The Adequacy of Household Saving in Canada[*]

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Abstract

This paper examines the state of retirement preparedness in Canada by assessing the adequacy of household private saving. Our definition of saving adequacy is based on the saving optimality implied by a stochastic life-cycle model. The model results are compared to the observed saving behaviors in the Survey of Financial Security (SFS). We find that overall Canadian households who were 60-64 years old in 2005 saved adequately given the existing generosity of private and public pensions, about 62 percent of whom had accumulated more non-pension wealth than the median simulated wealth implied by our life-cycle model. According to our benchmark model, fewer than 25 percent of households were undersaving. Couples and households with private pension coverage were better prepared than singles and those without private pension coverage, respectively.

JEL classification: D31; E21; J32

Keywords: Saving; Retirement wealth; Private pensions.

1   Introduction

As baby boomers are entering retirement, there is widespread concern about the adequacy of retirement saving in Canada. Canadian retirees could risk a non-trivial reduction in their living standards if they are not saving enough. This issue is closely related to the soundness of Canadian Retirement Income System and the current Canada's pensions debate, as well as how policies should respond to this concern.

Assessing the adequacy of retirement saving requires some standard against which to measure observed behaviors. One popular standard is to use replacement rate, which measures the percentage of pre-retirement income that is replaced by post-retirement income (Smith (2003), Munnell, Webb, and Golub-Sass (2007), LaRochelle-Côté, Myles, and Picot (2008), and Ostrovsky and Schellenberg (2009)).[1] Another approach is to make inferences about adequacy from consumption changes around retirement (Banks, Blundell, and Tanner (1998), and Bernheim, Skinner, and Weinberg (2001)).[2] Finally, several studies have used augmented life-cycle models to assess the adequacy of household saving (Engen, Gale, and Uccello (1999), and Scholz, Seshadri, and Khitatrakun (2006)).

This paper follows the last approach to assess the adequacy of retirement saving for Canadian households using a realistically calibrated life-cycle model. It sheds new light on the adequacy of private saving in Canada and contributes to the on-going debate about the state of retirement preparedness in Canada. Households in the model make optimal decisions to smooth consumption over the life cycle given their life time budget

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[1]How income is measured matters. See Brown, Hou, and Lafrance (2010), and Baldwin, Frenette, Lafrance, and Piraino (2011). However, the concept of replacement rate does not account for the timing of income and wealth shocks that may affect optimal wealth accumulation. Other factors like the number of children, home ownership, and health condition could also affect the rate. Simply using one replacement rate for all is likely to be a misleading indicator of the well-being of retirees.

[2]However, for the reasons given in Aguiar and Hurst (2005), Haider and Stephens (2007), Blau (2008), and Hurst (2008), it is difficult to make inferences about adequacy or optimality from patterns of consumption changes around retirement. Among others, the reasons include: (i) substitution of time for purchased goods during retirement and (ii) retirement is caused by an unexpected shock.

constraint. The optimal saving in the model provides us a normative benchmark target for how much resource one needs to maintain his living standard after retirement. In this framework, a household is said to save adequately for retirement if it accumulates more wealth than the benchmark optimality target upon retirement. Note that within this framework, we don't have to assume people behave exactly as in the life-cycle model or observed saving behavior is optimal.[3] In other words, our objective is not to explain or to match observed saving behaviors using the life-cycle model. Rather, we derive optimal saving as our normative benchmark for saving adequacy within a reasonable life-cycle model setup and compare the model predictions with the observed saving behaviors. We then interpret any shortfall of observed wealth compared to the model's implication as evidence of undersaving.

Our contributions are twofold. First, our study is the first attempt to assess retirement saving adequacy for Canadian households using a stochastic life-cycle model.[4] The model incorporates mortality risk, uncertainty about future earnings and private pension coverage, time-varying Canadian tax and transfer system (both federal and provincial), and public pension system. One crucial input to our model is 26 years of information on earnings realization drawn from restricted-access earnings records, the Longitudinal Administrative Data bank (LAD). The LAD is a random 20% sample of all Canadian tax-filers who filed tax returns since 1982. It includes detailed information on earnings, incomes, tax and transfer, Registered Pension Plan (RPP, which is employer sponsored private pension) coverage and contribution, and etc. This enables us to estimate sev-

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[3]Observed life-cycle saving choices may be suboptimal. "It would be astonishing if the average individual, with no practice and little or no training, could on his first try act as if he was a perfectly rational, far-sighted utility maximizer." See Bernheim (1994).

[4]Most Canadian studies use replacement rate. See LaRochelle-Côté, Myles, and Picot (2008), Ostrovsky and Schellenberg (2009), and Moore, Robson, and Laurin (2010). Using a two-period model, Horner (2009) examines saving adequacy issue for Canadian households. However, he uses simplified assumption on earnings, mortality, pension coverage, tax and transfer, and etc. Saving is not a decision but rather assumed to be constant over accumulation period.

eral key profiles that are essential in a realistic life-cycle model. Second, Canada has relatively generous public and private pension plans, which we carefully model in the paper. Unlike previous studies (Engen, Gale, and Uccello (1999), and Scholz, Seshadri, and Khitatrakun (2006)), our model treats the private pension coverage as a stochastic process before retirement. We use this stochastic process to match the increasing private pension coverage over age (before retirement) observed in the data. This allows for an additional source of uncertainty over the life cycle, which extends the standard life-cycle model.

Given that the LAD does not include wealth information, we are not able to examine the saving adequacy for each individual household in our sample as Scholz, Seshadri, and Khitatrakun (2006) did. Instead, we compare the model predictions with wealth observations from the 2005 Survey of Financial Security (SFS) to make inferences whether Canadian households (and different groups of households) had accumulated sufficient resources in 2005 to maintain pre-retirement living standards in retirement.[5] We focus on household private saving and compare the non-pension wealth distributions in both the model and the data. We also use the simulated median (non-pension) wealth from the model as the target and compute the fraction of households in the SFS whose actual (non-pension) wealth exceeded the simulated target.

Our benchmark results suggest that overall Canadian households with heads aged 60-64 in 2005 saved adequately given the existing generosity of private and public pensions, with about 62% of households accumulated more (non-pension) wealth than the simulated median. Fewer than 25% households were undersaving. Households with private pension coverage or the couples are doing a much better job, 70% and 72% of whom exceed the simulated median respectively. The risk of undersaving is low for these groups, with shortfall likely happening at the bottom 5 percentile. On the other hand,

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[5]The SFS is a large-scale survey on family assets and debts conducted by Statistics Canada. It is similar to the Survey of Consumer Finances (SCF) in the United States. The 2005 survey is the latest survey available in Canada.

households without private pension coverage or the singles are vulnerable groups with a high risk of undersaving. Households without private pension coverage are doing just fine at the median level, about 54% of whom exceed the simulated median. However, those households at the bottom 40% of the wealth distribution are likely undersaving according to the benchmark. Single households did not accumulate enough wealth at the median level, with only 45% of them accumulating more wealth than the simulated median. Our study points to the importance of focusing on these two groups for any policy response that is deemed to address the retirement income security issue for Canadians. We also find that the proportions of households whose (non-pension) wealth exceeds the simulated wealth median are all higher than 50% for all current earnings quartiles. The saving adequacy correlates positively with the earnings level. Our main results (that overall Canadian households are saving adequately and that couples and households with RPP coverage are better prepared than singles and households without RPP coverage) are largely robust to a series of sensitivity analysis.

The rest of the paper is organized as follows. Section 2 outlines the life-cycle model and Section 3 explains its parameterization. Section 4 documents empirical evidences of (non-pension) wealth accumulation among Canadian households in the SFS. In Section 5, we present our benchmark results and compare them with the observed wealth. Section 6 offers a series of robustness checks related to alternative specifications and choices of model parameters. Section 7 concludes.

2 Model

We consider a discrete time life cycle model where households live for J periods and maximize their lifetime discounted utility from consumption. Households in the model face uncertainty about future earnings, mortality risk, stochastic private pension coverage, time varying progressive income tax and transfer, as well as a public pension system. Because there is a positive probability of death in each period, borrowing against future

earnings is not allowed.[6]

2.1 Household Problem

Households' preferences are represented by

$$\sum_{j=1}^{J} \beta^{j-1} \Pi_{t=1}^{j} P_t n_j \frac{(\frac{c_j}{n_j})^{1-\sigma}}{1-\sigma} \tag{2.1}$$

where $\beta < 1$ is the discount factor, P_t denotes the probability that the household is alive in period t conditional on being alive in period $t-1$, n_j adjusts consumption for the number of adults and children in the household in period j,[7] σ is the coefficient of relative risk aversion, and c_j denotes consumption of the household in period j.

Households work in the first $R < J$ periods. After R, households retire and receive their retirement income. R and J are assumed to be exogenous and deterministic. The budget constraint in working periods is:

$$k' = (1+r)k + (1 - rppcr)y + I + transfer - tax - cppcr - c \tag{2.2}$$

where k is the non-pension wealth brought from the last period to current period, r denotes the riskless interest rate, y represents the labor income in the current period, $rppcr$ is the household's registered pension plan (RPP, which is private pension) contribution rate, $cppcr$ is household's contributions to Canada Pension Plan (CPP),[8] I is a random inheritance received by the household, tax is the income tax (both federal and provincial)

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[6]We consider inheritance in the model. However, we do not incorporate a bequest motive as we are mainly interested in savings for retirement.

[7]As in Baker, Gruber and Milligan (2009), the first adult is counted as one, each subsequent adult counts as 0.7, and each child under age 18 counts as 0.5.

[8]CPP, a public pension, is the major part of Canada's retirement income security system. Quebec Pension Plan (QPP) is the sister plan of CPP in Quebec, which is almost identical to CPP. Thus, we use CPP to represent both CPP and QPP in the paper. Canadian public pension system includes CPP/QPP, Old Age Security (OAS), and Guaranteed Income Supplement (GIS). We discuss it in more details in next section.

paid by the household, *transfer* denotes the transfer income received by the household, and c is consumption. We assume that each household begins its life with zero initial wealth.

In each working period $1 \leq j \leq R$, labor earnings are determined by a deterministic age-earnings profile, h_j, and a persistent productivity, e:

$$y_j = h_j e \tag{2.3}$$

The evolution of e for a household is governed by an AR(1) process:

$$e_{j+1} = \rho e_j + \varepsilon_{j+1} \tag{2.4}$$

where ε are independent and identically normally distributed $N(0, \sigma_\varepsilon^2)$.

The budget constraint in retirement periods is given by:

$$k' = (1 + r)k + CPP + OAS + GIS + rpp + transfer - tax - c \tag{2.5}$$

where CPP are CPP/QPP benefits, computed based on the average ratio of earnings to the year's maximum pensionable earnings (YMPE) over the last 35 working years; OAS, representing Old Age Security, and GIS, Guaranteed Income Supplement, are the public pension benefits in Canada financed through general tax revenue to provide old-aged security benefits to low- to middle-income households; rpp stands for the benefits from Registered Pension Plans (private pensions). We discuss these benefits in more details in next section.

The household's problem can be written as the following recursive formation:

$$V_j(k, e, \bar{y}_{cpp}, pen, n_{rpp}) = \max_c \left\{ n_j \frac{(c_j/n_j)^{1-\sigma}}{1-\sigma} + \beta P_{j+1} E[V_{j+1}(k', e', \bar{y}'_{cpp}, pen', n'_{rpp})] \right\} \tag{2.6}$$

subject to the budget constraint (2.2) or (2.5) depending on whether the household is working or not. k , e, $\bar{y}_{cpp}$, pen, n_{rpp} are 5 state variables in period j, where k is non-pension wealth, e denotes the earnings state, $\bar{y}_{cpp}$ is the average ratio of earnings to

YMPE until current period,[9] *pen* is the RPP coverage status in period j, and n_{rpp} is the number of years of RPP coverage up to current period.

3 Parameterization

In this section, we first outline our benchmark parameter values on demographics and preferences. We then discuss in details the main data sources used in this study, the Longitudinal Administrative Data bank (LAD) and the Survey of Financial Security (SFS), and our empirical strategies to calibrate life cycle earning process, tax and transfer system, public and private pensions, as well as household compositions.

3.1 Demographics and Preferences

Households enter the model at age 22, work until age 64 and retire at 65 mandatorily. They can live to a maximum age of 95 subject to mortality risk every period for which we use female mortality rates from the 2000 to 2002 Life Tables, Canada. The coefficient of relative risk aversion σ is set to 2.0, the annual discount factor β to 0.96, and the rate of return to 0.04 in the benchmark.[10]

3.2 LAD

The main dataset we use for our model calibration is the Longitudinal Administrative Data bank (LAD). The LAD is a random 20% sample of the T1 family file, a yearly cross-sectional file of all tax filers.[11] Individuals selected into the LAD can be linked

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[9]$\bar{y}_{cpp}$ will be used to compute the CPP benefits. For a two earners household, each earner will receive his/her CPP benefits. We divide the total earnings by two for these two earners households to find $\bar{y}_{cpp}$ for each earner.

[10]The coefficient of relative risk aversion of 2.0 falls in the range of 1-3 commonly used in the literature. We will conduct sensitivity analysis by using a higher value (3.0) and a lower value (1.5).

[11]A smaller, 10% sample is used for our calibration.

across years, so it is possible to create a longitudinal profile of each individual. The LAD contains basic demographics (year of birth, sex and marital status) and detailed income and tax information for the period from 1982 to 2007, which makes it possible to track individuals for 26 years. Our LAD sample includes only those who lived in all 10 Canadian provinces and excludes those who lived in the territories and Indian reserves. We restricted our sample to individuals who filed tax returns in all years starting from 1992 and were 22 to 64 years old. This is because before the introduction of the Goods and Services Tax (GST) rebate in 1986 and, particularly, before the introduction of the Canada Child Tax Benefit in 1992, low income families did not have strong incentive to file tax returns. Focusing on those that filed tax returns after 1992 makes our sample more representative, especially for low-income families.[12]

3.3   Life-cycle Earnings Process

We divide our LAD sample into three types based on marital status and the number of earners: singles and lone parents (hereafter, S), 1-earner couples (married or common-law)(1EC), and 2-earner couples (2EC).[13]

We estimate the age-earnings profiles and persistent productivity shock for each of the three household types defined above. Household earnings are total pre-tax household earnings that include both heads and spouse's (if any) earnings from T4 slips, other employment income, and net self-employment income (net business income, net professional income, net commission income, net farming income and net fishing income). All

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[12]The age restriction is conditional on the filer's age, which is not necessarily the age of the husband for married or common-law couples.

[13]Unfortunately, the LAD dos not include information on education. Thus, we are not able to use education as a criterion. Moreover, we do not model marriage, divorce, and fertility in this paper. Each type of households is assumed to make its optimal decisions as if its type was maintained throughout the life cycle. In the working paper version, we also include the presence of children as one of the grouping criteria, thus resulting in 6 household types. The results are largely consistent between these two versions.

household earnings are converted to 2005 dollars using the Consumer Price Index.

For each household type, we pool together all households with positive earnings and regress the logarithm of household earnings against age, age squared and year dummies:

$$log(y_{it}^\tau) = \alpha^\tau + \beta_1^\tau age_{it}^\tau + \beta_2^\tau (age_{it}^2)^\tau + \sum_{k=1983}^{2007} \gamma_{(k-1982)}^\tau year_{k-1982} + e_{it}^\tau \qquad (3.1)$$

where τ is the type index, i the individual household, and t the year; age_{it} is the household's age (husband's age in the case of couples); $year_{k-1982}$s are year dummies for 1983 to 2007. This gives us three sets of household type-specific parameters (see Table 1). Since the regressions use only strictly positive earnings observations, the implied age earnings profile is multiplied by the labor force participation rates among Canadian males during the period from 1980 to 2005.[14] We use the residuals from the earnings regression (3.1) to estimate the AR(1) process that governs the persistent earnings shock for each type, as in the following regression:

$$e_{i,t}^\tau = \rho^\tau e_{i,t-1}^\tau + \varepsilon_{i,t}^\tau, \qquad (3.2)$$

Table 1 shows that estimates of the persistence parameters range from 0.74 for Singles and lone parents (S) to 0.86 for 2-earner couples (2EC). The earnings shocks are more persistent for the couples than for the singles. A similar relationship has been found in other studies such as Scholz, Seshadri, and Khitatrakun (2006). The standard deviation of earnings shocks ranges from 0.55 for 2-earner couples (2EC) to 0.94 for 1-earner couples (1EC). These estimates are larger than those found in Scholz, Seshadri, and Khitatrakun (2006). The difference may be attributed to the fact that education is controlled for in their earnings regression, while it effectively enters the error terms in our earnings regressions because the LAD does not contain any information about education.

The remaining parameters of the earnings process are the mean earnings and standard deviation (σ_{e1}) for the households in the first period (age 22). New households draw their

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[14]Hendricks (2007) and MacGee and Zhou (2010) use a similar adjustment.

Table 1: Labor income process: coefficients and standard deviation

	S	1EC	2EC
Constant	6.9646	6.1646	8.4896
Age	0.1590	0.2179	0.1219
$Age^2/100$	-0.1863	-0.2548	-0.1385
ρ	0.7391	0.8215	0.8551
σ_ε	0.7636	0.9409	0.5512
σ_{e1}	0.9644	0.9794	0.5664

first labor endowment from a Normal distribution with a mean earnings and standard deviation σ_{e1}. Since the earliest earnings record in the LAD was in 1982, we find the value of σ_{e1} from households aged 22 in 1982 (see Table 1). We also have the mean earnings for households at age 22 in the regression. However, households in the model reach age 22 in 1962, which is earlier than 1982.[15] To take into account the earnings growth in 1962-1982, we consider an annual earnings growth rate of 1.5% during the period to obtain the mean earnings in the first period. Finally, the AR(1) process is discretized as a seven-state Markov process using the Tauchen method.

3.4 Number of Children

In our analysis, children are dependents under 18. They do not contribute to household income but affect household consumption through household size in the utility function. They also affect tax payments and transfer income received by a household. We allow the number of children within each household type to vary with age, but assume that this variation is exogenous. We pool households of the same type (across years) in the

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[15]We are targeting the retirement in 2005 when we have the wealth data from the Survey of Financial Security (SFS). Thus, the model households were 22 in 1962 and 65 in 2005.

LAD and compute the average number of children for each household type for different age ranges. Table 2 shows the number of children over age groups for different household types. The number of children increases until the middle age and then decreases toward zero. In the model, we assume that the number of children is zero for households aged 65 and above.

Table 2: Number of children over age

Type	22-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
S	0.06	0.17	0.41	0.61	0.59	0.37	0.16	0.06	0.02
1EC	0.96	1.43	1.89	2.10	1.94	1.28	0.59	0.23	0.09
2EC	0.37	0.71	1.31	1.72	1.72	1.20	0.59	0.25	0.12

3.5 Tax and Transfer System

Since disposable income is particularly important for households' consumption and saving decisions, it is important to incorporate the effect of the tax and transfer system into our model. We use the LAD data to estimate the tax and transfer equations for each province and each year from 1982 to 2007. Following Frenette, Green, and Milligan (2007), we regress federal (provincial) tax paid by a household against income ranges, the interaction terms between household income and income ranges, number of children under 18, old age (over 65) dummy, household type dummies, and provincial dummies (only when estimating federal tax).

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\begin{aligned}
Tax_{it} = {} & \alpha_t + \sum_{m=1}^{10} \beta_{mt} IR_{imt} + \sum_{m=1}^{10} \gamma_{mt} IR_{imt} IN_{it} + \lambda_t KID_{it} + \delta_t KID_{it}^2 \\
& + \sum_{q=1}^{5} \phi_{qt} TYPE_{iqt} + \theta_t SENIOR_{it} + \sum_{s=1}^{9} \rho_{st} PROV_{ist} + u_{it}.
\end{aligned}
\tag{3.3}
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where Tax_{it} is the total federal (provincial) tax paid by each household; IR_{imt} are dummies for 10 income ranges: $5-10k$, $10-20k$, $20-30k$, $30-40k$, $40-50k$, $50-60k$, $60-100k$, $100-150k$, $150-250k$, and $250+k$; IN_{it} is the household taxable income that includes both employment income and investment income, net of private pension contributions and other deductions. These income ranges and the interaction terms are to capture the progressive nature of Canadian personal income taxes. We also include 5 household type dummies, $TYPE_{iqt}$, with single household (type S) being omitted. The family type dummies, number of children KID_{it}, old age dummy $SENIOR_{it}$, and provincial dummies $PROV_{ist}$ are to capture differences in tax exemption amounts, age credit, provincial tax credits and other non-refundable tax credits. We run the regressions for all households aged 22 and above, separately for federal tax and provincial tax. Our tax regressions show very good fit with R^2 above 0.8 or 0.9 in all years and for all provinces.

We define transfer income as total transfers excluding CPP, OAS, GIS benefits, and Unemployment/Employment Insurance (UI/EI).[16] Hence, transfer income includes family benefits, child care benefits, Goods and Service/Federal Sales Tax credits (GST/FST), social assistance, and workers' compensation. We regress total household transfer income on the same set of explanatory variables as in provincial tax regressions, for all households 22 and over with positive transfer income, by province and year. Our transfer regressions also work well: the estimated mean transfer incomes received by a household is identical to the observed mean in the LAD sample, $1860. The estimated median is higher than the observed median transfer income, $1170 compared to $830 in the LAD. Also, our transfer regression predicts a slightly higher fraction of households with positive transfer income, 68% compared to 63% in the LAD.

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[16]CPP, OAS, and GIS will be modeled explicitly. UI/EI is excluded from the transfer system in our model because it depends on additional variables such as weeks worked and hours worked that are not available in the LAD.

3.6 Public Pension

Canada's retirement income security system (public pension ststem) includes three major components: the Canada Pension Plan and the Quebec Pension Plan (CPP/QPP), the Old Age Security (OAS) Pension, and the Guaranteed Income Supplement (GIS).

The CPP/QPP is the largest component of public pensions. The amount of CPP/QPP benefits is 25% of the product of three parts: (1) the first part is the average of the ratios of earnings to the Years Maximum Pensionable Earnings (YMPE) over the contributory period, and the ratios are capped at one;[17] (2) the second part is the average YMPE in the five years preceding the time of retirement (the five years include the year of retirement); and (3) the third part adjusts the pension benefits for the age of retirement. The "full" (100%) pension benefits are received if retirement occurs at age 65. For every month before (after) age 65, an actuarial adjustment of 0.5 percent is deducted (added).[18] The CPP/QPP benefits are fully indexed to the Consumer Price Index (CPI) and subject to income taxes.

The OAS pension is available to all Canadians aged 65 or over meeting residency requirements.[19] In January 2005 the maximum monthly benefits paid to individuals were $471.76. The benefits are clawed back from higher income individuals at a 15

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[17]The contributory period is the window of time between 1966 or age 18 (whichever is later) and age 60. If retirement occurs after age 60, the contributory period is extended to age 65. We use the historical contribution rates in the paper. In reality, the ratio of earnings to 1/12 of the Years Maximum Pensionable Earnings (YMPE) is calculated in each month. These ratios are capped at one. Finally, the average of the ratios over all the months in the contributory period is calculated (the lowest-earning 15 percent of the contributory period may be dropped out). In the model, we find the ratio of annual earnings to the YMPE in each period and take the average of the ratios in the last 35 years of working life.

[18]These adjustments are capped for a maximum of five years. In our model, these adjustments are not applicable, since everyone retires at 65.

[19]A minimum of 10 years of residence in Canada after age 18 is required to receive OAS benefits in Canada and a minimum of 20 years to receive OAS benefits outside of Canada.

percent rate, starting at income of $60,806. The benefits are indexed to the CPI and fully taxable as regular income.

The GIS is an income tested supplement paid to those aged 65 or older. In January 2005 the maximum monthly benefits were $560.69 for single individuals and $365.21 for each member of a couple. The income test is applied annually based on taxable income (excluding OAS income) at the family level. For each dollar of family income (excluding OAS income), the GIS benefits are reduced by 50 cents for singles and by 25 cents each for married couples. The GIS benefits are also indexed to the CPI, but they are not taxable income.

3.7   Registered Pension Plan

Registered Pension Plans (RPP) in Canada are employer-sponsored private pension plans registered through Canada Revenue Agency. According to the 2005 SFS, assets held in RPPs represented 19% of total assets held by Canadians, second only to the principal residence. Recent studies also show that private pensions play an important role in affecting wealth accumulation.[20] Hence it is important to incorporate private pensions into our life cycle model.

There are two types of RPPs in Canada: Defined Benefit (DB) plans and Defined Contribution (DC) plans. Under DB plans, benefits are generally determined by a formula based on the earnings history and years of coverage. DB plans are managed by employers, and employees typically do not make active investment decisions. By contrast, participation in DC plans often requires active decisions by eligible employees, who are given investment options and can choose the amount of their contributions (subject to plan and legislative provisions). Under DC plans, employers often match employees' contributions. DB plans have historically been prevalent in Canada. Although partici-

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[20]For example, MacGee and Zhou (2010) find that a life cycle model with private pension can lead to higher wealth dispersion for households with similar lifetime earnings, closer to what is observed in data.

pation in DB plans had been declining, about 75% of all RPP members in 2008 were still DB plan members. Unfortunately, it is not possible to distinguish DB from DC plans in the LAD. As DB plans still represent the majority of the RPP membership, we assume RPPs as DB plans.

Coverage. Not all Canadian employees are covered by RPPs. The RPP coverage rate changes with age. It is low for young workers and increases with age until late 50s. RPP coverage is also affected by employment changes, as are potential benefits. We model the RPP coverage as a stochastic process in this paper to match the RPP coverage rate over the life cycle observed in the data.

We use the "pension adjustment" variable in the LAD to proxy RPP coverage. Pension adjustment represents total contributions to an RPP plan by employers and employees, plus credits from deferred profit sharing plans. The latter is received only by a very small portion of tax filers. Thus, a positive pension adjustment is a good measure of RPP coverage (Morissette and Ostrovsky (2006)). We assume that a household is covered by a RPP plan if it reports a positive amount of pension adjustment.

The initial household RPP coverage rate and pension transition matrix are set to match the initial and lifetime pension coverage in the data. In the LAD, the average RPP coverage rate of households among 22 years old is about 13%. As a result, the initial pension coverage in the model is set at 13%. We allow the initial RPP coverage rate varies by earnings and household type as observed in the LAD. In general, high-earners have a higher RPP coverage rate than low-earners, and couples with two earners have higher coverage rate than other types.

We use the pension coverage rate for households 60-64 years old in the 2005 SFS to measure the lifetime pension coverage, which is 57.9% (more details on SFS will be discussed in later section).[21] Given the initial coverage rate, the transition matrices containing the probabilities of having and not having a RPP coverage conditional on the

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[21]These SFS households are currently covered by RPPs, or are receiving RPP benefits. In the LAD, pension coverage rate for households at 55-57 years old is 52%.

prior RPP coverage, are then calibrated to match the lifetime pension coverage rate. The resulting pension transition matrices are asymmetric. Households with pension coverage at period t have a probability of 98% of continuing to have coverage at $t + 1$, and a 2% of probability of losing coverage. The probability of having pension coverage at $t + 1$ conditional on no coverage at t ranges from 0% to 6% depending on household type and earnings level. Together with the initial pension coverage, our transition matrices generate a lifetime pension coverage rate of 56.5% as compared to 57.9% in the 2005 SFS.[22]

Contributions. Employee's RPP contributions are tax-deductable. Hence, we need to compute employee's RPP contribution to derive a measure of taxable income in our model.[23] We examine the distributions of RPP contributions as a percentage of household earnings for all households covered by RPPs and under age 64 in the LAD. The distribution is fairly close across household types. Therefore, in our benchmark model, we set the RPP contribution rate to 3.5% of household earnings, which is the median contribution rate of all households with positive RPP contributions in the LAD.[24]

Benefits. DB pension benefits determined by specific formulas are usually tied to the employee's earnings, length of services, or both. For example, an employer may promise to pay each participant a benefit equal to a percentage of the employee's final five-year average salary times the number of years of service at retirement. In some cases, pension benefits are computed based on the career-average pay or a flat dollar amount per year of service. In this paper, we use the following formula to determine a household's private pension benefits:

$$rpp = \alpha(n_{rpp})n_{rpp}\tilde{y}_R, \tag{3.4}$$

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[22]The model also does relatively well in matching private pension coverage by marital status. The lifetime pension coverage for couples is 67% in the data and 65% in the model; the lifetime coverage rate for singles is 42% in both data and model.

[23]Some plans do not require employees' contributions. But more than 70% of RPP members belonged to contributory plans in 2000.

[24]The average contribution rate for these households is 3.6%.

where $\alpha(n_{rpp})$ is an accrual rate that depends on the number of years of pensionable service, n_{rpp}. In the benchmark, we set $\alpha = 0$ if $n_{rpp} < 5$, the vesting period in the paper, and $\alpha = 1.5\%$ if $n_{rpp} \geq 5$.[25] n_{rpp} is the cumulative years of pensionable service over the life time. In other words, we treat multiple RPP coverage over the life cycle as continuous coverage by adding up the number of years of pensionable service. We use the adjusted earnings, $\tilde{y}_R$, to calculate the private pension benefits.[26] Recall that we use $\bar{y}_{cpp}$, a state variable, to track the lifetime average earnings up to YMPE. In the last working year, if a household's earnings are lower than $\bar{y}_{cpp}$, we set $\tilde{y}_R = \bar{y}_{cpp}$. Otherwise, $\tilde{y}_R$ is equal to the realized earnings in the last working year for the household.

3.8 Survey of Financial Security

To assess retirement saving adequacy, we would like to compare our model predictions to the actual wealth holdings. As the LAD does not include information on wealth, we use the 2005 Survey of Financial Security (SFS) to document wealth accumulation by Canadian households. The SFS covers a representative cross section of Canadian households in all ten provinces, excluding territories. It provides a comprehensive picture of the net worth of Canadians. Information on detailed assets and debts from more than 5200 families was collected. Therefore, we use the 2005 SFS to calibrate the composition of household types.[27]

Household composition. As our primary focus is the adequacy of household saving for retirement, we confine the SFS sample of analysis to households with heads aged 60-64 in 2005 who were close to retirement or just retired. We categorize the SFS sample

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[25]According to the 2000 survey of Pension Plans in Canada, the vesting period ranges from 2 to 5 years. Given the pension transition matrices, a vesting period shorter than 5 years would yield higher lifetime RPP coverage rate in our model.

[26]The main reason is to reduce the state space. Using the average earnings in the last 5 working years will add an additional state variable to the model.

[27]For this analysis, we use the confidential, restricted-access version of SFS rather than the Public Use Microdata (PUMF).

into three household types based on marital status and the number of earners as we do for the LAD.[28] Table 3 shows the composition of households in the 2005 SFS and in the model. We also look at the composition across provinces in the 2005 SFS. The composition varies but not much. Thus, we assume that the composition is the same across provinces in the simulation. We generate 20,000 households and distribute them among provinces according to population weight and household type composition. The Appendix provides more details on how we solve the model and conduct the simulation.

Table 3: Composition of households

Household Type	Data: 2005 SFS (%)	Model (%)
S	36.55	36.55
1EC	30.67	30.67
2EC	32.78	32.78

Inheritance. The 2005 SFS also collects information on the date and value of inheritance (up to 5 times) received by household members.[29] The proportion of households aged 55-64 in 2005 that reported receiving inheritance is about 30%. The mean (median) age of receiving the first inheritance among those households is 47. The median value of all inheritances received by those household is about $42,000 in 2005 dollar.[30] We incorporate inheritance in the model and assume that inheritance is unanticipated, random, and not correlated with household earnings. In our model, 30% of households receive in-

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[28]To define the number of earners for each household in the 2005 SFS, we use the information on whether respondents worked last year either full-time or part-time, earnings, the amount of CPP benefits received, and RPP status. The number of earners for 7 households in the data cannot be identified and we drop them from the sample.

[29]For those households that received inheritance, the majority (more than 70%) only received once. Thus, we use the first inheritance to compute the age at which the inheritance is received. However, we use all inheritances received (up to 5 times) to calculate the amount of inheritance.

[30]The average inheritance for the top 10% of these households is $639,000 in 2005 dollar.

heritance randomly at age 47. The values of inheritance are based on the corresponding distribution we observe in the 2005 SFS.

4 Wealth in SFS

We use the 2005 SFS to document wealth accumulation by Canadian households. The variable "net worth" used in the SFS is total assets, which exclude public pensions but include private pensions, net of total debts.[31] In the model, household private saving is defined as the total non-pension wealth.[32] Thus, it corresponds to "net worth" minus private pension wealth in the SFS.[33]

Table 4 summarizes main statistics for the SFS households with heads aged 60-64 in 2005 who were close to retirement or just retired.[34] Note that single families have a lower RPP coverage rate than couples, 42% as opposed to 67%, and less RPP wealth on average than couples.[35] Total private saving (non-pension wealth) of single families is

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[31]Total assets in the SFS include all financial (deposits, stocks, mutual funds, bonds, RRSPs/LIRAs, RRIF, RPP, etc) and non-financial (principal residence, other real estate, vehicles, business equity) assets. Total debts include mortgage on principal residence, mortgage on other real estate, line of credit, credit card and installment debt, student loans, vehicle loans, and other debts. The SFS does not provide information on values of public pension entitlement.

[32]Focusing on household private saving is a common practice in the literature (Engen, Gale, and Uccello (1999), and Scholz, Seshadri, and Khitatrakun (2006)).

[33]The private pension wealth we subtracted from the net worth in the SFS include private pension value (termination) and other retirement funds (deferred profit sharing plans, executive and foreign pension plans and annuities). Also note that in the SFS, the Locked-In Retirement Account (LIRA) was included in the RRSP category, which is treated as part of private saving. The money in the LIRA would have been the transfer from an employer pension plan after the individual terminated employment. This will slightly overstate private saving in the data.

[34]The "Single" category includes singles and lone parents.

[35]The RPP coverage in the SFS is defined as either household head or spouse(if any) being covered by deferred RPPs (offered by previous employers), current RPPs, or RPPs in pay. Hence it represents the RPP coverage status during the lifetime until the interview date.

much lower than that of couples. We also group the sample according to private pension coverage status. About 57.9% of households between 60-64 in 2005 had RPP coverage for some time during the working life. Overall, families with RPP coverage accumulate more non-pension wealth both at the median and the mean levels.

Table 4: Sample statistics for households aged 60-64 in 2005 SFS

	Single			Couple		
	mean	median	sd	mean	median	sd
Age	61.91	62.00	1.36	62.03	62.00	1.44
RPP wealth($1000)	104.16	0.00	171.01	265.94	97.42	343.43
Non-pension wealth($1000)	215.31	90.23	353.85	585.73	361.80	1142.86
RPP coverage rate (%)	42			67		
No. of obs.	124			269		
	Not covered by RPP			Covered by RPP		
	mean	median	sd	mean	median	sd
Age	61.94	62.00	1.35	62.01	62.00	1.46
RPP wealth($1000)	–	–	–	356.50	279.44	323.45
Non-pension wealth($1000)	405.78	183.75	1117.57	482.67	313.00	810.72
No. of obs.	187			206		

Table 5 illustrates the distribution of non-pension wealth for all households with heads aged 60-64 in the 2005 SFS. It also documents the wealth distribution by marital status, RPP status, and current earnings quartiles.[36] Couples accumulated more wealth than singles across the wealth distribution. Comparing the wealth distribution across current earnings deciles, we find that the mean (median) wealth levels for the lowest three earnings quartiles are close, while the wealth holdings in the highest earnings quartile are much larger.[37] We note that the current earnings are not sufficient to capture earnings

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[36]Here the earnings distribution is only based on those families with positive earnings.

[37]Because we have a small sample, we are not able to show the wealth level at the 5th percentile for

Table 5: Distribution of non-pension wealth ($1000) for households aged 60-64 in 2005 SFS

	5%	10%	25%	50%	75%	90%	95%	Mean
All	1.00	4.20	68.90	231.00	545.00	871.50	1244.00	450.33
Single	0.25	0.65	4.70	90.23	218.00	710.70	1074.10	215.31
Couple	29.20	46.00	172.50	361.80	609.80	1042.00	1525.90	585.73
Covered by RPP	4.00	24.50	117.26	313.00	564.10	977.10	1244.00	482.67
Not-covered by RPP	0.25	0.65	10.00	183.75	488.10	829.70	1252.35	405.78
Earnings quartile								
1(lowest)		0.56	29.20	195.21	463.00	725.00	1244.00	301.78
2		4.00	70.00	242.39	508.50	977.10	1220.53	350.61
3		26.78	90.00	231.00	397.50	727.50	786.20	325.51
4		95.50	276.00	440.00	640.81	1864.00	5196.80	886.85

histories (lifetime earnings) that are central to wealth accumulation.

5   Simulation Results

After solving the model and conducting simulations for different household types and provinces, in this section we compare our benchmark results with the actual wealth for households aged 60-64 in the 2005 SFS. Our strategy for examining the adequacy of saving focuses mainly on two issues: (1) determining the proportion of households in the data whose wealth exceeded the median simulated wealth for households with similar characteristics (i.e., age, marital status, pension status, and current earnings); and (2) comparing wealth at different percentiles of the actual and simulated distributions.

each earnings quartile due to confidentiality rule.

5.1 Median wealth

A life-cycle model with stochastic earnings predicts different retirement savings even for households with similar characteristics because of different timing of earnings shocks. If households in the SFS behave exactly the same as in our benchmark model, we should expect only 50 percent of households to exceed the median simulated wealth level. If there are more than 50% of households in the SFS whose wealth exceeded the simulated median in our benchmark, this would suggest adequate wealth accumulation relative to our benchmark model at the median level.

Table 6 presents information on median (mean) wealth in the 2005 SFS and the benchmark for all households and subgroups, as well as the percentage of households in the data that had accumulated more wealth than the simulated median. The mean wealth is higher than the median in both data and model. The median wealth of all subgroups in the SFS, except singles, exceeded the median of simulated wealth in the benchmark for the same category. For all sample households aged 60-64 in the 2005 SFS, 62.47% of them accumulated more non-pension wealth in 2005 than the simulated median. This suggests that overall households aged 60-64 saved adequately in 2005 as we expect only 50% of households will exceed the simulated median. The saving surplus (difference between the observed median wealth and the simulated median wealth) was about $73,000.

Table 6 also shows several interesting results for different subgroups. Marriage and private pension coverage are associated with higher proportion of households with wealth exceeding the simulated median wealth. For example, 69.52% of households with RPP coverage accumulated more wealth than the simulated median. For households without RPP coverage, the percentage dropped to 53.60% and for single households below 50%. The saving surplus for couples is the largest, about $172,000. The only group that incurs the saving deficit (negative difference between the observed median wealth and the simulated median wealth) is single households. The deficit is about $30,000. The

proportion of households whose wealth exceeded the median simulated wealth generally increases as current earnings rise. It is higher than 50% for all four earnings quartiles. Overall, we find Canadians at 60-64 years old in 2005 were preparing sensibly, given the existing generosity of private pensions and public pensions.

Table 6: Households aged 60-64: 2005 SFS vs. benchmark

sample	Non-pension wealth ($1000)				
	median		mean		
	2005 SFS	Model	2005 SFS	Model	% of households in SFS exceeding simulated median
All	231.00	158.09	450.33	197.16	62.47
Single	90.23	120.14	215.31	146.54	44.65
Couples	361.80	189.44	585.73	226.32	72.48
Covered by RPP	313.00	155.44	482.67	194.44	69.52
Not covered by RPP	183.75	161.28	405.78	200.67	53.60
Earnings quartile					
1(lowest)	195.21	117.77	301.78	160.89	60.36
2	242.39	138.67	350.61	180.21	63.72
3	231.00	156.44	325.51	193.82	63.57
4	440.00	218.94	886.85	254.93	78.63

5.2 Wealth distribution

Table 7 compares the simulated and actual wealth distributions at various percentiles for all households of 60-64 in our sample and by marital status. For all households aged 60-64, the actual wealth is consistently lower than the simulated wealth at the 10th

percentile and below. Above (and including) the 25th percentile, the actual wealth is consistently higher than the predicted wealth. If we define adequacy threshold as the point in the wealth distribution above which the actual savings exceed the simulated targets consistently and below which fall short, this threshold is the 23rd percentile for our full sample households aged 60-64 in the 2005 SFS. This suggests undersaving at the low end of the wealth distribution. The adequacy threshold for singles is at the 60th percentiles, which suggests a quite high risk of undersaving. The couples in the SFS do a much better job than the singles, accumulating more wealth than the simulated target even at the 5th percentile.

Table 7: Non-pension wealth ($1000) distribution for all and by marital status

		5%	10%	25%	50%	75%	90%	95%	Mean
All	**2005 SFS**	1.00	4.20	68.90	231.00	545.00	871.50	1244.00	450.33
	Benchmark	6.14	17.92	60.28	158.09	287.54	436.20	534.57	197.16
Single	**2005 SFS**	0.25	0.65	4.70	90.23	218.00	710.70	1074.10	215.31
	Benchmark	4.70	13.52	46.04	120.14	211.36	315.49	390.60	146.54
Couple	**2005 SFS**	29.20	46.00	172.50	361.80	609.80	1042.00	1525.90	585.73
	Benchmark	7.68	21.38	74.02	189.44	336.70	486.84	579.98	226.32

Similar comparison by RPP coverage is given in Table 8. Households with RPP coverage appear to be doing well. All households above the 10th percentile of the wealth distribution accumulate more wealth than what is implied by our benchmark model, and even at the 5th percentile, the deficit is only about $1,400. Households without RPP coverage accumulate more wealth than the simulated target at the median level. However, the adequacy threshold for households without RPP coverage locates at the neighborhood of the 40th percentile, which also suggests a high risk of undersaving.

Table 9 shows the comparison by current earnings quartiles. The earnings quartiles for the SFS are only based on positive earnings. The risk of undersaving is larger for

Table 8: Non-pension wealth ($1000) distribution by RPP coverage

		5%	10%	25%	50%	75%	90%	95%	Mean
Covered by RPP	**2005 SFS**	4.00	24.50	117.26	313.00	564.10	977.10	1244.00	482.67
	Benchmark	5.40	16.56	57.28	155.44	287.44	430.14	530.55	194.44
Not covered by RPP	**2005 SFS**	0.25	0.65	10.00	183.75	488.10	829.70	1252.35	405.78
	Benchmark	7.08	20.15	64.09	161.28	287.85	444.63	540.29	200.67

Table 9: Non-pension wealth ($1000) distribution by earnings quartiles

Earnings quartile		10%	25%	50%	75%	90%	95%	Mean
1(lowest)	2005 SFS	0.56	29.20	195.21	463.00	725.00	1244.00	301.78
	Benchmark	6.88	36.47	117.77	239.40	383.90	474.36	160.89
2	2005 SFS	4.00	70.00	242.39	508.50	977.10	1220.53	350.61
	Benchmark	11.52	45.74	138.67	265.31	413.38	516.02	180.21
3	2005 SFS	26.78	90.00	231.00	397.50	727.50	786.20	325.51
	Benchmark	22.38	63.14	156.44	279.66	424.50	517.28	193.82
4	2005 SFS	95.50	276.00	440.00	640.81	1864.00	5196.80	886.85
	Benchmark	53.66	113.70	218.94	358.44	505.80	604.54	254.93

households at lower earnings quartiles. For example, the saving shortfall likely happens somewhere between the 25th and 50th percentile for the bottom earnings quartile and the 10th and 25th percentile for the second lowest earnings quartile. We do not find evidence of undersaving for the highest and second highest earnings quartiles even at the 10th percentile of the wealth distribution.

6 Sensitivity Analysis

In this section, we conduct a series of sensitivity analysis to check the robustness of the implications from our benchmark model. Table 10 presents the results.

Pooled SFS sample. Our 2005 SFS sample consists of only 393 observations.

The number of observations becomes even smaller when we break the sample down by household type, RPP coverage status and earnings quartile. It is possible that some of our results may be driven by a relatively small sample. To investigate this possibility, we pool households of 60 to 64 years old from the 1999 SFS, which has a much larger overall sample size than the 2005 SFS, together with those in the 2005 SFS to construct a larger sample.[38] The resulting sample has 1397 observations. The results are largely similar to those based on the 2005 sample. The third column of Table 10 shows that 63.22% of all households in the new sample accumulated more non-pension wealth than the median simulated wealth in the benchmark, as compared to 62.47% in the 2005 SFS sample. The number is 73.62% for households with RPP coverage in the pooled sample as opposed to 69.52% in the 2005 sample and 50.32% as opposed to 53.60% for households without RPP coverage. The proportions are similar for singles and couples. The main reason for this similarity appears to be the similarity between the wealth distributions in the pooled sample and the 2005 sample. For example, after controlling for year effects, the median non-pension wealth of all households between 60-64 years old in the pooled sample is about $237, 000, compared to $231,000 in the 2005 sample. The mean wealth is about $432, 000 in the pooled sample compared to $450,000 in the 2005 sample.

Home equity. In the benchmark analysis, we include all housing equity into the measure of private saving in the 2005 SFS. There has been debates in the literature about the degree to which people are willing to reduce housing equity to sustain consumption in retirement. To explore the impact of altering the treatment of housing in our analysis, we now only include half of the housing equity into the resources available for our sample households in the 2005 SFS. Table 10 shows that the percentage of households whose wealth exceeds the simulated median wealth drops to about 51% for all households when we exclude half of housing equity. The proportions are more than 10 percentage points lower for all subgroups when compared to those in the benchmark. This suggests a

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[38]The 1999 SFS is the only SFS before the 2005 SFS. We control for the year effect when constructing the new sample.

Table 10: Percentage of households with wealth higher than simulated median

Sample	Benchmark	Pooled SFSs	Half housing equity	Lower risk aversion (1.5)	Higher risk aversion (3.0)	Higher accrual rate of RPP (2%)	Discount factor heterogeneity	Rate of return heterogeneity
All	62.47	63.22	50.92	65.57	55.27	63.97	62.36	62.52
Covered by RPP	69.52	73.62	57.55	73.67	61.19	71.72	69.00	69.52
Not covered by RPP	53.60	50.32	41.51	56.93	47.76	53.60	53.60	53.60
Single	44.65	44.93	33.48	49.98	39.42	49.98	44.65	44.65
Couple	72.48	72.18	59.97	76.32	65.73	75.63	72.48	72.48

significant role of home equity in measuring the adequacy of retirement savings.

Risk aversion. The impact of the relative risk-aversion on saving adequacy is tested by considering a lower relative risk aversion coefficient of 1.5 and a higher relative risk aversion coefficient of 3.0.[39] Table 10 reports the results. As expected, when the coefficient of relative risk aversion is lower (higher), more (less) households in the data met the median wealth target compared to the benchmark. This is because households in the model save less (more) when they are less (more) risk averse. The percentage of households aged 60-64 whose wealth exceeded the simulated median increases to 65.57% when the coefficient of risk averison is lower (1.5), while it drops to 55.27% with a higher risk aversion (3.0). Similar patterns apply to other subgroups.

Accrual rate of RPP. The generosity of private pensions also influences saving decisions. Households with more generous private pensions would likely to reduce their private savings. In our next experiment, we increase the accrual rate of private pension to 2% from 1.5% used in the benchmark. We find that more generous private pensions reduce the median non-pension wealth in the model, thus pushing up the saving adequacy. Overall, 63.97% of households aged 60-64 in the 2005 SFS accumulated more wealth than the simulated median as compared to 62.47% in the benchmark. There are 71.72% of households with RPP coverage accumulating more wealth than the simulated median, as opposed to 69.52% in the benchmark. Singles and couples also experienced increases in saving adequacy. It is not surprising that the generosity of private pension has no impact for the saving adequacy of households without RPP coverage.

Discount factor heterogeneity. Savings decisions are also affected by the value of the discount factor, β. A higher discount factor increases the incentive to save. In the life cycle model, this raises the optimal (or "target") level of wealth. It is possible that households may have different discount factor (i.e., they discount future at different rates). In this sensitivity analysis, we examine the effect of discount factor heterogeneity.

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[39]These numbers fall in the range of 1-3 widely used in the literature.

We randomly assign β=0.96 to 60% of the population, a lower β (0.94) to 20% of the population, and a higher β (0.98) to the remaining 20%. The results are shown in the eighth column of Table 10. The proportion of households in the 2005 SFS sample that accumulated more non-pension wealth than the new simulated median is slightly lower than that in the benchmark. This is because the simulated median wealth in the model with discount factor heterogeneity is only slightly higher than those in the benchmark. Instead, if all households in the model have a lower discount factor (0.94), we find that 70.85% of all sample households met the median wealth target as the target is lower now; if all households in the model have a higher discount factor (0.98), only 49.06% met the median target.

Rate of return heterogeneity. Another parameter that plays an important role for saving is the rate of return. A higher rate of return increases wealth in the model and thus lowers the percentage of households with actual wealth more than the simulated wealth in the model. Households in real world are likely to face different rate of return, for example due to different portfolio holdings. We introduce a simple form of rate of return heterogeneity. We assume that each household draws a rate of return on savings in the first period. Specifically, 60% households will receive a return of 4%, 20% households with return of 2%, and another 20% households with return of 6%. The last column of Table 10 suggests that the results do not change much compared to those in the benchmark. However, if all households in the model have a lower rate of return (2%), 70.74% of all sample households met the median wealth target; if all households in the model have a higher rate of return (6%), only 53.04% met the median target.

6.1 Discussion

This paper does not address some other issues related to private savings. We discuss them in this section.

First, we do not model marriage, divorce, and fertility choices. Following Scholz,

Seshadri, and Khitatrakun (2006), married individuals are modeled as making their life-cycle consumption decisions jointly with their partners throughout their lives. Similarly, single households are modeled as if they were single throughout their lives. As we are interested in retirement saving, our model also abstracts entrepreneurship, very high capital income, as well as productivity links between generations. These features could be important for the wealth accumulation for households at the very top of the wealth distribution.

Second, private pension benefits often take the form of fixed nominal annuities (i.e., they are not protected against inflation by formal indexation).[40] Our model may underestimate the wealth accumulation for households with RPP coverage as our model does not incorporate inflation expectations. When households take inflation into account, they are likely to save more to insure against the potential loss of their private pension value caused by inflation.

Third, the focus of our paper is on the preparedness for retirement among current retirees, more specifically, households with heads aged 60-64 in 2005. Our paper does not address the retirement prospects of future retirees, which would require modeling of future earnings processes and making assumptions about future economic conditions. A recent study, Moore, Robson, and Laurin (2010), examines the prospects of future retirees and argues that Canadians may find it more difficult to maintain the level of their working-life consumption in retirement because of the declining RPP coverage among other reasons.[41]

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[40]There is no such problem for public pension as public pension benefits (CPP/QPP) are fully indexed to the CPI.

[41]Wolfson (2011) also argues that a significant portion of young Canadians with middle earnings may, under some circumstances, experience at least a 25% decrease in their living standards when they retire.

7   Conclusion

This paper assesses the adequacy of retirement saving in Canada by comparing observed non-pension wealth with the simulated wealth derived from a stochastic life-cycle model. Our benchmark results suggest that overall Canadian households were preparing well for retirement, with about 62% of all households exceeding the simulated median wealth. Fewer than 25 percent of households in the benchmark were undersaving. Households with RPP coverage and the couples appear to be better positioned to face retirement than other households: about 70% of the former and 72% of the latter have more wealth than the simulated medians. The risk of undersaving is very small for these groups. On the other hand, households without RPP coverage and the singles are potentially vulnerable groups that likely face a greater risk of undersaving. Our study points to the importance of focusing on these two groups for any policy response that is deemed to address the retirement income security issue for Canadians. We also find the comparative advantage in terms of retirement savings by couples and households with private pension coverage and the disadvantage by singles and households without private pension coverage are fairly persistent across different parameter specifications. Finally, we should also acknowledge that our main analysis is based on the 2005 wealth records, a year characterized by a rapid growth in the financial and housing markets. Our conclusions might have been different if we examined post-2008 wealth data. This underscores the importance of re-examining the issue as more recent wealth data become available.

Appendix: Numerical Solution

We use numerical dynamic programming techniques to approximate the decision rules as well as the value function. The dynamic program has five state variables in addition to period j: non-pension wealth k, earnings state e, the average ratio of earnings to YMPE until current period $\bar{y}_{cpp}$, RPP coverage status pen, and years of RPP coverage

until current period n_{rpp}.

We discretize the state-space along the two continuous state variables, k and $\bar{y}_{cpp}$. The model is solved using backward induction. In the last period $(j = J)$ the policy functions are trivial. In periods prior to J, we calculate optimal decision rules for each possible combination of nodes, using stored information about the subsequent period's decision rules and value function. We follow Tauchen (1986) to approximate the distributions of the innovations to the labor earnings process. For points which do not lie on the state-space grids, we evaluate the value function using a bi-cubic spline interpolation along the two dimensions. After computing the values of all the alternatives, we pick the maximum, thus obtaining the decision rules for the current period.

Once we determine the optimal decision rules for all possible nodes in each period, we simulate the income history of 20,000 households. We allocate these households to provinces and household types according to population weight and household composition.[42] All programs are parallelized and run on SHARCNET.[43]

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[42]Price Edward Island is the smallest province in Canada with a population weight of 0.3%. We merge it with Newfounderland, another small province, in the simulation.

[43]SHARCNET is a multi-institutional High Performance Computing network that spans 17 academic institutions in Ontario, Canada.

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