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AVQ	Activités de la vie quotidienne
ADL	Activity of daily living
AIVQ	Activités instrumentales de la vie quotidienne
CAMS	Consumption and Activities Mail Survey
CCHS	Canadian Community Health Survey
CHIP	Canadian Home Income Plan
CMA	Cencus metropolitan area
CREA	Canadian Real Estate Association
FHA	Federal Housing Administration
IADL	Instrumental activity of daily living
GDP	Gross domestic product
HRS	Health and Retirement Study
IRA	Individual retirement accounts
LISA	Longitudinal and International Study of Adults
MIP	Mortgage insurance premium
NNEG	No-negative equity guarantee
OLS	Ordinary least squares
SDF	Single family dwelling
SES	Socio-economics status
UK	United Kingdom
U.S.	United States

RÉSUMÉ

Cette thèse est composée de trois chapitres portant sur la santé, la consommation et les outils de décumulation d'épargne.

Un premier chapitre porte sur l'effet d'une volatilité soutenue du revenu durant la vie active sur la santé et le bien-être à un âge plus avancé. Bien qu'il y ait de plus en plus de preuves que des chocs de revenus importants, par exemple sous la forme d'une perte d'emploi, peuvent avoir un impact sur la santé et la mortalité, il existe peu d'études sur la relation potentielle entre la volatilité soutenue du revenu et la santé, indépendamment du niveau de revenu. Ce chapitre exploite de riches données d'enquête sur la santé et le bien-être de Canadiens d'un âge avancé, ainsi que leurs dossiers fiscaux, pour déterminer si une relation existe entre la santé et le bien-être d'une part, et la volatilité du revenu propre à chaque individu de l'autre, décomposant la volatilité en composantes permanente et transitoire. En tenant compte du revenu moyen durant la vie active, nous avons constaté qu'une augmentation d'une unité de la variance de la composante permanente du revenu (log) vécu au cours de la vie professionnelle était associée à une probabilité plus faible d'être en excellente (-23,9 %) ou en très bonne (-13,3 %) santé, d'être satisfait de la vie (-34,9 %), et implique une augmentation de 1,1 problème de santé mentale supplémentaire. Nous avons trouvé des résultats semblables, quoique plus faibles, pour la composante transitoire du revenu. Ces résultats ont des implications potentiellement importantes pour les politiques publiques, ainsi que pour la compréhension de la relation entre le marché du travail et la santé de la population.

Un deuxième chapitre étudie comment les dépenses et la composition des dépenses changent en raison de l'incidence de limitations dans les activités de la vie quotidienne (AVQ). En combinant les données longitudinales du *Consumption and Activities Mail Survey* (CAMS) et du *Health and Retirement Study* (HRS), nous avons construit un test visant à identifier dans quelle mesure l'utilité marginale des dépenses dépend de la santé dans un contexte intertemporel. Une dépendance positive à l'égard de l'état de santé signifie qu'un dollar dépensé a plus de valeur lorsqu'on est en bonne santé. Nous avons constaté que l'utilité marginale des dépenses totales

et non durables augmente avec l'incidence de limitations dans les activités instrumentales de la vie quotidienne (AIVQ), entraînant ainsi une dépendance négative. Étant donné que certaines assurances protègent contre les difficultés financières en cas de mauvaise santé, ce résultat implique que ces assurances ont plus de valeur que celle prévue en utilisant le cadre standard. D'un autre côté, l'utilité marginale des dépenses totales n'a pas changé en raison de l'incidence de limitations des AVQ, ce qui suggère l'absence de dépendance à l'égard de l'état de santé à la suite de tels chocs. Suite à l'incidence de limitations AIVQ, nous avons observé un remaniement dans les catégories de dépenses et dans les catégories d'actifs, en réaffectant les actifs résidentiels vers des actifs financiers. Ce dernier résultat suggère que les propriétaires utilisent la valeur nette de leur maison comme un outil d'assurance.

Un troisième chapitre étudie les déterminants de la faible demande d'hypothèques inversées au Canada. La caractéristique principale qui différencie une hypothèque inversée d'une marge de crédit hypothécaire est la *no-negative equity guarantee* (NNEG). Cette caractéristique assure que, au moment de repayer le prêt, l'emprunteur n'aura qu'à payer le minimum entre la valeur de revente de la maison et le solde du prêt. Dans ce chapitre, nous utilisons un modèle de tarification pour calculer les primes d'assurances hypothécaires permettant de couvrir les pertes reliées à la NNEG. Étant donné les prêts actuellement accordés dans le marché canadien, nous trouvons que les primes actuarielles justes sont approximativement de zéro, ce qui implique que la NNEG est inexistante dans le marché canadien. Nous avons aussi construit une enquête de type *stated-choice experiment*, où des répondants canadiens étaient invités à évaluer divers produits de prêt hypothécaire inversé. En utilisant une variation exogène des taux d'intérêt et de la taille des prêts présentés lors de l'enquête, nous avons utilisé ces évaluations pour calculer l'élasticité de la demande au Canada et pour identifier les autres facteurs qui peuvent expliquer la faible demande. Nos résultats montrent que plus de la moitié des Canadiens admissibles n'ont même pas de connaissances de base sur les prêts hypothécaires inversés. De plus, les Canadiens admissibles ne semblent pas comprendre comment tirer parti de la NNEG. Enfin, la demande canadienne en prêts hypothécaires inversés est inélastique, mais elle devient élastique avec un meilleur niveau de connaissance du produit. Par conséquent, une combinaison d'ajustement des prix et d'éducation sur les hypothèques inversées pourrait être un bon moyen d'élargir la taille du marché canadien et pourrait représenter une solution gagnant-gagnant pour les prêteurs et les emprunteurs.

Mots clés : Volatilité du revenu, santé, bien-être, Canada, consommation, cycle de vie, assurance, richesse, hypothèques inversées, demande du marché de l'habitation.

ABSTRACT

This thesis consists of three chapters on health, consumption and decumulation tools.

The first chapter looks at the effect of sustained income volatility during a person's working life on their health and well-being at a later age. While there is mounting evidence that large income shocks—e.g., a job loss—may impact health and mortality, little evidence exists on the potential relationship between sustained income volatility, keeping average lifetime income constant, and health. This chapter exploits rich survey data on the near-elderly in Canada paired with their administrative tax records to investigate whether a relationship exists between health and well-being, on the one hand, and individual-specific volatility of income on the other, decomposing volatility into permanent and transitory components. Controlling for average lifetime income, we found that a one unit increase in the variance of the permanent component of (log) income experienced over the working life is associated with a lower probability of being in excellent (-23.9%) or very good (-13.3%) health, of being satisfied with life (-34.9%), and implies the onset of 1.1 additional mental health issues. Similar results, albeit smaller in size, were found for the transitory component of income. The implications of these results are potentially important for public policy, as well as for understanding the relationship between the labor market and population health.

The second chapter investigates how spending and the composition of spending change as a result of the onset of limitations in activities of daily living (ADL) and limitations in instrumental activities of daily living (IADL). Combining longitudinal data from the Consumption and Activities Mail Survey (CAMS) and the Health and Retirement Study (HRS), we constructed a test aimed to identify the presence of health state dependence of the marginal utility of spending in an intertemporal context. A positive health state dependence of the marginal utility of spending is when a dollar spent is more valuable when in good health. We found evidence that the marginal utility of total and non-durable spending increased with the onset of instrumental activities of daily living (IADL) limitations, hence resulting in negative state dependence. Given that insurance protects against financial hardship while in poor health, this result implies that insurance is more valuable than expected using

the standard framework. On the other hand, the marginal utility of total spending didn't change as a result of the onset of ADL limitations, suggesting the absence of state dependence as a result of such shocks. We also found evidence of some reshuffling across spending categories and wealth portfolio by reallocating housing wealth to financial wealth with the occurrence of IADL limitations. This last result suggests that homeowners use their home equity as an insurance tool.

A third chapter examines the determinants of weak demand for reverse mortgages in Canada. One of the main features that differentiate reverse mortgages from a more traditional home equity line of credit is the no-negative equity guarantee (NNEG). This feature ensures that, at the time of repaying the loan, the borrower only has to repay the minimum between the resale value of the house and the value of the loan. In this chapter, we use a pricing model to calculate mortgage insurance premiums charged to cover the losses related to the NNEG. Given the size of the loans that are granted in the Canadian market, we find that actuarially fair premiums are approximately zero, which implies that the NNEG is a missing feature in the Canadian market. We then constructed a stated-choice experiment where Canadian respondents were asked to evaluate various reverse mortgage products. By using exogenous variations of the interest rates and the size of the loans from the survey design, we used these stated-choice evaluations to compute the demand elasticity of reverse mortgages in Canada and to look at other factors that could explain low demand. Our results show that more than half of eligible Canadians do not even have basic knowledge about reverse mortgages. Also, eligible Canadians do not seem to understand how to take advantage of the NNEG. Finally, Canadian demand for reverse mortgages is inelastic, but becomes elastic with a better level of knowledge of the product. As a result, a combination of price adjustment and education on reverse mortgages could be a good way to expand the size of the Canadian market and could represent a win-win solution for both lenders and borrowers.

Keywords: Income volatility, health, well-being, Canada, consumption, life-cycle, insurance, wealth, mortgages, housing demand.

INTRODUCTION

La qualité de l'environnement dans lequel les ménages retraités évoluent est déterminée par plusieurs facteurs. Un facteur important est la quantité et la qualité des ressources disponibles pour financer la consommation une fois à la retraite. Un autre facteur important est l'état de santé dans lequel les ménages vivront tout au long de leur retraite.

Les gouvernements et les ménages ont la responsabilité partagée de prévoir des ressources suffisantes qui seront destinées à financer la consommation de ces derniers tout au long de leur retraite. Par conséquent, la majorité des ménages participent au marché du travail et épargnent une fraction de leur revenu dans le but de financer leur retraite. Durant leur vie active, la taille et la stabilité de leur revenu ont le potentiel d'affecter leur niveau de santé actuel et, du même coup, de déterminer celui qu'ils auront une fois à la retraite.

En plus d'avoir le potentiel d'entraîner des coûts financiers, un mauvais état de santé peut influencer la capacité d'exercer certaines activités et d'apprécier certains biens consommés. Puisqu'il est généralement observé que l'état de santé se détériore avec les années, celui espéré à la retraite doit être considéré pour bien évaluer quels seront les besoins de consommation une fois à cette étape. L'état de santé qu'on aura à la retraite est toutefois difficile à prévoir. Par conséquent, certaines assurances offrent une protection contre les difficultés financières en cas de mauvaise santé. Pour bien évaluer ses besoins en assurance, il est donc important de bien comprendre si un

dollar dépensé a plus ou moins de valeur lorsqu'on est en bonne santé. Le niveau de protection nécessaire sera donc influencé par la complémentarité entre la santé et l'utilité marginale de la consommation.

Une autre problématique à laquelle font face certains ménages retraités est liée à l'accessibilité des ressources qu'ils ont accumulées. Alors qu'une partie des ressources accumulées est composée d'actifs financiers liquides, une autre consiste souvent en actifs moins liquides, tels qu'une résidence principale. La résidence principale est généralement l'actif le plus important possédé par les ménages retraités. Par conséquent, certains d'entre eux pourraient souhaiter accéder à une partie de la valeur nette de celle-ci pour financer leurs dépenses courantes. Une manière de toucher la valeur de la résidence principale est de la vendre pour ensuite devenir locataire ou en acheter une moins dispendieuse. Puisque certains ménages sont réticents à quitter leur résidence pour un logement plus petit une fois à la retraite, on observe l'émergence de nouveaux produits financiers qui permettent d'obtenir une portion de la valeur de la résidence tout en y demeurant.

Dans l'objectif de contribuer à la réflexion sur ces sujets, cette thèse est composée de trois chapitres portant sur la santé, la consommation et les outils de décumulation. Un premier chapitre porte sur l'effet d'une volatilité soutenue du revenu durant la vie active sur la santé et le bien-être à un âge plus avancé. Bien qu'il y ait de plus en plus de preuves que des chocs de revenus importants, par exemple sous la forme d'une perte d'emploi, peuvent avoir un impact sur la santé et la mortalité, il existe peu d'études sur la relation potentielle entre la volatilité soutenue du revenu et la santé, indépendamment du niveau de revenu. Ce chapitre exploite de riches données d'enquête sur la santé et le bien-être de Canadiens d'un âge avancé, ainsi que leurs dossiers fiscaux, pour déterminer si une relation existe entre la santé et le bien-être

d'une part, et la volatilité du revenu propre à chaque individu de l'autre, décomposant la volatilité en composantes permanente et transitoire. En tenant compte du revenu moyen durant la vie active, nous avons constaté qu'une augmentation d'une unité de la variance de la composante permanente du revenu (log) vécu au cours de la vie professionnelle était associée à une probabilité plus faible d'être en excellente (-23,9 %) ou en très bonne (-13,3 %) santé, d'être satisfait de la vie (-34,9 %), et implique une augmentation de 1,1 problème de santé mentale supplémentaire. Nous avons trouvé des résultats semblables, quoique plus faibles, pour la composante transitoire du revenu. Ces résultats ont des implications potentiellement importantes pour les politiques publiques, ainsi que pour la compréhension de la relation entre le marché du travail et la santé de la population.

Un deuxième chapitre étudie comment les dépenses et la composition des dépenses changent en raison de l'incidence de limitations dans les activités de la vie quotidienne (AVQ). En combinant les données longitudinales du Consumption and Activities Mail Survey (CAMS) et du Health and Retirement Study (HRS), nous avons construit un test visant à identifier dans quelle mesure l'utilité marginale des dépenses dépend de la santé dans un contexte intertemporel. Une dépendance positive à l'égard de l'état de santé signifie qu'un dollar dépensé a plus de valeur lorsqu'on est en bonne santé. Nous avons constaté que l'utilité marginale des dépenses totales et non durables augmente avec l'incidence de limitations dans les activités instrumentales de la vie quotidienne (AIVQ), entraînant ainsi une dépendance négative. Étant donné que certaines assurances protègent contre les difficultés financières en cas de mauvaise santé, ce résultat implique que ces assurances ont plus de valeur que celle prévue en utilisant le cadre standard. D'un autre côté, l'utilité marginale des dépenses totales n'a pas changé en raison de l'incidence de limitations des AVQ, ce qui suggère

l'absence de dépendance à l'égard de l'état de santé à la suite de tels chocs. Suite à l'incidence de limitations AIVQ, nous avons observé un remaniement dans les catégories de dépenses et dans les catégories d'actifs, en réaffectant les actifs résidentiels vers des actifs financiers. Ce dernier résultat suggère que les propriétaires utilisent la valeur nette de leur maison comme un outil d'assurance.

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produit. Par conséquent, une combinaison d'ajustement des prix et d'éducation sur les hypothèques inversées pourrait être un bon moyen d'élargir la taille du marché canadien et pourrait représenter une solution gagnant-gagnant pour les prêteurs et les emprunteurs.

CHAPITRE I

INCOME VOLATILITY, HEALTH AND WELL-BEING

Abstract

While there is mounting evidence that large income shocks—e.g., a job loss—may impact health and mortality, little research exists on the potential relationship between sustained income volatility, keeping average lifetime income constant, and health. This chapter exploits rich survey data on the near-elderly in Canada paired with their administrative tax records to investigate whether a relationship exists between health and well-being, on the one hand, and individual specific volatility of income on the other, decomposing volatility into permanent and transitory components. Controlling for average lifetime income, we found that a one unit increase in the variance of the permanent component of (log) income experienced over the working life is associated with a lower probability of being in "excellent" (-23.9%) or "very good" (-13.3%) health, of being satisfied with life (-34.9%), and implied the onset of 1.1 additional mental health issues. Similar results, albeit smaller in size, were found for the transitory component of income. These results have potentially important implications for public policy, as well as for understanding the relationship between the labor market and population health.

Keywords: Income volatility, health, well-being, Canada.

Note: A version of this study co-authored with Amélie Adeline, Raquel Fonseca and Pierre-Carl Michaud is published in the IZA discussion papers and is available at the following address: https://www.iza.org/en/publications/dp/12823/income-volatility-health-and-well-being

1.1 Introduction

Over time and space, a strong correlation has been documented between socio-economic status (SES), in particular income, and health (Winkleby et al., 1992; Smith, 1999; Case et al., 2002; Deaton, 2008). Understanding the sources of this SES gradient in health has been at the forefront of the research agenda in health economics for the last decades. As documented by Smith (2007), the gradient expands over the working years to fade once individuals reach retirement. Hence, some of its origins may stem from experience on the labor market.

There is mounting evidence that labor market shocks, such as job loss, may impact health, sometimes later in life. In the United States, Strully (2009), Sullivan & Von Wachter (2009), Michaud et al. (2016), and Schaller & Stevens (2015) all found a negative effect of job loss on health and well-being outcomes. For example, Sullivan & Von Wachter (2009) showed that there was a 10 to 15% increase in mortality rates for displaced workers 20 years after the job displacement when compared to other workers. A link between job loss and biomarkers has been found by Michaud et al. (2016), who used the Health and Retirement Study. General well-being also appeared to suffer after events such as unemployment (Winkelmann & Winkelmann, 1998).

Yet, Smith (2007) found modest evidence that dynamics in income predict health events during the working life. While using noisy measures of income from survey data could explain this weak result, it is also possible that the impact of labor market turmoil may take time to materialize. In fact, some biological theories emphasize the potential negative health effects of the cumulative toll from stress related to shocks in various domains of life, including the labor market (Seeman et al., 1997). This cumulative toll has often been referred to as the allostatic load. Just like any

machinery, the human body experiences more rapid wear and tear when its capacity to adapt is challenged repeatedly.

The theory of allostatic load would predict that workers with higher volatility may experience more stress, and therefore carry a larger allostatic load, which could lead to adverse health effects later in life. While the theory is plausible and could explain why the gradient expands over the working years, we know of no empirical test looking for associations between volatility over workers' careers and their health at older ages.

In this paper, we investigate whether a correlation exists between the income volatility (both permanent and transitory) experienced over the working life and health and well-being after age 50. Permanent income volatility depends on factors that affect income permanently, such as a loss of transfers or an event implying a permanent work stoppage, while transitory income volatility depends on factors such as the economic cycle or a temporary drop in wages due to, for example, group or individual layoffs, or business closures. We used health and well-being information from the 2012, 2014 and 2016 waves of the Longitudinal and International Study of Adults (LISA) for respondents over the age of 50, and we estimated individual level income volatility measures by applying the methodology developed by Carroll & Samwick (1997) on Canadian administrative tax records associated with each respondent between 1982 and 2015 (34 years). We then related the two in a regression framework which controlled for various confounders and, importantly, for lifetime average income.

Our results support the view that volatility over the life cycle is associated with worse health and well-being. Controlling for the average level of income during the

working life, we found evidence that permanent and transitory income volatility are negatively associated with health and well-being. Indeed, a one unit increase in the variance of the permanent component of income experienced over the working life was associated with a decrease in the probabilities of being in "excellent" or "very good" health by 23.9% and 13.3%, respectively; a decrease in the probability of being satisfied with life by 34.9%; and implied the onset of 1.1 additional mental health issues. Moreover, a one unit increase in the variance of the transitory component of income was associated with a decrease in the probabilities of being in "excellent" or "very good" health by 5.74% and 3.20%, respectively; a decrease in the probability of being satisfied with life by 11.95%; and implied the onset of 0.42 additional mental health issues. One particular threat to our identification strategy was that health shocks during the working life caused volatility in income. In order to control for this issue, we showed that results were very similar whether or not we excluded those who may have received disability benefits during the 34 years covered by the data.

Our analysis is structured as follows. Section 1.2 details the two databases used to carry out the analysis and gives some descriptive statistics. Section 1.3 presents the method used to compute measures of volatility, as well as the econometric analysis. In section 1.4, we give an interpretation of our results. Section 1.5 concludes the chapter.

1.2 Data and Descriptive Statistics

To conduct our analysis, we used the Longitudinal and International Study of Adults (LISA), a multi-topic and unique database of microdata on health, life satisfaction, education, employment, income, and family of individuals from Canada. Since 2012,

LISA has been asking questions to a sample of households throughout Canada, these households being re-interviewed every 2 years in the panel.

We also used the retrospective component of the LISA database based on administrative data sources. Indeed, LISA is linked to the "T1 Family File" corresponding to annual tax records for census families and individuals[1] and gives access to individuals' income history, to information on whether individuals are eligible to and used different tax credits, and to their marital status, between 1982 and 2015.

1.2.1 Sample Selection

To properly identify the relationship between income volatility and health and well-being, we focused on a population of men aged 50 to 75 in 2012, 2014 and 2016, since this corresponds to a period in which health generally begins to deteriorate. We focused our analysis on individuals who were surveyed at least once in the three waves of this survey. When they had been interviewed more than once, we focused on their answers from the most recent wave.

To estimate income volatility, we focused on income history of these respondents while they were between 30 and 55 years of age between 1982 and 2015. We restricted our sample to respondents aged 30 to 55 since such an age range corresponds to a working-age period in which individuals are no longer in school and are not yet retired. We chose to work on a male population as men are less likely to voluntarily leave the labor force due, for example, to childbearing, which could also have health consequences. Since information on income history from 1982 to 2015 is available,

[1]These data give information on demographic characteristics and income, collected from income tax returns submitted to the Canada Revenue Agency (CRA).

we excluded respondents who were over 75 years old in 2012, 2014 and 2016 to ensure sufficient information concerning income history. Indeed, the older the individuals considered in the 2012–2016 sample, the less information we had to compute income variances, given that the latter were computed during the working age (from 30 to 55 years old).[2]

Table 1.1 gives details about the different sample restrictions. We ended up with a sample of 5,134 respondents over the three waves.

Table 1.1: Sample selection - LISA database

(1) Total individuals	27,712
(2) Men	13,434
(3) 50-75 years old	5,416
(4) Available information on current income in tax records	5,134

Note: Starting from the original LISA sample (1), we restricted the sample to men (2), and then selected only respondents aged between 50 and 75 (3). We also dropped respondents for whom we had missing information on their annual income between 1982 and 2015 (4).

1.2.2 Health and Well-Being Outcomes

We now define the different health and well-being variables: self-perceived health status, life satisfaction and mental health.

[2]For instance, an individual who is 86 years old in 2012 in the well-being sample was 55 years old in 1982, such that we only have a single observation to compute their income variances given the selection criteria (income variances computed during the working age). The white part of Table A.1 in the appendix section A represents the information set for respondents aged between 50 and 75 years old in 2012 (final health and well-being sample), which can be used to compute variances of income (the latter being computed during the working age).

Self-perceived health status assesses the general perceived health of an individual. Respondents were asked: "Would you say your health in general is. . . " and they had to choose between five answers: "excellent," "very good," "good," "fair" or "poor". Self-perceived health status is an important subjective predictor of an individual's health since it combines different elements that an individual knows about their own health and integrates factors which are not always considered by health professionals, such as their beliefs and attitudes towards health commodities (Benitez-Silva et al. (2004)).

We also considered an indicator on individuals' satisfaction with their life to investigate well-being. Individuals were asked to rate their feelings about life in general, from "very unsatisfied" (0) to "very satisfied" (10). We created a dummy variable equal to one when the individual rated their feeling about life from 7 to 10 or, in other words, when the individual seems satisfied with their life in general.[3]

Moreover, LISA asked individuals a set of ten questions on their feelings concerning their mental health, such as "In the last month, how often did you feel anxious" or, "In the last month, how often did you feel sad/depressed," to which individuals responded with "never," "rarely," "sometimes," "most of the time," or "all the time" (see Appendix section A.1 for further details). We created a dummy variable equal to one when individuals responded "sometimes," "most of the time" or "all the time." The categories were grouped this way in order to capture the chronicity of these mental health problems. Then, we created a variable which added up each issue reported by an individual. Thus, we considered this variable as a sum of these different problems, which ranges from 0 to 10.

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[3]Using the score without transformation results found are similar and available upon request.

Figure 1.1 presents descriptive statistics on the different outcome variables. A majority of respondents rated their self-assessed health as "good" or "very good". Over 80% of them rated their life satisfaction at a level of 7 or above, meaning that the majority of individuals seemed satisfied with their life. Finally, about 40% of individuals reported having had at least one mental health issue in the previous month.

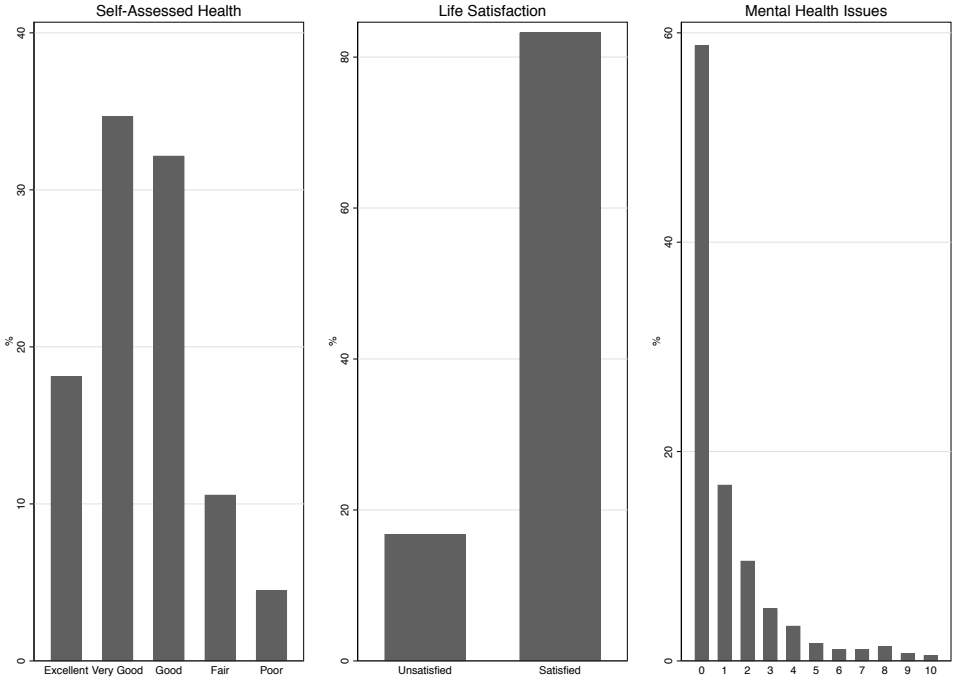
Figure 1.2 presents the distribution of specific mental health issues used to construct our mental health index. About 24% and 17% of the respondents reported feeling tired out for no good reason, and restless or unable to stand still, respectively. Close to 16% of the respondents declared feeling nervous. More than 10% reported feeling either depressed or that everything was an effort. Finally, around 5% revealed feeling desperate, worthless, so nervous that nothing could calm them down, so restless that they could not stand still, or so depressed that nothing could cheer them up.

1.2.3 Retrospective Component of LISA

To measure income volatility, we used the variance of residual income. To decompose the variance of income into permanent and transitory dimensions, we used information obtained in the retrospective component of the data from 1982 to 2015. We focused on total family income before taxes, which includes the taxfiler's income from taxable as well as nontaxable sources. Using family income instead of personal income gives more information about the financial situation of the respondents, because it allows us to account for the insurance effects between household members.[4]

[4]Using the personal income of the respondents might be misleading due to an overestimation of the variances of income whenever a respondent has an unstable income situation and lives with someone who might have a stable financial situation. On the other hand, we might underestimate the variances of income when considering an individual who has a stable income situation but lives with someone who is financially unstable. There is, however, a limit to this approach. Indeed, faced

Figure 1.1: Distribition of health and well-being outcomes



Income was then deflated using the Consumer price index with 2013 as the base year.

Some individuals reported having a very low income, which might be equal to zero sometimes. However, individuals could apply for a welfare aid program representing a few thousand dollars a year. Moreover, individuals reporting zero income may have worked abroad during that period. To address this concern, we excluded individuals who reported an income of $0. Then, for the other incomes below $11,000, we im-

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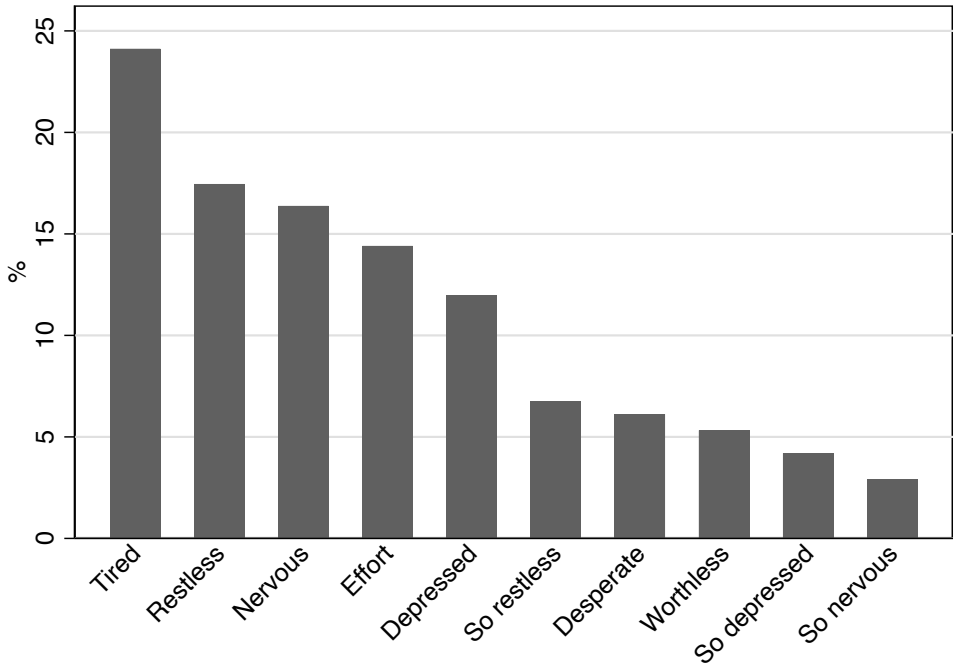
with the high income volatility of a member of a household, a spouse may have to work more to compensate for it. Our approach therefore does not capture this source of volatility, which could have an effect on the respondent's health and well-being.

Figure 1.2: Mental health issues



Note: Tired refers to "tired out for no good reason." So nervous refers to "so nervous that nothing could calm down." Restless refers to "restless or unable to stand still." So restless refers to "so restless that they could not stand still." Depressed refers to "sad/depressed." So depressed refers to "so depressed that nothing could cheer them up." Effort refers to "everything was an effort." Worthless refers to "the feeling of being good-for-nothing."

posed the latter to take this upper limit as a minimum.[5] Finally, for individuals who claimed to be retired, we excluded their income observations in the years following the year they retired.

[5]We chose this amount since it corresponds to the 2013 non-refundable tax credit, also known as the personal amount, and adjusted annually to allow for inflation.

1.2.4 Covariates

We also used a set of covariates when estimating effects of permanent and transitory income risk on health and well-being. As a result, we included categories for age and education, civil status, number of children, whether or not they were born in Canada and, in order to capture regional effects, dummies for provinces of Canada.[6]

1.3 Econometric Analysis

First, we present the methodology used to estimate the variances of the permanent and transitory components of income in order to identify the income volatility experienced by each respondent during their working life. Next, we detail the methodology used to analyze the association between income volatility on the one hand and health and well-being on the other.

1.3.1 Estimating Variances of Transitory and Permanent Shocks

The estimation of the variances of permanent and transitory shocks follows the methodology proposed by Carroll & Samwick (1997). Two steps are involved.[7] First, we are interested in residual income volatility once predictable changes in income are accounted for. Hence, the predictable growth needs to be removed from the income

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[6]Descriptive statistics on these variables are not included here, but are available upon request.

[7]Meghir & Pistaferri (2004) also used this method to investigate dynamics of the variance of income and the associated observable and unobservable heterogeneity using an ARCH process on the Panel Study of Income Dynamics. They looked at the impact of income shocks early in life on earnings determination.

process. In a second step, we computed a specific time series estimation of the variance of transitory and permanent components which come from unexpected events for each respondent.

Our approach to estimate income volatility differs from Carroll & Samwick (1997) in two ways. First, we used administrative data which comes from income tax returns in Canada, while they used U.S. survey data from the Panel Study of Income Dynamics. The advantage of administrative data is that it reduces the potential for measurement errors, which bias income volatility (Bound et al. (2001) explained that measurement errors might be prevalent in survey data). Second, our observation window and selected sample gave access to up to 26 observations per respondent, while Carroll & Samwick (1997) only used 7 observations per individual.[8]

We modeled log income, $\log y_{it}$, as the product of a predictable component, p_{it}, a permanent shock (random walk), η_{it}, and a transitory component, ϵ_{it}, which is iid with variance $\sigma^2_{i,\epsilon}$ (individual specific). We denote (log) income as:

$$\log y_{it} = p_{it} + \eta_{it} + \epsilon_{it} \tag{1.1}$$

The predictable component is given by $p_{it} = x_{it}\gamma$. We allowed for heterogeneity between respondents growth path by allowing γ to vary by province (Atlantic, Quebec, Ontario, Prairies and British Columbia) and level of education (less than high school and high school, college, university). We included in x_{it} a quadratic age and

[8]Indeed, we had access to information on respondents aged between 30 and 55 between 1982 and 2015, while Carroll & Samwick (1997) had access to data only from 1982 to 1987.

marital status (single or couple). In order to have robust results, we also controlled for health status in a robustness test since it can affect the ability to work, and thus income. To do so, we included in x_{it} a dummy if the respondent receives a tax benefit for being disabled.[9] We thus created a binary variable equal to one when an individual stated having received this help.[10] Denoting $\nu_{it} = \eta_{it} + \epsilon_{it}$, we first netted out the predictable component by estimating γ by ordinary least squares (OLS) from $\log y_{it} = x_{it}\gamma + \nu_{it}$ (for each province and education group pair). We then obtained the residuals $\hat{\nu_{it}}$ from this regression. These residuals were used in the second step.

We modeled the permanent component of income as a random walk, $\eta_{it} = \eta_{i,t-1} + \zeta_{it}$ where ζ_{it} is iid with variance $\sigma^2_{i\zeta}$. We then defined the difference in residuals between d years as:

$$r_{id} = \hat{\nu}_{it+d} - \hat{\nu}_{it} \tag{1.2}$$

$$= \eta_{it+d} + \epsilon_{it+d} - \eta_{it} - \epsilon_{it}, \tag{1.3}$$

Recursively substituting we obtained:

$$r_{id} = (\zeta_{it+1} + \zeta_{it+2} + ... + \zeta_{it+d}) + \epsilon_{it+d} - \epsilon_{it} \tag{1.4}$$

which is a function of d permanent shocks and 2 transitory shocks. The variance of

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[9] The variable is defined as follows: "A taxfiler may claim a preset disability amount if he or she was severely physically or mentally impaired in the tax year, and the impairment noticeably restricted the taxfiler's activities of daily living."

[10] Available since 1982, this disability indicator is only used in order to compute the variances of income because it allows the purging of the variances from health effects. As a result, when using these variances, we try to ensure the exogeneity of the latter in the health and well-being estimates. However, mental health factors that do not lead to benefits could have a significant influence on the variance.

equation (1.4) is given by:

$$r_{id}^2 = Var(r_{id}) = d\sigma_{i\zeta}^2 + 2\sigma_{i\epsilon}^2 \tag{1.5}$$

For each respondent, we constructed the set of all possible r_{id}^2 (for each pairwise combination of residuals), which is a function of d and the constant 2, to estimate $\sigma_{i\zeta}^2$ and $\sigma_{i\epsilon}^2$.[11] The latter are obtained by running, for each individual i, a regression of r_{id}^2 on d, and 2, a constant term for all d. We allowed for serial correlation in ϵ_{it}, in the form of a moving average of order 2 process, by exploiting only pairwise comparisons of order $d > 2$.[12]

Table 1.2 shows means across respondents of the variances of permanent and transitory components. We see that estimated variances of the permanent component of income were quite low, with an average of 0.0261, while variances of the transitory component of income were higher, with an average of 0.0994.[13]

Table 1.2: Variances of permanent and transitory components of income

	Permanent	**Transitory**
Mean	0.0261	0.0994
Standard deviation	0.0841	0.2996

[11] Indeed, equation 1.5 corresponds to d times the variance of the permanent component of income and 2 times the variance of the transitory component of income.

[12] As discussed by Carroll & Samwick (1997), studies in the literature do not find evidence of household income process with transitory component of order greater than $MA(2)$ (see MaCurdy (1982), Abowd & Card (1989) and Moffitt & Gottschalk (2011)).

[13] The fact that the average variance of the permanent component of income was smaller than the transitory one does not indicate that the former contributes less to the total variance. Given that permanent shock is a random walk, the variance of a permanent shock T periods ahead is $T\sigma_{i,\zeta}^2$.

Table 1.3 shows OLS estimates of these variances on the different covariates used in the health and well-being estimates, i.e. (i) the logarithm of the average income when individuals are between 30 and 55 years old, (ii) the birth year of individuals, (iii) their marital status between 2012 and 2016, (iv) their level of education, (v) the province in which they live, (vi) whether or not they were born in Canada, and (vii) the number of children they have. On the one hand, results suggest that variances of the permanent component of income are positively and significantly correlated with the birth year, the level of education and the number of children. On the other hand, a positive relationship is found with the province and the fact of being born in Canada for the variances of the transitory component of income. As a result, living in British Columbia relatively to the Atlantic provinces was significantly correlated with a higher variance of both permanent and transitory components of income. On the contrary, being born in Canada was negatively related to the variance of the permanent component of income. Moreover, the variance of the transitory component of income was negatively correlated to the marital status and the number of children. Finally, the average level of income was negatively related to the variances of both permanent and transitory components.

1.3.2 Estimating Impacts of Income Volatility on Health and Well-Being

We used these estimates to investigate the association of permanent and transitory income volatility occurring during the working life (from 30 to 55 years of age) on self-perceived health status, life satisfaction and mental health in older age (from 50 to 75 years of age, from 2012 to 2016). We estimated the following equation:

Table 1.3: Estimates of the variances of permanent and transitory components of income

	Income volatility	
	Permanent	**Transitory**
$\log \overline{y}_i$	-0.0045 ***	-0.0499 ***
	(0.0017)	(0.0052)
1940-1944	-0.0028	0.0042
	(0.0056)	(0.0170)
1945-1949	0.0011	0.0017
	(0.0051)	(0.0156)
1950-1954	-0.0032	0.0145
	(0.0050)	(0.0153)
1955-1959	-0.0027	0.0195
	(0.0050)	(0.0151)
1960-1964	0.0040	0.0020
	(0.0050)	(0.0153)
1965-1969	0.0114 **	-0.0248
	(0.0058)	(0.0177)
Marital status	-0.0027	-0.0212 ***
	(0.0024)	(0.0074)
High School	-0.0028	-0.0009
	(0.0024)	(0.0073)
College	-0.0021	0.0047
	(0.0028)	(0.0084)
University	0.0083 ***	0.0097
	(0.0028)	(0.0087)
Quebec	0.0031	0.0006
	(0.0024)	(0.0073)
Ontario	0.0018	0.0236 ***
	(0.0025)	(0.0076)
Prairies	0.0062 ***	0.0117
	(0.0024)	(0.0072)
British Columbia	0.0054 *	0.0284 ***
	(0.0030)	(0.0090)
Born in Canada	-0.0391 ***	0.0442 ***
	(0.0022)	(0.0067)
Number of children	0.0024 **	-0.0067 **
	(0.0010)	(0.0030)
cons	0.0710 ***	0.2607 ***
	(0.0084)	(0.0256)
N	**4,890**	**4,890**

Note: Standard errors in parentheses. ***: statistically significant at 1%; **: statistically significant at 5%; *: statistically significant at 10%.

$$h_i = \beta_0 + \beta_1 \hat{\sigma}^2_{i\zeta} + \beta_2 \hat{\sigma}^2_{i\epsilon} + \beta_3 \log \overline{y}_i + X_i \Gamma + u_i \tag{1.6}$$

where h_i corresponds to the health or well-being outcome of individual i; $\sigma^2_{i\zeta}$ corresponds to the variance of the permanent component of income; $\sigma^2_{i\epsilon}$ corresponds to the variance of the transitory component of income; $\log \overline{y}_i$ is the logarithmic transformation of average income of the household i when the individual was between 30 and 55 years old; X_i stands for control variables (socio-demographic characteristics of individual i) and u_i is an error term assumed to be normally distributed.

Concerning self-assessed health, it corresponds to a qualitative dependent variable. We observed an indicator of the category such that the observed variable was equal to 1, 2, 3, 4 or 5 for "excellent," "very good," "good," "fair" or "poor," respectively. Thus, we estimated the following equation with an ordered probit model:

$$h^*_i = \beta_0 + \beta_1 \hat{\sigma}^2_{\zeta,i} + \beta_2 \hat{\sigma}^2_{\epsilon,i} + \beta_3 \log \overline{y}_i + X_i \Gamma + u_i \tag{1.7}$$

where h^*_i is a latent variable which underlies self-reported health status.

Next, we investigated a more general definition of well-being with life satisfaction.For this outcome, we estimated equation 1.7 with a probit, where h^*_i is a latent variable which underlies life satisfaction.

Finally, the LISA database contains detailed information on mental health such that we investigated the impact of income risk on a sum of mental health issues using an OLS model.

We studied the impact of income risk on a broad range of health and well-being

outcomes to get a relatively complete picture of the relationship between income volatility during a working-age period and the health and well-being of individuals aged 50 and older. For each outcome, we ran two specifications where covariates were added one by one: **(1)** only variances of the permanent and transitory components of income; **(2)** plus logarithm of the average income between 30 and 55 years of age[14], and demographic variables (groups of age, being in a relationship, categories of education, dummies for provinces of Canada, number of children and a dummy equal to one when the individual was born in Canada)[15].

1.4 Results

1.4.1 General Results

We focused on the impact of income volatility on three outcomes: self-assessed health, life satisfaction and mental health. In Table 1.4, we reported strong associations of both transitory and permanent components of income with our outcomes. Column (1) represents the estimates without the covariates and the logarithmic transformation of the average income and covariates. Results across columns were very similar, such that we focused our analyses on the last column.

The variance of the permanent component of income had a global negative association with the different outcomes studied (see coefficients of $\hat{\sigma}^2_\zeta$ in column (2) of Table 1.4). Indeed, a one unit increase in the variance of the permanent component of income

[14]Estimates controlling for the square of the logarithm of average income were implemented as a robustness check. Results were very similar and are available upon request.

[15]The regressions do not take into account the fact that the volatility variables are generated regressors.

experienced over the working life decreased the probability of being in "excellent" or "very good" health by 23.86% and 13.31%, respectively, and decreased the probability of being satisfied with life by 34.95%. Furthermore, our estimates suggest that the variance of the permanent component of income was associated with a change of the onset of 1.1 additional mental health issues. More specifically, the variance of the permanent component of income had a negative association with "feeling so nervous that nothing could calm them down," "depressed" and "worthless" (see coefficients $\hat{\sigma}^2_\zeta$ in Table 1.5).

Moreover, the variance of the transitory component of income had a global negative association with each outcome (see the coefficients of $\hat{\sigma}^2_\epsilon$ in column (2) of Table 1.4). For all these outcomes, the associations were smaller than the associations of the variance of the permanent component of income. Indeed, a one unit increase in the variance of the transitory component of income was associated with a decrease of the probability of being in "excellent" or "very good" health of 5.74% and 3.20%, respectively, and with a decrease of the probability of being satisfied with life of 11.95%. Concerning mental health, a one unit increase in the variance of the transitory component of income was associated with an increase of 0.42 in the number of mental health issues. More specifically, we investigated this last relationship by studying the association of these variances with each mental health outcome (see Table 1.5). According to these results, the negative relationship between the mental health indicator and the variance of the transitory component of income came from the following mental health issues: "feeling nervous," "so nervous that nothing could calm them down" and "depressed". Particularly, a one unit increase in the variance of the transitory component of income was associated with an increase of around 7% in the probability of reporting being nervous or depressed. In other words, events

such as a job loss, group or individual layoffs, or business closures, have negative associations with mental health issues.

Finally, in the second column of Table 1.4, we investigated the association of the logarithmic transformation of the average income while the individuals were between 30 and 55 years old. Indeed, we focused on income volatility, such that we should also control for the average income level in order to capture the real impact of the variances of income. For each outcome, results suggested a positive association of average income with health and well-being. Indeed, looking at self-assessed health, a 1% increase of the average income during the working life was associated with an increase in the probability of reporting being in "excellent" or "very good" health of 8.17% and 4.56%, respectively. For life satisfaction, a 1% increase of the average income during the working life was associated with an increase in the probability of being satisfied with life of 8.16%. For mental health, a 1% increase of the average income during the working life was associated with a decrease of 0.51 mental health issues. Moreover, focusing on each mental health outcome (Table 1.5), we see that a 1% increase of the average income during the working life was associated with a significant decrease of the probability of the onset of each mental health issue.

Table 1.4: Effect of income volatility on health and well-being

			(1)	(2)
Self-assessed health	$\hat{\sigma}_{\zeta}^{2}$	Excellent	-0.2703***	-0.2386***
			(0.0774)	(0.0787)
		Very good	-0.1518***	-0.1331***
			(0.0435)	(0.0440)
		Good	0.1810***	0.1592***
			(0.0519)	(0.0526)
		Fair	0.1472***	0.1317***
			(0.0423)	(0.0436)
		Poor	0.0940***	0.0808***
			(0.0273)	(0.0270)
	$\hat{\sigma}_{\epsilon}^{2}$	Excellent	-0.1237**	-0.0574**
			(0.0262)	(0.0258)
		Very good	-0.0695**	-0.0320**
			(0.0148)	(0.0144)
		Good	0.0828**	0.0383**
			(0.0176)	(0.0172)
		Fair	0.0673**	0.0317**
			(0.0144)	(0.0143)
		Poor	0.0430**	0.0194**
			(0.0094)	(0.0088)
	ln(Income)	Excellent		0.0817***
				(0.0082)
		Very good		0.0456***
				(0.0047)
		Good		-0.0546***
				(0.0055)
		Fair		-0.0451***
				(0.0047)
		Poor		-0.0277***
				(0.0032)
		N	**4,890**	**4,890**
	Covariates	Demographic	No	Yes

Note: $\hat{\sigma}_{\zeta}^{2}$ refers to the variance of the permanent component of income, while $\hat{\sigma}_{\epsilon}^{2}$ refers to that of transitory component of income. Marginal effects are reported, with standard errors in parentheses. ***: statistically significant at 1%; **: statistically significant at 5%; *: statistically significant at 10%. Demographic variables are categories of age and education, marital status, number of children, being born in Canada and categories for provinces. Self-assessed health is clustered at the respondent level.

Table 1.4 (continued): Effect of income volatility on health and well-being

		(1)	(2)
Life satisfaction	$\hat{\sigma}_{\zeta}^{2}$	-0.6000***	-0.3495***
		(0.0977)	(0.1008)
	$\hat{\sigma}_{\epsilon}^{2}$	-0.2288***	-0.1195***
		(0.0326)	(0.0331)
	ln(Income)		0.0816***
			(0.0108)
	N	**4,153**	**4,153**
Number of mental health issues	$\hat{\sigma}_{\zeta}^{2}$	1.6115***	1.0985*
		(0.5715)	(0.5950)
	$\hat{\sigma}_{\epsilon}^{2}$	0.8895***	0.4213**
		(0.1936)	(0.1951)
	ln(Income)		-0.5094***
			(0.0606)
	N	**4,143**	**4,143**
Covariates	Demographic	No	Yes

Table 1.5: Effect of income volatility on mental health issues

	Tired	Nervous	So nervous	Desperate	Restless	So restless	Depressed	So depressed	Effort	Worthless
$\hat{\sigma}^{\mathbf{2}}_{\zeta}$	0.0329	0.1441	0.0829*	0.0933	0.1220	-0.0393	0.2376**	0.0489	0.1381	0.1397**
	(0.1433)	(0.1141)	(0.0459)	(0.0676)	(0.1282)	(0.0884)	(0.0944)	(0.0562)	(0.1086)	(0.0618)
$\hat{\sigma}^{\mathbf{2}}_{\epsilon}$	0.0416	0.0741**	0.0370***	0.0185	0.0509	-0.0023	0.0758**	0.0024	0.0495	0.0327
	(0.0458)	(0.0367)	(0.0143)	(0.0232)	(0.0393)	(0.0266)	(0.0309)	(0.0194)	(0.0345)	(0.0203)
ln(Income)	-0.0997***	-0.0421***	-0.0166***	-0.0470***	-0.0234*	-0.0351***	-0.0378***	-0.0238***	-0.0883***	-0.0455***
	(0.0140)	(0.0117)	(0.0051)	(0.0072)	(0.0124)	(0.0081)	(0.0100)	(0.0059)	(0.0108)	(0.0067)
N	**4,142**	**4,142**	**4,142**	**4,142**	**4,142**	**4,142**	**4,142**	**4,142**	**4,142**	**4,142**
Covariates: Demographic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: $\hat{\sigma}^2_{\zeta}$ refers to the variance of the permanent component of income, while $\hat{\sigma}^2_{\epsilon}$ refer to the one of the transitory component of income. Marginal effects are reported, with standard errors in parentheses. ***: statistically significant at 1%; **: statistically significant at 5%; *: statistically significant at 10%. Demographic variables are categories of age and education, marital status, number of children, being born in Canada and categories for provinces.

1.4.2 Robustness

We investigated the association of income volatility on health and well-being outcomes using two additional sub-samples in order to extend the validity of our results (see columns (2) and (3) of Table 1.6) .

The first robustness test performed used the variances for which we controlled for the disability benefits an individual may have received. The idea was to correct for health shocks during the working life which may cause volatility in income. In column (2) of Table 1.6, results for the variances of both permanent and transitory components of income were very similar to the baseline estimates (column (1)). For instance, a one unit increase in the variance of the permanent component of income is associated with a 23.59% decrease in the probability of reporting being in "excellent" health (compared to a 23.86% decrease in the baseline results), a 35% decrease in the probability of reporting being satisfied with life (compared to a 34.95% decrease in the baseline results), and an increase of 1.13 of the onset of mental health issues (compared to 1.1 in the baseline results, i.e., column (1)). As a result, when disability was used to compute income variances, we purged the latter from health effects and came closer to measures of the variances which were orthogonal to health shocks. Results were very similar to the baseline ones. One possibility is that volatility of income was caused by changes in household composition. The second robustness test performed considered a sample with a control over the number of different relationships that an individual had (column (3)). When the variances of the permanent and transitory components of income were estimated, even if a person reported being in a relationship for two consecutive years, this individual may have been in a relationship with different people who earned different annual

incomes. We thus controlled for the different relationships in order to capture such effects. Results for all outcomes were qualitatively similar (and even smaller in magnitude for the permanent component of income) when compared to the baseline estimates (column (1)). The variance of the permanent component of income had a negative association with probability of being in "excellent" or "very good" health, of reporting being satisfied with life, and increased the number of mental health issues. Specifically, a one unit increase in the latter was associated with a 23.19% decrease in the probability of reporting being in "excellent" health, a 34.67% decrease in the probability of reporting being satisfied with life, and an increase of the number of mental health issues by 1.07. Similarly, results for the variance of the transitory component of income were qualitatively similar to the baseline results.

Table 1.6: Robustness tests

			(1)	(2)	(3)
Self assessed health	$\hat{\sigma}^2_\zeta$	Excellent	-0.2386***	-0.2359***	-0.2319***
			(0.0787)	(0.0788)	(0.0813)
		Very good	-0.1331***	-0.1316***	-0.1287***
			(0.0440)	(0.0440)	(0.0452)
		Good	0.1592***	0.1575***	0.1581***
			(0.0526)	(0.0526)	(0.0554)
		Fair	0.1317***	0.1302***	0.1266***
			(0.0436)	(0.0436)	(0.0445)
		Poor	0.0808***	0.0799***	0.0760***
			(0.0270)	(0.0270)	(0.0270)
	$\hat{\sigma}^2_\epsilon$	Excellent	-0.0574**	-0.0584**	-0.0634**
			(0.0258)	(0.0257)	(0.0272)
		Very good	-0.0320**	-0.0326**	-0.0352**
			(0.0144)	(0.0144)	(0.0151)
		Good	0.0383**	0.0390**	0.0432**
			(0.0172)	(0.0172)	(0.0185)
		Fair	0.0317**	0.0322**	0.0346**
			(0.0143)	(0.0142)	(0.0149)
		Poor	0.0194**	0.0198**	0.0208**
			(0.0088)	(0.0088)	(0.0090)
	ln(Income)	Excellent	0.0817***	0.0817***	0.0807***
			(0.0082)	(0.0082)	(0.0086)
		Very good	0.0456***	0.0456***	0.0448***
			(0.0047)	(0.0047)	(0.0049)
		Good	-0.0546***	-0.0545***	-0.0550***
			(0.0055)	(0.0055)	(0.0059)
		Fair	-0.0451***	-0.0451***	-0.0440***
			(0.0047)	(0.0047)	(0.0049)
		Poor	-0.0277***	-0.0277***	-0.0265***
			(0.0032)	(0.0032)	(0.0032)
		N	**4,890**	**4,889**	**4,678**
Covariates		Demographic	Yes	Yes	Yes

Note: Marginal effects are reported. Standard errors in parentheses. ***: statistically significant at 1%; **: statistically significant at 5%; *: statistically significant at 10%. Demographic variables are categories of age and education, marital status, number of children, being born in Canada and categories for provinces. Self-assessed health is clustered at the respondent level. (1) corresponds to the baseline results. (2) uses the variances for which we control for the disability benefits an individual may have received. (3) considers a sample with a control over the number of different relationships that an individual had.

Table 1.6 (continued): Robustness tests

		(1)	(2)	(3)
Life satisfaction	$\hat{\sigma}^2_\zeta$	-0.3495***	-0.3500***	-0.3467***
		(0.1008)	(0.1009)	(0.1010)
	$\hat{\sigma}^2_\epsilon$	-0.1195***	-0.1223***	-0.1186***
		(0.0331)	(0.0329)	(0.0343)
	ln(Income)	0.0816***	0.0814***	0.0782***
		(0.0108)	(0.0108)	(0.0110)
	N	**4,153**	**4,153**	**3,987**
Number of mental health issues	$\hat{\sigma}^2_\zeta$	1.0985*	1.1289*	1.0676**
		(0.5950)	(0.5955)	(0.932)
	$\hat{\sigma}^2_\epsilon$	0.4213**	0.4375**	0.5731**
		(0.1951)	(0.1946)	(0.305)
	ln(Income)	-0.5094***	-0.5083***	-0.3396***
		(0.0606)	(0.0606)	(0.073)
	N	**4,143**	**4,142**	**3,979**
Covariates	Demographic	Yes	Yes	Yes

1.5 Conclusion

In this paper, we tested the hypothesis that income volatility is associated with worse health outcomes and well-being. Using the Longitudinal and International Study of

Adults (LISA) and its associated retrospective component for administrative data that follows Canadians, we investigated whether a relationship exists between health and well-being, on the one hand, and individual-specific volatility of income on the other, decomposing volatility into permanent and transitory components.

Our results suggest that permanent and transitory income volatility are associated with a deterioration of health and well-being, which is consistent with the theory of allostatic load (Seeman et al. (1997)). A one unit increase in the variance of the permanent component of income experienced over the working life is associated with a decrease in the probability of being in "excellent" or "very good" health of 23.86% and 13.31%, respectively, a decrease in the probability of being satisfied with life of 34.95%, and is associated with the onset of 1.1 additional mental health issues. Moreover, a one unit increase in the variance of the transitory component of income is associated with a decrease of the probability of being in "excellent" and "very good" health of 5.74% and 3.20%, respectively, a decrease in the probability of being satisfied with life of 11.95%, and an increase of 0.42 in the number of mental health issues. These results were robust to the inclusion of controls for disability during the working life, an attempt to account for reverse causality. They also held if we controlled for the composition of the household. In other words, this association was not due to changes in household composition over the life cycle.

Establishing causality between income volatility and health outcomes is a difficult endeavor. Despite our best efforts to control for other lifetime factors, including disability, it is possible that causality runs the other way: individuals who are more fragile in terms of both physical and mental health sustain more income shocks. Our results are, however, consistent with a mounting body of work which shows that labor market shocks have a causal impact on health outcomes (Strully (2009); Sullivan

& Von Wachter (2009); Michaud et al. (2016); Schaller & Stevens (2015)). Finally, understanding this potential relationship has important implications for social policy. For example, if causal, this relationship would imply that social insurance improves health at older ages. Furthermore, it emphasizes that health policy may target both lower income individuals and individuals who have significant variation in their incomes.

CHAPITRE II

CONSUMPTION AND HEALTH IN OLD AGE

Abstract

We investigate how spending and the composition of spending change as a result of the onset of limitations in activities of daily living (ADL) and limitations in instrumental activities of daily living (IADL). Combining longitudinal data from the Consumption and Activities Mail Survey (CAMS) and the Health and Retirement Study (HRS), we constructed a test aimed at identifying the presence of health state dependence of the marginal utility of spending in an intertemporal context. A positive health state dependence of the marginal utility of spending is when a dollar spent is more valuable when in good health. We find evidence that the marginal utility of total and nondurable spending increase with the onset of IADL limitations, hence resulting in negative state dependence. Given that insurance protects against financial hardship when in poor health, this result implies that insurance is more valuable than expected using the standard framework. On the other hand, the marginal utility of total spending doesn't change as a result of the onset of ADL limitations, suggesting the absence of state dependence as a result of such shocks. We also find evidence of some reshuffling across spending categories and wealth portfolios by reallocating housing wealth to financial wealth with the onset of IADL limitations. This last result suggests that homeowners use their home equity as an insurance tool.

Keywords: Consumption, health, life cycle, insurance, wealth.

Note: This study is co-authored with Michael Hurd, Pierre-Carl Michaud and Susann Rohwedder.

2.1 Introduction

A long-standing question in the study of consumption and the demand for insurance is whether consumption is less valuable when a person's health is poor than when it is good. Given that insurance protects against financial hardship when in poor health, evidence of a lower marginal utility of consumption in that state would imply that insurance is less valuable than expected using the standard framework. This would help explain several puzzles, such as the low take-up of long-term care insurance (Brown & Finkelstein, 2011). It would also help explain why consumption declines with age, with implications for the estimation of preferences and for retirement preparation, as households who expect their health to decline faster would not need to save as much for retirement (Skinner, 2007; Hurd & Rohwedder, 2011).

The first studies that looked at this question aimed to estimate measures of compensating variation for varying health risk (e.g., job injury) using hypothetical survey questions. Conclusions from studies assessing the state dependence of utility using this method are mixed. Evans & Viscusi (1991) found no difference, while Sloan et al. (1998) and Viscusi & Evans (1990) found positive state dependence (marginal utility is larger in good health). Although this method had the advantage of directly eliciting the type of trade-offs informative to answer the question, the risks involved were narrowly defined (multiple sclerosis or exposure to chemicals) and the questions were hypothetical, raising questions about external validity and generalizability.

Other studies directly estimated the state dependence of the marginal utility of consumption on health using structural life cycle models on panel data containing information on wealth (savings). An early example is Lillard & Weiss (1997), who found negative state dependence (marginal utility is larger in poor health) using data

from the *Retirement History Survey*. DeNardi et al. (2010) also found negative state dependence using data from AHEAD cohorts in the *Health and Retirement Study* although not statistically significant. Scholz & Seshadri (2010) found positive state dependence when modeling both health and consumption as joint choices. Scholz & Seshadri (2016) found a positive state-dependence effect using spending data from the *Consumption and Activities Mailout Survey* and using self-reported health from the *Health and Retirement Study*. Not surprisingly, results from structural models hinged on the specification of preferences and, perhaps more importantly, on how health impacts budget constraints, since wealth data is used to estimate preferences. Furthermore, the health measure is often self-reported health, which may encompass many dimensions of health. An important question is to assess whether the dependence may differ across health dimensions. In particular, measures of limitations with activities of daily living are important as benefits from long-term care insurance may be conditioned on such measures of health (for example in Canada). An alternative is to look at subjective well-being. Finkelstein et al. (2013) used life satisfaction data to directly infer how the slope of the utility function depends on health. Their results support positive state dependence. Since the authors did not observe consumption, they investigated instead how life satisfaction was related to measures of permanent income.

As argued by Finkelstein et al. (2009), a promising avenue is to use spending trajectories in panels and investigate how these trajectories vary across individuals with different health statuses. In this chapter, we use panel data on detailed spending of *Health and Retirement Study* (HRS) respondents collected as part of the *Consumption and Activities Mailout Survey* (CAMS) covering a period of 16 years (9 waves). The use of detailed information on the composition of expenditures distinguishes our

paper from others who have studied the issue. Because spending data is collected in the off years of the survey, we also have access to the wealth of information contained in the Health and Retirement Study regarding changes in health as well as in other characteristics. We used limitations in activities of daily living (bathing, eating, dressing, walking across a room and getting out of bed) and instrumental activities of daily living (using the phone, taking medication and handling money) as measures of health. Activities of daily living (ADL) represent activities that people do in the morning to prepare themselves to start the day, while instrumental activities of daily living (IADL) represent activities that people do once the day has started. The ability to do IADLs is not fundamental to functioning but helps to be self-sufficient. The availability of subjective expectations on survival, bequests and nursing home entry allows us to investigate mechanisms behind the change in spending following changes in health.

Controlling for the change in the subjective probability of survival associated with the health shocks, our results suggest that the increase in total and nondurable spending following the onset of IADL limitations is related to an increase in the marginal utility of total spending, hence resulting in negative state dependence. However, the absence of variation in total spending following the onset of ADL limitations suggests the absence of a state dependence related to this dimension of health. Moreover, we found a reshuffling in the spending shares assigned to transportation, donations and gifts, and health spending following the onset of IADL limitations. Although there was no significant evidence of a drawdown in total net wealth, IADL limitations led to a reshuffling in the wealth portfolio by reallocating housing wealth in financial wealth. This last result suggests that homeowners use their home equity as an insurance tool.

The chapter is structured as follows. In section 2.2, we show how theory leads to predictions on how changes in health are related to changes in spending. In section 2.3, we provide a description of the data and a definition of variables. Section 2.4 proposes an empirical strategy in order to formally test for state dependence of utility. Finally, section 2.5 presents results while section 2.6 concludes.

2.2 Theoretical Framework

We consider a simple life cycle problem of allocating consumption across the life cycle with uncertainty in health and mortality. Consumption can be allocated among J consumption items which include health spending. We denote the consumption vector at age t as $\mathbf{c_t} = (c_{1,t}, ..., c_{J,t})$. The utility from consumption is:

$$u(\mathbf{c_t}, h_t) = \sum_{j=1}^{J} \delta_j(h_t) \frac{c_{jt}^{1-\sigma_j}}{1-\sigma_j}, \tag{2.1}$$

with $\sigma_j > 0$ and where h_t represents health measured from bad to good. The function $u()$ allows the marginal utility of each spending item to be different as a function of health. We say that a good is a complement to health if $\frac{\partial^2 u(\mathbf{c_t}, h_t)}{\partial c_{jt} \partial h_t} > 0$, and a substitute if $\frac{\partial^2 u(\mathbf{c_t}, h_t)}{\partial c_{jt} \partial h_t} < 0$. It follows that the complementarity between health and consumption of a good will depend on the value of $\frac{\partial \delta_j(h_t)}{\partial h_t}$. Given a total spending budget m_t[1] and using within period preferences, the intraperiod allocation problem is simply to allocate m_t between each consumption item by solving :

[1]We assumed prices were constant over time and therefore we did not distinguish between consumption and expenditures in what follows.

$$\max_{\{c_{j,t}\}_{j=1}^{J}} \sum_{j=1}^{J} \delta_j(h_t) \frac{c_{jt}^{1-\sigma_j}}{1-\sigma_j} \tag{2.2}$$

under intraperiod budget constraints:

$$\sum_j c_{j,t} = m_t. \tag{2.3}$$

The solution is such that :

$$\frac{\partial u(\mathbf{c_t}, h_t)}{\partial c_{j,t}} = \frac{\partial u(\mathbf{c_t}, h_t)}{\partial c_{k,t}}, \quad \forall j, k \tag{2.4}$$

and the budget constraint holds. From our explicit formulation, we have:

$$\begin{aligned} \delta_j(h_t) c_{jt}^{-\sigma_j} &= \delta_k(h_t) c_{kt}^{-\sigma_k}, \quad \forall j, k \\ \Rightarrow c_{kt} &= c_{jt}^{\frac{\sigma_j}{\sigma_k}} \left(\frac{\delta_k(h_t)}{\delta_j(h_t)} \right)^{\frac{1}{\sigma_k}}, \quad \forall j, k. \end{aligned} \tag{2.5}$$

Substituting in the intratemporal budget constraint, we have:

$$m_t = c_{jt}^{\frac{\sigma_j}{\sigma_1}} \left(\frac{\delta_1(h_t)}{\delta_j(h_t)}\right)^{\frac{1}{\sigma_1}} + ... + c_{jt}^{\frac{\sigma_j}{\sigma_J}} \left(\frac{\delta_J(h_t)}{\delta_j(h_t)}\right)^{\frac{1}{\sigma_J}}, \quad \forall j$$

$$\Rightarrow m_t = \sum_{k=1}^{J} c_{jt}^{\frac{\sigma_j}{\sigma_k}} \left(\frac{\delta_k(h_t)}{\delta_j(h_t)}\right)^{\frac{1}{\sigma_k}}, \quad \forall j \tag{2.6}$$

The solution to this problem then yields a conditional optimal allocation for each consumption item as a function of total budget and health $c^*_{j,t}(m_t, h_t)$ that satisfies equation (2.6). When $\sigma_j \neq \sigma_k$, the Engel curves are nonlinear, so the share of m_t allocated to the consumption of item j, that we express as $\alpha_j(m_t, h_t)$, is a function of the total budget as well as of the health status. When $\sigma_j = \sigma_k = \sigma, \forall j, k$, the Engel curves are linear, so the share $\alpha_j(h_t) = \frac{\delta_j(h_t)^{\frac{1}{\sigma}}}{\sum_{k=1}^{J} \delta_k(h_t)^{\frac{1}{\sigma}}}$ of m_t allocated to the consumption of item j is a function of h_t and is independent of m_t.

Replacing the solution for each consumption item $c^*_{j,t}(m_t, h_t)$ as a function of total spending into the utility function, we obtain the indirect utility function $v(m_t, h_t)$. As an example, we can take the special case where $\sigma_j = \sigma_k = \sigma, \forall j, k$ and $c^*_{j,t}(m_t, h_t) = m_t \frac{\delta_j(h_t)^{\frac{1}{\sigma}}}{\sum_{k=1}^{J} \delta_k(h_t)^{\frac{1}{\sigma}}}$. By substituting this solution in the indirect utility function, we get:

$$v(m_t, h_t) = \sum_{j=1}^{J} \delta_j(h_t) \frac{\left(m_t \frac{\delta_j(h_t)^{\frac{1}{\sigma}}}{\sum_{k=1}^{J} \delta_k(h_t)^{\frac{1}{\sigma}}}\right)^{1-\sigma}}{1-\sigma}$$

$$\Rightarrow v(m_t, h_t) = \frac{m_t^{1-\sigma}}{1-\sigma} \frac{1}{\left[\sum_{k=1}^{J} \delta_k(h_t)^{\frac{1}{\sigma}}\right]^{1-\sigma}} \sum_{j=1}^{J} \delta_j(h_t)^{\frac{1-\sigma}{\sigma}+1}$$

$$\Rightarrow v(m_t, h_t) = \frac{m_t^{1-\sigma}}{1-\sigma} \frac{1}{\left[\sum_{k=1}^{J} \delta_k(h_t)^{\frac{1}{\sigma}}\right]^{1-\sigma}} \sum_{j=1}^{J} \delta_j(h_t)^{\frac{1}{\sigma}}.$$

Knowing that $\sum_{j=1}^{J} \delta_j(h_t) = \sum_{k=1}^{J} \delta_k(h_t)$, we then have:

$$\Rightarrow v(m_t, h_t) = \frac{m_t^{1-\sigma}}{1-\sigma} \left[\sum_{k=1}^{J} \delta_k(h_t)^{\frac{1}{\sigma}}\right]^{\sigma}$$

$$\Rightarrow v(m_t, h_t) = \delta(h_t) \frac{m_t^{1-\sigma}}{1-\sigma}, \tag{2.7}$$

where $\delta(h_t) = \left[\sum_{k=1}^{J} \delta_k(h_t)^{\frac{1}{\sigma}}\right]^{\sigma}$. We then see that this solution corresponds to the formulation of the utility of consumption used by DeNardi et al. (2010).

The choice of m_t is governed by the intertemporal allocation problem. We say that total spending is a complement to health if $\frac{\partial^2 v(m_t,h_t)}{\partial m_t \partial h_t} > 0$, and a substitute if $\frac{\partial^2 v(m_t,h_t)}{\partial m_t \partial h_t} < 0$. The dynamic budget constraint is given by:

$$w_{t+1} = R(w_t + y_t - m_t) \tag{2.8}$$

where w_t denotes wealth, y_t income, R the gross return and $m_t = \sum_j c_{j,t}$ total expenditures. The agent has a discount factor β. He faces risk in terms of health (and mortality). Let $p_m(h_t, t)$ be the probability of dying next year and $p_h(h_{t+1}|h_t, t)$ the probability of health status in the year $t+1$ as a function of current health h_t. We assume that there is no bequest motive, a hypothesis that we will validate empirically in a subsequent section. Hence, the intertemporal choice of m_t is given by:

$$V(w_t, h_t) = \max_{m_t} v(m_t, h_t) + \beta(1 - p_m(h_t, t)) \sum_h V(w_{t+1}, h_{t+1} = h) p_h(h_{t+1} = h|h_t, t), \tag{2.9}$$

subject to the law of motion for wealth $w_{t+1} = R(w_t + y_t - m_t)$. If the borrowing constraint is not binding, the solution for the path of m is governed by the Euler equation:

$$v'(m_t, h_t) = R\beta(1 - p_m(h_t, t)) \sum_h v'(m_{t+1}, h_{t+1} = h) p_h(h_{t+1} = h|h_t, t) \tag{2.10}$$

and the lifetime budget constraint. Upon finding a solution for $m_t^*(w_t, h_t)$, we can obtain a solution for each spending item by solving:

$$\frac{\partial v(m_t^*(w_t,h_t),h_t)}{\partial c_{j,t}} = \frac{\partial v(m_t^*(w_t,h_t),h_t)}{\partial c_{k,t}}, \quad \forall j,k \tag{2.11}$$

under intratemporal budget constraints $\sum_j c_{j,t} = m_t^*(w_t,h_t)$. This solution leads us to a set of optimal consumption items $\mathbf{c_t^*} = \{c_j^*(w_t,h_t)\}_{j=1}^J$.

To analyze how health changes affect the marginal utility of consumption items, it is useful to express the solution of this intraperiod problem as $\alpha_j(h_t, m_t^*(w_t,h_t)) = \frac{c_j^*(w_t,h_t)}{m_t^*(w_t,h_t)}$. Hence, the solution can be decomposed in two terms:

$$c_j^*(w_t,h_t) = \alpha_j(h_t, m_t^*(w_t,h_t)) m_t^*(w_t,h_t). \tag{2.12}$$

A change in health can have three different effects on consumption items. Taking the total derivative with respect to h, we get:

$$\frac{\partial c_j^*(w_t,h_t)}{\partial h_t} = \left(\frac{\partial \alpha_j(h_t,m_t^*)}{\partial h_t} + \frac{\partial \alpha_j(h_t,m_t^*)}{\partial m_t} \frac{\partial m_t^*}{\partial h_t} \right) m_t^* + \alpha_j(h_t,m_t^*) \frac{\partial m_t^*(w_t,h_t)}{\partial h_t} \tag{2.13}$$

The first term is the pure *state-dependence effect* on the marginal utility of spending in category j. Other things held constant, it captures the nature of the relationship between the marginal utility of each consumption item and health. For example, consumption of some goods may be less pleasurable when in worse health, while it may be more necessary to consume other goods when in poor health. The second is an *income effect* on the composition of spending: the induced effect of a change in

total spending on within period allocation. For example, if the shock shortens the life horizon and therefore current consumption rises, spending on goods which are more elastic to income will increase relative to other goods. If Engel curves are linear (shares are constant with income or total spending), this term vanishes. Finally, the last term is the *life-cycle effect* on total spending which affects spending of category j even if shares do not vary with h_t. As shown above, this effect is both related to the change in the probability of dying and to the change in marginal utility of total expenditures.

The formulation above makes it clear that aggregate spending may fall or increase with a change in health. It can also remain roughly constant despite considerable complementarity or substitutability within particular consumption items. Importantly, unconditional changes in aggregate spending as a function of health do not isolate state dependence unless one can control for the income and life-cycle effects.

2.3 Data

2.3.1 Sample Selection

Our primary data source is the *Consumption and Activities Mailout Study* (CAMS) which is an off-wave component of the *Health and Retirement Study* (HRS). Starting in 2001, a sub-sample of the 2,000 HRS core respondents takes part in a paper survey aimed at measuring spending at the household level. Details on the design of the survey can be found in Hurd et al. (2014). Of the original 5,000 questionnaires sent in 2001, 77% were completed. Respondents were then followed over time for up to 9 waves. Additional sub-samples were included in 2005 and 2011 to take the Early Baby Boomer and the new Mid Baby Boomer cohorts into account, which were

recruited for the HRS the year before. In this paper, we used waves 2 (2003) to 9 (2017) of the survey. We dropped the 2001 wave because of differences in spending categories. We used the survey weights provided with CAMS. Measures of health and other variables needed for the analysis were obtained by merging information from the adjacent waves of the HRS.

We focused on single respondents, using marital status at the time of CAMS interviews. Decision-making at the household level involves several complexities which make it more difficult to isolate the effect of health on the marginal utility of consumption (e.g., risk sharing, bargaining). Furthermore, most of the literature focusing on consumption and saving of older individuals focuses on singles. For the most part, these are widows and widowers. We also restricted the age range from 65 to 95 years old. Prior to age 65, more respondents were working. Furthermore, the eligibility age for universal health insurance coverage is 65 (Medicare), which reduces heterogeneity in medical expenditure risk exposure. We focused on respondents aged less than 95 for sample size considerations and because a large fraction of respondents above this age resided in nursing homes and were likely to have limited control over their spending. We also dropped respondents between the ages of 65 and 95 who were in nursing homes, as the reliability of their expenditure data was limited due to the fact that nursing homes provide services which have considerable consumption value but are not recorded in CAMS. We also dropped observations with zero total expenditures or too many missing spending categories (we kept those with more than 20 out of 32 categories). Finally, using information on time use, we dropped respondents who reported having worked at least one hour. In Table 2.1, we provide details on the consequences of these various sample restrictions. The final sample includes 6,926 observations from approximately 850 respondents per wave.

Table 2.1: Sample selection from CAMS and HRS

	Observations
CAMS wave 2	3004
CAMS wave 3	3598
CAMS wave 4	3446
CAMS wave 5	3301
CAMS wave 6	4094
CAMS wave 7	3799
CAMS wave 8	3454
CAMS wave 9	3241
CAMS total	**27937**
Age: 65-94	**17495**
Single	**10702**
Not in nursing home	**8450**
Nondurable spending > 0	**8435**
Doesn't work	**6926**
Final sample:	
Wave 2	862
Wave 3	1023
Wave 4	885
Wave 5	825
Wave 6	853
Wave 7	865
Wave 8	819
Wave 9	794
Total	**6926**

Note: Sample selection from CAMS and HRS: Starting from the original CAMS sample, we restricted to age 65–95 and selected only single respondents. We also dropped those in nursing homes, those with zero expenditures and those who worked.

2.3.2 Definition of Spending Variables

The CAMS questionnaire covers 32 spending items. In what follows, we focus on total and nondurable spending. Total spending is composed of durable (refrigerator, washer, dishwasher, television and computer) and nondurable spending. Out of those nondurable spending items, we constructed 9 categories: housing, transportation, utilities, donations (and gifts), food (both at home and eating out), leisure, household supplies, clothing and health (insurance, drugs, services and supplies). The mapping for each wave of original spending categories to the ones used here is presented in Table B.1 in the appendix.

For missing items, imputations were used. Hurd & Rohwedder (2006) reported no statistically significant pattern of missing responses across socio-economic groups. Over 54% of respondents had complete records over the 32 items, another 26% only had one or two items missing. Overall, 90% had more than 26 items with nonmissing records. The highest category with missing information was rent, but core interview responses from HRS allowed to determine that most were homeowners. Overall, mean imputations were used for remaining observations. Respondents were allowed to report several nondurable items on a weekly, monthly and annual basis. All responses were transformed into an annual measure covering the last 12 months. To account for changes in price levels, we used the general consumer price index to transform all monetary amounts in 2017 dollars. Given the relatively short time span, we did not adjust for changes in relative prices across consumption items.

Table 2.2 reports the distribution of spending across different items. On average households in our sample spend $27,809 on nondurables in a year. Housing, food and health and the three largest items, household spending close to $6,765 per year on

housing, on average, $4,556 on food and $4,141 on health. Transportation, utilities and donations (and gifts) are the next highest spending categories. Not surprisingly, the distribution of most spending items is skewed, with medians generally lower than means.

Table 2.2: Nondurable spending categories

Variables	obs	% share	mean	p10	p25	p50	p75	p90
Housing	6857	24.3%	6764	1089	2489	4609	8262	13188
Transport	6857	10.3%	2728	0	762	2133	3607	6037
Utilities	6857	15.7%	3640	888	2065	3323	4642	6168
Gifts	6857	6.9%	2443	0	100	708	2259	5595
Food	6857	17.7%	4555	931	2005	3495	5814	8864
Leisure	6857	3.4%	1119	0	0	315	1247	2936
HH supplies and services	6857	4.5%	1249	79	252	627	1438	2777
Clothing	6857	2.1%	559	0	71	274	653	1262
Health	6857	15.2%	4141	466	1351	3040	5292	8428
Nondurable	6857	100.0%	27808	10672	15523	23327	33684	48334

Note: This table reports statistics on nondurable spending categories over the previous 12 months. *p10* and *p90* refer to the 10th and the 90th percentile, respectively. Weighted using CAMS weights.

2.3.3 Health Measures

Measures of health were obtained from HRS core interviews. As opposed to health conditions such as cancer, which if treated does not reflect physical and cognitive incapacity, we created proxies of health states by constructing measures of disability using limitations on activities of daily living (ADL; bathing, eating, dressing, walking across a room and getting out of bed) and instrumental activities of daily living (IADL; using the phone, taking medication and handling money). ADLs represent activities that people do in the morning to prepare themselves to start the day, while

IADLs represent activities that people do once the day has started. The ability to do IADLs is not fundamental to functioning but helps to be self-sufficient. ADL and IADL limitations are most likely to impact the enjoyment of consumption. Table 2.3 presents the joint probabilities of having ADL and IADL limitations. In 73% of the observations in our sample, respondents do not have any of these limitations. It is also most common to have only one of these kinds of limitations, ADL limitations being the most frequent.

Table 2.3: ADL & IADL joint probabilities

		IADL			
		0	1	2	3+
ADL	0	0.7336	0.0351	0.0040	0.0017
	1	0.0956	0.0111	0.0036	0.0019
	2	0.0402	0.0089	0.0026	0.0022
	3+	0.0312	0.0150	0.0071	0.0061

Note: This table reports the joint distribution of limitations in activities of daily living and instrumental activities of daily living. N = 6,926. Weighted using CAMS weights. ADL refers to limitations in activities of daily living (bathing, eating, dressing, walking across a room and getting out of bed). IADL refers to limitations in instrumental activities of daily living (using a telephone, taking medication and handling money).

2.3.4 Net Wealth

The HRS also has extensive information on each respondent's balance sheet. We constructed a measure of household net wealth from the core interview prior the CAMS interview. This measure accounted for all sources of assets minus debt. Assets were composed of checking accounts, certificates of deposit, stocks, bonds, housing

(primary and other real estate), transportation, and individual retirement accounts (IRAs), while debts were composed of mortgages (primary and other), home loans and other debts (credit cards, etc.). Net household wealth was the difference between assets and debt. We focused on the main categories composing net wealth: financial wealth, housing wealth, transportation wealth and real estate. Descriptive statistics of these categories can be seen in Table 2.4.

Table 2.4: Net wealth categories

Variables	obs	% share	mean	p10	p25	p50	p75	p90
Net financial	6926	34.2%	119637	-500	50	10000	84700	302000
Net housing	6926	38.0%	100512	0	0	55000	150000	250000
Transport	6926	9.3%	7206	0	0	3000	10000	20000
Real estate	6926	2.5%	22831	0	0	0	0	0
Net wealth	6926	100.0%	312850.9	20	16000	111000	346550	764700

This table reports statistics on the distribution of each wealth category as well as totals. Net financial refers to the net financial wealth, net housing refers to the net housing wealth and transport refers to transportation wealth. *p10* and *p90* refers to the 10th and the 90th percentile, respectively. Weighted using CAMS weights.

On average, households in our sample had $312,850 in net wealth. Financial and housing wealth were the two largest sources of wealth, with $119,637 of financial wealth on average and $100,512 of housing wealth. Transportation assets and real estate followed with an average of $7,206 and $22,831, respectively. Not surprisingly, the distribution of wealth categories was skewed with medians generally lower than means.

2.3.5 Other Variables

For our subsequent analysis, we constructed additional variables. In our model, health status is a determinant of mortality risk. As shown by the Euler equation (2.10), mortality risk is a key element determining the consumption path. Indeed, Hurd (1989) and Salm (2010a) found that consumption choices were sensible to change in mortality risk. So, this change in probability could affect the path of spending change by increasing the future expected spending. Changes in health could also affect the probability of needing services like nursing home in the subsequent years and affect the expectation of leaving a bequest.

To understand the mechanisms explaining the spending path, we used variables measuring these different types of expectations. First, the HRS core asked respondents about their probability of living another 10 years. Second, the HRS core contained several questions on intentions of leaving a bequest. We used the probability that the respondent would leave an inheritance of more than $10,000. Finally, we used a question from the core interview where they asked respondents about their chances of entering a nursing home in the next 5 years. Descriptive statistics on these expectations by age group are provided in Table 2.5.

We also constructed a measure of household net income from the core interview preceding the CAMS interview (as the reference period coincides with CAMS). This measure accounted for all the sources of income of the household.

Table 2.5: Expectations

Age	Bequest $> 10k$	Nursing home < 5 years	Survive 10 years
65-69	57.12	11.64	47.61
70-74	57.94	13.86	51.52
75-79	61.40	16.21	44.79
80-84	61.95	21.58	36.18
85-89	62.36	24.18	30.13
90-94	58.82	25.23	25.70
Total	**59.78**	**17.63**	**42.88**

Note: This table presents the average probability for different kinds of expectations by 5-year age groups. *Bequest* $> 10k$ refers to the subjective probability of leaving a bequest over \$10,000. *Nursing home* < 5 yrs refers to the subjective probability of entering a nursing home in the next 5 years. *Survive 10 yrs* refers to the subjective probability of living another 10 years. Weighted using CAMS weights.

2.3.6 Timing

In order to merge CAMS information with HRS survey waves, we needed to overcome one important difficulty. CAMS surveys are done in the survey year between two HRS survey years and measure consumption on an annual basis. On the other hand, health is measured contemporaneously in HRS interviews. In particular, while we used answers to questions about ADL limitations, if an HRS respondent answered not having limitations in one wave and having some in the next one, we do not know whether or not the respondent had limitations at the time of the CAMS interview. We tried a number of ad hoc rules to assign health status to CAMS interviews, such as assigning to the closest interview. However, the match is far from perfect and results are very sensitive to the exact matching procedure. Instead, we constructed

a sample for which the baseline CAMS measurement of spending is surrounded by HRS waves in which the respondent did not report limitations. We then used the occurrence of limitations after these two waves and the subsequent measurement of spending in CAMS for inference. Hence, we constructed change in total spending as:

$$\Delta log(m_{i,t}) = log(m_{i,t}) - log(m_{i,t-4}) \tag{2.14}$$

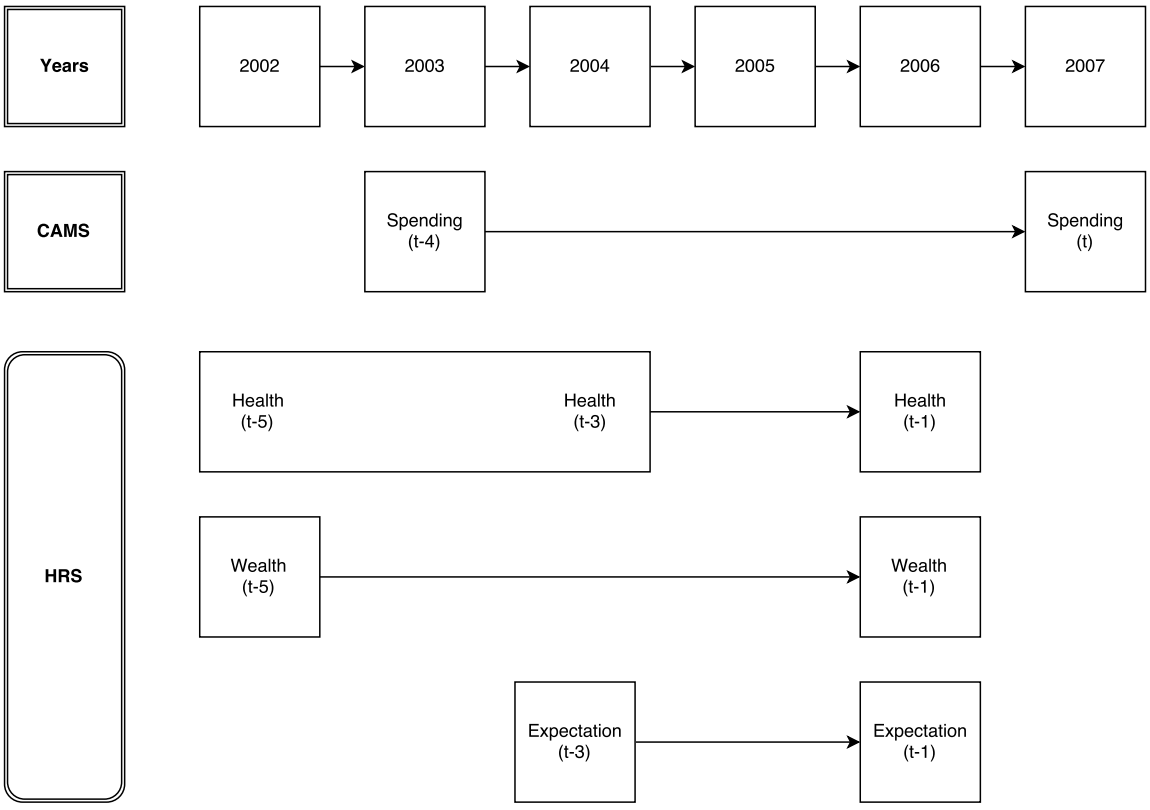
and two binary variables indicating if there was an increase in the number of ADL and IADL limitations conditional to having had no limitations the previous 2 waves:

$$\Delta h_{i,t-1} = I(h_{i,t-1} > h_{i,t-k}, h_{i,t-k} = 0), \tag{2.15}$$

with $h_{i,t} \in \{ADL_{i,t}, IADL_{i,t}\}$ and $k \in \{3, 5\}$. Fixing the health baseline to zero limitations allowed us to capture a cleaner effect of the onset of a limitation on spending. We give a schematic representation of the sample design in Figure 2.1.

Take the CAMS interview in 2007, which we refer to as period t. We know that the HRS report of health in the 2006 interview is prior to the measurement of consumption. The *treatment* is given by the onset of limitations in year 2006. In order to obtain an uncontaminated measure of baseline spending, we look at the sample of respondents who reported no limitations in the 2004 and 2002 interviews. In the case of that sample, we have baseline spending measured in the 2003 CAMS interview. Since we did not use the first wave of CAMS and our data runs until 2017, we

Figure 2.1: HRS and CAMS Timing



Note: We present an example of health change, wealth change and spending change timing between HRS and CAMS data for the 2002 to 2007 waves.

have potential differences in spending (2007-2003, 2009-2005, 2011-2007, 2013-2009, 2015-2011 and 2017-2013).

We also computed variables on change in total wealth. Since we are interested in the wealth endowment of individuals prior to spending measurements, we computed wealth changes between $t-5$ and $t-1$:

$$\Delta w_{i,t} = w_{i,t-1} - w_{i,t-5}. \tag{2.16}$$

We finally computed variables on change in expectations. Since the expectations and health measures both come from the HRS core and that measured the expectations at the moment of the interview, we computed expectations change between $t-1$ and $t-3$:

$$\Delta p_{i,t} = p_{i,t-1} - p_{i,t-3} \tag{2.17}$$

where $p_{i,t} \in \{Survival_t, NursingHome_t, Bequest_t\}$. We then had the change in expectations that could be related with the onset of our two types of limitations.

2.4 Empirical Strategy

This section presents empirical strategy in order to formally test for state dependence of utility. For this purpose, we present different econometric specifications to estimate

the effect of the onset of ADL and IADL limitations on different outcomes.

To account for factors which may explain spending changes with changes in health leading to worse health, we considered a median regression specification on aggregates, where the outcome quantities are defined as the differences between log of spending, $\Delta log(m_{i,t}) = log(m_{i,j,t}) - log(m_{i,j,t-4})$:

$$\Delta log(m_{i,t}) = x_i\beta + \gamma_A ADL_{i,t-1} + \gamma_I IADL_{i,t-1} + \Delta\tilde{p}_{i,t-1}^{survival} + \lambda_t.$$

We used the same strategy for the log change of net wealth. x_i is a vector of demographic variables controlling for age, gender, race and ethnicity. x_i also controls for baseline socio-economic status (SES) using log of income, log of net wealth and education level at $t-5$. To capture a state dependence effect, we also controlled for the life cycle effect coming from the change in survival using $\Delta\tilde{p}_{i,t-1}^{survival} = p_{i,t-1}^{survival} - p_{i,t-5}^{survival}$, which is the change in the probability of surviving another 10 years between the health measurements. We accounted for the panel nature of the data by using standard errors which accounted for clustering at the respondent level.

Next, we used a tobit with random effects on change in expectation of leaving a bequest and of entering a nursing home, and on subjective survival probability. The reason we use a tobit is that the possible share and expectation changes depend on the initial expectation of each individual. The outcome is the difference in expectations: $p_{i,t-1} - p_{i,t-3}$. We controlled for the same demographic and SES variables as before. For spending categories, we also considered a tobit with random effects. The outcome was the difference in the share of each item: $\alpha_{i,t} - \alpha_{i,t-4}$. We finally did the same

for share change in composition of net wealth. We then had a different left and right censoring for each observation. The left censoring limit for share was set as $-\alpha_{i,t-4}$ for respondent i, and the right censoring limit was set as $1 - \alpha_{i,t-4}$. We can then formulate the method as:

$$\Delta\alpha^*_{it} = \beta x_{it} + \gamma_A ADL_{i,t-1} + \gamma_I IADL_{i,t-1} + v_i + u_{it},$$

$$\text{with} \quad \Delta\alpha_{it} = \begin{cases} -\alpha_{i,t-4} & \text{if } \Delta\alpha^*_{it} < -\alpha_{i,t-4}, \quad \forall i \\ \Delta\alpha^*_{it} & \text{if } -\alpha_{i,t-4} \leq \Delta\alpha^*_{it} \leq 1 - \alpha_{i,t-4}, \quad \forall i \\ 1 - \alpha_{i,t-4} & \text{if } \Delta\alpha^*_{it} > 1 - \alpha_{i,t-4}, \quad \forall i \end{cases}$$

The estimation with random effect at the respondent level is another way to take the panel nature of the data into account and leads to efficiency gains.

2.5 Results

This section presents results on the effect of the onset of ADL and IADL limitations on different outcomes.

A. Effects on Expectations

We first analyzed the effect of onset of ADL and IADL limitations on expectations that had the potential to play an important role in the Euler equation. Table 2.6 reports coefficients of tobit regressions with random effects on the subjective prob-

ability of leaving a bequest over $10,000, entering a nursing home in the next 5 years and surviving the next 10 years.

Table 2.6: Effect on Expectations

	Bequest $> 10k$	Nursing home < 5 years	Survive 10 years
ADL	-0.638	2.110	-2.168
	(4.407)	(2.633)	(2.348)
IADL	-4.703	2.828	-11.694 ***
	(7.398)	(4.206)	(3.871)
σ_ν	13.46	0.00	0.00
σ_u	59.03	35.45	33.71
Observations	3087	2672	2862
Individuals	1344	1153	1269

Note: This table presents a tobit with random effect estimations where the outcome is changes in expectations over 4 years. For each respondent i, the left censoring limit was set as $-p_{i,t-4}$ and the right censoring limit was set as $1 - p_{i,t-4}$, where $p_{i,t-4}$ was the expectation 4 years before. *Bequest* $> 10k$ refers to the change in the subjective probability of leaving a bequest over $10,000. *Nursing home* < 5 *yrs* refers to the change in the subjective probability of entering a nursing home in the next 5 years. *Survive 10 yrs* refers to change in the subjective probability of living another 10 years. *ADL* refers to the onset of limitations in activities of daily living (bathing, eating, dressing, walking across a room and getting out of bed), conditional to not having had any limitation 4 years before. *IADL* refers to the onset of limitations in instrumental activities of daily living (using a telephone, taking medication and handling money), conditional to not having had any limitation 4 years before. σ_μ refers to the panel-level standard deviation. σ_u refers to the standard deviation of u_{it}.

First of all, none of these limitations had any significant effect on the probability of leaving a bequest superior to $10,000 and entering a nursing home in the next 5 years. These results justify the absence of these expectations in our theoretical framework.

On the other hand, IADL limitations had a negative and significant effect on the subjective probability of surviving another 10 years, decreasing this probability by around 12 percentage points. The effect of ADL limitations on survival was not significant and close to zero. This result shows that the subjective probability of surviving is a key element of our theoretical framework and must be taken into account to identify the health state dependence effect of total spending.

Indeed, the Euler equation presented in the theoretical framework tells us that a decrease in the probability of survival due to a change in health state requires a reduction in the ratio between the marginal utility of total expenditure at time t relative to the expected marginal utility of total expenditures at $t+1$. Equation (2.18) shows that a decrease in the probability of survival causes a wealth effect that increases the budget for the remaining years of life, allowing an increase in total spending at the present time.

$$\underbrace{\frac{v'(m_t, h_t)}{\sum_h v'(m_{t+1}, h_{t+1} = h) p_h(h_{t+1} = h | h_t, t)}}_{\Delta^-} = R\beta \underbrace{(1 - p_m(h_t, t))}_{\Delta^-}. \tag{2.18}$$

An increase in expenditure will decrease the value of $v'(m_t, h_t)$, thus allowing the equality of Euler's equation to be respected. However, an increase in total spending could also be the result of a negative health state dependence effect, which would mean that the marginal utility of spending is higher when we are in bad health. All these elements must be taken into account when we try to identify the health state dependence of the marginal utility of total spending.

B. Effects on Aggregates

Next, we analyzed the health state dependence of the marginal utility of total spending. We identified the health state dependence effect by estimating how spending and net wealth change following the onset of ADL and IADL limitations, controlling for the life cycle effect coming from the change in subjective survival. Table 2.7 reports coefficient of median regressions of ADLs, IADLs and the change in survival for all these aggregates.

Table 2.7: Effect on Aggregates

	Total spending	Non-durable	Net wealth
ADL	-0.0068	-0.0140	-0.0786
	(0.0280)	(0.0268)	(0.0499)
IADL	0.0937 *	0.0953 **	0.0481
	(0.0489)	(0.0442)	(0.0776)
Survive 10 years	-0.0001	-0.0001	0.0003
	(0.0003)	(0.0003)	(0.0005)
Observations	2530	2530	2677
R-Squared	0.010	0.010	0.009

Note: This table presents median regressions where outcome is the change in log of aggregates over 4 years. Estimates were corrected for clustering at individual level. *ADL* refers to the onset of limitations in activities of daily living (bathing, eating, dressing, walking across a room and getting out of bed), conditional to not having had any limitation 4 years before. *IADL* refers to the onset of limitations in instrumental activities of daily living (using a telephone, taking medication and handling money), conditional to not having had any limitation 4 years before. *Survive 10* years refers to the change in the subjective probability of living another 10 years.

Results showed that total and nondurable spending changes were the only aggregates

significantly affected by the onset of IADL limitations. The onset of IADL limitations significantly increased total and nondurable spending by almost 10% at the median. There was no significant effect of the onset of ADL limitations on any of the aggregates. Furthermore, none of these limitations had a statistically significant effect on total net wealth. Finally, the effect of the change in the subjective probability of surviving another 10 years on these aggregates was very close to zero and not significant.

These results suggest that the onset of IADL limitations increase the marginal utility of total and nondurable spending. This result is consistent with those of Lillard & Weiss (1997) and DeNardi et al. (2010). On the other hand, the onset of ADL limitations did not seem to affect the marginal utility of total and nondurable spending.

C. Effects on Spending Shares

The onset of ADL and IADL limitations can have a specific effect on the marginal utility of each spending item. These effects can go in opposite directions. Even if there is an absence of change in total spending following the onset of ADL limitations, there may still be an effect on spending items that compensate each other and lead to a simple reshuffling of spending categories. Thus, it is important to investigate how ADL and IADL limitations affect spending items separately.

The theoretical framework shows that changes in spending categories following the onset of a limitation are in part explained by the change of their respective shares. The change in spending share, expressed by $\left(\frac{\partial \alpha_j(h_t, m_t^*)}{\partial h} + \frac{\partial \alpha_j(h_t, m^*)}{\partial m}\frac{\partial m^*}{\partial h}\right)$, is composed of a pure *state dependence effect* and an *income effect*. Tobit regressions on shares of spending categories allow us to capture the combination of these two effects. Results

are reported in Table 2.8.

Table 2.8: Effect on composition of spending

	Housing	Transport	Utilities	HH services	Health	Gifts	Food	Leisure	Clothing
ADL	0.001	-0.006	-0.008	-0.005	0.009	-0.014	0.003	-0.003	-0.005
	(0.011)	(0.008)	(0.007)	(0.004)	(0.008)	(0.008)	(0.009)	(0.005)	(0.003)
IADL	-0.004	-0.027 **	0.007	-0.002	0.036 ***	-0.025 **	0.001	-0.007	-0.003
	(0.018)	(0.012)	(0.011)	(0.007)	(0.013)	(0.013)	(0.014)	(0.007)	(0.005)
σ_ν	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
σ_u	0.173	0.111	0.109	0.066	0.131	0.119	0.133	0.065	0.043
Observations	2922	2922	2922	2922	2922	2922	2922	2922	2922
Individuals	1250	1250	1250	1250	1250	1250	1250	1250	1250

Note: This table presents a tobit with random effects estimations where outcomes are changes in consumption shares over 4 years. For each respondent i, the left censoring limit was set as $-\alpha_{i,t-4}$ and the right censoring limit was set as $1-\alpha_{i,t-4}$, where $\alpha_{i,t-4}$ was the share 4 years before. *ADL* refers to the onset of limitations in activities of daily living (bathing, eating, dressing, walking across a room and getting out of bed), conditional to not having had any limitation 4 years before. *IADL* refers to the onset of limitations in instrumental activities of daily living (using a telephone, taking medication and handling money), conditional to not having had any limitation 4 years before. σ_μ refers to the panel-level standard deviation. σ_u refers to the standard deviation of u_{it}.

These results suggest that only the onset of IADL limitations has a significant effect on the composition of spending. Indeed, there was a significant reallocation from transportation and gifts spending to health spending, with an increase of 3.6 percentage points of the share of health spending. On the other hand, the effect of ADL limitations on composition of spending is very close to zero and nonsignificant.

Based on equation (2.13), Table 2.9 presents the expenditure variations, $\frac{\partial c_j^*(w_t,h_t)}{\partial h_t}$,

of each spending category following the occurrence of ADL and IADL limitations, as well as the decomposition of these variations in terms of a combination of *state dependence effect* and *income effect* on the one hand, and in terms of *life cycle effect* on the other.

The values of $\frac{\partial m^*(w_t,h_t)}{\partial h_t}$ are based on the results presented in Table 2.7 for nondurable spending. The values of $\left(\frac{\partial \alpha_j(h_t,m_t^*)}{\partial h_t} + \frac{\partial \alpha_j(h_t,m_t^*)}{\partial m_t}\frac{\partial m_t^*}{\partial h_t}\right)$ are based on the results presented in Table 2.8. The value of $m_t = \$23,531$ is the median value of nondurable spending at the baseline and $\alpha_j(h_t, m_t^*)$ is the share of total spending allocated to spending category j at the baseline.

We first analyzed the decomposition of change of transportation and gift spending following the onset of IADL limitations. While the *life cycle effect* put upward pressure on transportation and gifts spending, the combination of the *state dependence effect* and the *income effect* was much more important, leading to a decrease in transportation and gifts spending. For health spending, both effects led to an increase in health spending, but the combination of the *state dependence effect* and the *income effect* was much more important.

Table 2.9: Decomposition of spending categories change

	Total change	= State-dependence & income	+ Life-cycle
IADL			
Housing	\$440	-\$98	\$538
Transport	-\$356	-\$628	\$272
Utilities	\$500	\$169	\$331
HH services	\$55	-\$36	\$91
Health	\$1,148	\$838	\$310
Gifts	-\$414	-\$590	\$176
Food	\$413	\$30	\$384
Leisure	-\$77	-\$170	\$93
Clothing	-\$18	-\$67	\$49
ADL			
Housing	-\$55	\$25	-\$79
Transport	-\$178	-\$138	-\$40
Utilities	-\$241	-\$192	-\$49
HH Services	-\$124	-\$111	-\$13
Health	\$160	\$206	-\$46
Gifts	-\$359	-\$334	-\$26
Food	\$20	\$77	-\$57
Leisure	-\$73	-\$59	-\$14
Clothing	-\$120	-\$113	-\$7

Note: This table presents the expenditure variations, $\frac{\partial c_j^*(w_t,h_t)}{\partial h_t}$, of each spending category following the onset of ADL and IADL limitations, as well as the decomposition of these variations in terms of a combination of *state dependence effect* and *income effect* one hand, and in terms of *life cycle effect* on the other. *ADL* refers to the onset of limitations in activities of daily living (bathing, eating, dressing, walking across a room and getting out of bed), conditional to not having had any limitation 4 years before. *IADL* refers to the onset of limitations in instrumental activities of daily living (using a telephone, taking medication and handling money), conditional to not having had any limitation 4 years before.

D. Effects on Wealth Shares

Next, we looked at the dynamic behind total net wealth by analyzing the wealth portfolio choices. Table 2.10 shows that there was a significant reallocation from housing wealth to financial wealth with the onset of IADL limitations. The share of housing wealth decreased by 12.1 percentage points while the share of financial wealth increased by 10.7 percentage points. There are two channels that can explain this phenomenon. First, it is possible that a person with an IADL limitation no longer has the capacity to take care of their house. Another channel can be a reallocation from non-liquid to liquid wealth given that an increase in health spending caused by the onset of IADL limitations also announce an increase in the probability of future health spending. In this case, home equity could be a substitute for insurance, such as health insurance or long-term insurance (Davidoff (2009a) and Davidoff (2010)). Moreover, the onset of ADL limitations significantly decreases the share of housing wealth by 5.3 percentage points.

Table 2.11 gives us more details about what is happening. The first column presents marginal effects of logistic regressions where the dependent variable is a dummy variable indicating if the respondents have moved since the base year. The second column presents marginal effects of logistic regressions where the dependent variable is a dummy variable indicating if the respondents became renters or not, conditional to having been a homeowner in the base year. We see that the onset of ADL and IADL limitations significantly increased the likelihood of moving from the current house by 3.2% and 5.3%, respectively. Also, the onset of IADL limitations significantly increased the likelihood of becoming renters by 6.5%. The onset of ADL limitations also increased the likelihood of becoming renters, but not significantly.

Table 2.10: Effect on composition of net wealth

	Financial	Housing	Transport
ADL	0.011	-0.053 **	-0.017
	(0.026)	(0.026)	(0.017)
IADL	0.107 ***	-0.121 ***	-0.024
	(0.040)	(0.041)	(0.026)
σ_ν	0.000	0.189	0.090
σ_u	0.375	0.311	0.215
Observations	2740	2740	2740
Individuals	1226	1226	1226

Note: This table presents a tobit with random effect estimations where the outcome is changes in share of net wealth over 4 years. For each respondent i, the left censoring limit was set as $-\alpha_{i,t-4}$ and the right censoring limit was set as $1 - \alpha_{i,t-4}$, where $\alpha_{i,t-4}$ was the share 4 years before. *ADL* refers to the onset of limitations in activities of daily living (bathing, eating, dressing, walking across a room and getting out of bed), conditional to not having had any limitation 4 years before. *IADL* refers to the onset of limitations in instrumental activities of daily living (using a telephone, taking medication and handling money), conditional to not having had any limitation 4 years before. σ_μ refers to the panel-level standard deviation. σ_u refers to the standard deviation of u_{it}

.

Table 2.11: Housing wealth dynamics

	Moved Logit	Rent home Logit	House value OLS	Mortgage OLS
ADL	0.032 **	0.024	-0.273	-0.002
	(0.016)	(0.018)	(0.250)	(0.282)
IADL	0.053 **	0.065 ***	-0.697 *	0.373
	(0.022)	(0.022)	(0.395)	(0.329)
Observations	3324	2148	2481	2481
R2	0.017	0.025	0.010	0.016

Note: *Moved* means that the household has moved since the base year. *Rent home* means that the household rents their home in the current wave, conditional to having been a homeowner in the base year. *House value* and *Mortgage* refer to the log change in the composition of net housing wealth, conditional to having been a homeowner in the base year. *ADL* refers to the onset of limitations in activities of daily living (bathing, eating, dressing, walking across a room and getting out of bed), conditional to not having had any limitation 4 years before. *IADL* refers to the onset of limitations in instrumental activities of daily living (using a telephone, taking medication and handling money), conditional to not having had any limitation 4 years before.

The third and the fourth columns show results of OLS regressions on the house value and mortgage balance, conditional to having been a homeowner in the base year. The onset of IADL limitations had a significant and negative effect on the house value, decreasing it by 69.7%. Finally, there was not any significant effect of these onsets on the mortgage balance. These results suggest that, if there is need for liquid wealth following the onset of IADL limitations, respondents do not see loans based on their home equity as an instrument to finance health spending and they are more likely to sell their house and buy a smaller one or become renters.

2.6 Conclusion

We investigated how spending and the composition of spending change as a result of the onset of ADL and IADL limitations. Using the longitudinal data from CAMS and HRS, we constructed a test aimed to identify the presence of health state dependence of the marginal utility of spending in an intertemporal context.

Our results suggest that total and nondurable spending increase in response to the onset of an IADL limitation. Since we were controlling for the change in survival, this result suggests a negative health state dependence of the marginal utility of total and nondurable spending related to this health dimension. There is also evidence of spending reallocation from transportation and gifts spending to health spending. This reallocation is mostly related to the combination of a *state dependence effect* and an *income effect* following the onset of an IADL limitation. None of these limitations affect the subjective probabilities of entering a nursing home. However, the subjective probability of surviving another 10 years decreases with the onset of IADL limitations. Finally, there was no evidence of overall effect on net wealth, but

evidence of a shift from housing wealth to financial wealth. This shift is explained by the fact that, following the onset of IADL limitations, homeowners sell their house and buy a smaller one or become renters.

These results have important implications for two key policy questions. The first is knowing why more households are not buying long-term care insurance. Our results suggest that home equity might be used as a substitute to health and long-term care insurance. The substitution for a health insurance is more likely since health spending increases with the onset of IADL limitations, and the onset of ADL and IADL limitations does not affect the subjective likelihood of using the services of a nursing home.

The second important policy question concerns the degree to which households are prepared for retirement. Given that the likelihood of poor health increases with age, our results suggest that optimal savings for retirement may be higher than often calculated because the decline in health and its effect on the marginal utility of consumption are not taken into account. Incorporating this mechanism in life cycle models and estimating such models from longitudinal spending data is an important next step to better understand the insurance and savings needs of the near-elderly in the future. For example, this would allow us to separate the state dependence effect and the income effect according to the impact of the ADL and IADL limitations for each of the expenditure categories

Finally, our estimates suggest that the onset of IADL limitations is not related to a decrease of net wealth. However, there still is a puzzle behind the wealth reallocation from housing wealth to financial wealth with the onset of IADL limitations. This pattern might be related to the limitation itself, affecting the capability of caring

for and using these kinds of assets. It might also be related to the need for more liquid wealth given the increase in expected future health spending with the onset of IADL limitations. Even if they wished to stay a few more years in their house, that need for liquid wealth might force people to sell it. An interesting extension could be to analyze how financial products such as reverse mortgages could help liquid-constrained households keep their house if they so desired.

CHAPITRE III

LOW DEMAND FOR REVERSE MORTGAGES IN CANADA : PRICE OR PREFERENCES ?

Abstract

One of the main features that differentiate reverse mortgages from a more traditional home equity line of credit is the no-negative equity guarantee (NNEG). This feature ensures that, at the time of repaying the loan, the borrower only has to repay the minimum between the resale value of the house and the value of the loan. In this chapter, we used a pricing model to calculate mortgage insurance premiums charged to cover the losses related to the NNEG. Given the size of the loans that are granted in the Canadian market, we find that actuarially fair premiums are approximately zero, which implies that the NNEG is a missing feature in the Canadian market. We then constructed a stated-choice experiment in which Canadian respondents were asked to evaluate various reverse mortgage products. By using exogenous variation of the interest rates and the size of the loans from the survey design, we used these stated-choice evaluations to compute the demand elasticity of reverse mortgages in Canada and to look at other factors that could explain low demand. Our results showed that more than half of eligible Canadians do not even have a basic knowledge of reverse mortgages. Also, eligible Canadians do not seem to understand how to take advantage of the NNEG. Finally, Canadian demand for reverse mortgages is inelastic, but becomes elastic with a better level of knowledge on the product. As a result, a combination of price adjustment and education on reverse mortgages could be a good way to expand the size of the Canadian market.

Keywords: Mortgages, Housing Demand.

Note: This study is co-authored with Pierre-Carl Michaud.

3.1 Introduction

Housing is a major component of household wealth in retirement. The primary residence accounts for approximately 33% of the median wealth accumulated by Canadian households[1]. In retirement, owning a house provides a service flow with a shadow price equal to the price of renting a similar location. In addition, home equity acts as insurance against financial risks due to disability risk, since the house is typically sold when individuals enter a nursing home (Davidoff, 2009b, 2010). Given that housing is illiquid, many households are *house rich* and *cash poor*, which limits their capacity of extracting home equity to finance consumption in their old age.

Downsizing a house is a direct way of extracting home equity. Yet, Venti and Wise (2004) show that the elderly are reluctant to move to smaller houses or become renters. An indirect way of downsizing a house is by reducing or eliminating maintenance, which implies higher consumption against a lower resale value (Davidoff, 2006). However, Davidoff (2006) shows that this is an ineffective way of downsizing, because the amount of extra money that can be spent while letting the house depreciate is lower than the appreciation that could have been obtained by maintaining it. Borrowing against home equity while remaining in the house is becoming a popular alternative. For those who qualify, home equity lines of credit allow borrowing against equity, but expose owners to the risk that the loan accumulated will end up being greater than the value of the house. Furthermore, qualification for these loans is restricted among the elderly, because of their limited repayment capacity. An emerging alternative is reverse mortgages.

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[1] https://www150.statcan.gc.ca/n1/daily-quotidien/171207/dq171207b-eng.htm

A reverse mortgage is a financial product that allows a homeowner to convert a portion of the current net value of his principal residence into cash. Unlike many other mortgage products, the borrower is not obligated to make payments before moving out, selling or dying. In addition, the borrower's estimate is insured against the risk that the loan is worth more than the house when it is sold. This is called the no-negative equity guarantee (NNEG) of the reverse mortgage. This feature means that the borrower's longevity risk, as well as the risk of a drop in house prices, is transferred to the lender. A reverse mortgage will typically command a higher borrowing rate because of that guarantee. That premium will also depend on whether or not lenders are insured against losses. In the United States, the Federal Housing Administration (FHA) provides that insurance. In Canada, these reverse mortgages are not insured. In North America, the market for reverse mortgage purchases is tiny. In 2014, only 2.11% of Canadian households reported planning to obtain a reverse mortgage as a source of income upon retirement (Gouvernement du Canada, 2014). The average borrowing rate for reverse mortgages is roughly two percentage points above the rate charged on home equity lines of credit.

One reason why this market is tiny is that reverse mortgages are mispriced. Several attempts have been made to estimate the fair price of a reverse mortgage (Wang et al., 2011; Yang, 2011; Huang et al., 2011; Shao et al., 2015). In this chapter, we first use a pricing model to calculate actuarially fair mortgage insurance premiums charged to cover losses related to the NNEG in Canada. We consider survival risk given the borrower's characteristics as well as the risk of downward variation of the Canadian houses market. Given the size of loans granted in the Canadian market, we found that actuarially fair mortgage insurance premiums are approximately zero. This result shows that lenders do not take any risk by offering the NNEG, making

it a missing feature in the Canadian market.

Another reason for the small size of this market is the preferences and resources of the clients (demand side). Reverse mortgages are particularly useful for those who are *house rich* and *cash poor*. This means that potential market size is limited. Since the supply of reverse mortgages is relatively new in some Canadian provinces, the low demand could also be explained by a lack of knowledge about reverse mortgages. Moreover, households with a large bequest motive could have a lower demand for reverse mortgages. Retirees who expect to receive care from their family may also have a lower demand, as they face fewer financial risks. Furthermore, government programs that effectively provide insurance against financial risk may dampen demand. Finally, they may be very price sensitive, which may explain low demand to the extent that the price is high. Nakajuma & Telyukova (2017) studied the effect of some of these factors on the demand for reverse mortgages in the United States. Using a lifecycle model, they found that bequest motive and uncertainty about health and expenses are factors that account for low demand. To understand what role these factors play in Canada, we constructed a stated-choice experiment in which Canadian respondents were asked to evaluate various reverse mortgage products. These products are composed of a proportion of the equity of the house that can be borrowed and an interest rate. Using exogenous variation in interest rates (price) and in the amount of the loan from the survey design, these stated choices were used to look at factors that explain low demand and to compute the demand elasticity of the Canadian market. Our results showed that more than half of eligible Canadians (55.48%) do not even have a basic knowledge of reverse mortgages. Also, Canadians do not seem to understand how to take advantage of the no-negative equity guarantee, since the stated demand increased significantly with the subjective

expectation of house price growth. Expecting that their family would take care of them financially if needed, or would take up the responsibility of taking care of them if they had important limitations in activities of daily living (ADL), did not have any significant effect on the stated demand. Those who thought that their home is an asset that must be sold only in the case of financial hardship had a significantly higher demand, making reverse mortgages an interesting product for those with a high level of attachment to their home. Although our results suggested an overall inelastic Canadians market (0.81), the demand goes from highly inelastic (0.51) to elastic (1.18) with a better knowledge of this product. As a result, a combination of price adjustment and education on reverse mortgages could be a good way to expand the size of the Canadian market, in addition to increasing profits.

The chapter is divided as follows. Section 3.2 presents a pricing framework used to compute actuarially fair mortgage insurance premiums to cover losses related to the NNEG. In the section 3.3, we describe the structure of the reverse mortgage supply in Canada and compare the actuarially fair mortgage insurance premium with the actual premiums charged on the market. Section 3.4 presents an overview of a survey of 3,000 Canadians with the objective of measuring their level of knowledge about reverse mortgages, and also of presenting the stated-choice experiment that measures their intention of buying different reverse mortgage products. Section 3.5 provides a descriptive analysis of the Canadian knowledge and estimates of the Canadian demand models, while section 3.6 concludes.

3.2 What Should the Price of a Reverse Mortgage Be?

There is a vast literature of studies on the pricing of reverse mortgages (Li et al., 2010; Chen et al., 2010; Cho et al., 2013; Alai et al., 2014; Shao et al., 2015). The loaner is exposed to a multitude of risks, since the no-negative equity guarantee gives the assurance to the borrower that the amount of debt will never exceed the resale value of the house. Therefore, a mortgage insurance premium must be charged to cover the losses associated to these risks. The main risks considered in the recent literature are the longevity risk, the risk of downward variation in house prices and the risk of interest rate (Li et al., 2010; Chen et al., 2010; Cho et al., 2013; Alai et al., 2014; Shao et al., 2015).

The modeling of these risks has been done in several ways. Some have modeled the house price dynamic by using a nationwide house price index for the United States (Chen et al., 2010) and for the UK (Li et al., 2010). Others, like Cho et al. (2013), consider this risk using data at the city level. More recently, Shao et al. (2015) modeled the house price dynamic using Australian data on individual property transactions. They used a Vector Auto-Regression model to account for the correlation between the house price growth and other components, such as GDP growth rate and the yield of short-term bonds. The longevity risk has also been taken into account in different ways. While the majority of papers have considered a deterministic model for mortality improvement from one cohort to another, other papers, like Shao et al. (2015)), consider both deterministic and stochastic models. Finally, the risk of interest rate is generally modeled using the yield of short-term bonds and is estimated in the Vector Auto-Regression model (Li et al., 2010; Chen et al., 2010; Cho et al., 2013; Alai et al., 2014; Shao et al., 2015).

In this section, we present a pricing framework used to compute actuarially fair mortgage insurance premiums to cover losses related to the no-negative equity guarantee in Canada. We use a simplified version of the models suggested by Chen et al. (2010), Shao et al. (2015), Li et al. (2010) and Alai et al. (2014)), only considering the longevity risk and the risk of downward variation in house prices. We estimated the house price risk using a simple autoregressive model instead of a vector autoregression model as used in many studies (Li et al., 2010; Shao et al., 2015; Cho et al., 2013; Alai et al., 2014). To do so, we used Canadian historical data on the price of housing. This data set gave us detailed information on the average price of different types of dwelling for the principal Canadian cities, allowing heterogeneity in price growth and volatility (more details are provided in section 3.2.2). Finally, we modeled the longevity risk considering a deterministic mortality improvement from one cohort to another (more details are provided in sections 3.3.1 and 3.4.1).

3.2.1 Computation of the Reverse Mortgage Insurance Premium

Let γ be the loan-to-value ratio of the equity of the house H_a, borrowed by an individual of age a. The initial value of the loan, L_a, is then given by $L_a = \gamma H_a$. The value of the loan at $a + t$ is given by:

$$L_{a+t} = L_a(1 + r_{LC} + \pi)^t, \tag{3.1}$$

where r_{LC} represents the rate of a home equity line of credit that we consider constant over time, π represents a mortgage insurance premium to cover losses related to the

NNEG, and $r_{RM} = r_{LC} + \pi$ represents the interest rate of the loan. Let H_{a+t} be the resale value of the house if the borrower leaves or dies at the t period. The no-negative equity guarantee ensures that the amount recovered by the lender at the time of the sale of the house is:

$$\min\{L_{a+t}, (1-c)H_{a+t}\}, \tag{3.2}$$

where c is a transaction cost calibrated at 5% [2] of the selling price. The loss by the lender is then defined as:

$$\max\{L_{a+t} - (1-c)H_{a+t}, 0\}. \tag{3.3}$$

The expected present value of future losses related to the NNEG is given by:

$$\text{NNEG}(a, \pi, \gamma) = E_H \left(\sum_{t=1}^{T} q_{a,a+t} \frac{max(L_{a+t} - (1-c)H_{a+t}, 0)}{(1+i)^t} \right), \tag{3.4}$$

where i is the discount rate of 3.8%[3] and q_{a+t} is the conditional probability of dying

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[2] According to Sun Life Financial, the transaction costs in Canada are around 3% and 7%.

[3] We define the discount rate as $i = \beta \left(\frac{c_{t+1}}{c_t} \right)^{\sigma}$. We calibrate $\frac{c_{t+1}}{c_t}$ at 4%, which represent the FRED average annual nominal consumption growth between 2005 and 2017. β is a discount factor calibrated at 0.96 and σ is a CRRA utility calibrated at 2.

at age $a + t$ for someone of age a at $t = 0$. The expected present value of the accumulated mortgage insurance premium is given by:

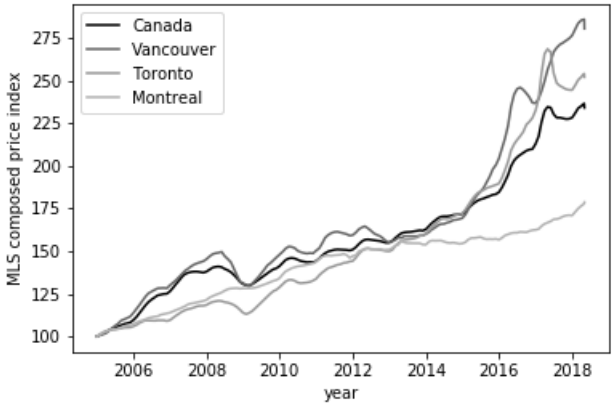
$$\text{MIP}(a, \pi, \gamma) = \pi(a, \gamma) E_H \left(\sum_{t=1}^{T} s_{a,a+t} \frac{L_{a+t}}{(1+i)^t} \right), \tag{3.5}$$

where $s_{a,a+t}$ is the conditional probability to survive at age $a + t$ for someone aged a at $t = 0$. Finally, the actuarial fair mortgage insurance premium $\pi(a, \gamma)$ is such as $\text{NNEG}(a, \pi, \gamma) = \text{MIP}(a, \pi, \gamma)$.

3.2.2 House Price Dynamics

We calibrated the house price dynamics using the MLS Home Price Index from the Canadian Real Estate Association (CREA), which provides information on the price of housing in the main cities of importance in Canada. This set of data gives information on the average price of all types of dwellings, as well as the average price per type of dwelling, namely single-family dwellings, townhouses and condos. We used monthly data from January 2005 to August 2018 for the cities of Vancouver, Toronto and Montreal. Figure 3.1 presents the evolution of the composite price index between 2005 and 2018 for all of Canada, as well as for the cities of Vancouver, Toronto and Montreal. We see that the cities of Vancouver and Toronto are the ones that have had the most important growth, with an average annual growth of 6% and 6.8%, respectively, while the city of Montreal has had an average annual growth of 3.7%. The cities of Vancouver and Toronto also have higher variability than the city of Montreal.

Figure 3.1: MLS Home Price Index for the cities of Vancouver, Toronto and Montreal, from 2005 to 2018



Tu & Zhou (2015) studied the volatility of house prices in major Canadian cities. They applied an adjusted Dickey-Fuller test and a Phillips-Perron test and rejected the null hypothesis of the presence of a unit root for these cities. In addition, they found that an AR(1) is a good representation of the stochastic process of these cities. Therefore, we estimated parameters of the house price dynamic using a simple an AR(1) with a deterministic trend:

$$log(H_{h,p,m}) = \delta_{h,p} m + \epsilon_{h,p,m} \tag{3.6}$$

$$\epsilon_{h,p,m} = \rho_{h,p} \epsilon_{h,p,m-1} + \eta_{h,p,m}, \tag{3.7}$$

where $H_{h,p,m}$ is the average house price of type h, in the city p in the month m, $\delta_{h,p}$ is the deterministic trend and $\eta_{h,p,m}$ is an error term normally distributed with an average of zero and a variance of $\sigma^2_{h,p}$. The table 3.1 presents estimates per type of dwelling for the cities of Vancouver, Toronto and Montreal. In each specification, the

coefficient of the deterministic trend and the auto-correlation coefficient are significant at a level of 1%. These estimates were used to calibrate the risk of downward variation of house prices in the provinces of Quebec (Montreal), Ontario (Toronto) and British Columbia (Vancouver).

Table 3.1: House price dynamic

prov	type	$\delta_{h,p}$	$\rho_{h,p}$	$\sigma^2_{h,p}$
Vancouver	SFD	0.006***	0.964***	0.023
	Townhouse	0.004***	0.988***	0.018
	Condo	0.004***	0.993***	0.018
Toronto	SFD	0.006***	0.949***	0.022
	Townhouse	0.006***	0.956***	0.021
	Condo	0.005***	0.966***	0.020
Montreal	SFD	0.003***	0.965***	0.011
	Townhouse	0.004***	0.912***	0.016
	Condo	0.003***	0.968***	0.011

Note: This table reports estimated parameters of the house price dynamics by city and type of dwelling. SFD refers to a single-family dwelling. $\delta_{h,p}$ is the monthly deterministic trend, ρ_{h_p} is the AR(1) coefficient and $\sigma^2_{h,p}$ is the variance for a dwelling of type h and in city p. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

3.3 Canadian Home Income Plan

Canadians have access to reverse mortgage products through the Canadian Home Income Plan (CHIP) offered by HomeEquity Bank. They are the only ones to offer reverse mortgages in Canada. This program was first offered in the Vancouver area

in 1986, and then in Ontario and Alberta starting in 2001. In the following years, the program was gradually offered across the country.

In order to be eligible to the program, the borrower must be a Canadian citizen and at least 55 years old. In addition, they must be the owner of their own residence, and it must be their primary residence. The initial advance must be at least $25,000.

The program allows the borrower to remain the owner of the residence, as long as certain conditions are met. These conditions are that the residence must be maintained in good condition, the property taxes must continue to be paid, a home insurance must be had and there must be no delay of payment on the property in the case of those who have another mortgage attached to the residence.

The CHIP program also gives a NNEG, which means that it guarantees that the amount to be repaid will never exceed the fair market value of the property at the time of sale. Once a loan-to-value has been granted, the homeowner has several options to choose from in order to receive the funds. They can receive 100% of the funds allowed in one lump sum. They can also initially receive a fraction of the funds granted, in the form of an initial lump sum of $25,000, with subsequent advances. In our case, we based our analysis on the option of receiving 100% of the funds in one lump sum.

There are some fees charged to the borrower. First, CHIP charges a closing and administrative fee of $1,495, which includes security lookup, title insurance and mortgage registration. Added to this are fees ranging from $175 to $400 for an assessment of the property. Finally, it charges a fee between $300 and $500 for independent legal advice.

In 2017, the CHIP program allowed people to borrow between 10% and 55% of the estimated equity of the residence. The loan-to-value depends on the borrower's age, sex and marital status. It also depends on the type of residence and its geographical location. Table 3.2 provides an example of a loan-to-value for a single-family dwelling that can be borrowed by a single woman between 55 and 75 years old, in the cities of Montreal, Toronto and Vancouver, in 2017. All these reverse mortgages are lent at an interest rate of 5.59%.

Table 3.2: Maximum loan-to-value

Age	Montreal	Toronto	Vancouver
55	0.260	0.253	0.245
65	0.354	0.364	0.347
75	0.420	0.434	0.413

Note: This table presents the maximum loan-to-value ratios of the home equity that can be borrowed by a single woman living in a single-family dwelling. These results are divided by age and city. Source: HomeEquity Bank, 2017.

In order to reduce the losses related to the NNEG, the loan-to-value is lower for younger borrowers. It is also lower for women, since they have a higher life expectancy than men. When compared with single individuals, couples can borrow at a lower loan-to-value since the joint probability of survival is taken into consideration. Finally, according to the type of dwelling and its location, a higher loan-to-value will be loaned to those for which a higher price growth and a lower volatility are expected.

3.3.1 Actuarially Fair Mortgage Insurance Premium in Canada

We used the pricing framework to calculate actuarially fair mortgage insurance premiums based on the loan-to-values offered by the CHIP program. We first calibrated the interest rate of a home equity line of credit r_{LC} at 4%, which is the average rate that was offered on the Canadian market in 2017[4]. Next, we calibrated the conditional probabilities of dying and surviving using the prospective life tables produced by Statistics Canada (Bohnert & Statistics Canada, 2015). These life tables are divided by cohort, gender and province. We finally calibrated the loan-to-values using the maximum loan-to-values offered by CHIP as reported in the Table 3.2.

Using our pricing framework, we calculated the actuarially fair mortgage insurance premium for women living in a single-family dwelling, 55, 65, and 75 years old, in the cities of Montreal, Toronto and Vancouver. In each case, we ran 100 simulations and took the average actuarially fair mortgage insurance premium. Table 3.3 reports the actuarially fair interest rate, $r_{LC} + \pi^{fair}$, by age and province. These results suggest that actuarially fair premiums are between 0% and 0.03%. These actuarially fair premiums are very low when compared to the 1.59% premium charged by CHIP[5]. We repeated this exercise for men, couples and other types of dwelling, and results were very similar[6].

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[4]https://www.ratehub.ca

[5]The interest rate for the CHIP program in 2017 was 5.59%. We then calculated the CHIP premium as the CHIP interest rate minus the average interest for a home equity line of credit of 4%.

[6]These results can be provided on request.

Table 3.3: Actuarially fair rates

Age	Montreal	Toronto	Vancouver
55	0.0401	0.04	0.0401
65	0.0401	0.04	0.0402
75	0.0400	0.04	0.0403

Note: These rates correspond to a home equity line of credit rate (r_{LC}) of 4%, plus an actuarially fair premium (π^{fair}), for women owners of a single-family dwelling. These results are divided by age and city.

To analyze which factors could justify a mortgage insurance premium as large as the one charged by CHIP, Figure 3.2 presents different static comparatives to see how actuarially fair mortgage insurance premiums and the probability of loss for the loaner are affected by different parameters. We show results for the case of a 65-year-old woman, owner of a single-family dwelling in Montreal. The three graphs on the left present the actuarially fair mortgage insurance premium as a function of the house price growth, the relative standard deviation of the house price uncertainty, and the loan-to-value ratio, respectively. The three graphs on the right present the probability of loss, defined as $Pr(\text{NNEG} > 0)$, as a function of the same parameters. In each case, the dotted line represents the premium charged by CHIP (1.59%) and the dashed line represents the actual value of these parameters.

Figure (a) shows how the actuarially fair premium decreases as a function of the house price growth. All other things being equal, the premium charged by CHIP corresponds to a fair premium in an environment of negative house price growth. As shown in Figure (b), CHIP is exposed to the probability of a loss below 5% with

the actual house price growth, while a negative house price growth scenario would expose CHIP to the probability of a loss of more than 50% and could justify such a high premium.

Figure (c) shows how the actuarially fair mortgage insurance premium increases as a function of the relative standard deviation of house price uncertainty in Montreal. All other things being equal, the premium charged by CHIP corresponds to the situation where the standard deviation is 8 times higher than the actual one. As shown in Figure (d), CHIP is exposed to the probability of a loss of less than 5%, while an 8 times higher standard deviation corresponds to the probability of a loss of approximately 40%.

Figure (e) shows how the actuarially fair mortgage insurance premium increase as a function of loan-to-value ratio. All other things being equal, the premium charged by CHIP corresponds to a situation where the loan-to-value ratio corresponds to 90% of the equity of the home, while the effective loan-to-value for a 65-year-old woman in Montreal is 35.4%. As presented by Figure (f), CHIP is exposed to the probability of a loss of less than 5%. On the other hand, the probability of a loss increases to more than 80% with a loan-to-value ratio of 90%[7].

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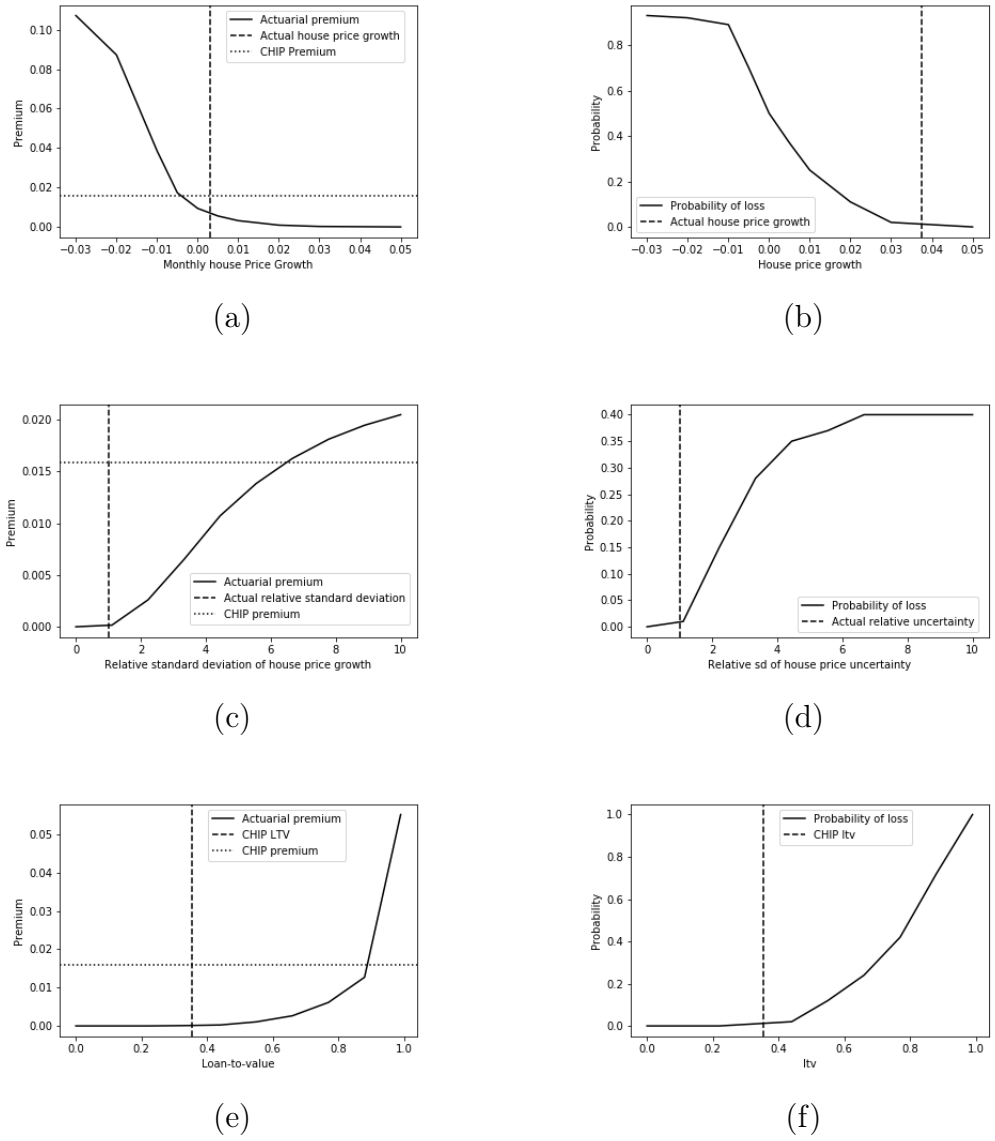
[7]A probability of loss of 80% may seem high. However, it is important to note that the probability of loss is not necessarily related to the size of the loss

Figure 3.2: Comparative statics

Actuarially fair premium **Probability of loss**



Note: This figure presents different static comparatives to see how actuarially fair premiums and the probability of loss for the loaner are affected by different parameters in the case of a female owner of a single-family dwelling, 65 years old and living in Montreal. Figures (a) and (b) present actuarially fair premium and the probability of loss as a function of the house price growth; Figures (c) and (d) present the actuarially fair premium and the probability of loss as a function of the relative standard deviation of house price growth; and Figures (e) and (f) present the actuarially fair premium and the probability of loss as a function the loan-to-value corresponding to the loan.

The actual maximum loan-to-value ratio offered by CHIP ensures that they take no risk related to the no-negative equity guarantee (NNEG), making it a missing feature in the Canadian reverse mortgage market. In this context, it is hard to differentiate a reverse mortgage from a home equity line of credit. The price difference between these two products may be hard to justify to buyers, which could explain why the market is currently so small. Finally, it is important to note that our pricing framework does not take into account the possibility of terminating the contract before death. However, a pricing framework allowing the termination of the contract before death would have brought a downward pressure on the actuarially fair premium, making the premium charged by CHIP even more difficult to justify. Moreover, our pricing framework does not take into consideration the possibility of moral hazard, where homeowners who contract a reverse mortgage could stop maintaining their residences, with the consequence of decreasing their values. However, one of the conditions attached to reverse mortgage contracts offered by the CHIP program is that the residence must be maintained in good condition. Hence, this condition prevents potential losses related to the moral hazard and justify the fact that moral hazard is not taken into consideration in the pricing framework. Finally, even if it had no effect on house prices, the 2008 crisis may have considerably changed expectations about events that could possibly have a negative impact on house prices, due to the American experience. Household debt relative to household income has increased significantly since 2008 in Canada, much like it had in the United States before the crisis. However, Figure (e) shows that we would need very high uncertainty relative to what we estimated to justify such a high premium.

3.4 Survey

Since 2016, the Retirement and Savings Institute at HEC Montréal regularly conducts web surveys on different topics related to retirement preparation. In fall 2016, they first conducted a survey to examine the cause of the low market penetration of long-term care insurance in Canada (Boyer et al., 2019). These surveys are conducted in partnership with AskingCanadians, an online survey company. By responding to surveys, participants accumulate points that can be redeemed for products from companies such as Hudson's Bay, Aeroplan, Petro-Points and Via Preference. Based on the same survey structure, we surveyed 3,000 Canadians in the summer of 2017. Respondents were aged 55 to 75 and lived in the provinces of Quebec, Ontario or British Columbia. In each province, 50% of respondents came from the census metropolitan area (CMA), while the rest came from outside the CMA.

The questionnaire was presented in 5 parts relevant to the study of the demand for reverse mortgages. First, we asked general questions in order to have information on the socio-economic, demographic and health characteristics of respondents. There was also a section on preferences, risk perception and expectations for the future. Another section measured respondents' level of financial literacy and knowledge of probabilities. A fourth section focused on respondents' general knowledge about reverse mortgages. Finally, the last section ran a stated-choice experiment, where respondents were offered different reverse-mortgage products and had to evaluate them by giving their probability of buying each of these financial products within the next year. A copy of the questionnaire can be found in Appendix C.2.

In order to represent the distribution of the population characteristics of these three provinces, we created a weighting based on the weighting of the Canadian Community

Health Survey (CCHS) for the year 2010. The weight cells are divided by age group (5-year), gender, province and education (3 levels).

Of the 3,000 Canadians surveyed, 2,399 reported owning a home. As many of them still held mortgages on their homes, 2,306 of them reported having a home equity of over $25,000. 2,163 of them were single or had a spouse aged 55 or older, making them eligible for the CHIP program. Finally, 2,140 respondents did not have any missing information. A description of those eligible respondents is reported in Table 3.4.

Canadians corresponding to our weighted sample are 63 years old on average, and half of them are male. Around 20% of them are from British Columbia, 30% from Quebec and 50% from Ontario. 75.5% of them are married or in a common-law relationship, and 76.5% reported having at least one living child. Most of them have at least a college education. 66% of them consider themselves retired. On average, their annual income is around $89,000 and they have average total savings of $266,000[8]. In both cases, the median values are below the mean values. The average current market value of their home is $570,000 and an average of 11.1% of the current market value is still owed on their mortgages. As a result, the median equity value of their residence is around $520,000. 80.3% of households are *house rich* and *cash poor*, which means that the equity of their house is worth more than their accumulated non-housing wealth. Finally, 56.1% of them have an employer pension plan.

Respondents were questioned on their bequest motive, their level of attachment to

[8]To prevent the effect of outliers, we imposed a maximum annual income of $500,000 and maximum total savings of $5,000,000

their house and their expectations about the care and financial support they will receive from their family in the future. They were also asked a sequence of four multiple-choice questions to assess their level of financial literacy[9]. 17.8% of them agreed with the fact that parents should set aside money to leave their children as inheritance, even if it means somewhat sacrificing their own comfort in retirement. On average, they evaluate at 44.7% the probability that their family would take up the responsibility of taking care of them if they had important ADL limitations and at 45.2% the probability that their family would take care of them financially if needed. They also evaluate on average at 43.9% their probability of staying in their current home until death, and 44% agreed with the statement that a house is an asset that should only be sold in case of financial hardship. Finally, 50.1% of respondents answered all four questions evaluating their financial literacy correctly.

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[9]The following questions were asked:

- *Suppose you have $100 in a savings account, the interest rate is 2% per year and you never withdraw money. After 5 years, how much will you have in this account in total?*
- *True or False? You should invest most of your money in a single stock that you select rather than in lots of stocks or in mutual funds.*
- *Imagine leaving $1,000in a savings account that pays 1% interest and has no charges. Imagine that inflation is running at 2%. Do you think that if you withdraw the money in a year's time you will be able to buy more than, exactly the same as, or less than today with the money in this account?*
- *Suppose the chances of someone aged 50 living to age 85 are 60%. What do you think the chances are that this same person will live to age 60?*

Table 3.4: Sample Description

	mean	SD	min	max
Age	63.388	5.305	55.000	75.000
Men	0.488	0.500	0.000	1.000
Ontario	0.502	0.500	0.000	1.000
British Columbia	0.193	0.395	0.000	1.000
Quebec	0.305	0.460	0.000	1.000
Married	0.755	0.430	0.000	1.000
Has kids	0.765	0.424	0.000	1.000
Less than high school	0.180	0.384	0.000	1.000
High school	0.384	0.486	0.000	1.000
College	0.436	0.496	0.000	1.000
Retired	0.663	0.473	0.000	1.000
Total income ($1,000)	88.544	66.092	0.001	500.000
Total non-housing saving ($1,000)	265.681	424.297	0.000	5000.000
Home value	570.049	468.803	25.322	3000.000
Mortgage (% of the home value)	0.111	0.190	0.000	0.926
Equity ($1,000)	519.638	456.115	25.322	3000.000
House rich & cash poor	0.803	0.398	0.000	1.000
Employer pension plan	0.561	0.496	0.000	1.000
Bequest motive	0.178	0.383	0.000	1.000
Probability of family support if ADL	0.447	0.342	0.000	1.000
Probability of family support if financial need	0.452	0.368	0.000	1.000
Probability of staying home until death	0.439	0.337	0.000	0.990
House must be sold only if financial hardship	0.580	0.494	0.000	1.000
Financial literacy (4 correct answers)	0.501	0.500	0.000	1.000

Note: This table presents descriptive statistics on the Canadian population corresponding to our sample. "House rich cash poor" refers to a dummy variable equal to one if the equity of the house is superior to the total non-housing savings. Statistics weighted according to 2010 Canadian Community Health Survey (CCHS).

3.4.1 Survival Rates

We used three sources in order to identify the probability of mortality $q_{a,a+t}$ and survival $s_{a,a+t}$ of respondents:

1. Prospective survival rates from Statistics Canada,
2. Objective survival rates using microsimuation,
3. Subjective survival rates.

Prospective Life Tables

We first use the prospective life tables produced by Statistics Canada (Bohnert & Statistics Canada, 2015). These prospective survival rates are divided by cohort, gender and province. For each respondent, we then attached a specific life table based on their specific characteristics. Let x_i be a vector with the information on the cohort, the gender and the province of individual i. Based on the prospective life tables, we define $q^{LT}_{a,a+t}(x_i)$ and $s^{LT}_{a,a+t}(x_i)$ as individual i's probability of dying or surviving between the ages of a and $a+t$.

Objective Life Tables

To compute our objective life tables, we used COMPAS, a microsimulation model that projects objective mortality rates specific to each respondent, based on their characteristics (Boisclair et al., 2016). To make these projections, the model takes into account the individual's current age, gender, education level, and their self-reported diagnosis of health conditions (heart disease, diabetes, cancer, lung disease and hypertension)[10]. Let x_i be a vector with the information on individual i's current age, gender, education, and the self-reported diagnosis of health conditions. Based on the individual specific objective life table from the microsimulation model, we define

[10]Statistics on the respondents health conditions are available upon request.

$q^O_{a,a+t}(x_i)$ and $s^O_{a,a+t}(x_i)$ as individual i's objective probability of dying or surviving between the ages of a and $a+t$.

Subjective Life Tables

To compute subjective life tables, we followed the approach used by Salm (2010b). Let the subjective mortality hazard of respondent i at age a be given by:

$$\lambda^S_a(x_i) = \psi_i \lambda^O_a(x_i), \tag{3.8}$$

where $\lambda^O_a(x_i)$ is the individual's objective mortality hazard based on microsimulation. In continuous time, let the subjective probability of surviving from age a to age 85 be given by:

$$s^S_{a,85}(x_i) = \exp\left(-\psi_i \int_a^{85} \lambda^O_s(x_i)\right), \tag{3.9}$$

while the objective probability of surviving based on microsimulation for the same ages is:

$$s^O_{a,85}(x_i) = \exp\left(-\int_a^{85} \lambda^O_s(x_i) ds\right). \tag{3.10}$$

Let $\Lambda^O_{a,85}(x_i) = \int_a^{85} \lambda^O_s(x_i) ds$. Then,

$$\log(s^{O}_{a,85}(x_i)) = -\Lambda^{O}_{a,85}(x_i) \tag{3.11}$$

and

$$\log(s^{S}_{a,85}(x_i)) = -\psi_i \Lambda^{O}_{a,85}(x_i) \tag{3.12}$$

Dividing equation (3.12) by equation (3.11), we have:

$$\psi_i \;=\; \frac{\log(s^{S}_{a,85}(x_i))}{\log(s^{O}_{a,85}(x_i))}. \tag{3.13}$$

In the survey, each respondent was asked to give his subjective probability of surviving until the age of 85, $s^{S}_{a,85}(x_i)$. We used this information to identify ψ_i. To avoid indeterminate values, we set $s^{S}_{a,85}(x_i) = 0.01$ as a minimum and $s^{S}_{a,85}(x_i) = 0.99$ as a maximum. Based on the objective life table of individual i, it is then possible to use ψ_i and construct their subjective life table. Let x_i be the same vector of information used to compute the objective life table of individual i. We then define $q^{S}_{a,a+t}(x_i)$ and $s^{S}_{a,a+t}(x_i)$ as individual i's subjective probability of dying or surviving between the ages of a and $a + t$.

Table 3.5 presents the average expected remaining years of life using the objective, prospective and subjective life table. On average, the expected number of remaining

years of life is 22.4 years using the prospective life tables from Statistics Canada, 20.8 years using the objective life tables from microsimulations and 27 years using the subjective life tables. It means that the respondents of our sample have a lower survival rate than the average population with the same characteristics (cohort, age, gender and province). On the other hand, respondents overestimate their probability of surviving. Finally, the use of subjective life tables instead of the other life tables should contribute to increasing the mortgage insurance premium to cover the additional survival risk.

Table 3.5: Expected remaining years of life

	Objective	Prospective	Subjective
mean	20.82	22.4	27.03
SD	5.57	5.12	10.22

Note: This table presents the average expected remaining years of life using the objective, prospective and subjective life tables. Statistics weighted according to the 2010 Canadian Community Health Survey (CCHS).

3.4.2 Experiment

For each of the respondents in our sample, we proposed 5 different scenarios. These scenarios were distinguished from each other by different interest rates offered and a different loan-to-value that can be borrowed. Here is the introductory text presented to the respondents [11]:

[11] A French version was presented to the respondents who chose to answer the questionnaire in French.

We will refer to a reverse mortgage as a financial product that lets you turn part of your current home equity into cash. Unlike many mortgage-based financial products, you're not obligated to make any payments until you move, you sell your home, or you die. Importantly, you have the certainty that once your residence will be sold, the amount required to repay the loan will not exceed the selling price of the residence.When we use the expression "current home equity", we are referring to the current market value of your primary residence after subtracting outstanding mortgage balances. For the rest of this section, try to have your current home equity in mind. We are going to show you some simple reverse mortgage products and ask you to rate them. Each reverse mortgage has three attributes:

1. *The percentage of your current home equity that you can borrow. The amount borrowed must be a minimum of $25,000.*
2. *A fixed annual interest rate on the balance of the loan, generating interests that you do not need to pay before you move, sell or die.*
3. *A fixed fee of $2,245 that you only have to pay once. The money you obtain from the reverse mortgage will be used to pay this fee.*

We then presented the scenarios the following ways:

1. *You can borrow a minimum of $25,000 and up to $\beta\%$ of your current home equity.*
2. *You will be charged a fixed annual interest rate of $r\%$ on the balance of the loan for as long as you hold the loan.*
   Reminder: You're not obligated to make any payments until you move, you sell your home, or you die; and you have the certainty that once your residence will be sold, the amount required to repay the loan will not exceed the selling price of the residence.
3. *There is a fixed fee of $2,245 that you only have to pay once. The money you obtain from the reverse mortgage will be used to pay this fee.*

For each individual i and scenario n, we exogenously propose an interest rate, $r_{i,n}^{experiment}$, which can take the values:

$$r_{i,n}^{experiment} = [3.8\%, 4.1\%, 4.4\%, 4.7\%, 5\%, 5.3\%, 5.59\%, 6\%, 6.5\%, 7\%],$$

each with probability 1/10. Therefore, we randomized the rates around the interest rate of 5.59% proposed by CHIP for a 5-year term at the moment when the survey was conducted.

For each individual i and scenario n, a loan-to-value is proposed in term of percentages of equity, $\beta_{i,n}$, that can be borrowed. We denote the maximum loan-to-value that can be borrowed by the individual i from CHIP as β_i^{CHIP}. We have information on the CHIP's average maximum loan-to-value, by 5-year age group[12], gender, marital status (single or couple), and residence location (inside or outside the metropolitan area)[13]. These values come from the CHIP calculator that can be found on their website[14] and are presented at the end of Appendix C.2. To randomize the loan-to-value around β_i^{CHIP}, we exogenously created a percentage change in loan-to-value by drawing a value, $\tau_{i,n}$, that can take the values:

$$\tau_{i,n} = [0.5, 0.75, 1, 1.25, 1.5], \text{ each with probability of } 1/5.$$

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[12]For couples, we used the average age of the couple, $\frac{age_R + age_S}{2}$, where age_R is the age of the respondent and age_S is the age of the spouse as reported in the survey. We rounded the result to the nearest integer and set the age as 79 when $\frac{age_R + age_S}{2} > 79$.

[13]To identify the residence location, we asked respondents to give us the first three characters of their postal code. This information allowed us to identify the respondents who were or were not part of the central city of the metropolis of their respective province.

[14]https://www.chipadvisor.ca/calculator/

The loan-to-value proposed in the scenario n of the respondent i will therefore be $\beta_{i,n} = \tau_{i,n}\beta_i^{CHIP}$.

With the objective of measuring the concern that some elements of the contract could not be respected, we randomized the presence of the following sentence with a probability of 0.5:

> *Suppose you have the certainty that you will never be put under pressure to sell your residence and that the contract terms will be respected.*

Finally, after presenting a scenario, we asked the respondent to evaluate the probability, from 0% to 100%, that they would buy this reverse mortgage if a trusted financial institution offered it within the next year.

3.4.3 Relative Fairness

As we have seen above, it is not possible to compare different reverse mortgage contracts simply by comparing their interest rates. Actually, the actuarially fair mortgage insurance premiums will vary according to several factors, such as the respondent's age, sex, place of residence, type of home and the loan-to-value ratio of the equity of the house that is lent. In order to create a measurement that allows the comparison of the contracts offered with each other, we created an indicator that we called the *relative fairness*. To do so, we first computed the actuarially fair mortgage insurance premiums, $\pi_{i,n}$, for each individual $i \in \{1, ..., N\}$ and scenario $n \in \{1, ..., 5\}$. For each scenario, we ran 100 simulations and calculated the average actuarially fair mortgage insurance premium, $\pi_{i,n}$. Then, we defined the *relative fair-*

ness, $RF_{i,n}$, as a measurement of the actuarially fair interest rate, $r_{LC} + \pi_{i,n}$, relative to the rate proposed to the respondents, $r_{i,n}^{experiment}$ in their respective scenarios:

$$RF_{i,n} = \frac{r_{LC} + \pi_{i,n}}{r_{i,n}^{experiment}}. \tag{3.14}$$

A higher value of RF signifies a more advantageous reverse mortgage contract for the consumer. Table 3.6 presents statistics on the *relative fairness* of the rates proposed to the respondents in the experiment using the objective, prospective and subjective life tables. On average, the *relative fairness* of the reverse mortgage contract proposed was around 0.8. Also, these statistics did not differ between types of life table.

Table 3.6: Relative Fairness

	Objective	Prospective	Subjective
mean	0.7974	0.7978	0.7984
SD	0.1510	0.1513	0.1516

Note: This table presents the relative fairness of the reverse mortgage contract proposed to the respondents during the experiment. The *relative fairness* is defined as $\frac{r_{LC}+\pi_{i,n}}{r_{i,n}^{experiment}}$ where r_{LC} is the interest rate of a home equity line of credit, $\pi_{i,n}$ is the actuarially fair mortgage insurance premium for the reverse mortgage contract, and $r_{i,n}^{experiment}$ is the interest rate proposed to respondent i and scenario n during the experiment. Statistics weighted according to the 2010 Canadian Community Health Survey (CCHS).

3.5 Analysis

3.5.1 Knowledge and Intention of Buying

Respondents were asked a sequence of questions with the objective of measuring their level of knowledge of reverse mortgages. Statistics on the answers are reported in Table 3.7. Without naming the financial product, we first presented a sentence containing the definition of a reverse mortgage to the respondents[15]. Then, respondents were asked if they had ever heard of this financial product. 77.3% of eligible Canadian homeowners claimed to have heard of that kind financial product. Fewer homeowners from Quebec answered having heard this definition, a difference of nearly 20 percentage points with the two other provinces. Then, we asked those who claimed to have heard of this financial product if they could name it. 59.5% of these homeowners claimed to be able to name the product in question. Once again, there was a noticeable difference between provinces. Fewer homeowners from Quebec who had heard of this financial product claimed to be able to name it, a difference of 15 percentage points with the two other provinces. Finally, those who claimed to be able to name the product were asked to identify it from a list of financial product names. 96.8% of them answered correctly. Once again, fewer homeowners from Quebec answered this question correctly. Overall, 44.52% of all homeowners had heard of the existence and correctly identified the reverse mortgage as the name of that financial product. Moreover, the level of knowledge was twice as important among homeowners in Ontario and British Columbia than it was in homeowners in Quebec.

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[15]The definition was presented as follows: "*Imagine a financial product that lets you turn part of your current home equity into cash. You're not obligated to make any payments until you move, you sell your home, or you die. You have the certainty that once your residence is sold, the required amount to repay the loan will not exceed the selling price of the residence.*"

One plausible explanation for this phenomenon is that the CHIP program has been offered longer in Ontario and British Columbia than in the province of Quebec. Although the level of knowledge is higher in Ontario and British Columbia, the level of awareness of the very existence of this financial product remains very low among eligible respondents. Hence, the simple fact that more than half of Canadians eligible for a reverse mortgage do not have a basic knowledge of the existence of this product could be the major factor that explains why this market is so small in Canada.

Table 3.7: Knowledge of reverse mortgages

	Canada	**B.C.**	**Ont.**	**Que.**
1: Ever heard of the existence of this fin product: based on definition of reverse mortgages (N=2,163)				
No	**22.7%**	15.3%	17.1%	36.5%
Yes	**77.3%**	84.7%	82.9%	63.5%
2: Can you name the financial product: based on definition of reverse mortgages (if heard) (N=1,717)				
No	**40.5%**	35.2%	36.5%	53.3%
Yes	**59.5%**	64.8%	63.5%	46.7%
3: Name that financial product: based on definition of reverse mortgages (if can name) (N=1,067				
Annuity	**0.4%**	0.1%	0.0%	1.7%
Reverse mortgage	**96.8%**	96.6%	98.9%	90.9%
Life insurance	**0.1%**	0.0%	0.0%	0.3%
Line of credit	**1.2%**	2.9%	0.4%	1.7%
None of the above	**1.6%**	0.4%	0.7%	5.4%
Correctly answered all three questions (N=2,163)				
No	**55.48%**	46.94%	47.87%	73.09%
Yes	**44.52%**	53.06%	52.13%	26.91%

Note: Statistics weighted according to the 2010 Canadian Community Health Survey (CCHS)

Another factor that should influence taking a reverse mortgage is the subjective expectation of house price growth. Indeed, a part of the NNEG is an insurance covering the risk of downward variation in house prices. For a given interest rate and loan-to-value, it is therefore more advantageous for someone who anticipates a drop in the price of their house to get a reverse mortgage. Each homeowner in the survey was asked to categorize their expectation of their house's price growth over

the next five years among the following answer choices: more than 20%, between 5% and 20%, between -5% and 5%, between -20% and -5% and less than -20%. Table 3.8 reports the distribution of subjective expectation of house price growth over the next 5 years by province. Homeowners from the province of British Columbia are those who expected a higher growth rate, with almost 80% of them expecting a growth higher than 5%. Homeowners from Ontario and Quebec followed, with 75% and 66% of them expecting a growth higher than 5%, respectively.

Table 3.8: Subjective expectation of house price growth over the next 5 years

	more than 20%	5 to 20%	-5 to 5%	-5 to -20%	less than -20%
British Columbia	0.190	0.603	0.163	0.035	0.009
Ontario	0.165	0.583	0.217	0.020	0.014
Quebec	0.061	0.598	0.322	0.006	0.013

Note: This table presents the distribution of subjective expectation of house price growth over the next 5 years by province. Statistics weighted according to the 2010 Canadian Community Health Survey (CCHS).

Table 3.9 shows the average stated probability of buying a reverse mortgage reported in the experiment, by province and category of expectation of house price growth. Respondents from British Columbia did not seem to base their probability of buying a reverse mortgage on their expectation of house price growth. On the other hand, the respondents from Quebec and Ontario who expected a higher price growth were also those with a higher stated probability of buying a reverse mortgage. The average stated probability of buying gradually decreased with a lower expectation of house price growth rate. While we should expect that those who expected a lower house price growth should also be the ones most interested in buying reverse mortgages, it is the opposite that we observed. This is another clue that Canadians do not

fully understand how to take advantage of the NNEG. Misunderstanding can make it difficult to differentiate a reverse mortgage from a home equity line of credit, and thus make it hard to justify the payment of a mortgage insurance premium. As a result, this may be a factor explaining the low average probabilities observed across all subgroups.

Table 3.9: Probability of buying a reverse mortgage within the next year

	more than 20%	5 to 20%	-5 to 5%	-5 to -20%	less than -20%
British Columbia	0.059	0.052	0.050	0.064	0.000
Ontario	0.107	0.067	0.038	0.032	0.000
Quebec	0.188	0.052	0.070	0.031	0.052

Note: This table presents the average probability of buying a reverse mortgage within the next year by province and category of subjective expectation on the house price growth over the next 5 years. Statistics weighted according to the 2010 Canadian Community Health Survey (CCHS)

3.5.2 Empirical Strategy

This section explains the empirical strategy used to estimate the demand elasticity and to identify the factors determining the demand for reverse mortgages in Canada. Since some respondents reported a probability of buying equal to zero, it was not possible to directly compute the reverse mortgage demand elasticity utilizing the log of the probability of buying as a dependent variable. Instead, we estimated the elasticity in two steps. First, we ran OLS regressions[16]:

[16]We did the same exercise using tobit estimation, where the lower bound was 0 and the upper bound was 100. The results were very similar to the results from OLS estimations.

$$S_{i,n} = \alpha log(RF_{i,n}) + \beta X_i + \nu_{i,n}, \tag{3.15}$$

where $S_{i,n}$ is the stated probability of buying a reverse mortgage reported by respondent i for scenario n, $log(RF_{i,n})$ is the log of the *relative fairness* of the reverse mortgage offered, X_i is a vector of control variables and μ is an error term assumed to be normally distributed. X_i groups all the variables presented in Table 3.4. It includes demographic variables: the respondent's age, gender, province, level of education, marital status, if the respondent has children or not and retirement status. It also includes variables on the household's financial situation: the logarithm of the house value, the logarithm of annual income, the logarithm of savings, the logarithm of the mortgage (in terms of percentage of the house value), and a dummy variable indicating if the respondent has an employer pension plan. It also controls for the respondent's financial literacy using a dummy variable equal to one if the respondent answered all the questions assessing the familiarity with financial concepts correctly. Another dummy variable equal to one was added if the respondent answered all the questions on the knowledge of reverse mortgage presented in the table 3.7 correctly. It includes a dummy variable indicating the presence of the sentence on the certainty that the respondent will never be put under pressure to sell the residence. To control for the bequest motive, it includes a dummy variable indicating if the respondent agreed with the statement that parents should set aside money for their children's inheritance, even if it means somewhat sacrificing their own comfort in retirement. We controlled for the expected financial and care support from the family using the subjective probability that the family would take care of them financially if needed,

and the subjective probability that the family would take up the responsibility of caring for them if they had important ADL limitations. We controlled for the level of attachment to the house using the probability of staying in the current home until they die, and use a dummy variable equal to one if they agreed with the statement that a house is an asset that should only be sold in case of financial hardship. Finally, we controlled for the subjective expected house price growth using a dummy variable equal to one if the respondent expected a growth of more than 5%.

Hence, the coefficient of the log of the *relative fairness* can be interpreted by equation (3.16):

$$\hat{\alpha} = \frac{\partial S}{\partial log(RF)} = \partial S \frac{RF}{\partial RF}. \tag{3.16}$$

To calculate the elasticity at the mean, we divided $\hat{\alpha}$ by the average stated probability of buying (6,36%):

$$\epsilon_{RM}^{buy} = \frac{\partial S}{\bar{S}} \frac{RF}{\partial RF}. \tag{3.17}$$

First, we did this sequence of computations using the total sample. We then repeated this exercise using different subsamples. We estimated the elasticity for a sample composed of respondents who have a basic overall knowledge of reverse mortgages and for a sample composed of those who don't. We also computed elasticity by province, gender and ten-year age group. In each case, a specification was made

using objective, prospective and subjective life tables.

3.5.3 Results

Table 3.10 reports OLS coefficients for the total sample. Table 3.11 reports demand elasticities for the total sample and other subsamples. The *relative fairness* used in the column (1) was computed using the objective life tables, while the *relative fairness* of the column (2) and (3) were computed using prospective life tables from Statistics-Canada and subjective life tables, respectively.

First of all, there was not much difference between the estimations based on objective, prospective or subjective life tables, meaning that the nature of the life table does not determine the stated demand. Therefore, the following discussion will focus on the first column. An increase of one percent of the *relative fairness* significantly increased the probability of contracting a reverse mortgage by 5.21 percentage points. It represents a demand elasticity of 0.819, with a standard deviation of 0.139. As a result, the demand for reverse mortgages in Canada is a little inelastic, but not significantly so. The stated demand for reverse mortgages was significantly larger for men (2.5 percentage points), and lower for retirees (1.9 percentage points). It was also significantly higher for those who still had a traditional mortgage to pay. An explanation could be that respondents who still have mortgages feel less intimidated by mortgage contracts. Another possible explanation is that they are the ones who have more financial needs. Those who have more savings were less interested in reverse mortgages. The bequest motive was a significant factor determining the demand for reverse mortgages. The stated demand for reverse mortgages was significantly higher for those who agreed with the statement that parents should set

aside money for their children's inheritance (1.7 percentage points). This result goes in the opposite direction to the one estimated by Nakajuma & Telyukova (2017). A scenario that could explain this result could be that respondents plan to leave a bequest coming from their nonhousing wealth. Considering that a house is an asset that should only be sold in case of financial hardship was positively and significantly correlated with the stated demand (1.38 percentage points). This result seems to show that reverse mortgages are a solution to those whose attachment to their home prevents them from touching its equity by selling it. Indeed, one can consider that a person experiencing a strong sense of attachment to their house will sell it only as a last resort. Having the opportunity of touching some of the equity of your home, while having the guarantee of being able to stay as long as you want, solves this problem. Finally, a higher expectation of house price growth is significantly increasing the stated demand (1.36 percentage points). This result support the view that Canadians probably do not fully understand how to take advantage of the NNEG.

Table 3.10: Results

	Objective	Prospective	Subjective
log(Relative fairness)	0.0521***	0.0531***	0.0527***
	(0.009)	(0.009)	(0.009)
Age	-0.00124	-0.00124	-0.00124
	(0.001)	(0.001)	(0.001)
Men	0.0252***	0.0252***	0.0252***
	(0.006)	(0.006)	(0.006)
Ontario	0.00238	0.00238	0.00243
	(0.008)	(0.008)	(0.008)
British Columbia	-0.0015	-0.00156	-0.00165
	(0.009)	(0.009)	(0.009)
High school	-0.00983	-0.00979	-0.00985
	(0.025)	(0.025)	(0.025)
University	-0.00947	-0.00939	-0.00948
	(0.025)	(0.025)	(0.025)
Married	-0.01246	-0.01244	-0.01224
	(0.008)	(0.008)	(0.008)
Has kids	-0.00287	-0.00287	-0.00288
	(0.007)	(0.007)	(0.007)
Retired	-0.0185**	-0.0185**	-0.0185**
	(0.008)	(0.008)	(0.008)
log(House value)	-0.00352	-0.00351	-0.00351
	(0.005)	(0.005)	(0.005)
log(Income)	-0.00066	-0.00065	-0.00067
	(0.002)	(0.002)	(0.002)
log(Saving)	-0.00124	-0.00124	-0.00124
	(0.001)	(0.001)	(0.001)
log(Mortgage)	0.1006***	0.1006***	0.1005***
	(0.025)	(0.025)	(0.025)
House Rich & cash poor	0.01175	0.01175	0.01175
	(0.008)	(0.008)	(0.008)
Pension	0.00178	0.00179	0.00179
	(0.006)	(0.006)	(0.006)
Financial literacy	-0.00805	-0.00803	-0.00803
	(0.007)	(0.007)	(0.007)
No pressure	0.00209	0.00207	0.00208
	(0.006)	(0.006)	(0.006)
Bequest motive	0.0172*	0.0172*	0.0173*
	(0.009)	(0.009)	(0.009)
Reverse mortgage knowledge	0.00235	0.00234	0.00234
	(0.006)	(0.006)	(0.006)
Family support if ADL	0.00531	0.00528	0.00529
	(0.011)	(0.011)	(0.011)
Family support if financial need	0.00939	0.00939	0.00941
	(0.011)	(0.011)	(0.011)
Probability of staying home until death	0.00421	0.00419	0.00416
	(0.009)	(0.009)	(0.009)
Sell only if financial hardship	0.0138**	0.0138**	0.0138**
	(0.006)	(0.006)	(0.006)
Expected growth of more than 5%	0.0136**	0.0136**	0.0136**
	(0.006)	(0.006)	(0.006)
Constant	0.1908**	0.1909**	0.1908**
	(0.077)	(0.077)	(0.077)
N	10700	10700	10700
R2	0.0406	0.0408	0.0407

Column (1) presents OLS coefficients where the relative fairness has been computed using the objective life tables from microsimulations. Column (2) presents OLS coefficients where the *relative fairness* has been computed using the prospective life tables from Statistics Canada. Column (3) presents OLS coefficients where the *relative fairness* has been computed using the subjective life tables. Standard deviations are corrected for clustering at individual level. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.11 shows the elasticity of the total sample and of all the subsamples. In each case, we test for the null hypothesis that the elasticity is equal to one. The OLS coefficients of each subsample are reported in Tables C.1, C.2 and C.3 in Appendix C.1. Once again, there was not much difference between elasticity computed using objective, prospective and subjective life tables. We first compared the sample of those who had heard of and could identify the name reverse mortgage among other products with those who couldn't. Those with a better knowledge of reverse mortgages had an elastic demand (1.184), while those with a worse knowledge had a significantly inelastic demand (0.527). Therefore, the level of basic knowledge about reverse mortgages seems to be a key determinant of demand elasticity. We then compared elasticity between provinces. Respondents from British Columbia had an elastic demand (1.333) while those from Ontario had an inelastic demand (0.863). Respondents from Quebec had a significantly inelastic demand (0.35). The more plausible explanation for this result is related to the level of knowledge since respondents from Quebec are also those with the lower knowledge of reverse mortgages. Among the three provinces, the province of Quebec is the one for which the reverse mortgage offer was implemented the latest. It is therefore likely that the use of such services is not part of the culture of that province. When we compare the elasticity between genders, we see that men had an inelastic demand (0.725) while women had a demand elasticity close to the unitary elasticity (1.017). Finally, respondents aged between 55 and 64 had a demand elasticity close to the unitary elasticity (0.987), while those aged between 65 and 75 had an inelastic demand (0.661).

Table 3.11: Elasticity

	Objective	Prospective	Subjective
Total sample	0.8193	0.8336	0.8283
	(0.139)	(0.14)	(0.141)
	N=10,700	N=10,700	N=10,700
Know	1.1838	1.2149	1.2222
	(0.216)	(0.218)	(0.221)
	N=5,145	N=5,145	N=5,145
Don't know	0.5265***	0.5261***	0.5069***
	(0.181)	(0.181)	(0.18)
	N=5,555	N=5,555	N=5,555
British Columbia	1.333	1.3765	1.3585
	(0.282)	(0.284)	(0.286)
	N=3,690	N=3,690	N=3,690
Ontario	0.8625	0.8624	0.8643
	(0.224)	(0.224)	(0.224)
	N=3,565	N=3,565	N=3,565
Quebec	0.3496***	0.3504***	0.3473***
	(0.238)	(0.238)	(0.237)
	N=3,445	N=3,445	N=3,445
Men	0.7253	0.7382	0.7433
	(0.178)	(0.177)	(0.178)
	N=5,295	N=5,295	N=5,295
Women	1.0168	1.0307	1
	(0.215)	(0.219)	(0.22)
	N=5,405	N=5,405	N=5,405
Age 55-64	0.9865	1.0009	0.9864
	(0.19)	(0.192)	(0.192)
	N = 5,475	N = 5,475	N = 5,475
Age 65-75	0.6608	0.6725	0.6812
	(0.21)	(0.209)	(0.212)
	N = 5,225	N = 5,225	N = 5,225

Note: Column (1) presents OLS coefficients where the relative fairness has been computed using the objective life tables from microsimulations. Column (2) presents OLS coefficients where the *relative fairness* has been computed using the prospective life tables from Statistics Canada. Column (3) presents OLS coefficients where the *relative fairness* has been computed using the subjective life tables. Estimates are corrected for clustering at individual level. Control variables are the same as those reported in Table 3.10. *Know* refers to a sample grouping respondents who had heard of and could identify the name "reverse mortgage" among other products, while *Don't know* refers to a sample grouping those who couldn't. Standard errors in parentheses. We tested for the null hypothesis that the elasticity is equal to one. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

3.6 Conclusion

The no-negative equity guarantee (NNEG) is the main feature that differentiates reverse mortgages from a home equity line of credit. By offering a NNEG, the reverse mortgage lender exposes himself to the risk that the amount of debt will exceed the resale value of the home. This risk comes from the longevity risk of the borrower, as well as the risk of downward variation in house prices. For a given loan-to-value ratio of the house that is lent, the lender charges a mortgage insurance premium to cover the losses related to the NNEG.

In this chapter, we used a pricing model to calculate actuarially fair mortgage insurance premiums that should be charged to cover the losses related to the NNEG in Canada. Given the size of the loans that are granted in the Canadian market, we found that actuarially fair premiums are approximately zero. This result implies that the lenders do not take any risks by offering a NNEG, making it a missing feature in the Canadian market. It could explain the low demand for reverse mortgages in Canada, since it is difficult for a buyer to differentiate a reverse mortgage from a home equity line of credit and to justify a higher interest rate.

We then assessed the level of knowledge Canadians have about reverse mortgages and conducted a stated-choice experiment where respondents were asked to rate various reverse mortgage products. Our analysis shows that a majority of Canadians do not even have basic knowledge about this financial product. We found that reverse mortgages could be a solution for those whose attachment to their home prevents them from accessing its equity by selling it. However, Canadians do not seem to be able to distinguish in which situations it is advantageous to obtain a reverse mortgage. Indeed, the stated demand was positively correlated with the subjective

expectation of house price growth. Finally, we found that the demand elasticity of the entire Canadian market was inelastic. However, the demand elasticity of those who had a basic knowledge of reverse mortgages was elastic, while the demand for those who did not know the product at all was significantly inelastic. As a result, a combination of price adjustment and reverse mortgage education could be a good way to expand the size of the Canadian market and could represent a win-win solution for both lenders and borrowers.

APPENDIX A

INCOME VOLATILITY, HEALTH AND WELL-BEING

A.1 Health Variables

1. Mental health: "In the last month, how often ('never,' 'rarely,' 'sometimes,' 'most of the time,' or 'all the time') did you feel. . . ""':

   (a) tired out for no good reason?

   (b) nervous?

   (c) so nervous that nothing could calm down?

   (d) desperate?

   (e) restless or be unable to stand still?

   (f) so restless that could not stand still?

   (g) sad/depressed?

   (h) so depressed that nothing could cheer up?

   (i) everything was an effort?

   (j) good for nothing?

2. Life satisfaction: "What feelings do you currently have about your life in general: very unsatisfied (0) [. . .] very satisfied (10)?"

3. Self-assessed health: "Would you say your health in general is . . . : excellent, very good, good, fair or poor?";

A.2 Information Window on Income

Note: A respondent who is 75 years old in 2012 was 45 years old in 1982 and 55 years old in 1992. Thus, we end up with 11 observations on their annual income .

Figure A.1: Information Window on Income

Age \ Year	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982
50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	
51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	
52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	
53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	
54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	
55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	
56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	
57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	
58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	
59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	
60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	
61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	
62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	
64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	
65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	
66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	
67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	
68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	
69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	
70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	
71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	
72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	
73	72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	
74	73	72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	
75	74	73	72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	

APPENDIX B

CONSUMPTION AND HEALTH IN OLD AGE

Table B.1: Spending category and variable names across waves

Category	Variable	CAMS03	CAMS05-17
Durable (do not include auto purchases)	Refrigerator	B2	B2
	Washer/Dryer	B3	B3
	Diswasher	B4	B4
	Television	B5	B5
	Computer	B6	B6
Housing	Mortgage	B13	B18
	Home/Rent Ins	B7	B7
	Property Tax	B8	B8
	Rent	B14	B19
	Home Repair Supplies	B24	B13
	Home Repair Services	B25	B14
Transportation	Auto Insurance	B9	B9
	Gasoline	B38	B39
	Vehicle Services	B10	B10
	Car Payments	B19	B24
Utilities	Electricity	B15	B20
	Water	B16	B21
	Heat	B17	B22
	Phone/Cable/Internet	B18	B23
Donations	Contributions	B34	B16
	Gifts	B35	B17
Food	Food/Drink Grocery	B36	B37
	Dining out	B37	B38
Leisure	Vacations	B12	B12
	Tickets	B31	B34
	Hobbies	B33	B36
	Sports Equipment	B32	B35
Household Supplies & Services	Housekeeping Supplies	B20	B25
	Yard Supplies	B22	B27
	Housekeeping Services	B21	B26
	Gardening/Yard Services	B23	B28
Clothing	Clothing	B26	B29
Health	Health Insurance	B11	B11
	Drugs	B28	B31
	Health Services	B29	B32
	Medical Supplies	B30	B33
	Personal Care	B27	B30

Note: We created spending categories based on CAMS variables. A total nondurable spending was also created. This variable includes the sum of all the variables excluding the durable spending categories. We dropped the 2001 wave because of differences in spending categories.

APPENDIX C

C.1 Regression Tables

Table C.1: Results using objective life tables

	Know	Don't know	B.C.	Ont.	Que.	Men	Women	Age 55-64	Age 65-75
log(Relative fairness)	0.0724***	0.0345***	0.0697***	0.0566***	0.02338	0.0577***	0.0493***	0.0652***	0.0396***
	(0.013)	(0.012)	(0.015)	(0.015)	(0.016)	(0.014)	(0.01)	(0.013)	(0.013)
Age	-0.00076	-0.0017*	-0.00104	-0.0029***	-0.00033	-0.0018*	-0.00088		
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)		
Men	0.0294***	0.0245***	0.01578	0.0307***	0.0328***			0.0261***	0.027***
	(0.009)	(0.009)	(0.01)	(0.011)	(0.011)			(0.009)	(0.008)
Ontario	0.01343	-0.00456				-0.00235	0.00809	0.00907	-0.00415
	(0.013)	(0.01)				(0.012)	(0.01)	(0.011)	(0.012)
British Columbia	0.00731	-0.00662				-0.0118	0.00916	-0.00129	-0.00346
	(0.013)	(0.012)				(0.013)	(0.01)	(0.013)	(0.012)
High school	-0.00955	-0.00967	0.00214	0.02825	-0.06423	-0.02817	0.00247	0.0434**	-0.04529
	(0.042)	(0.029)	(0.027)	(0.025)	(0.058)	(0.04)	(0.019)	(0.02)	(0.036)
University	-0.00632	-0.0107	0.01167	0.01391	-0.06267	-0.02822	0.00347	0.036*	-0.03809
	(0.043)	(0.029)	(0.027)	(0.024)	(0.058)	(0.04)	(0.018)	(0.019)	(0.036)
Married	-0.01728	-0.00829	-0.00983	-0.02066	-0.00477	-0.02035	-0.00866	-0.00226	-0.0237**
	(0.012)	(0.01)	(0.013)	(0.013)	(0.014)	(0.013)	(0.009)	(0.011)	(0.01)
Has kids	-0.00337	-0.00448	0.00406	-0.01402	-0.00171	0.00942	-0.00939	-0.0092	0.00026
	(0.01)	(0.01)	(0.012)	(0.014)	(0.012)	(0.011)	(0.01)	(0.01)	(0.01)
Retired	-0.028**	-0.01124	-0.01857	-0.01289	-0.0255*	-0.00773	-0.0241**	-0.0183**	-0.02055
	(0.012)	(0.011)	(0.015)	(0.013)	(0.015)	(0.013)	(0.01)	(0.009)	(0.014)
log(House value)	-0.00067	-0.0033	-0.00578	0.01213	-0.0191**	0.00075	-0.00429	-0.00227	-0.00388
	(0.008)	(0.006)	(0.008)	(0.01)	(0.009)	(0.008)	(0.007)	(0.007)	(0.007)
log(Income)	-0.00741	0.00275	-0.00402	-0.0033	0.007	-0.00449	0.00246	-0.00122	0.00056
	(0.005)	(0.003)	(0.004)	(0.004)	(0.005)	(0.004)	(0.003)	(0.005)	(0.003)
log(Saving)	-0.00188	-0.00053	-0.004**	-0.00068	0.00154	-0.00301	0.00037	-0.00071	-0.00226
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)
log(Mortgage)	0.0886***	0.1169***	0.0934**	0.132***	0.1049**	0.04476	0.1565***	0.1469***	0.0227
	(0.034)	(0.036)	(0.044)	(0.046)	(0.041)	(0.031)	(0.037)	(0.034)	(0.034)
House rich & cash poor	0.00822	0.01554	-0.00287	0.01303	0.02336	0.00853	0.01083	0.01426	0.0101
	(0.011)	(0.011)	(0.014)	(0.014)	(0.015)	(0.011)	(0.011)	(0.012)	(0.01)
Pension	0.0019	0.00273	0.00596	0.00873	-0.00996	0.00065	0.00309	0.00257	7e-05
	(0.009)	(0.009)	(0.011)	(0.011)	(0.013)	(0.01)	(0.008)	(0.01)	(0.008)
Financial literacy	-0.01108	-0.0063	0.00192	-0.00523	-0.0217**	-0.00803	-0.00735	-0.00643	-0.00963
	(0.01)	(0.009)	(0.011)	(0.012)	(0.011)	(0.011)	(0.009)	(0.009)	(0.009)
No pressure	-0.00454	0.00614	0.00702	-0.00788	0.00979	-0.00845	0.01119	-0.00546	0.01051
	(0.008)	(0.008)	(0.01)	(0.01)	(0.011)	(0.009)	(0.007)	(0.009)	(0.008)
Bequest motive	0.02227	0.0137	0.0332**	0.01559	0.00377	0.028**	0.00195	0.0293**	0.00811
	(0.014)	(0.012)	(0.016)	(0.013)	(0.017)	(0.013)	(0.011)	(0.013)	(0.012)
Knowledge			0.005	0.01302	-0.01118	0.00688	-0.00059	-0.00034	0.00506
			(0.01)	(0.011)	(0.012)	(0.009)	(0.009)	(0.009)	(0.009)
Family support if ADL	0.02173	-0.01128	0.0172	0.0341*	-0.0284	0.01302	0.00273	0.0318**	-0.01486
	(0.014)	(0.018)	(0.016)	(0.018)	(0.023)	(0.015)	(0.017)	(0.015)	(0.016)
Family support if financial need	0.00014	0.0196	-0.01329	-0.01207	0.0538**	0.01872	-0.00243	-0.01127	0.02296
	(0.012)	(0.019)	(0.015)	(0.016)	(0.023)	(0.015)	(0.016)	(0.014)	(0.015)
Probability of staying home until death	-0.00494	0.01119	0.00498	-0.00447	0.0084	0.00162	0.006	-0.00545	0.01402
	(0.015)	(0.012)	(0.014)	(0.018)	(0.016)	(0.014)	(0.013)	(0.013)	(0.013)
Sell only if financial hardship	0.0031	0.0239***	0.00608	0.0174*	0.0187*	0.018**	0.01308	0.01338	0.0133*
	(0.008)	(0.008)	(0.009)	(0.01)	(0.01)	(0.009)	(0.008)	(0.009)	(0.008)
Expected growth of more than 5%	0.0286***	0.00103	0.0204**	0.0259**	-0.00523	0.0346***	-0.00233	0.01157	0.0175**
	(0.009)	(0.009)	(0.009)	(0.011)	(0.012)	(0.01)	(0.008)	(0.01)	(0.008)
Constant	0.2141*	0.15846	0.2599**	0.07727	0.266*	0.2586**	0.12466	0.04913	0.14354
	(0.122)	(0.1)	(0.117)	(0.152)	(0.139)	(0.124)	(0.091)	(0.098)	(0.092)
N	5145	5555	3690	3565	3445	5295	5405	5475	5225
R2	0.0544	0.0411	0.0587	0.0633	0.0536	0.0426	0.0541	0.0543	0.037

Note: Control variables are the same as those reported in Table 3.10. *Know* refers to a sample grouping respondents who had heard of and could identify the name "reverse mortgage" among other products, while *Don't know* refers to a sample grouping those who couldn't. Estimates were corrected for clustering at individual level. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table C.2: Results using prospective life tables

	Know	Don't know	B.C.	Ont.	Que.	Men	Women	Age 55-64	Age 65-75
log(Relative fairness)	0.0743***	0.0345***	0.072***	0.0566***	0.02345	0.0587***	0.05***	0.0662***	0.0403***
	(0.013)	(0.012)	(0.015)	(0.015)	(0.016)	(0.014)	(0.011)	(0.013)	(0.013)
Age	-0.00077	-0.0017*	-0.00105	-0.0029***	-0.00033	-0.0018*	-0.00088		
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)		
Men	0.0294***	0.0245***	0.01571	0.0307***	0.0328***			0.0261***	0.027***
	(0.009)	(0.009)	(0.01)	(0.011)	(0.011)			(0.009)	(0.008)
Ontario	0.01344	-0.00456				-0.00235	0.0081	0.00906	-0.00416
	(0.013)	(0.01)				(0.012)	(0.01)	(0.011)	(0.012)
British Columbia	0.0072	-0.00664				-0.01189	0.00913	-0.00132	-0.00354
	(0.013)	(0.012)				(0.013)	(0.01)	(0.013)	(0.012)
High school	-0.00945	-0.00965	0.00239	0.02824	-0.06422	-0.02816	0.00259	0.0433**	-0.04521
	(0.042)	(0.029)	(0.027)	(0.025)	(0.058)	(0.04)	(0.019)	(0.02)	(0.036)
University	-0.00615	-0.01065	0.01206	0.0139	-0.06265	-0.02818	0.00365	0.036*	-0.03797
	(0.043)	(0.029)	(0.027)	(0.024)	(0.058)	(0.04)	(0.018)	(0.019)	(0.036)
Married	-0.01722	-0.00829	-0.00969	-0.02066	-0.00478	-0.02026	-0.00868	-0.00231	-0.0237**
	(0.012)	(0.01)	(0.013)	(0.013)	(0.014)	(0.013)	(0.009)	(0.011)	(0.01)
Has kids	-0.00334	-0.00449	0.00408	-0.01402	-0.00171	0.00944	-0.00941	-0.0092	0.00028
	(0.01)	(0.01)	(0.012)	(0.014)	(0.012)	(0.011)	(0.01)	(0.01)	(0.01)
Retired	-0.0279**	-0.01123	-0.01853	-0.01289	-0.0255*	-0.00773	-0.0241**	-0.0182**	-0.02052
	(0.012)	(0.011)	(0.015)	(0.013)	(0.015)	(0.013)	(0.01)	(0.009)	(0.014)
log(House value)	-0.00064	-0.00329	-0.00573	0.01212	-0.0191**	0.00078	-0.0043	-0.00224	-0.00388
	(0.008)	(0.006)	(0.008)	(0.01)	(0.009)	(0.008)	(0.007)	(0.007)	(0.007)
log(Income)	-0.00739	0.00276	-0.00398	-0.00329	0.007	-0.00449	0.00248	-0.00121	0.00057
	(0.005)	(0.003)	(0.004)	(0.004)	(0.005)	(0.004)	(0.003)	(0.005)	(0.003)
log(Saving)	-0.00188	-0.00053	-0.004**	-0.00068	0.00154	-0.00301	0.00037	-0.00071	-0.00225
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)
log(Mortgage)	0.0884***	0.117***	0.0933**	0.132***	0.1049**	0.04474	0.1565***	0.1469***	0.02272
	(0.034)	(0.036)	(0.044)	(0.046)	(0.041)	(0.031)	(0.037)	(0.034)	(0.034)
House rich & cash poor	0.00821	0.01554	-0.00287	0.01303	0.02336	0.00853	0.01083	0.01424	0.01011
	(0.011)	(0.011)	(0.014)	(0.014)	(0.015)	(0.011)	(0.011)	(0.012)	(0.01)
Pension	0.0019	0.00274	0.00602	0.00873	-0.00996	0.00065	0.0031	0.00259	7e-05
	(0.009)	(0.009)	(0.011)	(0.011)	(0.013)	(0.01)	(0.008)	(0.01)	(0.008)
Financial literacy	-0.01108	-0.00627	0.00199	-0.00523	-0.0217**	-0.00804	-0.00731	-0.00639	-0.00962
	(0.01)	(0.009)	(0.011)	(0.012)	(0.011)	(0.011)	(0.009)	(0.009)	(0.009)
No pressure	-0.0046	0.00614	0.00692	-0.00789	0.00979	-0.00848	0.01117	-0.00548	0.01048
	(0.008)	(0.008)	(0.01)	(0.01)	(0.011)	(0.009)	(0.007)	(0.009)	(0.008)
Bequest motive	0.02224	0.0137	0.0332**	0.01558	0.00376	0.028**	0.00195	0.0293**	0.00811
	(0.014)	(0.012)	(0.016)	(0.013)	(0.017)	(0.013)	(0.011)	(0.013)	(0.012)
Knowledge			0.00497	0.01302	-0.01118	0.00686	-0.0006	-0.00038	0.00508
			(0.01)	(0.011)	(0.012)	(0.009)	(0.009)	(0.009)	(0.009)
Family support if ADL	0.02167	-0.01128	0.01711	0.0341*	-0.02839	0.01299	0.0027	0.0318**	-0.01489
	(0.014)	(0.018)	(0.016)	(0.018)	(0.023)	(0.015)	(0.017)	(0.015)	(0.016)
Family support if financial need	0.00015	0.0196	-0.01329	-0.01208	0.0538**	0.0187	-0.00241	-0.01125	0.02296
	(0.012)	(0.019)	(0.015)	(0.016)	(0.023)	(0.015)	(0.016)	(0.014)	(0.015)
Probability of staying home until death	-0.00499	0.01119	0.0049	-0.00447	0.0084	0.00161	0.00599	-0.00546	0.01401
	(0.015)	(0.012)	(0.014)	(0.018)	(0.016)	(0.014)	(0.013)	(0.013)	(0.013)
Sell only if financial hardship	0.00313	0.0239***	0.00618	0.0174*	0.0187*	0.018**	0.01313	0.01342	0.0133*
	(0.008)	(0.008)	(0.009)	(0.01)	(0.01)	(0.009)	(0.008)	(0.009)	(0.008)
Expected growth of more than 5%	0.0285***	0.00102	0.0203**	0.0259**	-0.00523	0.0346***	-0.00233	0.01156	0.0175**
	(0.009)	(0.009)	(0.009)	(0.011)	(0.012)	(0.01)	(0.008)	(0.01)	(0.008)
Constant	0.2141*	0.15836	0.2592**	0.0773	0.266*	0.2586**	0.12481	0.04898	0.14344
	(0.122)	(0.1)	(0.117)	(0.152)	(0.139)	(0.124)	(0.091)	(0.098)	(0.092)
N	5145	5555	3690	3565	3445	5295	5405	5475	5225
R2	0.0548	0.0411	0.0593	0.0633	0.0536	0.0428	0.0542	0.0545	0.0371

Note: Control variables are the same as those reported in Table 3.10. *Know* refers to a sample grouping respondents who had heard of and could identify the name "reverse mortgage" among other products, while *Don't know* refers to a sample grouping those who couldn't. Estimates were corrected for clustering at individual level. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table C.3: Results using subjective life tables

	Know	Don't know	B.C.	Ont.	Que.	Men	Women	Age 55-64	Age 65-75
log(Relative fairness)	0.0748***	0.0332***	0.0711***	0.0567***	0.02323	0.0591***	0.0485***	0.0652***	0.0408***
	(0.014)	(0.012)	(0.015)	(0.015)	(0.016)	(0.014)	(0.011)	(0.013)	(0.013)
Age	-0.00077	-0.0017*	-0.00104	-0.0029***	-0.00033	-0.0018*	-0.00088		
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)		
Men	0.0293***	0.0245***	0.01563	0.0307***	0.0328***			0.026***	0.027***
	(0.009)	(0.009)	(0.01)	(0.011)	(0.011)			(0.009)	(0.008)
Ontario	0.01347	-0.00451				-0.0023	0.00814	0.00916	-0.00414
	(0.013)	(0.01)				(0.012)	(0.01)	(0.011)	(0.012)
British Columbia	0.00698	-0.00663				-0.012	0.00907	-0.00132	-0.00368
	(0.013)	(0.012)				(0.013)	(0.01)	(0.013)	(0.012)
High school	-0.00962	-0.00962	0.00201	0.02824	-0.06422	-0.02812	0.00244	0.0434**	-0.04534
	(0.042)	(0.029)	(0.027)	(0.025)	(0.058)	(0.04)	(0.019)	(0.02)	(0.036)
University	-0.00645	-0.01063	0.01156	0.0139	-0.06264	-0.02821	0.0035	0.036*	-0.03811
	(0.043)	(0.029)	(0.027)	(0.024)	(0.058)	(0.04)	(0.018)	(0.019)	(0.036)
Married	-0.01685	-0.0082	-0.00892	-0.02063	-0.00477	-0.01999	-0.00852	-0.00211	-0.0235**
	(0.012)	(0.01)	(0.013)	(0.013)	(0.014)	(0.013)	(0.009)	(0.011)	(0.01)
Has kids	-0.0034	-0.00448	0.00394	-0.014	-0.0017	0.00942	-0.00942	-0.00912	0.00021
	(0.01)	(0.01)	(0.012)	(0.014)	(0.012)	(0.011)	(0.01)	(0.01)	(0.01)
Retired	-0.0279**	-0.01125	-0.01858	-0.01289	-0.0255*	-0.00769	-0.0241**	-0.0182**	-0.02052
	(0.012)	(0.011)	(0.015)	(0.013)	(0.015)	(0.013)	(0.01)	(0.009)	(0.014)
log(House value)	-0.0006	-0.00331	-0.00571	0.01212	-0.0191**	0.00076	-0.00427	-0.00232	-0.00383
	(0.008)	(0.006)	(0.008)	(0.01)	(0.009)	(0.008)	(0.007)	(0.007)	(0.007)
log(Income)	-0.00739	0.00274	-0.00403	-0.0033	0.007	-0.00449	0.00244	-0.00123	0.00056
	(0.005)	(0.003)	(0.004)	(0.004)	(0.005)	(0.004)	(0.003)	(0.005)	(0.003)
log(Saving)	-0.00188	-0.00053	-0.004**	-0.00068	0.00154	-0.003	0.00037	-0.00071	-0.00225
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)
log(Mortgage)	0.0883***	0.117***	0.093**	0.1321***	0.1049**	0.04475	0.1563***	0.1467***	0.02266
	(0.034)	(0.036)	(0.044)	(0.046)	(0.041)	(0.031)	(0.037)	(0.034)	(0.034)
House rich & cash poor	0.0082	0.01555	-0.00291	0.01304	0.02337	0.00855	0.01083	0.01421	0.01013
	(0.011)	(0.011)	(0.014)	(0.014)	(0.015)	(0.011)	(0.011)	(0.012)	(0.01)
Pension	0.00196	0.00274	0.00605	0.00874	-0.00996	0.00066	0.0031	0.00263	5e-05
	(0.009)	(0.009)	(0.011)	(0.011)	(0.013)	(0.01)	(0.008)	(0.01)	(0.008)
Financial literacy	-0.01102	-0.00628	0.00204	-0.00523	-0.0217**	-0.00799	-0.00732	-0.00637	-0.00963
	(0.01)	(0.009)	(0.011)	(0.012)	(0.011)	(0.011)	(0.009)	(0.009)	(0.009)
No pressure	-0.00455	0.00614	0.00693	-0.00788	0.00979	-0.00844	0.01116	-0.00548	0.01049
	(0.008)	(0.008)	(0.01)	(0.01)	(0.011)	(0.009)	(0.007)	(0.009)	(0.008)
Bequest motive	0.0222	0.01377	0.0333**	0.01558	0.00376	0.028**	0.00207	0.0294**	0.00813
	(0.014)	(0.012)	(0.016)	(0.013)	(0.017)	(0.013)	(0.011)	(0.013)	(0.012)
Knowledge			0.00496	0.01301	-0.01118	0.00687	-0.00062	-0.00036	0.00507
			(0.01)	(0.011)	(0.012)	(0.009)	(0.009)	(0.009)	(0.009)
Family support if ADL	0.02174	-0.01128	0.01713	0.0341*	-0.02838	0.01304	0.00269	0.0319**	-0.01496
	(0.014)	(0.018)	(0.016)	(0.018)	(0.023)	(0.015)	(0.017)	(0.015)	(0.016)
Family support if financial need	0.00026	0.01958	-0.01326	-0.01206	0.0538**	0.01872	-0.00241	-0.01133	0.02304
	(0.012)	(0.019)	(0.015)	(0.016)	(0.023)	(0.015)	(0.016)	(0.014)	(0.015)
Probability of staying home until death	-0.00484	0.01111	0.00484	-0.00449	0.0084	0.00162	0.00592	-0.00546	0.01395
	(0.015)	(0.012)	(0.014)	(0.018)	(0.016)	(0.014)	(0.013)	(0.013)	(0.013)
Sell only if financial hardship	0.00304	0.0239***	0.00612	0.0174*	0.0187*	0.018**	0.01313	0.01337	0.0133*
	(0.008)	(0.008)	(0.009)	(0.01)	(0.01)	(0.009)	(0.008)	(0.009)	(0.008)
Expected growth of more than 5%	0.0285***	0.00098	0.0202**	0.0259**	-0.00524	0.0346***	-0.00238	0.01151	0.0174**
	(0.009)	(0.009)	(0.009)	(0.011)	(0.012)	(0.01)	(0.008)	(0.01)	(0.008)
Constant	0.2136*	0.1583	0.2593**	0.07735	0.2662*	0.2588**	0.12454	0.04974	0.14291
	(0.122)	(0.1)	(0.116)	(0.152)	(0.139)	(0.124)	(0.091)	(0.098)	(0.092)
N	5145	5555	3690	3565	3445	5295	5405	5475	5225
R2	0.0549	0.0409	0.0591	0.0633	0.0536	0.0429	0.054	0.0543	0.0372

Note: Control variables are the same as those reported in Table 3.10. *Know* refers to a sample grouping respondents who had heard of and could identify the name "reverse mortgage" among other products, while *Don't know* refers to a sample grouping those who couldn't. Estimates were corrected for clustering at individual level. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

C.2 Survey

INSTRUCTIONS INCLUDED WITH THIS ANONYMOUS QUESTIONNAIRE

FINANCIAL PRODUCTS FOR RETIREMENT

The following pages contain an anonymous questionnaire, which we invite you to complete. This questionnaire was developed as part of a research project at HEC Montréal.

Since your first impressions best reflect your true opinions, we would ask that you please answer the questions included in this questionnaire without any hesitation. We ask, however, that you take the time needed to consider certain questions on knowledge, which might involve concepts with which you are less familiar. There is no time limit for completing the questionnaire, although we have estimated that it should take approximately 15 minutes.

The information collected will be anonymous and will remain strictly confidential. It will be used solely for the advancement of knowledge and the dissemination of the overall results in academic or professional forums.

The online data collection provider agrees to refrain from disclosing any personal information (or any other information concerning participants in this study) to any other users or to any third party, unless the respondent expressly agrees to such disclosure or unless such disclosure is required by law.

You are free to refuse to participate in this project and you may decide to stop answering the questions at any time. By completing this questionnaire, you will be considered as having given your consent to participate in our research project and to the potential use of data collected from this questionnaire in future research. Since the questionnaire is anonymous, you will no longer be able to withdraw from the research project once you have completed the questionnaire because it will be impossible to determine which of the answers are yours.

If you have any questions about this research, please contact the principal investigator, Pierre-Carl Michaud, at the telephone number or email address indicated below.

HEC Montréal's Research Ethics Board has determined that the data collection related to this study meets the ethics standards for research involving humans. If you have any questions related to ethics, please contact the REB secretariat at (514) 340-6051 or by email at cer@hec.ca.

Thank you for your valuable cooperation!

Pierre-Carl Michaud
Professor
Department of Applied Economics
HEC Montréal
514-340-6466
pierre-carl.michaud@hec.ca

Section 1: Background

A Are you…?

1.1. Male

1.2. Female

B How old are you?

2.1. *Please Enter (terminate if not* 55-75 INCLUSIVELY)

[PN: MUST ENTER THE 2 CHARACTERS]

QC. Which province or territory do you live in?

1.1. British Columbia

1.2. Alberta [Screen Out]

1.3. Saskatchewan [Screen Out]

1.4. Manitoba [Screen Out]

1.5. Ontario

1.6. Quebec

1.7. New Brunswick [Screen Out]

1.8. Nova Scotia [Screen Out]

1.9. Prince Edward Island [Screen Out]

1.10. Newfoundland [Screen Out]

1.11. Northwest Territories [Screen Out]

1.12. Nunavut [Screen Out]

1.13. Yukon [Screen Out]

1.14. None of the above [Screen Out]

Q0 Can you please enter the first 3 characters of your postal code? Please type in below [PN: MUST ENTER FIRST 3 CHARACTERS] *FSAs validated with FSA file

Q1 What is the highest degree, certificate or diploma you have obtained?

1 Less than high school diploma or its equivalent

2 High school diploma or a high school equivalency certificate

3 Trade certificate or diploma

4 College, CEGEP or other non-university certificate or diploma (other than trades certificates or diplomas)

5 University certificate or diploma below the bachelor's level

6 Bachelor's degree (e.g. B.A., B.Sc., LL.B.)

7 University degree above the bachelor's level

Q2 What is your marital status?

1 married

2 living common-law

3 widowed

4 separated

5 divorced
6 single, never married
IF Q2 ==1,2
    Q2a How old is your partner (spouse)?
    Numeric (>0)
END IF

Q3 Do you have children?
1 Yes
2 No
IF Q3==1 ask Q3b
IF Q3 = 2 skip to Q4

Q3b Have you experienced a loss of a child?
1 Yes
2 No

IF Q3b = 1 ask Q3a
IF Q3b = 2 ask Q3c

    Q3a How many of your children are alive today?
    Numeric (>=0)

Q3c How many children do you have?
Numeric (>=0)

END IF

Q4 For 2016, what is your best estimate of the total income received by all members of your household, from all sources, before taxes and deductions?
Numeric (>0)
9999999 Don't know or prefer not to say
IF Q4==9999999
    Q4a Is it more than $60,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
    IF Q4a==1
        Q4b Is it less than $120,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
        IF Q4b == 1
            Q4c Is it more than $90,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
        END IF
    ELSE IF Q4a==2
        Q4d Is it more than $30,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
    END IF
END IF

Q5 Do you consider yourself retired?

1 Yes
2 No
IF Q5==2
Q5a What is your best estimate of what total income received by all members of your household will be once you are fully retired, as a fraction of your current income?
Numeric (0%-200%)
9999999 Don't know
IF Q5a==9999999
Q5b Is it more than 50%? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
IF Q5b==1
Q5c Is it less than 75%? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
IF Q5c == 1
Q5d Is it more than 62.5%? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
ELSE IF Q5c == 2
Q5e Is it less than 87.5%? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
END IF
ELSE IF Q5b==2
Q5f Is it more than 25%? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
IF Q5f == 1
Q5d Is it more than 37.5%? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
ELSE IF Q5f == 2
Q5e Is it less than 12.5%? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
END IF
END IF
END IF
END IF

Q6 Do you own your primary residence?
1 Yes
2 No
IF Q6==1
Q6a Which set of property type best fits your primary residence?
1 Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link home / Semi-Detached.
2 Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex, Triplex or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home
3 Condo-Townhouse / Mobile Home / Condo – Apartment Style
7777777 Don't know

Q7 What is the current market value of your residence?
Numeric (>0)
9999999 Don't know or prefer not to say
IF Q7==9999999

Q7a Is it more than $300,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
IF Q7a==1
Q7b Is it less than $600,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
IF Q7b == 1
Q7c Is it more than $450,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
ELSE IF Q7b ==2
Q7d Is it less than $750,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
IF Q7d == 2
Q7e Is it more than $900,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
END IF
END IF
ELSE IF Q7a==2
Q7f Is it more than $150,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
END IF
END IF

Q8 What proportion of the current market value of your residence do you still owe on your mortgage?
Numeric (0%-200%)
9999999 Don't know or prefer not to say
IF Q8 == 9999999
Q8a Is it more than 50%? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
IF Q8a == 1
Q8b Is it less than 75 %? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
IF Q8b == 1
Q8c Is it more than 62.5%? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
ELSE IF Q8b == 2
Q8d Is it more than 87.5%? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
END IF
END IF

ELSE IF Q8a == 2
Q8e Is it less than 25 % 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
IF Q8e == 1
Q8f Is it more than 12.5%? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
IF Q8f == 2

Q8g Is it less than 5%? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
END IF
ELSE IF Q8e == 2
Q8h Is it more than 37.5%? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know

END IF
END IF
END IF
END IF

Q9 We are interested in your pension plan and its nature, if you have one. Do you currently contribute to, or receive benefits from (in the form of regular payments), an employer-provided pension plan?
1 Yes
2 No
3 Don't Know
IF Q9==1
Q9a Do you agree with the following statement: "I have/expect to have sufficient pension income"?
1 Completely disagree
2 Disagree
3 Somewhat disagree
4 Neither agree nor disagree
5 Somewhat agree
6 Agree
7 Completely agree
END IF

Q10 What is your best estimate of how much you have accumulated in Registered Retirement Savings Plans (RRSPs), Tax-Free Savings Accounts (TFSAs) and other non-employer provided savings accounts?
Numeric
9999999 Don't know or prefer not to say
IF Q10==9999999
Q10a Is it more than $50,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
IF Q10a==1
Q10b Is it less than $200,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
ELSE IF Q10a==2
Q10c Is it more than $10,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
END IF
END IF

Q11 Looking at the following list of health conditions, has a doctor ever said you suffered from:
[Check any of:]
1 Heart disease
2 Stroke

3 Lung disease
4 Diabetes
5 Hypertension
6 Depression or other mental health problems
7 Cancer
8 None of the above

Q12 At the present time, do you smoke cigarettes daily, occasionally or not at all?
1 Daily
2 Occasionally
3 Not at all
IF Q12==1 GOTO Q13
ELSE IF Q12==2,3
    Q12a Have you ever smoked cigarettes daily?
    1 Yes
    2 No
    IF Q12a==1 GOTO Q13
    ELSE IF Q12a==2
        Q12b Have you smoked 100 cigarettes or more in your life?
        1 Yes
        2 No
        IF Q12b==1 GOTO Q13
        ELSE IF Q12b==2
            Q12c Have you ever smoked a whole cigarette?
            1 Yes
            2 No
        END IF
    END IF
END IF

Section 2: Risk Perception

Q13 On a scale of 0 to 100, where 0 is absolutely no chance and 100 is absolutely certain, what do you believe is the percent chance you will live to age 85 or more?
Numeric (0-100)
9999999 Don't know

    IF Q2==1,2 & Q2a < 85
        Q13a On a scale of 0 to 100, where 0 is absolutely no chance and 100 is absolutely certain, what do you believe is the percent chance your partner (spouse) will live to age 85 or more?
        Numeric (0-100)
        9999999 Don't know
    END IF

Q14 On a scale of 0 to 100, where 0 is absolutely no chance and 100 is absolutely certain, what do you believe is the percent chance you will leave a bequest of more than $10,000?
Numeric (0-100)

9999999 Don’t know
IF Q14 >0 & Q6 ==1

Q14a How likely is it that your primary residence will play a role in the bequest you plan to leave?

1 Not likely at all
2 Not very likely
3 Somewhat likely
4 Very likely
5 Extremely likely

END IF

Q15 On a scale of 0 to 100, where 0 is absolutely no chance and 100 is absolutely certain, what do you believe is the percent chance that your family would take up the responsibility of taking care of you if you had important limitations in activities of daily living such as bathing, eating, cleaning?

Numeric (0-100)
9999999 Don’t know

Q16 On a scale of 0 to 100, where 0 is absolutely no chance and 100 is absolutely certain, what do you believe is the percent chance that your family would take care of you financially if you needed financial support?

Numeric (0-100)
9999999 Don’t know

IF Q6==1

Q17 Here are three possibilities concerning your future expected residence. On a scale of 0 to 100, where 0 is absolutely no chance and 100 is absolutely certain, what is the percent chance that each of these possibilities comes true. Given that only one of these possibilities can occur, the sum of the three probabilities must equal 100.

Q17a I’m going to stay in my current home until I die.
Numeric (0-100)
Q17b I will eventually move from my current home to live in another house or apartment.
Numeric (0 to (100 – Answer Q17a))
Q17c I will eventually move from my current home to live in a long-term care home.
Numeric (0 to (100 – Answer Q17a – Answer Q17b))

[NOTE: SUM OF ANSWERS TO Q17a, Q17b AND Q17c MUST EQUAL 100.]
[NOTE: MAKE SURE THE QUESTION IS PROPERLY NUMBERED ON THE SCREEN.]
[NOTE: WOULD IT BE POSSIBLE TO INCLUDE A COUNTER TO LET THE RESPONDENT KNOW HOW MANY % LEFT TO FILL IN?]

Q18 Over the **next** five years, do you think the value of your home will:
1 Increase a lot (greater than 20 %)
2 Increase moderately (between 5% and 20%)
3 remain rather stable (between +5% and -5%)
4 decrease moderately (between -5% and -20%)

5 decrease a lot (less than -20%)

Q19 Do you agree with the following statement: “House prices can fluctuate a lot”?
1 Completely disagree
2 Disagree
3 Somewhat disagree
4 Neither agree nor disagree
5 Somewhat agree
6 Agree
7 Completely agree
END IF

Q20 Do you agree with the following statements? (Answers: 5 Strongly Agree; 4 Agree; 3 Disagree; 2 Strongly Disagree; 1 Don’t know)
Q20a It is the responsibility of the family, when feasible, to take care of elderly parents
Q20b Parents should set aside money to leave to their children or heirs once they die, even when it means somewhat sacrificing their own comfort in retirement
Q20c Children should inherit their parents’ family home
Q20d A house is an asset that should only be sold in case of financial hardship
Q20e Being in debt is never a good thing
[NOTE: Make sure the question is properly numbered on the screen.]
[NOTE: Might the scale for each statement be inverted (i.e. “increasing” from left to right)? We leave this with your expertise.]

Q21 Which of the following statements comes closest to describing the amount of financial risk that you are willing to take when you save or make investments?
1 I am willing to take substantial financial risks expecting to earn substantial returns
2 I am willing to take above average financial risks expecting to earn above-average returns
3 I am willing to take average financial risks expecting to earn average returns
4 I am willing to take below average financial risks expecting to earn below-average returns
5 I am not willing to take any risk, knowing I will earn a small but certain return

Section 3: Literacy and Knowledge

Now we would like to ask some questions about your familiarity and comfort with financial concepts. Please answer these questions the best you can.

Q22 Suppose you have $100 in a savings account, the interest rate is 2% per year and you never withdraw money. After 5 years, how much will you have in this account in total?
1 More than $110
2 Exactly $110
3 Less than $110
4 Don’t know

Q23 True or false? You should invest most of your money in a single stock that you select rather than in lots of stocks or in mutual funds.
1 True
2 False

3 Don’t know

Q24 Imagine leaving $1,000 in a savings account that pays 1% interest and has no charges. Imagine that inflation is running at 2%. Do you think that if you withdraw the money in a year's time you will be able to buy more than, exactly the same as, or less than today with the money in this account?
1 More than today
2 Exactly the same as today
3 Less than today
4 Don't know

Q25 Suppose the chances of someone aged 50 living to age 85 are 60%. What do you think the chances are that this same person will live to age 60?
1 Less than 60%
2 Greater than 60%
3 Don’t know

Section 4: Annuities

For the purposes of this section, when we use the term ‘**annuity’**, we are referring to a financial product that guarantees you a regular payment every month or year until death (the “benefit”), in exchange for an initial one-time payment (the “premium”).

Q26 This section is going to ask you questions about annuities. Which of the following best describes your current knowledge about this type of product?
1 A lot
2 A little
3 None at all

Q27 Have you purchased an annuity in the private market, for which you are currently receiving or will eventually receive benefits (please exclude all government provided annuities such as your provincial pension plan, the Canada Pension Plan and Old Age Security)?
1 Yes, I have purchased an annuity
2 Yes, I have purchased more than one annuity
3 No
4 Don't know
IF Q27==4(Don’t know) GOTO Q28
ELSE IF Q27==3 (No)
    Q27a Why haven’t you bought an annuity? Choose the main reason.
    1 I never thought about buying one, and I have never been offered one (for instance by a financial advisor).
    2 I thought about buying one, but I have not (yet) made a decision.
    3 I do not have sufficient savings to purchase one.
    4 Such products do not offer good value for money.
    5 Such products do not cover my needs.
    6 I do not think I will need such a product.
    7 I don’t know what an annuity is.
    8 Other, open...
    GOTO Q28
ELSE IF Q27==1,2 (Yes)

Q27b How did you come to purchase the annuity? If you have purchased more than one annuity, please think about the one you purchased most recently.
1 I was offered an annuity (by my financial advisor, pension plan representative, insurance company, etc.)
2 I searched myself for an annuity
3 Other, open …

Q27c What was the premium of the annuity (what did you pay)? If you have purchased more than one annuity, please indicate what you paid for the one you purchased most recently.
Numeric (>$0)
7777777 Don't know
IF Q27c==7777777
    Q27d Was it more than $250,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
    IF Q27d==1
        Q27e Was it less than $1,000,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
        IF Q27e == 1
            Q28f Was it more than $500,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
        END IF
    ELSE IF Q27d ==2
        Q27g Was it more than $150,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
        IF Q27g == 2
            Q27h Was it less than $100,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
            IF Q27h==1
                Q27i Was it more than $50,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
            END IF
        END IF
    END IF
END IF

Q27j What is the benefit amount the annuity pays out (monthly)? If you have purchased more than one annuity, please indicate the benefit paid by the one you purchased most recently.
Numeric (>$0)
7777777 Don't know
IF Q27j==7777777
    Q27k Is it more than $1,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
    IF Q27k==1
        Q27l Is it less than $4,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
        IF Q27l == 1
            Q27m Is it more than $2,000? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
        END IF

ELSE IF Q27k ==2
Q27n Is it more than $600? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
IF Q27n == 2
Q27o Is it less than $400? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
IF Q27o==1
Q27p Is it more than $200? 1 Yes 2 No 8888888 Refuse to answer 7777777 Don't know
END IF
END IF
END IF
END IF
END IF

Q28 Do you have life insurance for which you currently pay a premium or that is fully paid and still in force?
1 Yes
2 No
3 Don't Know
IF Q28==1 (Yes)
Q28a What type of life insurance policy do you have?
1 Term life insurance
2 Whole life insurance or Universal life insurance
3 Don't know
4 Other, open…
END IF

Section 6: Preferences for Annuities [SCENARIOS]

We are going to show you some simple annuities and ask you to rate them. You can assume that the institution offering the annuity will pay the monthly benefit no matter the circumstances. Once you pay the premium, you receive monthly benefits and have nothing else to pay.

Each product has two attributes:
a) a premium you have to pay;
b) a monthly benefit starting at a given age and lasting until death.

The benefit is adjusted for inflation (indexed).

Q30-34
[SCENARIOS]

What are the chances, 0% meaning no chance and 100% meaning for sure, that you would purchase this product if it were offered to you by [a trusted / an] insurance company within the next year?
Numeric (0-100)
*****
Randomize [a trusted / an] across individuals with probability 0.5, and keep constant for each respondent for questions 30-34 (i.e., present all of Q30-34 either with [a trusted] or with [an] for a given individual).
*****

Scenarios randomization scheme

Parameters:

Age_benefit = [(age+1), 75,85] with probability [2/5, 2/5, 1/5]
where (age+1)=the age of the respondent+1

Benefit = [200,600,1000] each with probability 1/3

Load = [0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0]
each with probability 1/16

For each combination of Age_benefit and Benefit we provide EPremium, which is the fair premium by age and sex (3 x 3 = 9 data points; see table attached).

The premium for the contract is given by (please round to nearest $500):

prem = EPremium x Load

Randomize Age_benefit, Benefit and Load independently (3 x 3 x 16 possibilities) for 5 draws (i.e., each respondent is presented with 5 combinations of Age_benefit, Benefit, and "prem" according to the above probabilities).

Present each draw following this example:

When you buy the annuity	*Starting at age [Age_benefit]*

You pay $[prem]	You receive $[Benefit] per month until death, indexed annually for inflation

*****

FAIR PREMIUMS (VALUES FOR "EPremium")

For Age_benefit=age+1

Benefit = 200			Benefit = 600			Benefit = 1000		
Age	Male	Female	Age	Male	Female	Age	Male	Female
55-59	45,111.40	49,890.91	55-59	135,334.20	149,672.72	55-59	225,557.00	249,454.53
60-64	38,942.44	43,719.50	60-64	116,827.32	131,158.51	60-64	194,712.20	218,597.52
65-69	32,755.36	37,352.10	65-69	98,266.07	112,056.30	65-69	163,776.79	186,760.50
70-75	26,135.90	30,292.54	70-75	78,407.71	90,877.61	70-75	130,679.51	151,462.69

For Age_benefit=75

Benefit = 200			Benefit = 600			Benefit = 1000		
Age	Male	Female	Age	Male	Female	Age	Male	Female
55-59	13,691.16	17,442.92	55-59	41,073.47	52,328.77	55-59	68,455.79	87,214.61
60-64	15,677.30	19,700.10	60-64	47,031.89	59,100.30	60-64	78,386.48	98,500.51
65-69	18,361.54	22,559.95	65-69	55,084.62	67,679.85	65-69	91,807.70	112,799.74
70-75	22,467.80	26,560.34	70-75	67,403.40	79,681.01	70-75	112,339.00	132,801.69

For Age_benefit=85

Benefit = 200			Benefit = 600			Benefit = 1000		
Age	Male	Female	Age	Male	Female	Age	Male	Female
55-59	3,912.57	5,959.01	55-59	11,737.70	17,877.03	55-59	19,562.83	29,795.06
60-64	4,480.15	6,730.13	60-64	13,440.45	20,190.39	60-64	22,400.75	33,650.65
65-69	5,247.24	7,707.14	65-69	15,741.71	23,121.41	65-69	26,236.18	38,535.69
70-75	6,535.00	9,210.44	70-75	19,605.01	27,631.32	70-75	32,675.02	46,052.19

IF Q6 == 1

Section 5: Financial product to extract the equity value of a primary residence

For the purposes of this section, when we use the expression "**current home equity**", we are referring to the current market value of your primary residence after subtracting outstanding mortgage balances. This section is going to ask you questions about financial products on the basis of your current home equity.

Imagine a financial product that lets you turn part of your current home equity into cash. You're not obligated to make any payments until you move, you sell your home, or you die. You have the certainty that once your residence will be sold, the required amount to repay the loan will not exceed the selling price of the residence.

Q29 Have you ever heard of the existence of this type of financial product in Canada?
1 Yes
2 No

IF Q29 == 1
Q29a Can you name that product?
1 Yes
2 No
IF Q29a==1
[DROP-DOWN]
Q29b What is it called?
1 Annuity
2 Reverse mortgage
3 Life insurance
4 Line of credit
5 None of the above
END IF
END IF

Section 7: Preferences for Reverse Mortgages [SCENARIOS]

We will refer to a **reverse mortgage** as a financial product that lets you turn part of your current home equity into cash. Unlike many mortgage-based financial products, you're not obligated to make any payments until you move, you sell your home, or you die. Importantly, you have the certainty that once your residence will be sold, the amount required to repay the loan will not exceed the selling price of the residence.

When we use the expression "**current home equity**", we are referring to the current market value of your primary residence after subtracting outstanding mortgage balances. For the rest of this section, try to have your current home equity in mind.

We are going to show you some simple reverse mortgage products and ask you to rate them.

Each reverse mortgage has three attributes:

a) The percentage of your current home equity that you can borrow. The amount borrowed must be a minimum of $25,000.

b) A fixed annual interest rate on the balance of the loan, generating interests that you do not need to pay before you move, sell or die.

c) A fixed fee of $2,245 that you only have to pay once. The money you obtain from the reverse mortgage will be used to pay this fee.

[Suppose you have the certainty that you will never be put under pressure to sell your residence and that the contract terms will be respected.]

*****

Randomize the presence of the sentence above for each respondent with probability 0.5 and keep constant for questions 35-39.

*****

Q35-Q39

[SCENARIOS]

What are the chances, 0% meaning no chance and 100% for sure, that you would buy this reverse mortgage if a trusted financial institution offered it to you within the next year?

Numeric (0-100)

IF Q35>0

Q35a In the event you purchased this reverse mortgage, considering you must borrow a minimum of $25,000 and taking into account the maximum amount that can be borrowed (« Reverse Mortgage » of your current home equity), what amount of money do you think you would borrow?

Numeric (>=$25,000)

END IF

[NOTE: REPEAT THE ABOVE SUB-QUESTION AFTER EACH OF Q35 TO Q39, USING THE EXACT SAME LOOP, WORDING AND CRITERIA]

END IF

Scenarios randomization scheme

Parameters:

Interest_rates = [3.8%, 4.1%, 4.4%, 4.7%, 5%, 5.3%, 5.59%, 6%, 6.5%, 7%] each with probability 1/10

Load = [0.5, 0.75, 1, 1.25, 1.5] each with probability 1/5

With these products we provide Borrow (see tables attached), which is the proportion that can be borrowed by city, marital status, age and sex.

The contract of the reverse mortgage is given by (please round to nearest percentage point):

$$\text{Reverse Mortgage} = \text{Borrow x Load}$$

Randomize both Interest_rates and Load independently (10 x 5 possibilities) for 5 draws (i.e., each respondent is presented with 5 combinations of Interest_rates and "Reverse Mortgage" according to the above probabilities).

Present each draw following this example:

You can borrow a minimum of $25,000 and up to [Reverse Mortgage] of your current home equity.
You will be charged a fixed annual interest rate of [Interest_rates] on the balance of the loan for as long as you hold the loan. *Reminder: You're not obligated to make any payments until you move, you sell your home, or you die; and you have the certainty that once your residence will be sold, the amount required to repay the loan will not exceed the selling price of the residence.*
There is a fixed fee of $2,245 that you only have to pay once. The money you obtain from the reverse mortgage will be used to pay this fee.

*****

VALUES FOR "Borrow"

[FOR COUPLES, PLEASE USE THE AVERAGE AGE OF THE COUPLE : $\frac{age+Q2a}{2}$, WHERE *age* IS THE RESPONDENT'S AGE GATHERED FROM THE SAMPLING/TARGETING. PLEASE ROUND THE RESULT TO THE NEAREST INTEGER AND SET THE AGE OF THE COUPLE AS 55 IF $\frac{age+Q2a}{2} < 55$ AND AS 79 IF $\frac{age+Q2a}{2} > 79$.]

If Q0 begins with H1, H2, H3, H4, H5, H8, H9 & Q2==1,2
(Island of Montreal, Couple)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	16.10%	23.10%	31.90%	39.10%	46.70%
IF Q6a == 2 (ownhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	15.30%	21.90%	30.30%	37.10%	44.50%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	12.90%	18.50%	25.50%	31.30%	37.50%

If Q0 begins with H1, H2, H3, H4, H5, H8, H9 & Q2==3,4,5,6 and sex is Male
(Island of Montreal, Single Male)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	25.10%	33.10%	39.10%	43.30%	49.90%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	23.90%	31.50%	37.30%	41.10%	47.30%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	20.10%	26.50%	31.30%	34.70%	39.90%

If Q0 begins with H1, H2, H3, H4, H5, H8, H9 & Q2==3,4,5,6 & sex is Female
(Island of Montreal, Single Female)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	26.70%	33.10%	37.90%	39.90%	44.90%
IF Q6a == 2(Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	25.50%	31.50%	36.10%	37.90%	42.70%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	21.50%	26.50%	30.30%	31.90%	36.10%

If Q0 is from Quebec and DOES NOT begin with H1, H2, H3, H4, H5, H8, H9 & Q2==1,2
(Rest of Quebec, Couple)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	15.03%	21.57%	29.77%	36.50%	43.63%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	14.30%	20.50%	28.30%	34.70%	41.50%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	12.03%	17.30%	23.83%	29.23%	34.97%

If Q0 is from Quebec and DOES NOT begin with H1, H2, H3, H4, H5, H8, H9 & Q2==3,4,5,6 & sex is Male
(Rest of Quebec, Single Male)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	23.43%	30.90%	36.57%	40.43%	46.50%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	22.30%	29.37%	34.77%	38.43%	44.17%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	18.77%	24.70%	29.30%	32.37%	37.23%

If Q0 is from Quebec and DOES NOT begin with H1, H2, H3, H4, H5, H8, H9 & Q2==3,4,5,6 & sex is Female
(Rest of Quebec, Single Female)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	24.97%	30.90%	35.43%	37.23%	41.97%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	23.77%	29.37%	33.70%	35.43%	39.90%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	20.03%	24.70%	28.37%	29.83%	33.70%

If Q0 begins with M2, M3, M4G, M4H, M4J, M4K, M4M, M4L, M4M, M4N, M4P, M4R, M4S, M4T, M4V, M4W, M4X, M4Y, M5, M6, M7A, M9L, M9M, M9N & Q2==1,2
(City of Toronto, Couple)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	14.50%	21.10%	29.70%	36.90%	44.50%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	13.70%	20.10%	28.30%	35.10%	42.30%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	11.50%	16.90%	23.70%	29.50%	35.70%

If Q0 begins with M2, M3, M4G, M4H, M4J, M4K, M4M, M4L, M4M, M4N, M4P, M4R, M4S, M4T, M4V, M4W, M4X, M4Y, M5, M6, M7A, M9L, M9M, M9N & Q2==3,4,5,6 & sex is Male
(City of Toronto, Single Male)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	23.10%	30.90%	36.90%	41.10%	47.70%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	21.90%	29.30%	35.10%	39.10%	45.30%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	18.50%	24.70%	29.50%	32.90%	38.10%

If Q0 begins with M2, M3, M4G, M4H, M4J, M4K, M4M, M4L, M4M, M4N, M4P, M4R, M4S, M4T, M4V, M4W, M4X, M4Y, M5, M6, M7A, M9L, M9M, M9N & Q2==3,4,5,6 & sex is Female
(City of Toronto, Single Female)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	24.70%	30.90%	35.70%	37.70%	42.70%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular)	23.50%	29.30%	33.90%	35.90%	40.70%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	19.70%	24.70%	28.50%	30.10%	34.30%

If Q0 is from Ontario and DOES NOT begin with M2, M3, M4G, M4H, M4J, M4K, M4M, M4L, M4M, M4N, M4P, M4R, M4S, M4T, M4V, M4W, M4X, M4Y, M5, M6, M7A, M9L, M9M, M9N & Q2==1,2
(Rest of Ontario, Couple)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	15.03%	21.77%	30.43%	37.63%	45.23%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	14.23%	20.70%	28.97%	35.77%	43.03%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	11.97%	17.43%	24.30%	30.10%	36.30%

If Q0 is from Ontario and DOES NOT begin with M2, M3, M4G, M4H, M4J, M4K, M4M, M4L, M4M, M4N, M4P, M4R, M4S, M4T, M4V, M4W, M4X, M4Y, M5, M6, M7A, M9L, M9M, M9N & Q2==3,4,5,6 & sex is Male
(Rest of Ontario, Single Male)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	23.77%	31.63%	37.63%	41.83%	48.43%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	22.57%	30.03%	35.83%	39.77%	45.97%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	19.03%	25.30%	30.10%	33.50%	38.70%

If Q0 is from Ontario and DOES NOT begin with M2, M3, M4G, M4H, M4J, M4K, M4M, M4L, M4M, M4N, M4P, M4R, M4S, M4T, M4V, M4W, M4X, M4Y, M5, M6, M7A, M9L, M9M, M9N & Q2==3,4,5,6 & sex is Female
(Rest of Ontario, Single Female)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	25.37%	31.63%	36.43%	38.43%	43.43%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	24.17%	30.03%	34.63%	36.57%	41.37%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	20.30%	25.30%	29.10%	30.70%	34.90%

If Q0 begins with V5K, V5L, V5M, V5N, V5P, V5R, V5S, V5T, V5V, V5W, V5Y, V6A, V6B, V6C, V6E, V6G, V6H, V6J, V6K, V6L, V6M, V6N, V6P, V6R, V6S, V6T, V6Z, V7G, V7H, V7J, V7K, V7L, V7M, V7N, V7P, V7R, V7S, V7T, V7V, V7W, V7X, V7T & Q2==1,2
(City of Vancouver, Couple)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	15.30%	22.10%	30.70%	37.90%	45.70%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	14.50%	21.10%	29.30%	36.10%	43.30%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	12.30%	17.70%	24.70%	30.50%	36.50%

If Q0 begins with V5K, V5L, V5M, V5N, V5P, V5R, V5S, V5T, V5V, V5W, V5Y, V6A, V6B, V6C, V6E, V6G, V6H, V6J, V6K, V6L, V6M, V6N, V6P, V6R, V6S, V6T, V6Z, V7G, V7H, V7J, V7K, V7L, V7M, V7N, V7P, V7R, V7S, V7T, V7V, V7W, V7X, V7T & Q2==3,4,5,6 & sex is Male
(City of Vancouver, Single Male)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	24.10%	31.90%	38.10%	42.30%	48.70%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	22.90%	30.30%	36.10%	40.10%	46.30%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	19.30%	25.70%	30.50%	33.70%	38.90%

If Q0 begins with V5K, V5L, V5M, V5N, V5P, V5R, V5S, V5T, V5V, V5W, V5Y, V6A, V6B, V6C, V6E, V6G, V6H, V6J, V6K, V6L, V6M, V6N, V6P, V6R, V6S, V6T, V6Z, V7G, V7H, V7J, V7K, V7L, V7M, V7N, V7P, V7R, V7S, V7T, V7V, V7W, V7X, V7T & Q2==3,4,5,6 & sex is Female
(City of Vancouver, Single Female)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	25.70%	31.90%	36.70%	38.90%	43.90%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	24.50%	30.30%	34.90%	36.90%	41.70%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	20.50%	25.50%	29.50%	31.10%	35.10%

If Q0 is from British Columbia and DOES NOT begin with V5K, V5L, V5M, V5N, V5P, V5R, V5S, V5T, V5V, V5W, V5Y, V6A, V6B, V6C, V6E, V6G, V6H, V6J, V6K, V6L, V6M, V6N, V6P, V6R, V6S, V6T, V6Z, V7G, V7H, V7J, V7K, V7L, V7M, V7N, V7P, V7R, V7S, V7T, V7V, V7W, V7X, V7T & Q2==1,2
(Rest of British Columbia, Couple)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	14.50%	20.97%	29.03%	35.77%	42.97%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	13.77%	19.97%	27.70%	34.03%	40.83%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	11.70%	16.83%	23.30%	28.70%	34.37%

If Q0 is from British Columbia and DOES NOT begin with V5K, V5L, V5M, V5N, V5P, V5R, V5S, V5T, V5V, V5W, V5Y, V6A, V6B, V6C, V6E, V6G, V6H, V6J, V6K, V6L, V6M, V6N, V6P, V6R, V6S, V6T, V6Z, V7G, V7H, V7J, V7K, V7L, V7M, V7N, V7P, V7R, V7S, V7T, V7V, V7W, V7X, V7T & Q2==3,4,5,6 & sex is Male
(Rest of British Columbia, Single Male)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	22.83%	30.17%	35.90%	39.77%	45.83%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	21.70%	28.70%	34.03%	37.77%	43.50%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	18.23%	24.17%	28.77%	31.77%	36.63%

If Q0 is from British Columbia and DOES NOT begin with V5K, V5L, V5M, V5N, V5P, V5R, V5S, V5T, V5V, V5W, V5Y, V6A, V6B, V6C, V6E, V6G, V6H, V6J, V6K, V6L, V6M, V6N, V6P, V6R, V6S, V6T, V6Z, V7G, V7H, V7J, V7K, V7L, V7M, V7N, V7P, V7R, V7S, V7T, V7V, V7W, V7X, V7T & Q2==3,4,5,6 & sex is Female
(Rest of British Columbia Single Female)

Age	55-59	60-64	65-69	70-74	75-79
IF Q6a == 1, 7777777 (Single Family Dwelling / Detached Duplex, Triplex or Quadruplex / Link Home / Semi-Detached)	24.37%	30.17%	34.70%	36.63%	41.30%
IF Q6a == 2 (Townhouse, Rowhouse / Fiveplex and Sixplex / Attached Duplex. Triplex, or Quadruplex / Stratified SFD, Bare Land Strata / Semi-Detached Strata Condo / Modular Home)	23.10%	28.70%	32.97%	34.77%	39.30%
IF Q6a == 3 (Condo - Townhouse / Mobile Home / Condo – Townhouse)	19.43%	24.10%	27.83%	29.30%	33.10%

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