Network Factors

Ruben G. Mercado
K. Bruce Newbold

SEDAP Research Paper No. 243

For further information about SEDAP and other papers in this series, see our web site:
http://socserv.mcmaster.ca/sedap

Requests for further information may be addressed to:
Secretary, SEDAP Research Program
Kenneth Taylor Hall, Room 426
McMaster University
Hamilton, Ontario, Canada
L8S 4M4
FAX: 905 521 8232
e-mail: sedap@mcmaster.ca

Car Driving and Public Transit Use in Canadian Metropolitan Areas: Focus on Elderly and Role of Health and Social Network Factors

Ruben G. Mercado
K. Bruce Newbold

SEDAP Research Paper No. 243

January 2009

The Program for Research on Social and Economic Dimensions of an Aging Population (SEDAP) is an interdisciplinary research program centred at McMaster University with co-investigators at seventeen other universities in Canada and abroad. The SEDAP Research Paper series provides a vehicle for distributing the results of studies undertaken by those associated with the program. Authors take full responsibility for all expressions of opinion. SEDAP has been supported by the Social Sciences and Humanities Research Council since 1999, under the terms of its Major Collaborative Research Initiatives Program. Additional financial or other support is provided by the Canadian Institute for Health Information, the Canadian Institute of Actuaries, Citizenship and Immigration Canada, Indian and Northern Affairs Canada, ICES: Institute for Clinical Evaluative Sciences, IZA: Forschungsinstitut zur Zukunft der Arbeit GmbH (Institute for the Study of Labour), SFI: The Danish National Institute of Social Research, Social Development Canada, Statistics Canada, and participating universities in Canada (McMaster, Calgary, Carleton, Memorial, Montréal, New Brunswick, Queen's, Regina, Toronto, UBC, Victoria, Waterloo, Western, and York) and abroad (Copenhagen, New South Wales, University College London).

Car Driving and Public Transit Use in Canadian Metropolitan Areas: Focus on Elderly and Role of Health and Social Network Factors[1]

Ruben G. Mercado
School of Geography and Earth Sciences
McMaster University
1280 Main Street West, Hamilton, Ontario L8S 4K1, Canada
Tel. No. 1-905-525-9140 ext. 23734
Email: mercadrg@mcmaster.ca

K. Bruce Newbold
McMaster Institute of Environment and Health
School of Geography and Earth Sciences
McMaster University
1280 Main Street West, Hamilton, Ontario L8S 4K1, Canada
Tel. No. 1-905-525-9140 ext. 27948
Email: newbold@mcmaster.ca

[1] This is a revised and upgraded version of a paper presented at:
- 104th Annual Meeting of the Association of American Geographers (AAG), (Boston, 15-19 April 2008)
- International Federation on Ageing (IFA) 9th Global Conference (Montréal, September 4-7, 2008)
- 88th Annual Meeting of the US Transportation Research Board. (Washington D.C. January 11-15, 2009)

Car Driving and Public Transit Use in Canadian Metropolitan Areas: Focus on Elderly and Role of Health and Social Network Factors

Abstract

Most studies analyzed the impact of decreased mobility on health and social network status, but only a few have provided evidence to understand how these latter factors could affect travel decisions or outcomes. This paper examined the linkage between people's car driving and public transit use in Canada and their personal, health and social network characteristics, with a focus on the elderly population. The study exploits Statistics Canada's General Social Survey (GSS-19), a unique survey with a nationally representative sample that contains questions on health, social network and transportation situation. Multilevel binary logistic regression models were estimated for the two travel modes. Results showed that regardless of age, poor health discourages both car driving and public transit use. Physical limitations that constrain mobility were found to decrease the likelihood of using public transit, a finding that was expected. However, a very interesting finding of this study is that even in the presence of physical or mental situations, mobility is still made possible through car driving. Relatedly, the study showed how important license possession and car ownership are to personal mobility and to be less dependent on other modes of transport including public transit.

Findings from this study have also underlined that family network could play an important role in influencing both mobility decisions and provision. Car driving was found to be more likely when a person lives alone versus with one or more people in the household, a tendency that is stronger among the elderly than the non-elderly group. However, in the event of voluntary driving cessation, suspension of driving license, or when other means of transport would not be a convenient or feasible option, support from family members or caregivers could be critical given that, and as this study finding showed, elderly people are likely to continue to strive to maintain their driving skills even with a health condition, rather than prepare to stop driving. The size of close family networks did not show a considerable influence, but the quality of these ties (i.e. being close to family) was found relevant in public transit use. Results underlined implications to road safety, the development of alternative transport strategies and strengthening social support to help maintain mobility necessary for health and quality of life in later years.

Keywords: elderly, transport, mode choice, Canada, health, social network

JEL Classification: I19, J14, O20, R42, R48

Résumé

De nombreuses études ont analysé l'impact d'une diminution de la mobilité sur la santé et sur le statut du réseau social, mais un petit nombre d'entre elles seulement ont apporté des éléments permettant de mieux comprendre comment ces facteurs affectent la décision de voyager. Ce papier examine les liens qui existent au Canada entre l'utilisation de l'automobile, des transports publics et les caractéristiques personnelles, l'état de santé et les réseaux sociaux, en portant une attention particulière sur les personnes âgées. L'étude utilise les données de l'Enquête sociale générale (ESG-19) de Statistique Canada, une enquête représentative de la population unique, qui contient des questions portant sur la santé, les réseaux sociaux et les moyens de transport. Des modèles logistiques multiniveaux ont été estimés pour les deux moyens de transport. Les résultats montrent qu'indépendamment de l'âge, un mauvais état de santé décourage l'utilisation de l'automobile et des transports en commun. Nos résultats montrent que les limitations physiques qui contraignent la mobilité diminuent la probabilité qu'un individu emprunte les transports en commun, ce qui n'est pas un résultat inattendu. Cependant, il est très intéressant de noter que nos résultats suggèrent aussi que même en présence de limitations physiques ou mentales, la mobilité reste toujours possible par le biais de l'automobile. Parallèlement, nos résultats montrent combien la possession d'un permis de conduire et d'une automobile demeurent essentielles à la mobilité individuelle et à la diminution de la dépendance aux autres moyens de transport y compris les transports en commun.

Les résultats de cette étude ont aussi mis en évidence l'importance du rôle des réseaux familiaux dans les décisions liées à la mobilité et la mise à disposition de moyens de transport. La conduite automobile est plus probable si une personne vit seule plutôt que dans un ménage composé d'une ou plusieurs personnes, en particulier chez les aînés. Toutefois, en cas d'un arrêt volontaire de la conduite, de la suspension du permis de conduire, ou lorsque des moyens de transport alternatifs ne sont pas une option commode ou possible, le support d'un membre de la famille ou d'une aide-soignante pourrait devenir critique, étant donné que, comme cette recherche le montre, les aînés sont susceptibles de continuer à s'efforcer de maintenir leurs compétences de conduite, même en présence d'un problème de santé, plutôt que de se préparer à cesser de conduire. La taille du réseau familial de proches n'apparaît pas d'une importance considérable, mais la qualité des liens familiaux (c.-à-d. être proche de sa famille) joue un rôle significatif dans l'utilisation des transports en commun. Nos résultats ont des implications pour la sécurité routière, le développement de stratégies de transports alternatifs et le renforcement du support social pour aider à maintenir la mobilité nécessaire à la santé et à la qualité de vie dans les dernières années.

Car Driving and Public Transit Use in Canadian Metropolitan Areas: Focus on Elderly and Role of Health and Social Network Factors

1. INTRODUCTION

Most studies in the recent past have focused on the impact of decreased mobility of older people on their health and social network status (e.g. Harrison & Ragland, 2003; Marottoli et al., 2000; Marottoli et al., 1997; Murata et al., 2006; Taylor & Tripoles, 2001). Only a few studies, though, have provided evidence as to the other important direction of the causality, i.e. how health and social network status affect mobility choices or outcomes, due largely to the limited number of surveys that incorporate information of a person's health, social network and transportation characteristics. Indeed, the links between these factors would have implications to road safety issues, the development of alternative transport strategies and social support to help maintain mobility necessary for health and quality of life in later years.

Older people tend to rely on private mobility as drivers or passengers (Alsnih & Hensher 2003; Collia et al., 2003; Newbold et al., 2005; Noble & Mitchell, 2001; Rosenbloom, 2003; Rosenbloom & Morris, 1998; Schmocker et al., 2007; Tacken, 1998). Car driving, especially for this age group, has been reported to be not just a necessity but a measure of freedom (Benekohal, 1994) and psychological health (Marottoli et al., 2000; Marottoli et al., 1997). The decision to drive could also be a reflection of a very strong preference to drive as individuals age (Golob & Hensher, 2007; Steg, 2004; Collia et al., 2003), an inevitable dependency on the car due to lack of alternative choices (Rosenbloom, 1998; Carp 1988), or the lack of awareness or knowledge of transit services (Kostyniuk & Shope, 2003). For the elderly, car driving does not come without difficulty, and health conditions could affect decisions whether to drive or not (Chipman et al., 1998). Study findings point, for example, to the risk the elderly take in driving a car given their health condition. Thus, implications of physically impaired driving on road safety continue to be an important topic in health and transportation research (e.g. Brenner, 2008; Wang & Carr, 2004; Freund & Szinovacz, 2002; Casson & Racette, 2000; Hakamis-Blomqvist, 1998).

There is a growing sense of urgency on the potential decline in public transit use amongst the old in view of the changing mobility lifestyles of the elderly and the sluggish improvements in public transit and other innovative alternatives to the private car (Hensher 2007; Rosenbloom 2001). While the demand for public transit tends to significantly increase from middle-age and beyond (Golob & Hensher 2007), it has also been shown to be quite unpopular among the elderly (Collia et al., 2003; Rye & Scotney, 2004) because of problems including accessibility (de Boer, 2004) and its inability to match the mobility, convenience and security that the car provides (Rosenbloom, 1998). Coughlin (2001) reported that there have been expressions of willingness to use other alternatives to driving (including public transit) if available and if it would closely provide a certain level of reliability, convenience, spontaneity, personal security and flexibility which make automobiles preferable.

Mobility options could be limited not only by personal characteristics and transportation infrastructure availability, but by the individual's lack of a well-functioning social network or

social support. Although empirical studies that test the significance of household factors in the transport behavior of the older group are still few, results point to the role of living circumstances as essential factors in this regard (e.g. Golob & Hensher 2007; Freund & Szinovacz 2002; Chipman et al., 1998). Sluzki (2000) contends that with old age comes a progressive attrition of social roles and close ties for various reasons (e.g. physical weakness, death of spouse or siblings, loss of friends and relationships due to retirement and/or relocation). However, the challenge to sustain active relationships could be overcome by allowing individuals to be mobile in old age. Increased emotional and instrumental support (including transport services), if needed, from the elderly's remaining intimate ties are important for remaining active and productive in later years.

This study aims to analyze factors that are associated with car driving and public transit use in metropolitan areas using Statistics Canada's 2005 General Social Survey (GSS-19), allowing us to model the relationship between health and social factors controlling for other personal and socio-economic situations. The remainder of the paper is organized as follows. The next section summarizes recent literature on trip modality determinants with reference to the older population. Then, data and methods employed for the analysis are discussed. The fourth section explains the main findings. Finally, conclusions are drawn from the research results and implications are highlighted on elderly transport mobility.

2. PRIOR RESEARCH

There have been relatively few published studies on the determinants of transport mode choices by the elderly. This section summarizes the significant determinants found in relevant studies and their major findings that inform the present study.

Age. Gardiner and Hill (1996) analyzed the older population (50-90 years old) in the city of Sheffield in the UK using data from the British Census. They found that older people are less likely to have car access, likely related to their declining health, and more limited exposure to car use and ownership compared to the younger generations. They argued, though, that this would no longer be relevant as a new, wealthier generation of older people with longer traditions of car use and ownership come into retirement. Tacken (1998) using the Dutch National Travel Survey (OVG) (1979-1994) underlined the car (as driver and passenger) as the dominant transport mode among the elderly, but with diminishing use with age. Moreover, cycling and walking, more than public transit (bus), were important modes for the elderly in this case. Kim and Ulfarsson (2004) analyzed travel mode choice of the elderly in Washington State and found car driving to be negatively associated with age. Schwanen et al. (2001) focused on shopping trips in studying travel mode of the older people 50 years and above. They found that age is positively associated with the use of car and public transit and negatively related to walking and cycling. Golob and Hensher (2007) used a trip chain approach (i.e travel from and return to home after intermediate destinations) in studying elderly travel behavior in Sydney, Australia. The main finding pointed to a modal shift starting at age 65 from car driving (partly linked to loss of driving license or through choice) to car passenger and then to public transit in complex trip chains.

Gender. The role of gender has been reported in a number of studies to be significant in explaining travel mode choices among the elderly, with men consistently more likely to drive a car, more likely to have access to a car (Chipman et al., 1998; Gardiner & Hill, 1996), and making more trips by car (Golob & Hensher, 2007). Schmocker et al. (2007) studied older and

disabled people in London, England and their use of car as driver, car as passenger, taxi, walking, tube/rail and bus/tram using data from the 2001 London Area Transport Survey (LATS). They found a strong preference for car and travel modes that provide independent mobility, particularly for men who would rather be a driver than a passenger compared to their female counterpart. The opposite is true for women. Kostyniuk and Shope (2003), for instance, revealed that most car passengers are women, while women are more dependent on public transit than men (Schwanen et al., 2001). These studies, however, pointed to a possible convergence of this gender divide in time as more women become licensed drivers and exhibit greater reliance on car driving for personal mobility. However, recent findings on gender differences in driving cessation in later years while strongly correlated with gender, have shown that the such decision to stop driving is related to personal driving history rather than gender per se (Hakamies-Blomqvist & Siren, 2003). Thus, the anticipated convergence in driving behaviour between men and women will not be the case unless women acquire more ‘‘male-like’’ driving habits.

Mobility tools. Mobility tools such as the possession of personal vehicles, driver license, or transit passes have been found to influence travel mode use (Scott & Axhausen, 2005). Of these, car ownership has been analyzed to be the most important factor in travel mode choice (Schwanen et al., 2001; Schmocker et al., 2007). Kim and Ulfarsson (2004) also found the number of available vehicles in the household to be positively associated with car driving, but negatively related to public transit use. In Hamilton, Canada, it was shown that while access to the car largely explains elderly trip-making in the area, transit pass ownership is also important, suggesting that public transit is an important mobility mode among older persons (Paez et al., 2006). Aside from the lack of awareness of transit services, older drivers in the US have also been found to have a sufficient lack of experience with public transportation (Kostyniuk & Shope, 2003). Analyzing survey data conducted among drivers and former drivers aged 65 and older in Michigan, Kostyniuk and Shope (2003) reported that most of them rely on the private automobile (as car driver and passenger) and an insignificant proportion reported relying on public transit and dial-a-ride as their primary mode of transport. Negative perception and lack of experience with public transportation were indicated as reasons for low transit use. In fact, drivers who expect problems in their driving ability within the next five years expect to continue driving for more than 5 or even 10 years or more. Accessibility to public transit (high bus stop density) is positively associated with public transport use. This complements another study (Kim & Ulfarsson, 2004) where they found negative association between car driving and nearness to bus stop. Golob and Hensher (2007) highlighted the loss of driver’s license as potential contributor to social isolation in the absence of inadequate public transport or support mechanisms to access a car as a passenger.

Health. Chipman et al. (1998), found car driving to be related to reporting one chronic disease. On the other hand, those not driving are more likely to report two or more chronic diseases. In their analysis, these variables, while interrelated, exerted independent associations after controlling for other factors. Gardiner and Hill (1996) explained that long-term illness has negative effects on car access. Schmocker et al. (2007) revealed that public transport (especially rail/tube modes) is not a preferred mode, especially for people with disabilities. In contrast, the healthy elderly are more likely to use buses and trams. Also, they found that age with disability increases the preferences for taxis.

Social Factors. Household size and marital status have been found to influence driving behaviour. Single-person households were more likely to drive (Kim & Ulfarsson 2004). The tendency to drive decreases as household size increases, such that people living in larger households are less likely to be drivers than people living alone or in two-person households (Chipman et al., 1998). Being married was also associated with being a driver (Chipman et al 1998) and more trips by car **(**Golob & Hensher 2007). As to public transit, single seniors are more likely to use it than their coupled counterparts (Schwanen et al., 2001;Golob & Hensher (2007).

Other Factors. Income has a consistent, positive, and direct relationship with driving (e.g. Golob & Hensher 2007; Kim & Ulfarsson 2004). Such relationships, however, do not hold true for public transit. In other words, as income increases, the use of public transit decreases (Schmocker et al., 2007; Kim & Ulfarsson 2004). Urban structure also plays a role in travel mode choice. For instance, Schwanen et al. (2001) reported that public transport is dependent on the residential environment (i.e. location in big and medium city with higher level of urbanization) and competes with cycling and walking rather than driving. In other words, residential environment matters more to those who do not own a car. Kim and Ulfarsson (2004) also found negative associations between car driving and population density. Conversely, they reported a positive association between public transit use and transit availability (measured by population density) and proximity to transit stops. Level of education was also a variable considered in mode choice analysis. Tacken's (1998) study mainly analyzed trip-making, but the results suggested that car (or bicycle) ownership negatively relate to having lower education. On the other hand, Schwanen et al. (2001) revealed that having higher education positively relates to taking the public transit.

The existing literature represents a range of findings, and highlights the very few studies that have been done to date regarding health and social network factors affecting travel mode choice. It is also not necessarily clear whether increased transit use is indeed associated with aging. In fact, the opposite would likely be the case, with the older population preferring automobile use over transit use for reasons including mobility, income, knowledge, accessibility, and gender roles. This study hopes to cast light on these issues as well as add to our knowledge concerning health and social network factors that have so far been understudied in relation to travel outcomes.

3. DATA SOURCE AND METHODS

3.1 Data Source

The General Social Survey (GSS) conducted by Statistics Canada provides a wealth of information to address the research gap on travel mode choices among the elderly and the role played by health and social factors. The GSS is a telephone survey conducted among the population aged 15 and older by Statistics Canada to monitor the living conditions and well-being of Canadians across the country's 10 provinces. Excluded in the survey are individuals residing in Yukon, Northwest Territories and Nunavut (Canada's three northern territories) and full-time institutional residents. The survey has been conducted since 1986 and additional sets of questions on specific social policy issues are included in every survey. In 2005, additional survey sections related to social network and transportation (car and public transit use) were included.

The coverage of the 2005 Cycle of the GSS (GSS-19) by the Random Digit Dialing (RDD) frame has been reported to be 93% complete. The GSS collected data over a twelve month period, with a total sample size of 19,597 individuals. Of this, a random sample (n = 9,746) was asked to respond to transportation and social network questions. In the present study, this sample was further restricted to those living in Canada's 33 Census Metropolitan Areas (CMAs). After consideration of the independent variables, the sample for the model analysis totalled 5,348 for car driving and 5,432 for public transit use.

3.2 Multilevel Binary Logistic Models

To analyze the factors influencing car driving and public transit and to examine the extent of variation in the effect of these determinants on each of these two modes, multilevel binary logit models were employed. The use of separate logit models for car driving and public transit use is deemed appropriate for the present study as we are interested in finding out the significant determinants associated with the use of each of these two modes. While it would be useful to compare the strength of these determinants on the two modes through the use of multinomial logit model or other logit models that consider more than one choice alternative, the structure of the survey data does not warrant their use. It should be noted that there is no general question on usual travel mode in the survey. Instead, separate sets of questions on car and public transit use were asked of the respondents. In view of this, these two modes are not necessarily exclusive to the respondent's choice set and thus the use of the binary logit model is more appropriate. In the sample data, about 72% drive a car and the rest take other modes of transportation. About 39% have used public transit in the past year.

3.2.1 Model Specification

The following applies the multilevel logit model specification for binary responses to the present study as explained in Rasbash et al. (2004). In this paper, the binary response (0,1) referring to non-use (0) or use (1) of car as driver (or use of public transit) for individual *i* is denoted by y_i where π_i is the probability that $y_i = 1$. Thus, the single-level binary logit model takes the following form with only one explanatory variable, x_i:

$$\text{logit}(\pi_i) = \log(\tfrac{\pi_i}{1-\pi_i}) = \beta_0 + \beta_1 x_i$$

where the quantity $\frac{\pi_i}{1-\pi_i}$ is the odds that $y_i = 1$.

In multilevel analysis, we take into account group effects (in this study, geographic effects, i.e. CMA) on the probability of being a car driver. A multilevel random intercept model for binary response data, thus, takes the following form, again as a matter of illustration, with one explanatory variable, x_{ij}:

$$\text{logit}(\pi_{ij}) = \beta_{0j} + \beta_1 x_{ij}$$

$$\beta_{0j} = \beta_0 + \mu_{0j}$$

In this model, binary response takes the form of y_{ij} which equals 1 if an individual *i* in CMA *j* is a car driver and 0 if otherwise. In contrast to the single-level model, the intercept β_{0j} of a multilevel model consists of two components: a fixed component β_0 and the random effect μ_{0j} representing the variance due to CMA. Additional explanatory variables $\beta_{2j}, \beta_{3j}, \ldots \beta_{ij}$ are

added to the model based on the variable selections. Table 1 outlines these variables as used in the final model. The same model specification is applied to binary response (0,1) in the case of public transit use.

3.2.2 Model Estimation and Evaluation of Goodness of Fit

This study uses the Monte Carlo Markov Chain (MCMC) method to estimate and evaluate the discrete response multilevel models discussed above. According to Rasbash (2004), the use of the MCMC estimation method addresses the weakness of using iterative generalised least squares (IGLS) methods (i.e. first order marginal quasi-likelihood (MQL) and the second-order predictive (or penalized) quasi-likelihood (PQL). Unlike MCMC, which is a maximum likelihood method, IGLS methods are basically quasi-likelihood which have significant limitations. The MQL offers a crude approximation and could lead to biased estimates, especially if sample sizes within Level 2 units (e.g. CMA) are small or the response proportion is extreme, conditions which are the case in the present study. The 2nd order PQL is an improved approximation procedure but is less stable and thus leads to convergence problems.

Another advantage of using MCMC estimation over the quasi-likelihood estimation procedures is the ability to evaluate model fit as log-likelihood can be derived using this procedure. In MCMC estimation using MLwiN, a diagnostic called the Deviance Information Criterion (DIC) is computed for every model, which is based on the following formula (Browne & Rasbash 2004; the interested reader should refer to Spiegelhalter et al. (2002) regarding the derivation of this evaluation index):

$$DIC = \overline{D}(\bar{\theta}) + 2\,p_D = 2\overline{D} - D(\bar{\theta})$$

where:

D = deviance at each model iteration where in a binary model this takes the following formula:

$D = -2\sum\left[y_i \log(p_i) + (1-y_i)\log(1-p_i)\right]$; p_i is the predicted value for observation *i;* $D(\bar{\theta})$ is the deviation at the expected value of the unknown parameters; $\overline{D}$ is the average deviance from the initial 5000 iterations using IGLS procedure; p_D is the effective number of parameters computed based on the difference between $\overline{D}$ and $D(\bar{\theta})$.

The DIC, as can be gleaned from the structure of its formulation, evaluates both the "fit" and the "complexity" of a model and is thus used to compare the robustness of two (or more) models. The DIC statistic is evaluated using chi-square test.

3.3 Model Variables

Table 1 presents a summary of the variables used in the model analysis. A brief discussion follows on the construction of some of the variables from the data source.

3.3.1 Dependent Variables

Car driving and public transit use are variables that were created based on survey responses to related questions regarding the use of these travel modes. In the 2005 GSS, there is no general question about the usual mode of transportation, but there are questions that can indirectly identify an individual respondent whether he/she is a car driver (or a public transit user)

or not. In this study, the binary response (0,1) for car driving was constructed from responses to questions on car availability in the household and the usual usage of the car as mostly driver, passenger or a combination of both. A code of 1 was assigned to a respondent possessing a car in the household and who mostly uses it as a driver. Otherwise, they are coded 0. With respect to public transit use, this dependent variable is constructed based on the question regarding public transit availability and frequency of its use. A code of 1 is assigned to respondents where public transit is available in the area where they reside and who have used it at least 1-4 days in a year. Otherwise, a code of 0 is assigned differentiating them as a non-public transit user.

Table 1
Independent Variable Definitions

Variables	Definition
Individual Traits	
Age Group	
Age <20	Age<20 if true, else 0
Age 20-49	20<=Age<49; if true, else 0
Age 50-64	49<=Age<65; 1 if true, else 0
Age 65-79	65<=Age<80; 1 if true, else 0
Age 80+	Age>=80; 1 if true, else 0
Gender	Female=1; Male=0
Marital Status	1=Married; 2=Separated; 3=Single
Education	1= Above High School; 2=High School; 3= Below High School
Employment	1=Full-time; 2=Part-time; 3=Student; 4=Flexible
Annual Median Income	1= Less than $30,000; 2=More than $30,000
Mobility Tools	
License Ownership	Licensed=1; No License=0
Vehicle Ownership	Vehicle Onwer=1; Not Owner=0
Public Transit Availability	Available=1; Not Available=0
Public Transit User	PT User=1; Not PT User=0
Health Status	
Perceived Health Status	1=Good; 2=Fair; 3=Poor
Activity Limitation	Limited=1; No Limitation=0
Social Network	
Live alone	Live Alone=1; Not live alone=0
Size of intimate network	Continuous variable
Household Size	Continuous variable
Close to Family	Close=1; Not Close=0
Civic Engagement (volunteer)	Volunteered=1; Not Volunteered=0
Knows transport help	Knows help=1; Not know=0

3.3.2 Independent Variables

Individual attributes which are traditionally used in mode choice analysis and are available from the survey data included age, gender, marital status, education, employment status and income. Variables pertaining to mobility tools and health status are largely straightforward from the survey data. Mobility tools include car ownership, license possession, public transit user and public transit availability. In the case of health status, two variables were included: health

status (perceived or self-assessed) and activity limitation (reported physical or mental situations that limit mobility including any of the following: “difficulty hearing, seeing, communicating, walking, climbing stairs, bending, learning or doing any similar activities”).

There are six variables used in the analysis pertaining to social networks. Three variables can be easily taken from the survey data including household size, volunteering (participation in church or religious groups, ethnic groups and clubs) and knows transport help (i.e. if a person knows someone -family member or otherwise- who can provide transportation service if needed). The other three variables were created from the data set. Living alone is a variable created from the recoding of responses to a question on the living arrangement of the respondent. A code of 1 is assigned to a respondent living alone, and 0 for all other combinations of household composition. Close to family is a variable derived from the question of how many members of the family the respondent considers being close to him/her. A code of 1 is assigned the respondent who answers that at least one family member is close, and 0 if there is none. The size of intimate network is constructed based on two separate questions: 1) the total number of family members living with the respondent who are considered close to the respondent; 2) those not living with respondent. The size of the intimate network variable thus constitutes the sum of the responses to these questions. While there were separate related questions regarding other social networks such as friends, neighbors, co-workers and others, the significant number of missing cases due to non-response meant that they were dropped from the analysis. It should be pointed out, though, that the choice of family members in this study as part of network size and composition augurs well with previous research work concerning the overwhelmingly family-oriented networks of older people in various countries studied (Litwin 1996) and the importance of children and relatives in the case of older Canadians (Stone and Rosenthal 1996).

4. MULTILEVEL ANALYSIS

Multilevel model results for car-driving and public transit use are shown in Tables 2 and 3, respectively. The following discusses the main findings influencing the use of these two modes.

4.1 Null Model

It would be worthy to underscore the null model (binary logit model without any explanatory variable) to show the average tendency of individuals living in the various CMAs to drive a car or use public transit. The deviation from this average could show the relative difference of use of these modes between metropolitan regions. The null model for car driving (Table 2) reveals that the majority tend to be car drivers as shown by the positive sign of the estimated constant. The random variable of the model shows that the tendency to use this mode does not vary significantly across the metropolitan regions. In contrast, the negative intercept in the null model for public transit use (Table 3) reveals that individuals in the sample are less likely to be public transit users. However, this varies significantly across metropolitan regions.

Figure 1 and 2 depict the null model residuals showing the deviation of the 33 CMAs from the overall average in the use of the car as driver and public transit, respectively. One will observe that the majority of the CMAs fall above the national average in terms of car driving. CMAs that fall below the average include Toronto, Victoria. Montreal, St. John’s, Ottawa-Gatineau, Moncton, Saint John, Winnipeg, Halifax, Kelowna and Kitchener, meaning that they could be considered relatively less car dependent than other CMAs. In the case of public transit

use, more CMAs fall below the average. CMAs which are above the average in public transit use include Toronto, Montreal, Vancouver, Calgary, Winnipeg, Victoria, Ottawa-Gatineau, Hamilton, Oshawa, Edmonton, Halifax, Quebec, Saskatoon and Kingston. It could be observed that those cities which tend to have above average use of public transit tend to be either larger cities with well-developed public transportation services, or university-oriented cities, including Victoria, Hamilton, Kingston, and Saskatoon. Rank correlation analysis did not confirm any significant relationship between the use of these two modes. In other words, metropolises which are above the average in the use of public transit are not necessarily less dependent on car driving for mobility and vice versa.

4.2 Full Model Results

4.2.1 Car Driving

Full model results explain the factors that influence car driving across the metropolitan regions (**Table 2**). The metropolitan-level variance was insignificant, suggesting homogeneity in the effects of the variables among the CMAs. Model results validate previous findings on some of the variables that relate to car driving, while the analysis highlights the importance and role of health and social network factors.

Socio-Demographic and Socio-Economic Factors. Propensity to drive decreases with age but the decline becomes more prominent as one reaches the elderly age groups. Even within the elderly group, the probability of driving decreases as an older person moves from the young-old (65-79) to the old-old (80+) category. Consistent with expectations, females were less likely to drive. There is also an increasing likelihood to drive as household income increases. This complements the observed strong positive relation between driving and level of education. As to employment, relative to being full-time, there was little difference in the probability of driving for part-time workers. However, students and those with flexible hours of work were less likely to drive than full-time workers.

Mobility Tools. Of all the variables considered in this study, car ownership not surprisingly registered the strongest positive influence on car driving. Results also showed that this factor exerts more influence on the elderly than the non-elderly. The attachment to car driving as a mode of travel is very noteworthy given the tendency for car drivers to be exclusive to this transport mode. This is evidenced by a strong negative relation of being a public transit user to the likelihood of being a car driver. Moreover, even the availability of public transit, which could have a negative effect on car driving, showed no significant effect. on driving a car for mobility.

Health Factors. Findings stressed that a person's health status is a significant factor in car driving. Expectedly, car driving would be most unlikely if a person is in poor health. However, the likelihood to drive a car if a person is in fair health does not differentiate with a person in good health. This result, coupled with the insignificant effect of the presence of physical limitation on car driving, demonstrates that individuals will drive to the extent the severity of their health limitation allows them to. In other words, people will likely curtail driving only if such limitation is severe. Interaction terms with age revealed that these results do not differ between the elderly and the non-elderly population.

Social Network Factors. Living arrangements exerted a strong influence in whether a person would drive or not. In particular, results showed that living alone is positively associated with car driving. A very interesting finding is that elderly persons are more likely to drive than the non-elderly if they live alone. The odds ratios imply a very high chance (three times more likely) for these tendencies to occur if the person (especially the elderly) lives alone. Other social network factors (closeness to family, household size, family network size, civic involvement and transport provider) did not significantly affect car driving.

4.2.2 Public Transit

The full model evinced significant variations between CMAs. This implies heterogeneity in the effects of the factors affecting public transit. The following summarizes the significant factors evinced by the model.

Socio-Demographic and Socio-Economic Factors. The likelihood of public transit use was greatest among the young aged less than 20. Then, as one gets older, results pointed to a decreasing likelihood to use public transit. The elderly returned the biggest negative coefficients relative to other age groups, with odds ratios suggesting a weak tendency to use public transit among the old. Men and women do not differ in their likelihood to use public transit. While gender does not matter, being married lowers the likelihood of a person using public transit, a finding which is largely consistent with the use of automobiles noted above. Expectedly, higher income was found to be negatively associated with public transit use. Interestingly, higher education showed the opposite direction. While it is anticipated that people with lower education would more likely use public transit which the results confirmed, those with higher than secondary education showed an even stronger positive association (odds ratio showing public transit use twice as likely to occur). Relative to full time workers, part-time workers and students are more likely to use public transit, with the latter showing a higher odds ratio. Students' high likelihood of public transit use could be attributed to lack of access to car in view of being away from home while attending school and/or the availability of transit passes through school-related transit subsidy.

Mobility Tools. Findings suggest that the ability to own, drive and maintain a car negatively affect the likelihood of taking public transport. Two mobility tools were examined and were found to significantly decrease such likelihood - car ownership and driving license possession. Based on the odds ratio, license possession was found to decrease public transit use more than car ownership.

Health Factors. Like car driving, poor health has a strong negative influence on public transit use. Similarly, the likelihood of taking public transit between those who are in fair health and good health were also found to be insignificant. In contrast to car driving, the chances of taking public transit are significantly decreased when a person has physical limitations.

Social Network Factors. The size of family network (people considered close to the individual) does not influence public transit use. Thus, even when a person lives alone, is involved in volunteer activities or knows a transport provider, these factors have no significant effect on the inclination to use public transit. In contrast to these findings, results showed that public transit use is negatively influenced by the proximity or quality of a person's social network. Public transit use is less likely as household size increases. Results also revealed being close to family

tends to make public transit use less attractive. It is likely that instead of performing activities alone, closeness with family increases joint activities with family members. It could also point to the likelihood of mobility being provided by family members in lieu of taking public transport.

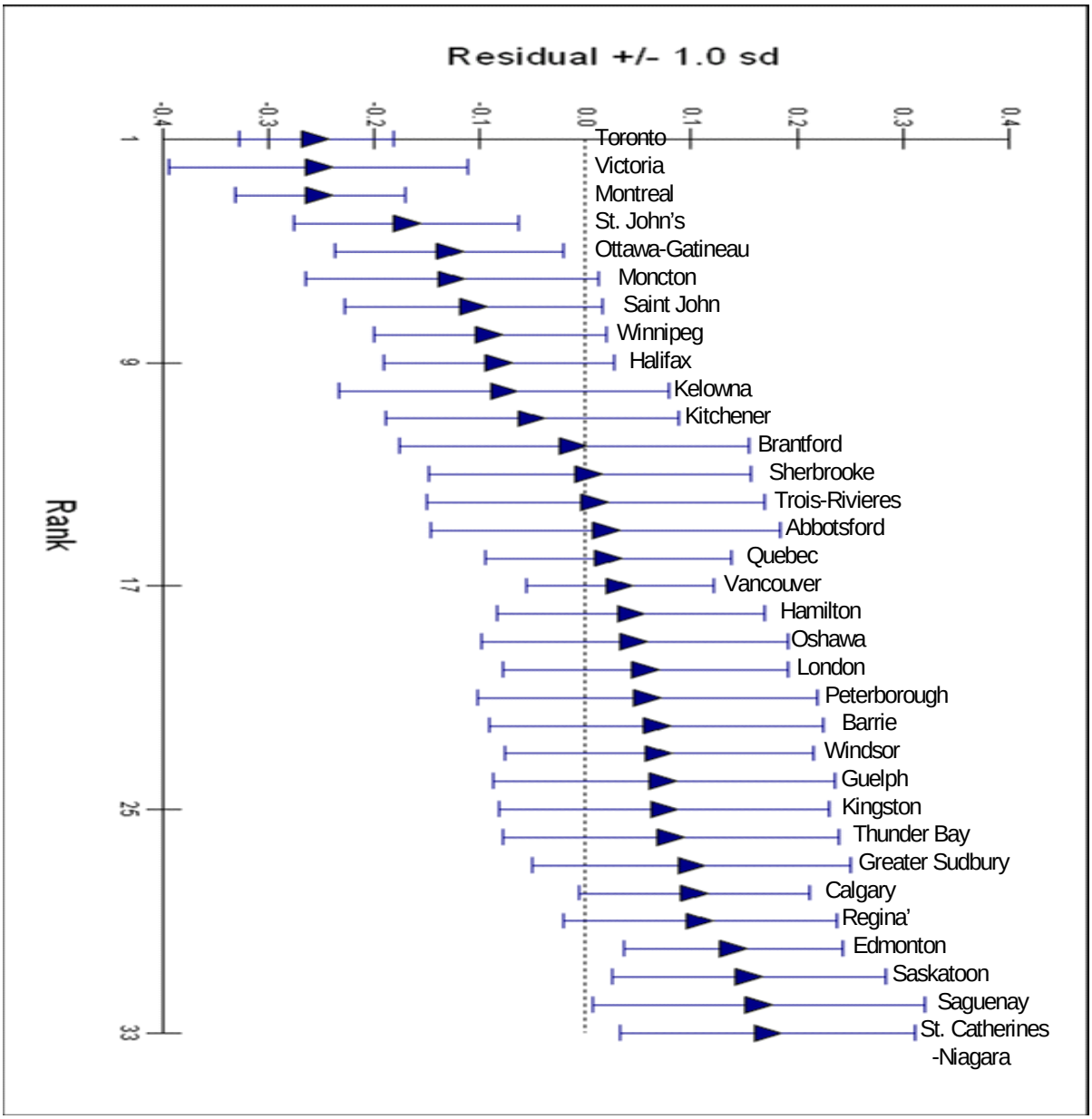
Table 2
Results of Two-Level Random Intercept Logit Model (Full Model) for Likelihood of Car Driving

MODEL/PARAMETERS		**Car Driving**			
		Parameter Estimate	Standard Error	t-stat	Odds Ratio
Null Model					
Intercept		1.0260	0.0580	17.6897	2.7899
Metropolitan-level Variance		0.0460	0.0250	1.8400	1.0471
DIC		6361.8			
Full Model					
INTERCEPT		0.0580	0.3291	0.1762	1.0597
SOCIO-DEMOGRAPHIC					
Age Group	Less 20	-1.6385	0.1953	-8.3897	0.1943
	20-49	Reference			
	50-64	0.0744	0.1119	0.6649	1.0772
	65-79	-1.7503	0.6271	-2.7911	0.1737
	80+	-2.4577	0.6849	-3.5884	0.0856
Gender	Male	Reference			
	Female	-1.1882	0.0886	-13.4108	0.3048
Marital Status	Single	Reference			
	Currently Married	-0.0748	0.0894	-0.8367	0.9279
	Divorced/Separated/Widowed	0.0774	0.1192	0.6493	1.0805
Education	High School	Reference			
	Above High School	0.4436	0.1132	3.9187	1.5583
	Below High School	-0.4163	0.1388	-2.9993	0.6595
Median Household Income	Less than $30,000	Reference			
	More than $30,000	0.2442	0.0864	2.8264	1.2766
Labor Force Status	Full Time	Reference			
	Part-time	-0.0555	0.1614	-0.3439	0.9460
	Student	-0.8989	0.1648	-5.4545	0.4070
	Flexible Work Hours	-1.0282	0.1058	-9.7183	0.3577
MOBILITY TOOLS					
Car Ownership	Car Owner	3.4861	0.1911	18.2423	32.6583
	Age 65+	1.6055	0.4974	3.2278	4.9803
Public Transit Availability	PT Available	0.0399	0.1191	0.3350	1.0407
Public Transit User	PT User	-1.3197	0.0993	-13.2900	0.2672
HEALTH FACTORS					
Perceived Health Status	Good	Reference			
	Fair	0.0863	0.1529	0.5644	1.0901
	Age 65+	-0.4101	0.3135	-1.3081	0.6636
	Poor	-0.9252	0.2676	-3.4574	0.3965
	Age 65+	-0.5370	0.6795	-0.7903	0.5845
Activity Limitations	Has Limitations	-0.0092	0.1599	-0.0575	0.9908
	Age 65+	-0.2988	0.2967	-1.0071	0.7417
SOCIAL NETWORK					
Household Size	HH Members	-0.0448	0.0449	-0.9978	0.9562
Family Network Size	Number of family members considered close	-0.0027	0.0112	-0.2411	0.9973
Perceived closeness to family	Close to family	-0.0358	0.1507	-0.2376	0.9648
	Age 65+	-0.3114	0.4578	-0.6802	0.7324
Live Alone	Live Alone	1.2160	0.1692	7.1868	3.3737
	Age 65+	1.1991	0.3145	3.8127	3.3171
Civic Involvement	Volunteered	-0.0953	0.0829	-1.1496	0.9091
Knowledge of Transport Provider	Knows Provider	Reference			
	Does Not Know Provider	0.1344	0.1487	0.9038	1.1439
	Age 65+	0.6450	0.4765	1.3536	1.9060
Metropolitan-level Variance		0.0460	0.0250	1.8400	1.0471
DIC		4155.2			
Chi-Square		2206.6			
p		0.0000			

Table 3
Results of Two-Level Random Intercept Logit Model for Likelihood of Public Transit Use

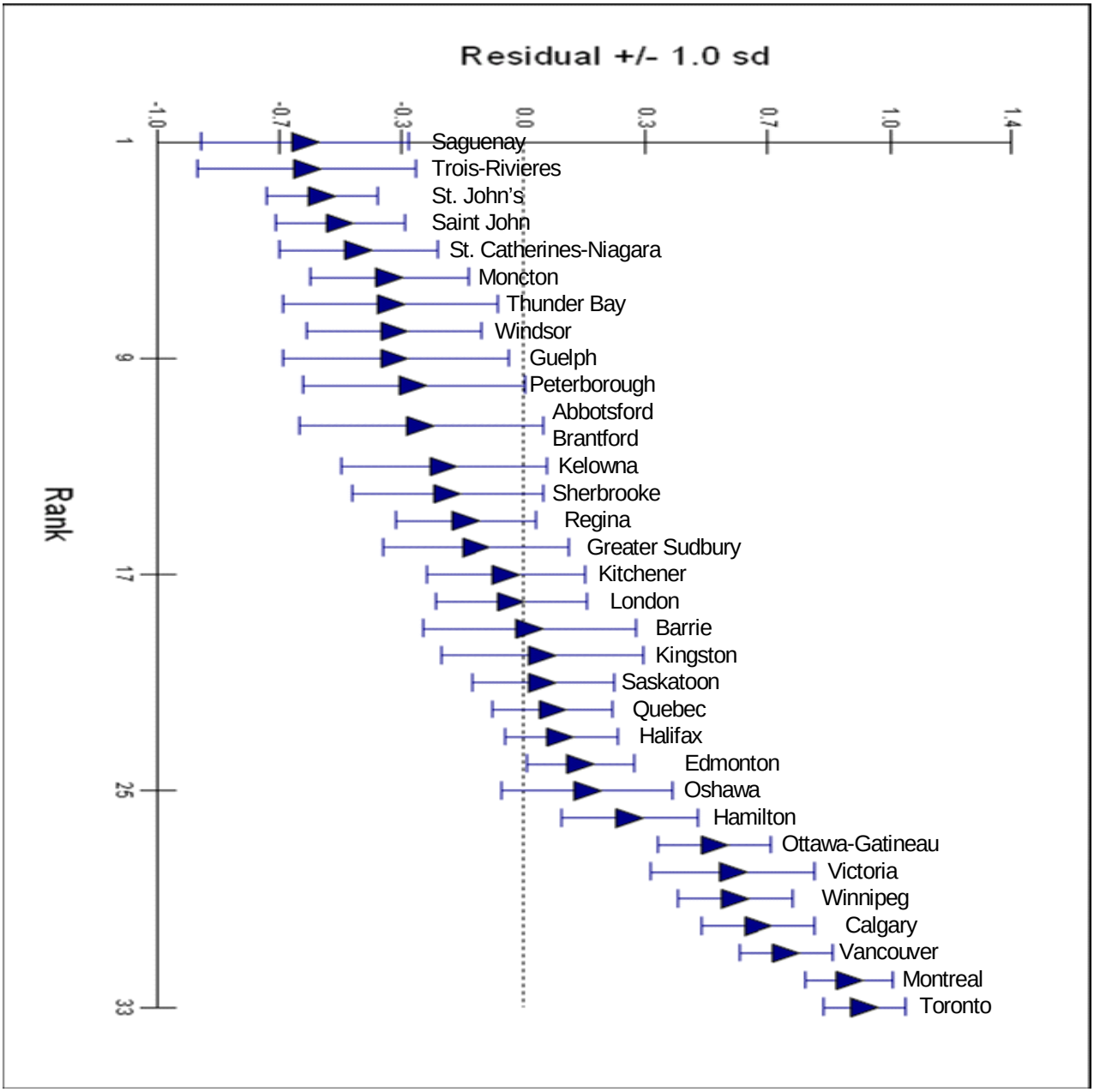
MODEL/PARAMETERS		Public Transit			
		Parameter Estimate	Standard Error	t-stat	Odds Ratio
Null Model (Level 1)					
Intercept				#DIV/0!	1.0000
DIC					
Null Model (Level 2)					
Intercept		-0.8300	0.1000	-8.3000	0.4360
Metropolitan-level Variance		0.2700	0.0810	3.3333	1.3100
DIC		6981.4			
Full Model					
INTERCEPT		1.6053	0.2505	6.4084	4.9794
SOCIO-DEMOGRAPHIC					
Age Group	Less 20	1.0671	0.1757	6.0734	2.9069
	20-49	Reference			
	50-64	-0.3556	0.0842	-4.2233	0.7008
	65-79	-0.4767	0.1303	-3.6585	0.6208
	80+	-1.2334	0.2207	-5.5886	0.2913
Gender	Male	Reference			
	Female	0.0716	0.0669	1.0703	1.0742
Marital Status	Single	Reference			
	Currently Married	-0.1301	0.0738	-1.7629	0.8780
	Divorced/Separated/Widowed	-0.1283	0.1018	-1.2603	0.8796
SOCIO-ECONOMIC					
Education	High School	Reference			
	Above High School	0.8196	0.0956	8.5732	2.2696
	Below High School	-0.0411	0.1252	-0.3283	0.9597
Median Household Income	Less than $30,000	Reference			
	More than $30,000	-0.3794	0.0708	-5.3588	0.6843
Labor Force Status	Full Time	Reference			
	Part-time	0.3907	0.1288	3.0334	1.4780
	Student	0.7102	0.1445	4.9149	2.0344
	Flexible Work Hours	0.1271	0.0922	1.3785	1.1355
MOBILITY TOOLS					
Car Ownership	Car Owner	-0.8238	0.1437	-5.7328	0.4388
Driving License Possession	Has License	-1.6140	0.1267	-12.7388	0.1991
HEALTH					
Perceived Health Status	Good	Reference			
	Fair	0.0043	0.1199	0.0359	1.0043
	Age 65+	0.1798	0.2752	0.6533	1.1970
	Poor	-0.5083	0.2301	-2.2090	0.6015
	Age 65+	0.1791	0.5048	0.3548	1.1961
Activity Limitations	Has Limitations	-0.2897	0.1234	-2.3476	0.7485
	Age 65+	0.1627	0.2836	0.5737	1.1767
SOCIAL NETWORK					
Household Size	HH Members	-0.1561	0.0362	-4.3122	0.8555
Family Network Size	Number of family members considered close	-0.0001	0.0092	-0.0109	0.9999
Perceived closeness to family	Close to family	-0.2871	0.1156	-2.4836	0.7504
	Age 65+	-0.0739	0.2332	-0.3169	0.9288
Live Alone	Live Alone	-0.1951	0.1078	-1.8098	0.8228
	Age 65+	0.1417	0.1963	0.7219	1.1522
Civic Involvement	Volunteered	0.0008	0.0676	0.0118	1.0008
Knowledge of Transport Provider	Knows Provider	Reference			
	Does Not Know Provider	-0.0245	0.1142	-0.2145	0.9758
	Age 65+	-0.1191	0.2901	-0.4105	0.8877
Metropolitan-level Variance		0.4473	0.1503	2.9760	1.5641
DIC		6112.0			
ChiSquare		869.4			
p		0.0000			

Figure 1
Estimated Residuals for 33 CMAs based on Two-level Random Intercept Logit Model (Null Model) for Likelihood of Car Driving *



* The arrowhead represents the point estimate, and the bar represents the confidence interval based on the 95% level of significance.

Figure 2
Estimated Residuals for 33 CMAs based on Two-level Random Intercept Logit Model (Intercept Only) for Likelihood of Using Public Transit



5. CONCLUSIONS

This study has examined the linkage between car driving and public transit use with focus on the Canadian elderly and their personal, mobility facility, health and social network characteristics. The unique Canadian data set allowed for the modeling of transport mode use variables that combine these factors. Results validated previous findings that both car driving and public transit use decline as one ages. It also confirmed the significant gender effect in car driving wherein men continue to show greater tendency to drive than women. Economic factors predict to a large extent whether people would drive or use public transit. In this study, car ownership, income and full-time employment displayed significant positive influence on driving a car. In contrast, these same factors showed considerable negative effect on public transit use. However, this does not appear to be the case with education status, with results indicating that there is a high propensity to use either of these two modes for those with higher education. This suggests that economic status would make one mode more competitive than the other, but high education status could portray both modes as competitive alternatives.

It is not difficult to understand the negative effect poor health could impact on both car driving and public transit use. Physical limitations that constrain mobility were found to decrease the likelihood of using public transit, a finding that was expected. However, a very interesting finding of this study is that such limitation does not seem to pose a significant deterrent to the likelihood of car driving. Even in the presence of physical health problems, mobility is still made possible through car driving, a finding that flags the issue of road safety for drivers at risk and those they would potentially put at risk. This study has shown how important license possession and car ownership are to personal mobility and to be less dependent on other modes of transport including public transit.

Problems in mobility upon driving cessation could be addressed by providing alternative transport choices. While public transit is an important alternative, multilevel analysis showed that at present, public transit use is not a popular mode choice across the metropolitan regions in Canada relative to other modes, especially the private car. Moreover, this is especially true for those with physical limitations, where mobility or other health restrictions limit public transit use. While availability of public transit may not be an issue as evidenced by this study, the quality of public transit service might explain its unpopularity in terms of accessibility, convenience and security as have been pointed out in previous studies (e.g. de Boer, 2004; Rosenbloom, 2001). Alternatively, the physical demands of using public transit – walking to/from stops, stepping in/out of buses, etc., may limit those with health issues. In Canada, improving the performance of the public transit system remains an issue and challenge. In Ontario, where the largest number of elderly Canadians resides,, less than 50% of the 55 public transit systems have accessible vehicles and some even have zero accessibility (Mercado et al., 2007). Specialized transport services as another vital mobility alternative have been emphasized time and again (e.g. Alsnih & Hensher 2003; Benjamin et al., 1998). The supply and quality of specialized transportation services (dial-a-ride services, accessible taxi services, etc.) should be reviewed in terms of coverage, affordability and frequency of service. Again by way of illustration, in Ontario, a significant number of these services are more prone to turn down requests due to insufficient capacity (Mercado et al., 2007). Improved reservation systems and increased awareness of the dial-a-ride system rather than fare reduction have been found to be crucial in improving current para-transit services (Benjamin et al., 1998).

Findings from this study have also underlined that family network could play an important role in influencing both mobility decisions and provision. Car driving was found to be more likely when a person lives alone versus with one or more people in the household, a tendency that is stronger among the elderly than the non-elderly group. This finding emphasizes that mobility, especially among the elderly, is not only important to carry out daily activities outside the home as a matter of necessity but also to avoid social isolation. However, in the event of voluntary driving cessation, suspension of driving license, or when other means of transport would not be a convenient or feasible option, support from family members or caregivers could be critical. Licensing authorities, family doctors, and family members should work together to address mobility options in such cases to maintain a person's health and quality of life. This is important given that, and as this study finding showed, elderly people are likely to continue to strive to maintain their driving skills even with a health condition, rather than prepare to stop driving (Yassuda et al., 1997). The study found that closeness with family could provide individuals with mobility support (apart from using public transport). This reinforces previous findings that family and friends are significant in providing transport support for the elderly including accessing health services (e.g. Moremen, 2008; Goldsmith & Goldsmith 1995; Goodwin et al., 1991), in encouraging the elderly to use specialized transport services (Nasvadi & Wister 2006) and preventing the elderly from resuming driving due to lack of transportation and to overcome feelings of insecurity (Johnson, 2008). Undeniably, a dependable social network in tandem with an efficient and convenient public transit and specialized transport services would be more imperative in the future in view of the increasing number of elderly drivers with health and social network challenges.

REFERENCES

Alsnih, R., & Hensher, D.A. (2003). The mobility and accessibility expectations of seniors in an aging population. *Transportation Research Part A*, 37, 903-916.

Banister, D., & Bowling, A. (2004). Quality of life for the elderly: the transport dimension. *Transport Policy*, 11, 105-115.

Benekohal, R.H., Michaels, R.M, Shim, E., & Resende, P.T.V. (1994). Effects of Aging on Older Drivers' Travel Characteristics. Paper presented at the 73rd Annual Meeting of the Transportation Research Board, Washington, D.C. January 1994.

Benjamin, J., Kurauchi, S, Morikawa, T, Polydoropoulou, A, Sasaki, K., & Ben-Akiva, M. (1998). Forecasting Paratransit Ridership Using Discrete Choice Models with Explicit Consideration of Availability. *Transportation Research Record*, 1618, 60-65.

Brenner, L.A., Homaifar, B.Y., & Schultheis, M.T. (2008). Driving, aging, and traumatic brain injury: Integrating findings from the literature. *Rehabilitation Psychology*. 53(1), 18-27.

Carp, F.M. (1988). Significance of mobility for the well-being of the elderly (TRB Special Rep. 218). In *Transportation in an aging society: Improving mobility and safety for older persons* (pp. 1-20), Washington, DC : National Research Council.

Casas, I., Clifton, K., Litwin, M. & Schlossverg, M. (2003). *Expanding Frameworks and Finding Focus.* STELLA-Focus Group: Society, Behaviour, and Private/Public Transport. Briefing Paper, March 22, 2003, Montreal, Quebec.

Casson, E.J., & Racette, L. (2000). Vision standards for driving in Canada and the United States. A review for the Canadian Ophthalmological Society. *Canadian Journal of Ophthalmology*, 35(4), 192-203.

Chipman, M.L., Payne, J., & McDonough, P. (1998). To Drive or Not to Drive: The influence of Social Factors on the decisions of elderly drivers. *Accident Analysis and Prevention*, 30(3), 299-304.

Cobb, R.W., & Coughlin, J.F. (2000). How Will We Get There from Here? Placing Transportation on the Aging Policy Agenda. *Journal of Aging and Social Policy*, 11(2/3), 201-210.

Collia, D.V., Sharp, J., & Giesbrecht, L. (2003). The 2001 national household travel survey: A look into the travel patterns of older Americans. *Journal of Safety Research*, 34, 461-470.

Coughlin, J. (2001). *Transportation and Older Persons: Perceptions and Preferences: A Report on Focus Groups*, Center for Transportation Studies and Age Lab, Massachusetts Institute of Technology, USA.

De Boer, E. (2004). Introducing and Sustaining Accessible Transport: Social and Physical Challenges, *Transportation Research Record: Journal of the Transportation Research Board*, 1885, 15-20.

Donaghy, K., Ruddinger, G., & Poppelreuter, S. (2004). Societal Trends, Mobility Behavior and Sustainable Transport in Europe and North America. *Transport Reviews*, 24(6), 679-690.

Evans, L. (2000). Risks older drivers face themselves and threats they pose to other road users. *International Journal of Epidemiology*, 29, 315-322.

Freund, B., & Szinovacz, M. (2002). Effects of Cognition on Driving Involvement Among the Oldest Old: Variations by Gender and Alternative Transportation Opportunities. *The Gerontologist*, 42, 621-633.

Golob, T.F., & Hensher, D.A. (2007). The trip chaining activity of Sydney residents : A cross-section assessment by age group with a focus on seniors. *Journal of Transport Geography*, 15(4), 298-312.

Hagerstrand, T., 1970. What about People in Regional Science? *Papers of the Regional Science Association* 24, 7-21.

Hakamies-Blomqvist, L., & Wahlstrom, B. (1998). Why do older drivers give up driving? *Accident Analysis and Prevention*, 30, 305– 312.

Harrison, A, Ragland D.R. (2003). Consequences of driving reduction or cessation for older adults. *Transportation Research Record*, 1843, 96-104.

Hensher, D.A. (2007). Some insights into the key influences on trip-chaining activity and public transport use of seniors and the elderly. *International Journal of Sustainable Transportation*, 1, 53-68.

HRSDC (2006). *HRSD Medium-Term Policy Research Priorities*, Paper prepared for the Annual Symposium of the Population, Work and Family Policy Research Collaboration (PWFC), Ottawa, Ontario, Human Resources and Social Development, Government of Canada.

Gardiner, C., & Hill, R. (1996). Analysis of Access to Cars from the 1991 UK Census Samples of Anonymised Records: A Case Study of the Elderly Population of Sheffield. *Urban Studies*, 33(2), 269-281.

Goldsmith, E.B., & Goldsmith, R.E. (1995). Full-time employees as caregivers to the elderly. *Journal of Social Behavior and Personality*, 10(3), 719-730.

Golob, T.F., & Hensher, D.A. (2007). The trip chaining activity of Sydney residents: a cross-section assessment by age-group with a focus on seniors. *Journal of Transport Geography* 15 (4), 298–312.

Goodwin J.S., Hunt, W.C., & Samet, J.M. (1991). A population-based study of functional status and social support networks of elderly patients newly diagnosed with cancer. *Archives of Internal Medicine*, 151(2), 366-370.

Hensher, D.A. (2007). Some insights into the key influences on trip-chaining activity and public transport use of seniors and the elderly. *International Journal of Sustainable Transportation*, 1, 53-68.

Johnson, J.E. (2008). Informal Social Support Networks and the Maintenance of Voluntary Driving Cessation By Older Rural Women. *Journal of Community Health Nursing*, 25(2), 65-72.

Kim, S., & Ulfarsson, G.F. (2004). Travel Mode Choice of the Elderly: Effects of Personal, Household, Neighborhood, and Trip Characteristics. *Transportation Research Record: Journal of the Transportation Research Board*, 1894, 117-126.

Kostyniuk, L.P., & Shope, J.T. (2003). Driving and alternatives: Older drivers in Michigan. *Journal of Safety Research*, 34, 407-414.

Litwin, H. (1996). A Cross–National Social Network Analysis. In H. Litwin (Ed.), *The Social Networks of Older People: A Cross-National Analysis* (pp. 205-222). Praeger, Westport, CT.

Marottoli, R.A., Mendes de leon, C.F., Glass, T.A., Williams, C.S., Cooney, L.M., & Berkman, L.F. (2000). Consequences of driving cessation: Decreased out-of-home activity levels. *The Journals of Gerontology. Series B, Psychological sciences and social sciences*, 55(6), S334-S340.

Marottoli, R.A., Mendes de leon, C.F., Glass, T.A., Williams, C.S., Cooney, L.M., Berkman, L.F., et al. (1997). Driving cessation and increased depressive symptoms: Prospective evidence from the New Haven EPESE, *Journal of the American Geriatrics Society*, 45(2), pp. 202-206.

Mercado, R.G., Paez, A.H., & Newbold, K.B., (2007). Policy Areas Impinging on Elderly Transportation Mobility: An Explanation with Ontario, Canada as Example. SEDAP Research Paper No. 187, McMaster University, Hamilton, Canada.

Moremen, R.D. (2008). Best friends: The role of confidantes in older women's health. *Journal of Women and Aging* 20(1-2), 149-167.

Murata, C., Kondo, T., Tamakoshi, K., Yatsuya, H., & Toyoshima, H. (2006). Factors associated with life space among community-living rural elders in Japan. *Public Health Nursing*, 23(4), 324-331.

Nasvadi, G.E., & Wister, A.V. (2006). Informal social support and use of a specialized transportation system by chronically ill older adults. *Environment and Behavior*, 38(2), 209-225.

Newbold, K.B., Scott, D.M., Spinney J.E.L., Kanaroglou P., & Paez, A. (2005). Travel behaviour within Canada's older population: a cohort analysis, *Journal of Transport Geography*, 13(4), 340-351.

Noble, B., & Mitchell, C.G.B. (2001). Some aspects of travel by older people. In: Proceedings of the 9th International Conference on Transport and Mobility for Elderly and Disabled People (TRANSED). Warsaw, Poland.

Paez, A., Scott, D.M., Potoglou, D., Kanaroglou, P., & Newbold, K.B. (2007). Elderly Mobility: Demographic and Spatial Analysis of Trip Making in the Hamilton CMA, Canada. *Urban Studies*, 44(1), 123-146.

Pitfield, D., & Waldorf, B. (2003). Effects of gender on aging on travel behaviour. Paper presented at the STELLA Focus Group 3 second meeting, Arlington, VA, USA.

Rosenbloom, S. (2003). The Mobility Needs of Older Americans: Implications for Transportation Reauthorization, Transportation Reform Series, The Brookings Institution, Washington, DC, July 2003.

Rosenbloom, S. (2001). Sustainability and automobility among the elderly: An International Assessment. *Transportation* 28, 375-408.

Rosenbloom, S., & Morris, J. (1998). Travel patterns of older Australians in an international context – policy implications and options. *Transportation Research Record*, 1617, 189-193.

Rye, T., & Scottney, D., 2004. The factors influencing future concessionary bus patronage in Scotland and their implications for elsewhere. *Transport Policy* 11, 133-140.

Schmocker, J.D., Quddus, M.A., Noland, R.B., & Bell, M.G.H. (2007). Mode choice of older and disabled people: a case study of shopping trips in London. *Journal of Transport Geography*, 16(4), 257-267.

Schwanen, T., Dijst, M., & Dieleman, F.M., 2001. Leisure Trips of Senior Citizens: Determinants of Modal Choice, *Tidschrift voor Economische en Sociale Geografie*, 92(3), 347-360.

Scott, D. M., & Axhausen , K.W. (2005). Household mobility tool ownership: modeling interactions between cars and season tickets. *Transportation*, 32, 311–328.

Social Development Canada (SDC) (2005). Knowledge Plan: A Discussion Paper. Knowledge and Research Directorate, SDC, Government of Canada, November 2005.

Siemiatycki, M. (2006). Implications of private-public partnerships on the development of urban public transit infrastructure - The case of Vancouver, Canada. *Journal of Planning Education and Research*, 26(2), 137-151.

Sluzki, C.E. (2000). Social Networks and the Elderly: Conceptual and Clinical Issues, and a Family Consultation, *Family Process*, 39(3), 271-284.

Smith, G.C., & Sylvestre, G.M. (2001). Determinants of the travel behavior of the suburban elderly. *Growth and Change*, 32(3), 395-412.

Spiegelhalter, D.J., Best, N.G., Carlin, B.P. & van der Linde, A. (2002). Bayesian measures of model complexity and fit. *Journal of the Royal Statistical Society, Series B*, 64, pp. 583-640.

Steg, L. (2005). Car use: lust and must. Instrumental, symbolic and affective motives for car use. *Transportation Research Part A*, 39, 147-162.

Steg, L., & Gifford, R. (2005). Sustainable Transportation and quality of life. *Journal of Transport Geography*, 13, 59-69.

Sterns, H.L., Burkhardt, J.E., & Eberhard, J.W. (2003). Moving along the Mobility continuum: Past, Present, and Future. Generations. *The Journal of the American Society on Aging*, 27(2), 8-13.

Stone, L., & Rosenthal, C. (1996). Profiles of the Social Networks of Canada's Elderly: An Analysis of 1990 General Social Survey Data. In H. Litwin (Ed.), *The Social Networks of Older People: A Cross-National Analysis* (pp. 77-98). Praeger, Westport, CT.

Tacken, M. (1998). Mobility of the elderly in time and space in the Netherlands: An analysis of the Dutch National Travel Survey, *Transportation*, 25, 379-393.

Tasca, L. (2005). *Senior Drivers: Safety and Mobility Issues*, Paper presented at the 22nd Annual McMaster Summer Institute on Gerontology, 10 June 2005, McMaster University, Canada.

Taylor, B.D., & Tripodes, S. (2001). The Effects of Driving Cessation on the Elderly with Dementia and Their Caregivers. *Accident Analysis and Prevention*, 33(4), 519-528.

Vance, C., & Iovanna, R. (2007). *Gender and the Automobile: An Analysis of Non-Work Service Trips.* Paper presented at the 86th Annual Meeting of the Transportation Research Board, Washington, D.C., CD-ROM.

Wang C.C., & Carr, D.B. (2004). Older driver safety. A report from the Older Drivers Project. *Journal of the American Geriatrics Society*, 52(1), 143-149.

Yassuda, M.S., Wilson, J.J., & von Mering, O. (1997). Driving Cessation: The Perspective of Senior Drivers, *Educational Gerontology*, 23(6), 525-538.

Number	Title	Author(s)
(2007)		
No. 168:	Health human resources planning and the production of health: Development of an extended analytical framework for needs-based health human resources planning	S. Birch G. Kephart G. Tomblin-Murphy L. O'Brien-Pallas R. Alder A. MacKenzie
No. 169:	Gender Inequality in the Wealth of Older Canadians	M. Denton L. Boos
No. 170:	The Evolution of Elderly Poverty in Canada	K. Milligan
No. 171:	Return and Onwards Migration among Older Canadians: Findings from the 2001 Census	K.B. Newbold
No. 172:	Le système de retraite américain: entre fragmentation et logique financière	D. Béland
No. 173:	Entrepreneurship, Liquidity Constraints and Start-up Costs	R. Fonseca P.-C. Michaud T. Sopraseuth
No. 174:	How did the Elimination of the Earnings Test above the Normal Retirement Age affect Retirement Expectations?	P.-C. Michaud A. van Soest
No. 175:	The SES Health Gradient on Both Sides of the Atlantic	J. Banks M. Marmot Z. Oldfield J.P. Smith
No. 176:	Pension Provision and Retirement Saving: Lessons from the United Kingdom	R. Disney C. Emmerson M. Wakefield
No. 177:	Retirement Saving in Australia	G. Barrett Y.-P. Tseng
No. 178:	The Health Services Use Among Older Canadians in Rural and Urban Areas	H. Conde J.T. McDonald
No. 179:	Older Workers and On-the-Job Training in Canada: Evidence from the WES data	I.U. Zeytinoglu G.B. Cooke K. Harry
No. 180:	Private Pensions and Income Security in Old Age: An Uncertain Future – Conference Report	M. Hering M. Kpessa

Number	Title	Author(s)
No. 181:	Age, SES, and Health: A Population Level Analysis of Health Inequalitites over the Life Course	S. Prus
No. 182:	Ethnic Inequality in Canada: Economic and Health Dimensions	E.M. Gee K.M. Kobayashi S.G. Prus
No. 183:	Home and Mortgage Ownership of the Dutch Elderly: Explaining Cohort, Time and Age Effects	A. van der Schors R.J.M. Alessie M. Mastrogiacomo
No. 184:	A Comparative Analysis of the Nativity Wealth Gap	T.K. Bauer D.A. Cobb-Clark V. Hildebrand M. Sinning
No. 185:	Cross-Country Variation in Obesity Patterns among Older Americans and Europeans	P.C. Michaud A. van Soest T. Andreyeva
No. 186:	Which Canadian Seniors Are Below the Low-Income Measure?	M.R. Veall
No. 187:	Policy Areas Impinging on Elderly Transportation Mobility: An Explanation with Ontario, Canada as Example	R. Mercado A. Páez K. B. Newbold
No. 188:	The Integration of Occupational Pension Regulations: Lessons for Canada	M. Hering M. Kpessa
No. 189:	Psychosocial resources and social health inequalities in France: Exploratory findings from a general population survey	F. Jusot M. Grignon P. Dourgnon
No. 190:	Health-Care Utilization in Canada: 25 Years of Evidence	L.J. Curtis W.J. MacMinn
No. 191:	Health Status of On and Off-reserve Aboriginal Peoples: Analysis of the Aboriginal Peoples Survey	L.J. Curtis
No. 192:	On the Sensitivity of Aggregate Productivity Growth Rates to Noisy Measurement	F.T. Denton
No. 193:	Initial Destination Choices of Skilled-worker Immigrants from South Asia to Canada: Assessment of the Relative Importance of Explanatory Factors	L. Xu K.L. Liaw
No. 194:	Problematic Post-Landing Interprovincial Migration of the Immigrants in Canada: From 1980-83 through 1992-95	L. Xu K.L. Liaw

Number	Title	Author(s)
No. 195:	Inter-CMA Migration of the Immigrants in Canada: 1991-1996 and 1996-2001	L. Xu
No. 196:	Characterization and Explanation of the 1996-2001 Inter-CMA Migration of the Second Generation in Canada	L. Xu
No. 197:	Transitions out of and back to employment among older men and women in the UK	D. Haardt
No. 198:	Older couples' labour market reactions to family disruptions	D. Haardt
No. 199:	The Adequacy of Retirement Savings: Subjective Survey Reports by Retired Canadians	S. Alan K. Atalay T.F. Crossley
No. 200:	Underfunding of Defined Benefit Pension Plans and Benefit Guarantee Insurance - An Overview of Theory and Empirics	M. Jametti
No. 201:	Effects of 'authorized generics' on Canadian drug prices	P. Grootendorst
No. 202:	When Bad Things Happen to Good People: The Economic Consequences of Retiring to Caregive	P.L. McDonald T. Sussman P. Donahue
No. 203:	Relatively Inaccessible Abundance: Reflections on U.S. Health Care	I.L. Bourgeault
No. 204:	Professional Work in Health Care Organizations: The Structural Influences of Patients in French, Canadian and American Hospitals	I.L. Bourgeault I. Sainsaulieu P. Khokher K. Hirschkorn
No. 205:	Who Minds the Gate? Comparing the role of non physician providers in the primary care division of labour in Canada & the U.S.	I.L. Bourgeault
No. 206:	Immigration, Ethnicity and Cancer in U.S. Women	J.T. McDonald J. Neily
No. 207:	Ordinary Least Squares Bias and Bias Corrections for *iid* Samples	L. Magee
No. 208:	The Roles of Ethnicity and Language Acculturation in Determining the Interprovincial Migration Propensities in Canada: from the Late 1970s to the Late 1990s	X. Ma K.L. Liaw
No. 209:	Aging, Gender and Neighbourhood Determinants of Distance Traveled: A Multilevel Analysis in the Hamilton CMA	R. Mercado A. Páez

Number	Title	Author(s)
No. 210:	La préparation financière à la retraite des premiers boomers : une comparaison Québec-Ontario	L. Mo J. Légaré
No. 211:	Explaining the Health Gap between Canadian- and Foreign-Born Older Adults: Findings from the 2000/2001 Canadian Community Health Survey	K.M. Kobayashi S. Prus
No. 212:	"Midlife Crises": Understanding the Changing Nature of Relationships in Middle Age Canadian Families	K.M. Kobayashi
No. 213:	A Note on Income Distribution and Growth	W. Scarth
No. 214:	Is Foreign-Owned Capital a Bad Thing to Tax?	W. Scarth
No. 215:	A review of instrumental variables estimation in the applied health sciences	P. Grootendorst
No. 216:	The Impact of Immigration on the Labour Market Outcomes of Native-born Canadians	J. Tu
No. 217:	Caregiver Employment Status and Time to Institutionalization of Persons with Dementia	M. Oremus P. Raina
No. 218:	The Use of Behaviour and Mood Medications by Care-recipients in Dementia and Caregiver Depression and Perceived Overall Health	M. Oremus H. Yazdi P. Raina
No. 219:	Looking for Private Information in Self-Assessed Health	J. Banks T. Crossley S. Goshev
No. 220:	An Evaluation of the Working Income Tax Benefit	W. Scarth L. Tang
No. 221:	The life expectancy gains from pharmaceutical drugs: a critical appraisal of the literature	P. Grootendorst E. Piérard M. Shim
No. 222:	Cognitive functioning and labour force participation among older men and women in England	D. Haardt
No. 223:	Creating the Canada/Quebec Pension Plans: An Historical and Political Analysis	K. Babich D. Béland
No. 224:	Assessing Alternative Financing Methods for the Canadian Health Care System in View of Population Aging	D. Andrews
No. 225:	The Role of Coping Humour in the Physical and Mental Health of Older Adults	E. Marziali L. McDonald P. Donahue

Number	Title	Author(s)
No. 226: (2008)	Exploring the Effects of Aggregation Error in the Estimation of Consumer Demand Elasticities	F.T. Denton D.C. Mountain
No. 227:	Using Statistics Canada LifePaths Microsimulation Model to Project the Health Status of Canadian Elderly	J. Légaré Y. Décarie
No. 228:	An Application of Price and Quantity Indexes in the Analysis of Changes in Expenditures on Physician Services	F.T. Denton C.H. Feaver B.G. Spencer
No. 229:	Age-specific Income Inequality and Life Expectancy: New Evidence	S. Prus R.L. Brown
No. 230:	Ethnic Differences in Health: Does Immigration Status Matter?	K.M. Kobayashi S. Prus Z. Lin
No. 231:	What is Retirement? A Review and Assessment of Alternative Concepts and Measures	F.T. Denton B.G. Spencer
No. 232:	The Politics of Social Policy Reform in the United States: The Clinton and the W. Bush Presidencies Reconsidered	D. Béland A. Waddan
No. 233:	Grand Coalitions for Unpopular Reforms: Building a Cross-Party Consensus to Raise the Retirement Age	M. Hering
No. 234:	Visiting and Office Home Care Workers' Occupational Health: An Analysis of Workplace Flexibility and Worker Insecurity Measures Associated with Emotional and Physical Health	I.U. Zeytinoglu M. Denton S. Davies M.B. Seaton J. Millen
No. 235:	Policy Change in the Canadian Welfare State: Comparing the Canada Pension Plan and Unemployment Insurance	D. Béland J. Myles
No. 236:	Income Security and Stability During Retirement in Canada	S. LaRochelle-Côté J. Myles G. Picot
No. 237:	Pension Benefit Insurance and Pension Plan Portfolio Choice	T.F. Crossley M. Jametti
No. 238:	Determinants of Mammography Usage across Rural and Urban Regions of Canada	J.T. McDonald A. Sherman

Number	Title	Author(s)
(2009)		
No. 239:	Negative Effects of the Canadian GIS Clawback and Possible Mitigating Alternatives	D. Chisholm R.L. Brown
No. 240:	Basic Living Expenses for the Canadian Elderly	B.-J. MacDonald D. Andrews R.L. Brown
No. 241:	Financial security of elders in China	Y. Cheng M.W. Rosenberg
No. 242:	The Impact of Skill Mismatch among Migrants on Remittance Behaviour	J.T. McDonald M.R. Valenzuela
No. 243:	Car Driving and Public Transit Use in Canadian Metropolitan Areas: Focus on Elderly and Role of Health and Social Network Factors	R.G. Mercado K.B. Newbold