Canadians’ Preparation for Retirement (CPR)

A summary report on the simulator and base results

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1 BACKGROUND

1.1 CHANGING ENVIRONMENT AND THE ROLE OF THE RETIREMENT INCOME SYSTEM

Canada's retirement income system was recently ranked 9th around the world by the Melbourne Mercer Global Pension Index (MMGPI).[1] The MMGPI report notes that important challenges are on the horizon for the Canadian retirement income system, in particular because of low employer pension plan coverage and a challenging long-term investment environment. Because one of the primary functions of a retirement income system is to make sure that individuals maintain a good standard of living in retirement, particular attention has been devoted in the last 15 years to assessing retirement readiness in Canada – both retrospectively and prospectively. The conclusions from these studies are wide-ranging: some report an alarming number of current workers who prospectively face a significant decline in their standard of living, while others emphasize that this number will be low and concentrated among relatively well-defined groups. Their approaches are described below, and some their results briefly reported in section 5 of this report. The debate culminated in 2016 with the adoption of a plan to enhance the coverage of the Canada Pension Plan (and, in 2018, its sister Quebec Pension Plan). Given the changing environment, more than ever is revisiting retirement readiness needed.

1.2 A NEW CALCULATOR, WHY?

In this report, we present and describe a comprehensive stochastic retirement income calculator (Canadians' Preparedness for Retirement, or CPR) that will be made available to the general public in the near future. We also present the latest results on retirement readiness using a large survey of Canadian households conducted in mid-2018.

Many assumptions are made when constructing such a calculator; the future is hard to predict. Our objective is to make the assumptions as transparent as possible so that stakeholders can judge the plausibility of our calculations and/or make their own assumptions. The calculator contains several innovations with respect to what has been done in the past. To name a few, it includes a detailed modelling of the evolution of private savings, accounting for individual and aggregate risk; taxation of savings, including capital gains; employer pensions; a realistic stochastic modelling of work income; the value of housing; and debt dynamics. While for practical reasons, we retain the concept of the retirement readiness index (McKinsey 2012; 2015), we innovate by including uncertainty in our assessment of retirement readiness at the individual and aggregate levels. In an environment where risks have – and are still being – shifted substantially towards individuals, allowing for uncertainty in the assessment of retirement readiness appears essential.

1.3 WHAT IS RETIREMENT READINESS?

One reason why results vary substantially between studies is that different concepts of retirement readiness are used. Retirement readiness involves a normative judgment over what is enough income, or consumption, in retirement. Hence, it involves comparing outcomes with some normative benchmark. Numerous outcomes have been proposed around the world and at least as many benchmarks. For economists, the ideal benchmark will be some target wealth derived from a life-cycle model (Scholz, Seshadri, and Khitatrakun 2006). Realized wealth at retirement will then be compared to the target wealth from the model given the realized earnings trajectory of those who retired. The model used to construct targets will involve a number of assumptions and these will yield different benchmarks (Skinner 2007). Beside delivering a well-grounded benchmark, both the unobserved nature of preferences – which requires some calibration – and the required simplicity of the heterogeneity that can be modelled, due to computational cost, make this approach less attractive in practice.

The most common approach to assessing retirement readiness thus consists of constructing a replacement rate, defined as retirement income divided by some measure of pre-retirement earnings, and comparing it to a benchmark. The measures vary across studies: retirement income divided by peak career earnings, by average career earnings, or by final earnings. There is also some heterogeneity in what is included in retirement income. Some studies will account for private savings by transforming stock measures into annuity – or flow – measures; some will account for housing while others will not. Some will consider after-tax income measures while others will instead use expenditures. There is also substantial heterogeneity in terms of the benchmark used. Financial advisors will often use the 70% rule of thumb as a good measure. Others will define the target based on observed data. For example, some studies define the target using expenditure data (80% for those in the lowest income quintile, 65% for others) (McKinsey 2012; 2015). Others use targets derived from a life-cycle model (Scholz and Seshadri 2009). They find an average optimal replacement rate of 75% for couples (55% for singles) but large heterogeneity. All of these studies define an indicator of preparation which is dichotomous. Although many conduct robustness analyses, the variability of individual measures cannot be assessed in a systematic way (e.g. with respect to benchmark value sensitivity; shocks; or uncertainty).

A significant number of studies have attempted to assess future retirement readiness in Canada (Baldwin 2016). Three broadly defined features of these calculations appear to be important. First, given that these are often prospective calculations, assumptions regarding the macroeconomic environment (for example the evolution of real wages) are extremely important. For example, in the Canadian context, the fact that OAS is price-indexed implies that its value relative to career earnings will decrease in the future. Understanding the effect of uncertainties in the macroeconomic environment on retirement preparedness may be an important gap to fill.

Second, studies differ in terms of how they account for registered pension plans (RPPs) in their assessment of retirement readiness. In particular, assumptions regarding the dynamics of RPP coverage over time appear to impact those assessments considerably. This is important because the downward trends in coverage witnessed until the 2000s may

[1] See https://www.mercer.ca/en/newsroom/2019-melbourne-mercer-global-pension-index.html.

have since stabilized for younger workers. A change in this assumption would likely have important consequences for projection results. For example, two studies account for declining coverage of employer pension plans (Moore, Laurin, and Robson 2010; Wolfson 2011). There is a marked decline in defined-benefit plans and an increase in defined-contribution plan coverage over a relatively short period. Given investment and timing risks associated with DC plans, assessing their effect on retirement income variability may be another important gap to fill.

Finally, the same can be said of the treatment of individual savings. Private savings, in the form of tax-sheltered savings or other savings, is becoming more and more important in the portfolio of Canadians. In particular, although most studies above included RRSPs, few were done in an environment where TFSAs are becoming a key vehicle of retirement saving for Canadian households (Messacar 2017). Similarly, several studies did not include other forms of private savings in their analysis. One other important asset held by households is housing. Although some studies did include housing, an important gap remains the modelling of both assets and liabilities when it comes to housing and the treatment of rents. This can be particularly important in the context of soaring house prices and mortgage values in recent years.

While there is disagreement over which measure to use, it is worth emphasizing the trade-off between, on one hand, the realism and level of detail in the projections of resources in retirement; and, on the other, the economic foundations of “retirement readiness” – which in principle should be based on knowledge of preferences and the solution of the full life-cycle problem of each individual. Because the main objective of this project is to incorporate a high level of detail while maintaining transparency, we have opted for a replacement rate measure.

2 CANADIANS’ PREPAREDNESS FOR RETIREMENT (CPR): A STOCHASTIC RETIREMENT READINESS CALCULATOR

2.1 MEASURING RETIREMENT READINESS

For the sake of comparison with previous studies, we use the definition of “retirement readiness” used by McKinsey and company in their two past assessments of retirement readiness (McKinsey 2012; 2015). The retirement readiness index (RRI) is defined as the ratio of equivalent consumption in retirement to equivalent consumption prior to retirement, multiplied by 100. Hence, an RRI of 100 means that a household is projected to be able to consume the same amount in retirement as just prior to retirement (defined here as the earliest of age 55 or the year just prior to retirement). Equivalent consumption prior to retirement is computed as income net of savings, debt payments and taxes. Consumption in retirement is derived from a projection of after-tax income in retirement – including the cashflow value of savings, which are transformed into income using a fairly priced annuity to provide a measure of equivalent consumption.

To measure readiness, we use the same thresholds as in the McKinsey studies. For individuals in the first quintile of income, this RRI threshold is set at 80; for those in the higher quintiles, it is set to 65.[2] McKinsey’s past analysis of consumption surveys revealed that consumption patterns in retirement matched these values most closely. One of the robustness exercises carried out in section 4 varies those thresholds to illustrate what role they play in determining aggregate retirement preparedness.

2.2 OVERVIEW OF THE CPR CALCULATOR

In Figure 1, we provide a visualization of the CPR calculator. Grey rectangles include the agents of the model. A household can be composed of up to two earners, the primary (in the base year, the highest) earner and the secondary one. Each is characterized by current earnings, demographic characteristics, and registered pension plan (RPP) coverage. The household also has a set of characteristics which are not, *per se*, attached to the earners. First, a list of inputs related to initial assets and debts. Another set of inputs relates to the saving strategy currently followed by the household (RRSP and TFSA contributions as well as other savings) and to the various debt payments (e.g. mortgage payments) that are made. As such, each blue circle represents a set of inputs that need to come from a dataset.

Each grey diamond in the figure represents a simulator/calculator that is used to compute net income pre-retirement (top part of the figure) and to project it until retirement, so that net income in retirement can be computed (bottom part of the figure). The first large component is the Simulator which projects assets (including DC RPP balances), debts and accrued DB RPP benefits yearly, based on inputs and assumptions. Pre-retirement income is fed into a disposable income simulator (DIS), which produces after-tax income measures, leading to “pre-retirement consumption” for a given pre-retirement year, defined later in this document.

The financial position of the household resulting at the time of retirement is then transformed into an immediate annuity using the Annuity calculator. At the same time, a CPP calculator takes care of collecting CPP/QPP contributions and transforming them into CPP/QPP benefits, which are then added to income from other sources in retirement (OAS/GIS, annuity and pension income). At this point, retirement income is also fed into the DIS and, combined with debt payments remaining in retirement, yields a measure of consumption in retirement.

The following sub-sections provide details regarding each of these elements. A more complete and technical description is found in the calculator’s technical documentation.

[2] To classify households in income quintiles for this purpose, we use the initial earnings as declared in the database (see below), adjusted for household size by dividing the household’s total gross earnings by the square root of the number of spouses in the household.

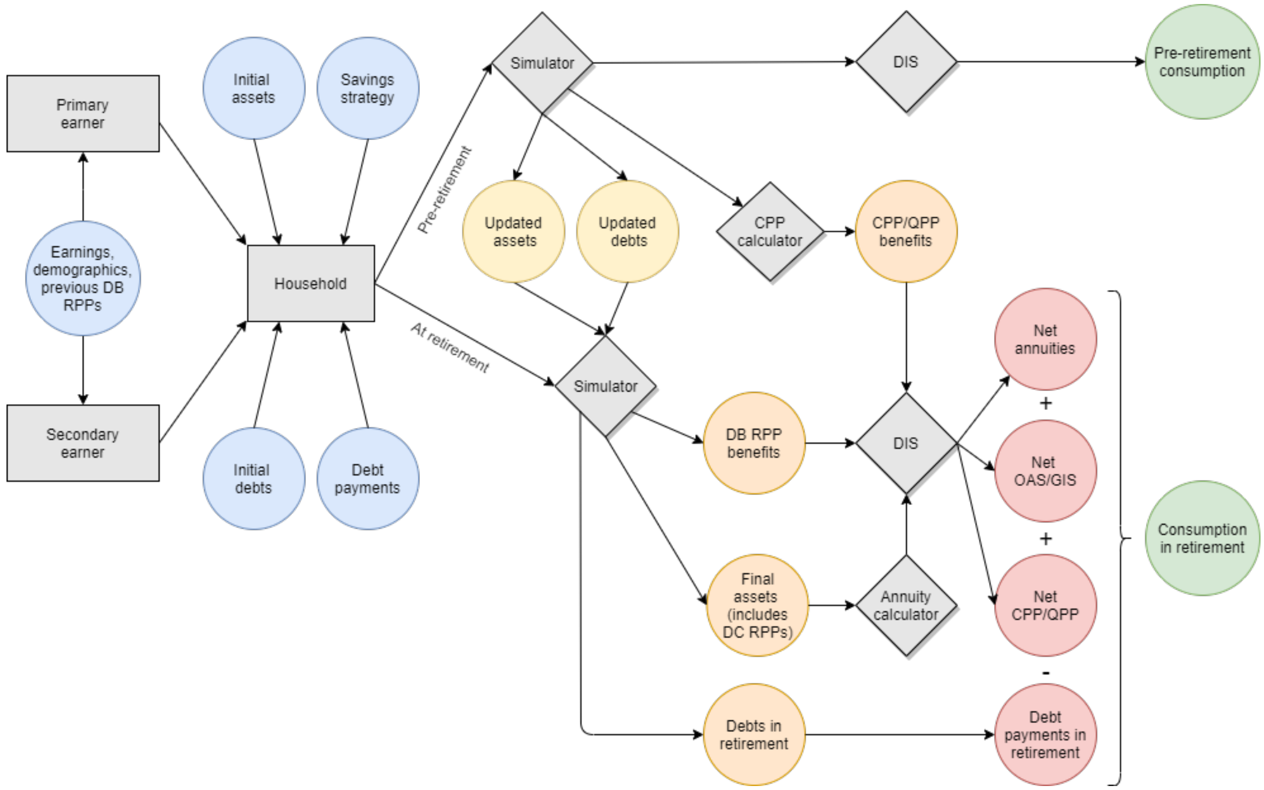

Figure 1 Model Structure

2.3 DATA INPUTS

Table 1 provides a list of inputs required in order to perform the simulation. These inputs are grouped according to the classification in Figure 1, where they appear as blue circles.

2.4 THE SIMULATOR

The simulator takes the data inputs and, using the savings strategy and the payments that need to be made on debts, projects account balances forward stochastically until retirement.[3] Retirement is triggered by a data input regarding the age at which individuals intend to retire.[4] The simulator needs to project the following outcomes dynamically:

- Work income
- RRSP, TFSA, other registered and unregistered account balances
- DC RPP account balances
- DB RPP entitlements
- RRSP (including "other registered accounts") and TFSA contribution rooms
- House value and mortgage balances
- Debts

For each outcome, we provide a summary of the key assumptions made regarding deterministic trends and stochastic elements.

[3] The simulator can either run in deterministic mode or in stochastic mode. In what follows, we describe the stochastic simulator.

[4] The simulator would allow modifying or constraining retirement ages to let them differ from respondent provided intended ages. Only one such manipulation is done in the context of this report: capping retirement age at 75 years old.

Table 1 Data Inputs for the CPR

Earner Characteristics	Initial Assets	Initial Debts	Savings Strategy	Debt Payments
Birth year	Initial balance: RRSPs	First mortgage	RRSP contribution rate	First mortgage payment
Sex	Initial balance: TFSAs	Second mortgage	RRSP withdrawals	Second mortgage payment
Education level	Initial balance: other registered assets	Credit card	TFSA contribution rate	Credit card payment
Province of residence	Initial balance: unregistered assets	Personal loan	TFSA withdrawals	Personal loan payment
Initial wage	Initial balance: DC pensions	Student loan	Contribution rate to other registered assets	Student loan payment
Household type (couple vs. single)	Purchase price of principal residence	Car loan	Withdrawals of other registered assets	Car loan payment
DB pensions from a previous employer	Market value of principal residence	Credit line	Contribution rate to unregistered assets	Credit line payment
Intended CPP/QPP claiming age	Purchase price of second residence	Other debt	Withdrawals of unregistered assets	Other debt payment
Intended retirement age	Market value of second residence		Expected replacement rate of current DB plan	
	Purchase price of business owned		Employee contribution rate to current DB plan	
	Business equity		Employee contribution rate to DC plans	
			Employer contribution rate to DC plans	
			Share of bills in portfolio	
			Share of bonds in portfolio	
			Share of equity in portfolio	
			Fees paid on investments	
			Net unrealized capital gains on unregistered assets	
			Carried-forward past losses on unregistered assets	
			Initial contribution room: RRSP	
			Initial contribution room: TFSA	

2.4.1 WORK INCOME

First, we estimate deterministic life cycle wage profiles using the 2016 Census Public Use Microdata Files (PUMF). We split the sample into 4 education groups (*less than high school; high school; post-secondary below university; university*), and regress the logarithm of work income on age using ordinary least squares (OLS). The deterministic wage profiles by education level are shown in Figure 2.

These work income profiles are for 2016. We account for time effects by adding a 1% real annual growth rate for work income. According to the actuarial evaluation of the CPP as at December 31, 2018, average real wage growth over the period 1962-2017 was 1.01% annually. For the years 2025 and on, the Office of the Chief Actuary assumes a 1.00% real wage growth – somewhat less for 2019 to 2024. In all cases, robustness checks revealed that, over a reasonable range of plausible values, this element has a very limited effect on aggregate retirement preparation.

The second component of work income is stochastic, to account for earnings volatility over the career. As is common in labor economics, we have estimated a work income process on longitudinal data from Statistics Canada's Longitudinal and International Study of Adults (LISA). The work income data comes from Revenue Canada T1 tax data matched to the survey. We allow for a persistent and a transitory shock to work income. The methodology to estimate these shocks is detailed in (Boisclair et al. 2018). These shocks are idiosyncratic (i.e. no aggregate shocks are included), and they reproduce well the dispersion in work income observed across individuals as well as within individual.

Finally, using the initial wage, age and level of education of our respondents (see Section 3), we project their stochastic life-cycle wage profiles backward and forward in time starting from 2018 (we need their earnings from age 18 on to compute CPP/QPP contributions and benefits). Figure 3 shows 100 simulations for an individual earning $30,000 at the time of the survey (at 35 years old) and who has a high school education; the thicker green line towards the middle of the estimates denotes the average for each age of the 100 simulations. We assume that this individual starts working at 18 and retires at 65. In practice, work income becomes zero once the individual retires (retirement age being an input to the calculator).

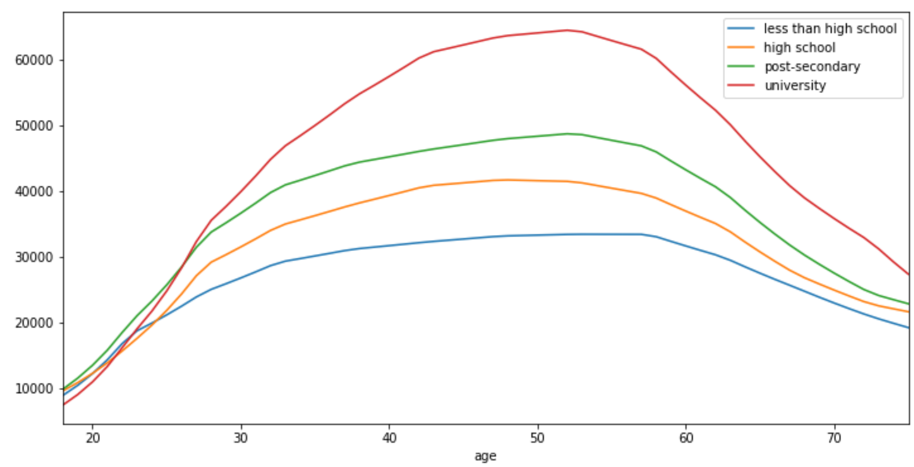

Figure 2 Work Income Age Profiles

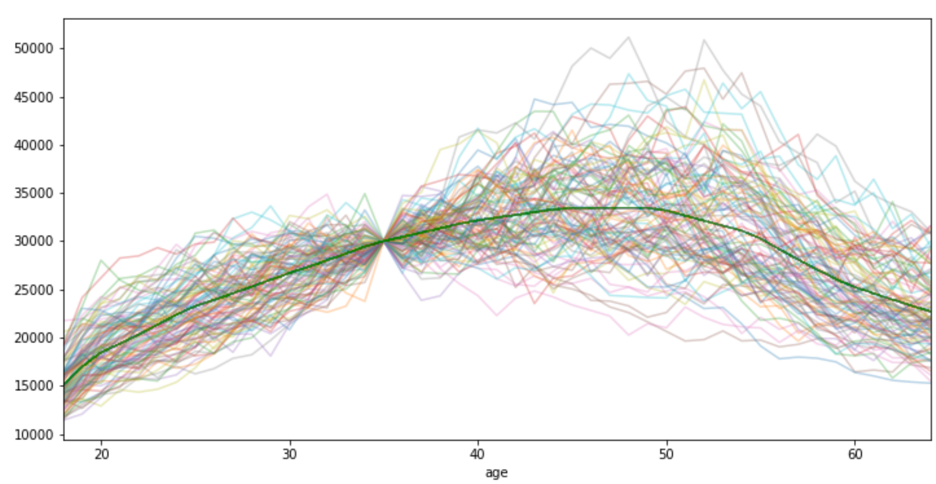

Figure 3 Example Stochastic Work Income Profile (100 simulations)

2.4.2 RRSP, TFSA, OTHER REGISTERED, AND UNREGISTERED ACCOUNT BALANCES

We input initial balances; expected contributions; and withdrawals for each type of account (TFSA, RRSP, other registered, unregistered) at the household level, as well as the type of assets held in each (checking or regular savings account, mutual funds, bonds, etc.).

We model contributions as a constant fraction of income over time, and keep annual withdrawals constant in real value (until the account is depleted or liquidated at retirement).

These simple rules guarantee some consumption smoothing and a positive correlation between income and savings: after a positive (negative) income shock, savings increase (decrease) because contributions increase (decrease) and withdrawals stay constant.

After-tax returns on households' investments depend on the type of assets held in their portfolio and on the type of account they choose. The returns on these assets are expressed as a linear combination of returns on short-term government bonds (bills), long-term government bonds (bonds), stock market returns (equity) and a fee, as illustrated in Table 2. For example, mutual funds are assumed to be composed of 40% bonds and 60% equity and to have fees of 1.5% on account balances. Compared to ETFs, the higher fee on stocks is due to the performance penalty that individual investors pay for active trading, which has been estimated to 1.8%-3.7% per year compared to the market return (Barber and Odean 2000).

We use the fraction of each type of asset that households hold in their portfolio to compute a mix of bills, bonds and equity as well as the average fee paid for each household. Then, using the latter and the returns on bills, bonds and equity, we can simulate households' returns on their portfolios.

To estimate historical returns, we use the *Jordà-Schularick-Taylor Macrohistory Database* (Jordà, Schularick, and Taylor 2016) on 16 advanced economies from 1870 (for most of them, but no later than 1880) to 2015, and in particular estimates computed by (Jordà et al. 2019). Real returns on bills and bonds are modelled as log-normal serially correlated processes. Equity returns also follow a log-normal process but that is serially uncorrelated, as implied by the efficient market hypothesis. Table 3 summarizes the calibration of these stochastic processes.

Mean returns and volatilities are taken from (Jordà et al. 2019). Autocorrelations are computed from the same database by taking the mean of the autocorrelation coefficient over all countries. The data show no clear correlation patterns between the three processes. Hence, we assume they are uncorrelated.

Balances are updated every period in the following manner. The balance at the end of the period is the sum of the balance at the beginning of the period, the return obtained during the period, and the net contribution (contribution minus withdrawal) made at the end of the period. Withdrawals from RRSPs and "other registered accounts" are taxed as regular income. In unregistered accounts, interests and dividends are taxed every period but capital gains are taxed when they are realized. To separate dividends from capital gains in equity, we assume that dividend yields are constant (their volatility is very small compared to total returns) with mean 0.0417, as in (Jordà et al. 2019). The return net of taxes on interests and dividends is added to the balance at the beginning of the following period, and taxes are deducted on realized capital gains from withdrawals.

Table 2 Asset Returns Composition and Fees, by Asset Type

	Bills	Bonds	Equity	Fees
Checking or regular savings accounts	100%	0%	0%	1%
High interest/premium savings accounts	100%	0%	0%	0%
Mutual funds	0%	40%	60%	1.5%
Stocks	0%	0%	100%	2.5%
Bonds	0%	100%	0%	2.5%
Guaranteed income certificates (GICs)	100%	0%	0%	0.5%
Cash value of permanent life policies	0%	100%	0%	2%
Individual segregated funds	0%	40%	60%	2%
Exchange-traded funds (ETFs)	0%	0%	100%	0.5%

Table 3 Real Returns Estimates: Calibration

	Mean return	Volatility	Autocorrelation
Bills	1.03%	6%	57.56%
Bonds	2.53%	10.69%	32.19%
Equity	6.88%	21.79%	0%

2.4.3 DEFINED CONTRIBUTIONS RPPs

We input the self-reported initial balance, as well as employee and employer contribution rates. To model returns, we assume a portfolio of 40% bonds and 60% equity, and 1.5% annual fees. The Office of the Superintendent of Financial Institutions (OSFI) recommends as default investment option a balanced fund of 40% to 60% in equity and the rest in fixed income.[5] The annual fees are based on the rules for Voluntary Retirement Savings Plans (VRSPs) in Quebec, which cap fees at 1.5%.

DC RPP accounts are very similar to RRSP accounts described above: returns are not taxed in the year they accrue, and total contributions (employee and employer) are added at the end of each period. Employee contributions are tax deductible and withdrawals are taxed as regular income.

2.4.4 DEFINED BENEFITS RPPs

The simulator can handle data on the expected replacement rate of participants, the employee's contribution rate and the expected income from a previous employer's plan. Contributions are tax deductible. Benefits start being paid at retirement and are equal to the average of the five highest earnings years multiplied by the replacement rate, a common formula in Canadian DB plans.[6]

Plans are presumed "integrated" with the Québec/Canada Pension Plan (CPP/QPP), another common feature of DB plans.[7] As such, once the recipient reaches age 65, benefits from the plan are adjusted downwards as follows, to account for the (potential) beginning of receipt of CPP/QPP benefits. For each year of service, up to 35, the minimum between earnings and the YMPE is multiplied by the pre-reform replacement rate of the CPP/QPP (25%) and divided by the maximum number of years of service considered (35). Taking the total for all years of participation in the DB plan, we obtain the amount deducted from annual benefits once the recipient turns 65. That means someone who has contributed to a DB plan for 35 years will see her benefits decrease by 25% of the CPP/QPP benefits accumulated over that period. An employee who has only contributed to the DB plan for a fraction of 35 years will see her benefits reduced by the same fraction of 25% of the CPP/QPP benefits accumulated over the period. For example, someone who contributed for 20 years will see her benefits reduced by about 14% of the CPP/QPP benefits accumulated.[8]

For DB pensions from previous employers, the amount that will be received at retirement should be collected at survey time as is the case here; it is then maintained over time in nominal terms.

2.4.5 CONTRIBUTION ROOM FOR RRSPs AND TFSAs

Individuals' initial contribution room for registered retirement savings plans (RRSPs) and tax-free savings accounts (TFSAs) is also an input; in their absence, we set these two values to zero and update them every year as follows. First, the lesser of 18% of the previous year's earned income and the annual RRSP limit ($26,230 in 2018) is added to the RRSP contribution room. When the person turns 71, the RRSP account is transformed into a RRIF account. Mandatory minimum withdrawals are then made every year according to prescribed factors[9] and added to TFSA contributions. The annual TFSA limit ($5,500 in 2018), as well as the previous year's withdrawals, are added to the TFSA contribution room. The future annual RRSP limit increases at the same rate as the CPP/QPP's YMPE, i.e. 3% per year, while the TFSA limit grows with inflation, at 2% per year.

Second, the pension adjustment for DB RPPs is subtracted from the available RRSP room. It is computed as follows, in accordance with the actual rules except as noted. The CPP offset equals the minimum between the mean of the

[5] https://www.osfi-bsif.gc.ca/Eng/pp-rr/ppa-rra/inv-plc/Pages/mcdcp.aspx

[6] In this version of the simulator, an actuarial penalty for early retirement was included for individuals retiring earlier than age 62 without accumulating 35 years of service — another common feature of DB plans (though some have a lower service requirement or a different "penalty-free retirement age"). Penalties amount to 5% of the accrued benefit per year missing to meet the requirement. It is worth noting that all calculations in this report use the self-reported intended age of retirement; it is likely that, faced with hefty penalties, many affected individuals would choose to retire later, thereby improving their retirement preparedness.

[7] We believe this is a reasonable assumption. Although we do not have specific data on this aspect for private sector DB plans, they constitute a small minority of such plans in terms of participants. Federal public sector plans are integrated, according to the Treasury Board Secretariat (link last accessed on March 26, 2020):

https://www.canada.ca/en/treasury-board-secretariat/services/pension-plan/retired-members/reaching-age-65-pension.html

For Quebec public sector plans, also very important, Retraite Québec offers clear and up-to-date information in the following leaflet, in French (link last accessed on March 26, 2020):

https://www.carra.gouv.qc.ca/pdf/4040f-coordination-rente.pdf

[8] Computation: $\frac{20}{35} * 25\% \approx 14.29\%$

[9] https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/completing-slips-summaries/t4rsp-t4rif-information-returns/payments/chart-prescribed-factors.html

5 best annual earnings until the current contribution year[10] and the YMPE, multiplied by the pre-reform replacement rate of the CPP/QPP (25%) and divided by the maximum number of years of service considered (35). The adjusted benefits are the benefits earned that year, i.e. 2% of the annual earnings, lowered by the amount of the CPP offset. Finally, the pension adjustment equals 9 times the adjusted benefits minus a $600 pension adjustment offset.

Third, contributions to DC RPPs and to RRSPs and "other registered accounts" are subtracted from the remaining RRSP room. If these contributions exceed the latter, the excess is added to existing (i.e. "self-declared") TFSA contributions.

Finally, TFSA contributions are subtracted from the available contribution room. If the latter is insufficient, any exceeding amount is added to contributions to unregistered accounts.

2.4.6 HOME EQUITY AND BUSINESS EQUITY

For owners of real estate, the value of the principal and secondary residences in the basis year (here, 2018) is used as input. House value growth is modelled as a log-normal serially correlated process with mean real return 0.0161, autocorrelation 0.21 and volatility 0.0987. The autocorrelation has been computed from the *Jordà-Schularick-Taylor Macrohistory Database* (Jordà, Schularick, and Taylor 2016) and the other estimates were computed by (Jordà et al. 2019), using data from many countries for the period stretching from 1870 to 2018. Although the mean real return, 0.0161, may seem low when compared with recent returns in the Canadian housing market,[11] it reflects the mean over 150 years for the sample of countries where data are available. Canadian data is only available without interruption from 1957 onwards, and reveals a mean real return of 0.0317 since then. The mean real return for the whole sample of countries from 1950 onwards, at 0.0239, is also higher than the very long run mean used here – maybe less so because, contrarily to most countries in the sample, Canada has not experienced a large decrease in value of the housing market around 2007-2008. Thus, if the goal is to predict growth rates over long periods, as it is here, the number above seems reasonable, though conservative by today's standards.

When households sell their principal residence (at retirement, in certain scenarios; see section 4.1.2 below), they do not owe taxes, but they need to start paying an equivalent rent. The imputed rent is obtained by dividing the value of the principal residence by the price/rent ratio, which implies that households selling their home move to a rental of an "equivalent value". The latter is modelled as a process that is correlated with house price growth. From the *Jordà-Schularick-Taylor Macrohistory Database* (Jordà, Schularick, and Taylor 2016), the long-run mean price/rent ratio is 15; the autocorrelation is 0.95; the volatility is 4; and the correlation between the shocks to house price growth and the price/rent ratio is 0.6. The initial price/rent ratio, in 2018, is set to 20.[12]

Capital gains on secondary residences are taxed in the usual fashion: 50% of the difference between the selling price and the initial value, in 2018, is taxed as income. If we do not know the purchase price, we assume that it equals the initial value. No rent is imputed in this case.

Some households own a business; their net business equity is defined as the household's share of the business, net of debts. Net business equity evolves according to a stochastic process identical to – but independent from – the one for equity (see section 2.4.2 above). Dividends are paid to owners every period, and currently taxed as regular income (to avoid complexities related to corporate profit taxation). When the business is sold, at retirement, taxes on capital gains are perceived if the lifetime capital gains exemption, $848,252 for 2018, is exceeded. Half the amount of capital gains above the lifetime capital gains exemption is taxed as income. In the absence of data on capital gains, we assume that they are equal to business equity. Likes houses, businesses are not sold in the baseline version of the model, but we allow for sales in robustness checks.

2.4.7 DEBTS

The simulator uses data on initial balances and monthly payments for different types of household debt. Quantitatively, mortgages are by far the most important type of debt in the data used in this report (see Section 3). Since residential mortgages are renewed every 5 years at most for the vast majority of households, it is important to consider the effects on payments of fluctuations in interest rates.

For this purpose, we model mortgages as a spread over a combination of bills and bonds returns. The coefficients are obtained by regressing the average rate on outstanding 5 years fixed uninsured mortgages, the most common type of mortgage, on bills and bonds returns as well as a constant. All other debts are usually set in relation to the prime rate, which is strongly correlated with the rate on bills. Thus, we express all other debts as a spread over the return on bills, using data from the Bank of Canada and Statistics Canada.[13]

[10] We currently use the 5 best years until the current contribution year to avoid having to project pensionable earnings at the time of retirement. In many cases — depending on the individual's age and position on his life cycle earnings profile — this likely underestimates the true pension adjustment for DB plan members. It also underestimates the pension adjustment relative to the actual rule put forward by the Canada Revenue Agency, which states that only earnings in the one year prior to the contribution year should be used in the calculation (*link last accessed on March 26, 2020*): https://www.canada.ca/en/revenue-agency/services/forms-publications/publications/t4084/pension-adjustment-guide.html

[11] See FRED, Real Residential Property Prices for Canada (QCAR628BIS), sourced from National sources, BIS Residential Property Price database (http://www.bis.org/statistics/pp.htm).

[12] *Numbeo* provides estimates of the price/rent ratio for the main Canadian cities in 2018: for Vancouver, Toronto, Montreal and Ottawa, these estimates are respectively 28.7, 21.9, 21.4, 19.4 in the city center; and 26.9, 21.3, 19.6, 14.2 outside of the city center. Since price/rent ratios are generally lower outside the main CMAs, 20 seems to be a reasonable aggregate value for Canada (https://www.numbeo.com/property-investment/region_rankings.jsp?title=2018&region=021).

[13] For bills and bonds, see (Fortin-Gagnon, Olivier and Leroux, Maxime and Stevanovic, Dalibor and Surprenant 2019).

For prime rate: Interest rates posted for selected products by the major chartered banks, Bank of Canada, https://www.bankofcanada.ca/rates/banking-and-financial-statistics/posted-interest-rates-offered-by-chartered-banks/

For car loans: https://www.bankofcanada.ca/rates/banking-and-financial-statistics/interest-rates-for-new-and-existing-household-lending/

For credit cards, personal loans, credit lines, other personal debt: retrieved by the Bank of Canada (2019-11-01)

For mortgages: Statistics Canada (n. d. b.). Table 10-10-0006-01: Funds advanced, outstanding balances, and interest rates for new and existing

Table 4 Debt Types and Interest Rates Composition

	Bills	Bonds	Spread	Value in 2018
Credit card	100%	0%	13.7%	15.36%
Personal loan	100%	0%	3.3%	4.01%
Student loan	100%	0%	4.2%	5.6%
Car loan	100%	0%	2.9%	4.06%
Credit line	100%	0%	2.8%	4.34%
Other personal debt	100%	0%	8.1%	9.68%
Mortgage	63%	37%	1.7%	2.86%

Using the initial debt payments and the initial interest rate, we infer the term of the debt (assuming the interest rate remains constant until the debt is fully repaid). The term is capped at 30 years. Payments are then adjusted yearly as a function of the interest rate, keeping constant the year of full repayment for each debt. Debts are not liquidated at retirement, except for mortgages when a residence is sold.

2.5 THE CPP CALCULATOR

For the most part, the CPP and QPP are modelled according to real world rules. The only notable exception is the "child drop out", which is not modelled and, in any case, would not be used in the absence – as is the case here – of information about the current or past presence of young children in the household.[14] Thus, from ages 18 until 70, people contribute to the CPP/QPP every year they work. Employees' contributions are computed as a percentage of earnings, up to the year's maximum pensionable earnings (YMPE), which grows at 3% per year, and net of a basic exemption amount of $3,500 (which is kept unchanged in nominal terms in the future).

Since the age at which people will claim their benefits is unknown, we assume that they do so at their stated intended age of retirement, but no earlier than 60 and no later than 70 (since there is no additional bonus for delaying claiming past age 70). Thus, no one under the age of 70 is allowed to keep working while receiving CPP/QPP benefits.

Benefits are computed based on average earnings up to the YMPE from age 18 to retirement, with the lowest years of earnings excluded.[15] Benefits also depend on claiming age: relative to the benefit that would be available at the "normal" age of 65, pensions claimed early will be reduced by 7.2% for each year between the claiming year[16] and the year of the 65th birthday; and pensions claimed late will be increased by 8.4% between the year of the recipient's 65th birthday and the claiming year.[17]

The reform being implemented from 2019 to 2025[18] is already fully accounted for by the calculator.

2.6 THE ANNUITY CALCULATOR

At the end of the year preceding an individual's retirement, financial accounts are liquidated; thus, no positive savings are allowed once an individual has retired. Taxes on interest, dividends and capital gains are paid on unregistered accounts. TFSAs, RRSPs, other registered accounts as well as DC RPP accounts remain untaxed at this stage. The proceeds of the liquidation are converted into annuities that start paying out immediately, i.e. at the beginning of the year of retirement.

Annuities are indexed to inflation and actuarially fair since the purpose of the exercise is to compare consumption before and after retirement. Their price is a function of survival probabilities, which depend on gender, age, birth year (or current year) and province, and of a discount rate. We model

lending, Bank of Canada. DOI: https://doi.org/10.25318/1010000601-eng (*Accessed 2019-11-01*)

For student debt, the (variable) rate has been reduced to the prime rate in November 2011: https://www.canada.ca/en/employment-social-development/corporate/notices/budget.html

[14] Another exception relates to work after 65 years old. Although the CPP (but not the QPP) allows for *voluntary* participation after age 65, we currently force all working individuals to contribute until they stop working, i.e. until they retire; and the years of work after age 65 are accounted for in the benefit computation in the same manner as the pre-65 years.

[15] Currently, 15% of the lowest years of earnings in Quebec and 17% in the rest of Canada (in reality, these fractions are applied to months).

[16] In Quebec, for pensions claimed before age 65, very small pensions are reduced by 0.5% and this percentage increases progressively to 0.6% for the maximum pension.

[17] The actual program adjusts pensions on a monthly basis: -0.6% for each month before the 65th birthday and +0.7% for each month after the 65th birthday. Calculations based on year of birth might thus lead to sizable discrepancies. Unfortunately, we do not have data about the month of birth and thus must work with years.

[18] https://www.rrq.gouv.qc.ca/en/programmes/regime_rentes/bonification/Pages/regime-supplementaire.aspx

the discount rate as a linear combination between the bond rate at the time of purchase and the long-run average bond rate. This is because annuity prices depend on current but also future interest rates over a long period (and bond returns are not very persistent, and thus quickly revert to the mean).

There are two distinct tax treatments for annuities: those bought with RRSPs; other registered accounts; and DC RPP accounts are fully taxed as income, while only the returns portion of the annuities purchased from TFSAs or unregistered accounts is taxed.

Houses and businesses can also be liquidated at the end of the year before the second spouse retires, if applicable (though not in the baseline version of the model). Capital gains on second residences and businesses are taxed as described in section 2.4.6, and the net amounts are split 50/50 between spouses. They are then converted into annuities of which only the returns are taxed, as is the case for annuities purchased with unregistered accounts (since the net amounts are after-tax money).

2.7 THE DISPOSABLE INCOME SIMULATOR (DIS)

The DIS is a stand-alone module that calculates income taxes and disposable income for each household based on age, province, marital status and income from all sources – i.e. wages, CPP/QPP benefits, taxable returns and other income (including a distinct treatment for capital gains), pensions and annuities, as well as RRSP withdrawals. It models and computes benefits from major transfer programs such as social assistance, OAS and GIS, as well as more than 100 tax measures at the provincial and federal levels. Pension income splitting is approximated by attributing to the spouse 50% of all eligible income (actual federal and provincial rules are used with respect to age of eligibility and to the different types of income eligible for splitting).

The DIS is used for three purposes. First, to compute after tax income in order to compare consumption before and after retirement. Second, to tax interest and dividends from unregistered accounts. Third, to tax withdrawals from RRSP and DC RPP accounts (after being converted into annuities) as well as capital gains realized on withdrawals from unregistered accounts and sales of second residences and businesses.

2.8 OUTPUTS GENERATED BY THE CPR CALCULATOR

The model produces a series of outputs. First, it produces each component of the current net income measure. Second, it produces all components of the retirement income measure – the after-tax measure of income and consumption – both before (at age 55 or in the year prior to retirement) and after retirement. Along with these outputs, using the latter “before” and “after” retirement measures, it also computes the retirement readiness index (RRI) for each household as well as an indicator variable (flag) for whether the household has an RRI which is above the thresholds discussed above.

2.9 REPLICATIONS AND UNCERTAINTY

When performing simulations in stochastic mode, 25 replications for each individual are performed for this report (many more can be generated), and are contained in the final dataset used to produce statistics. To compute aggregate retirement readiness, we take for each individual the mean of the RRI over all replications, using the thresholds discussed above. Other uncertainty measures are also produced (such as percentiles or standard deviation).

3 DATA

In the summer of 2018, the inter-company group of Power Corporation sponsored the fielding of a survey with IPSOS: *A survey on the Financial Readiness of Canadians with Respect to Canadians*. The online survey was aimed at the Canadian population aged 25 and older. A total of 17,528 households were surveyed in June and July 2018. In its core module, the survey asked respondents a total of 34 questions. Each respondent was also asked to respond to one of four modules which are not part of the present study. Three segments of the Canadian population were targeted: non-retired households earning less than $250,000 per year; retired households earning less than $250,000 per year; and a third segment consisting of individuals earning more than $250,000 per year.

The sample of interest for the present study consists of the 10,789 households in the first segment, for respondents who are under 65 years old, are not retired and earn less than $250,000 per year. Various filters[19] were also applied to drop households with inconsistent or implausible answers to some of the questions, such that a total of 6,601 households are included in the final sample. Since the sampling process was stratified by province, age and household gross income, we have used the 2016 Census of the Canadian population to weight the data using these characteristics along with household size.

Couples make up 52% of the households in the final sample. The numbers that follow relate to the primary earner, unless stated; 56% of primary earners and 34% of secondary earners are male. Tables 5 to 9 provide weighted statistics on earner characteristics, initial assets and debts, savings strategies, and debt payments.

[19] We dropped households with spouses younger than 25 or older than 64, to match respondents' ages and to avoid schooling issues and old-age benefits eligibility. We also dropped couples for whom information was only provided about one spouse, or where one spouse's wage was reported as null (as we do not know – and do not wish to model – whether this person will work in the future).

Table 5 Primary Earner Characteristics

	Obs.	Mean	Std Error	Min.	Median	Max.
Birth year	6601	1974	10.42	1954	1974	1993
Retirement age	6601	64.0	6.49	28	65	100
Pension from previous employer ($/year)	269	$8,749	$14,339	$1	$4,000	$100,000
Initial wage ($/year)	6601	$61,397	$33,684	$6,000	$57,000	$232,000
Spouse's initial wage ($/year)	3464	$40,710	$22,487	$1	$40,000	$120,000

Table 6 Initial Assets ($)

	Obs.	Mean	Std Error	Min.	Median	Max.
Initial RRSP balance	4453	$76,237	$200,886	$0	$27,778	$10,000,000
Initial TFSA balance	3991	$19,680	$35,686	$0	$7,317	$1,000,000
Initial balance other registered assets	1212	$28,282	$58,743	$0	$11,413	$1,000,000
Initial balance unregistered assets	2821	$46,241	$163,441	$0	$6,857	$6,363,636
Initial balance DC pension	1796	$75,470	$143,162	$0	$25,000	$2,000,000
Market value principal residence	4456	$468,616	$552,417	$1	$350,000	$15,000,000
Market value of second residence	510	$332,859	$401,848	$1	$250,000	$7,000,000
Business equity	1319	$47,946	$367,309	$0	$0	$10,000,000

Table 7 Initial Debts ($)

	Obs.	Mean	Std Error	Min.	Median	Max.
First mortgage	3169	$189,474	$149,566	$1	$165,000	$1,500,000
Second mortgage	283	$176,337	$162,586	$1	$130,000	$1,110,375
Credit card	2619	$7,463	$11,108	$1	$3,500	$160,000
Personal loan	583	$13,900	$16,642	$4	$8,000	$165,000
Student loan	567	$20,780	$36,292	$1	$11,000	$500,000
Car loan	1680	$20,875	$18,595	$1	$18,000	$300,000
Credit line	1591	$26,704	$45,990	$1	$12,000	$500,000
Other debt	127	$13,020	$21,831	$1	$3,228	$112,000

Table 8 Saving Strategies

	Obs.	Mean	Std Error	Min.	Median	Max.
Contribution rate RRSP	4453	3%	5%	0%	0%	100%
Withdrawal RRSP ($/year)	4453	$94	$1350	$0	$0	$50,000
Contribution rate TFSA	3991	2%	4%	0%	0%	65%
Withdrawal TFSA ($/year)	3991	$107	$1,004	$0	$0	$37,875
Contribution rate other registered assets	1212	1%	3%	0%	0%	50%
Withdrawal other registered assets ($/year)	1212	$2,971	$1,674	$0	$0	$24,737
Contribution rate unregistered assets	2821	3%	7%	0%	0%	80%
Withdrawal unregistered assets ($/year)	2821	$273	$1,848	$0	$0	$30,435
Replacement rate DB	2076	57%	16%	2%	60%	70%
Contribution rate DB employee	2076	5%	2%	0%	5%	9%
DB pension from previous employer ($/year)	473	$16,771	$57,123	$0	$1,000	$800,000
Contribution rate DC employee	1796	4%	2%	0%	4%	18%
Contribution rate DC employer	1796	4%	2%	0%	4%	18%
Share of bills in portfolio	6601	55%	44%	0%	60%	100%
Share of bonds in portfolio	6601	12%	20%	0%	0%	100%
Share of equity in portfolio	6601	21%	30%	0%	0%	100%
Fees paid on investments	6601	1%	1%	0%	1%	3%

Table 9 Debt Payments ($/year)

	Obs.	Mean	Std Error	Min.	Median	Max.
First mortgage payment	3169	$1,403	$4,346	$0	$1,100	$150,000
Second mortgage payment	283	$2,263	$13,470	$0	$800	$170,000
Credit card payment	2619	$681	$1,975	$0	$300	$100,000
Personal loan payment	583	$450	$1,748	$0	$300	$52,000
Student loan payment	567	$259	$761	$0	$150	$18,000
Car loan payment	1680	$832	$10,496	$0	$400	$526,062
Credit line payment	1591	$456	$1,279	$0	$200	$32,000
Other debt payment	127	$362	$476	$0	$156	$2,700

4 RESULTS: RETIREMENT READINESS IN 2018 ACCORDING TO CPR

In Figure 4, we plot the distribution of the Retirement Readiness Index (RRI) from 25 replications per individual. We take the average value for each individual. We obtain that the (weighted) average is 117.3, well above 100 (the median is 104.6). This means that on average, **if they retire at the age they intend to, maintain their saving and debt payment strategies, and convert all their financial wealth into income**, Canadians have net income in retirement which is higher than their pre-retirement income. The share of Canadians with an RRI above the thresholds discussed earlier in this report is 83.8%, meaning slightly more than 15% of Canadians are "not prepared" for retirement.

Given that the simulations are stochastic, we can plot the distribution of the probability that someone is ready for retirement (Figure 5). A large proportion of households exhibit a probability near 1 – suggesting that there is little uncertainty in the outcome for most households – while for others, the probability that they will not be prepared is very high. Very few households are found in the middle of the distribution, with fewer than 6.7% of households having a readiness probability between 35% and 65%. One interpretation of this result is that the Canadian retirement income system protects households well against shocks, either in the labour or in the financial markets.

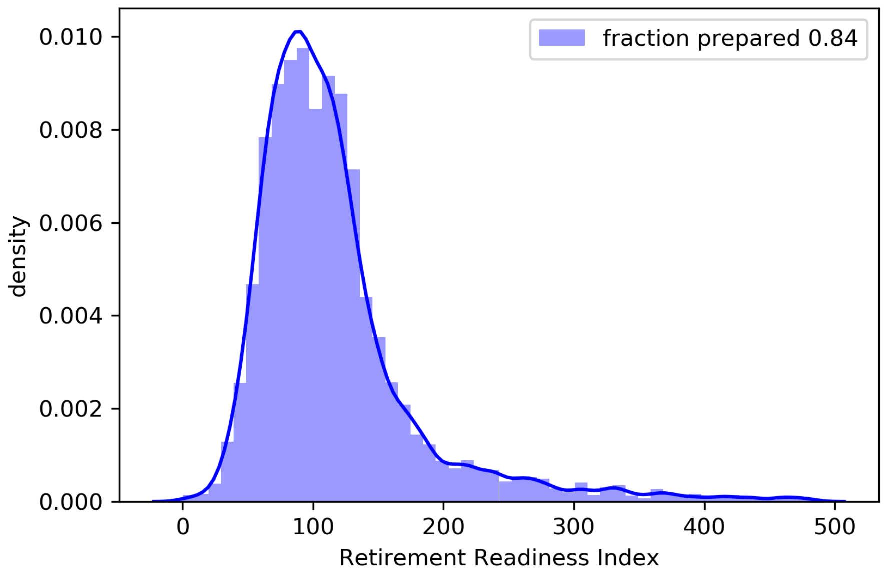

Figure 4 Distribution of Retirement Readiness

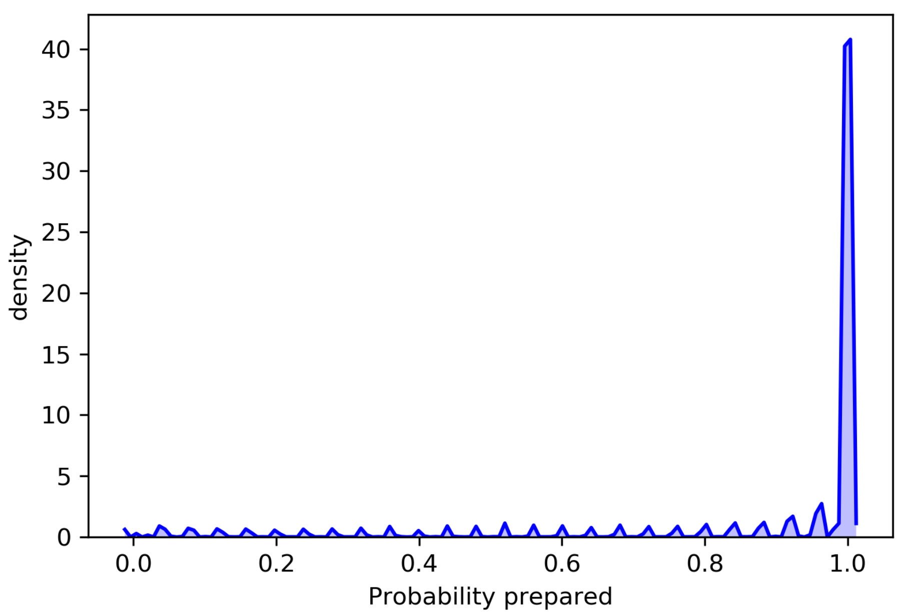

Figure 5 Distribution of the Probability of Being Ready for Retirement

Table 10 reports the demographic and economic profile of households by their retirement preparedness (being "prepared" defined as having a readiness probability of more than 50%). We observe that age and marital status are not very different among the two groups. Interestingly the group that is not prepared has higher wage income than the group who is prepared; this may in part reflect the structure of the Canadian retirement income system, which essentially ensures very high replacement rates for low earners. Those who are projected to be prepared have higher third-pillar savings and in particular are much more likely to be covered by a DB plan on their current job. Interestingly, those who are ready have lower mortgages and they also intend to retire several years later.

The importance of third-pillar savings can be emphasized by looking at the preparedness distribution according to household income and to various third-pillar asset holdings (RPP DC or DB coverage as well as savings in RRSP, TFSA or other unregistered accounts). Figure 6 shows average retirement readiness for different segments of the target population, defined by pre-retirement net income and by third-pillar asset holdings. We see that low income individuals are well covered by the public system even if they have no savings or RPP coverage, while the group that is least prepared is that of higher income households with no RPP coverage or savings. In this group, only 47.5% of households are on track to be ready for retirement.

Table 10 Primary Earner Profile by Retirement Preparedness (in $, unless otherwise noted)

	Not prepared	Prepared
Age (years)	43.0	44.0
Wage income in 2018	$81,954	$57,703
Initial RRSP balance	$55,641	$80,073
Initial TFSA balance	$13,461	$20,781
Other savings, initial balance	$17,923	$50,402
DB RPP coverage (share)	17%	37%
DC RPP initial balance	$72,070	$76,010
Couple (share)	62%	55%
Value of principal residence	$502,791	$461,468
First mortgage initial balance	$217,972	$183,067
Intended retirement age (years)	60.5	64.7

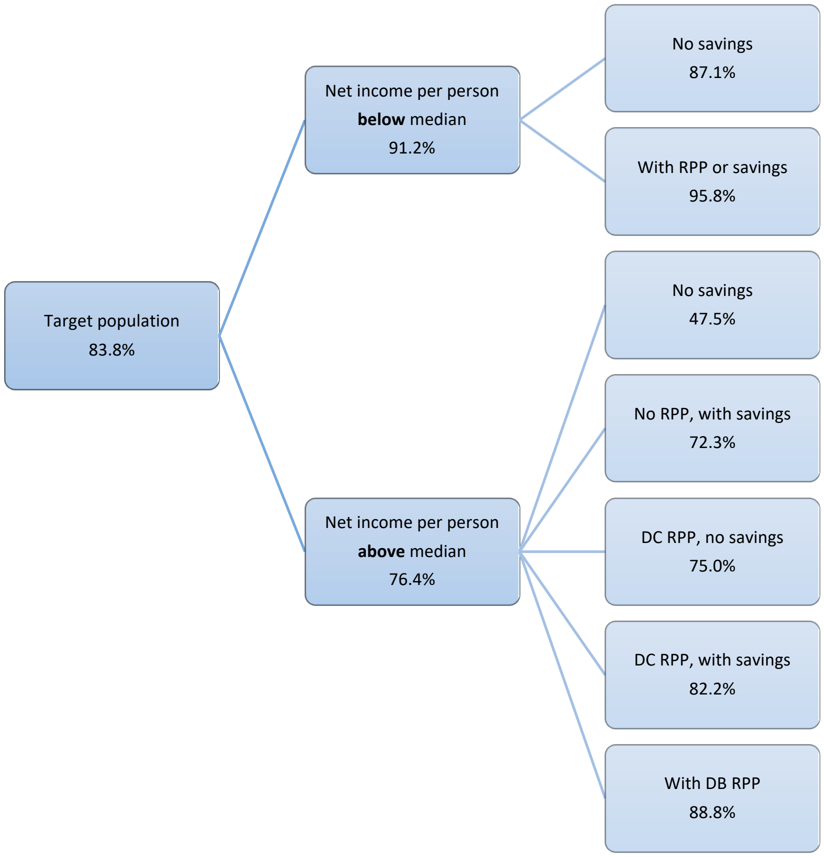

Figure 6 Retirement Readiness by Net Income and 3rd-Pillar Asset Holdings

Notes: After-tax income per adult in the household, in the year when the primary earner turns 55 y.o., or in the year just prior to retirement for those who retire earlier. Income categories are built using household level pre-retirement income per adult; other categories, savings- and retirement plan-based, are built using the responses of primary earners only.

4.1 SENSITIVITY ANALYSIS

We explore the impact of different variables on the baseline results. In particular, we consider the following set of assumptions:

- Investment returns
- Home disposition at retirement
- Generosity of DB RPPs
- Voluntary saving strategy
- Thresholds for retirement readiness

For each of these sets of assumptions, we will look at the fraction of households that is prepared according to our criteria while varying, relative to the baseline scenario, parameters over a certain range. Since the results of the non-stochastic version of the model are very close to those of the stochastic one along most dimensions, we use the former to speed up calculations. However, this means the reference point in all the following exercises is slightly higher, since the share of Canadians with an RRI above the thresholds using that version is 85.0% instead of the 83.8% value yielded by the stochastic model used to produce the main results above.

4.1.1 INVESTMENT RETURNS

Investment returns obviously affect our calculations of retirement readiness. The higher the investment returns, the more prepared households will be. But there is much expectation and discussion to the effect that we could witness from low investment returns in the coming decades. Hence, we want to assess how fragile our estimate of retirement readiness is.

In the baseline scenario, we have assumed that the mean real return was 6.88% for stocks; 2.53% for bonds; and 1.03% for bills. In Figure 7, we show how varying these mean returns (all at once) for RRSPs, TFSAs, DC pensions and unregistered savings, relative to baseline, impacts our estimate of retirement readiness. Importantly, these changes in returns do not affect DB plans or public programs here.

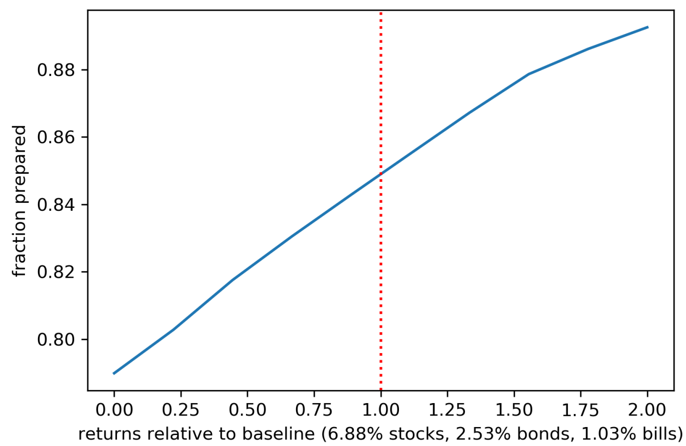

Figure 7 Sensitivity of Retirement Readiness to Investment Returns

We can observe that the assumption we make about mean returns has less than a +/-5 percentage point effect on the fraction of households who are prepared for retirement, according to our definition (79% prepared if returns are zero; 89% if they are twice as large as in the baseline). One of the reasons why this has a small effect is that households currently rely primarily on public pensions as well as DB pensions to meet their retirement needs, vehicles that are not subject to assumptions on those returns.

4.1.2 HOME DISPOSITION AT RETIREMENT

In the baseline scenario, we do not include home equity in retirement. If we did, without accounting for the fact that homeowners who sell their house would need to rent (or purchase a smaller house), we would be overestimating the consumption benefit that a house provides in retirement. To assess how important one's home is in retirement, we perform a simulation where we dispose of the house at the time of retirement. After paying the mortgage, the remaining value is converted into an annuity. On the liability side, we impute a rent for each homeowner, proportional to the value of the house they sold (see section 2.4.6). This rent is subtracted from the income available for consumption. Hence, it is the value of the implicit consumption annuity, net of rental cost, which is included in retirement consumption. In Figure 8, we plot the fraction prepared in such scenarios as a function of average house appreciation. In the baseline scenario, average house appreciation is 1.61% per year.

The decision to liquidate the house has a large impact on retirement readiness. This is because households who keep their house in retirement enjoy important consumption benefits in terms of not needing to rent accommodation. Given house prices and the price/rent ratio used, relative to annuity conversion factors, the fraction prepared for retirement is much lower when households dispose of their house at retirement: fewer than 68% of households would be prepared, compared to 85% in the baseline of the non-stochastic model. This is because annuitizing housing wealth will only be financially advantageous when the price/rent ratio exceeds the annuity factor. Furthermore, the situation is worse as house price growth increases because rental costs in retirement also increase, thus lowering consumption in retirement.

However, in reality households can also rent a smaller home (or just a cheaper home, for example in the countryside or in a different neighborhood). This strategy leads to substantial increases in the fraction of households prepared: downsizing by 50% increases the fraction of households prepared from 63% to 80% (Figure 9).

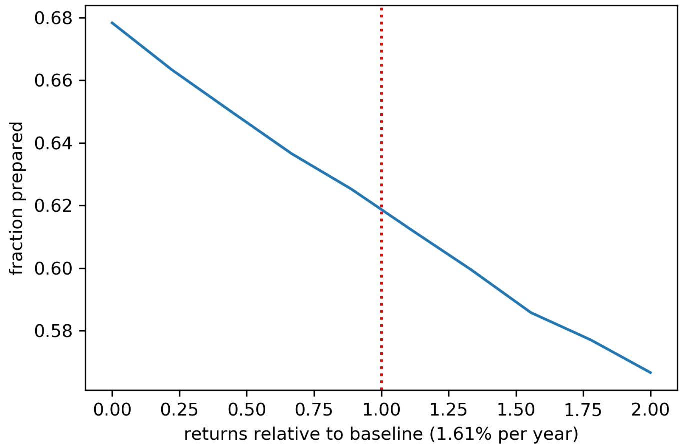

Figure 8 Sensitivity of Retirement Readiness to Home Equity Disposition at Retirement

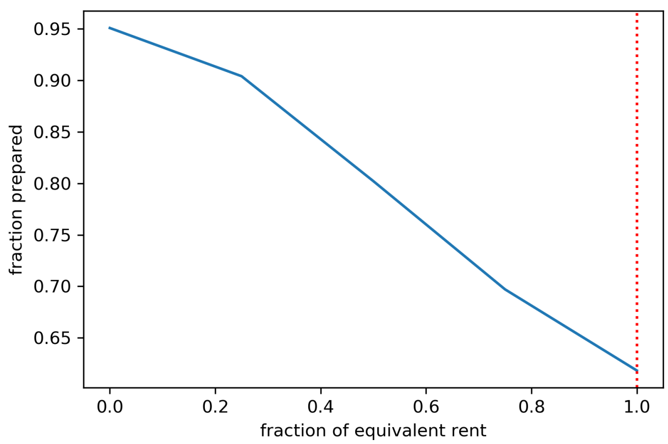

Figure 9 Sensitivity of Retirement Readiness to Home Downsizing at Retirement

4.1.3 DEFINED BENEFITS RPP GENEROSITY

As we have seen in the baseline scenario, RPPs – in particular DB pensions – play an important role in determining retirement readiness. Those without DB pensions and without savings have much lower retirement readiness scores than those with a DB pension. In the next decades, it is possible that coverage and generosity of DB pensions will be eroded. As a sensitivity test, we perform a series of simulations where we decrease in proportional terms the generosity of DB RPPs, adjusting contributions accordingly. Figure 10 shows the fraction of households prepared for retirement as a function of relative DB pension generosity.

When we change the relative generosity of DB pensions, we obtain substantial variation in the fraction prepared for retirement. In particular, if DB pensions were to disappear – and not be replaced by other savings – the share of "prepared" households would drop to 72% (from 85% in the non-stochastic baseline used here). A more realistic scenario, for instance a 25% decline in generosity, yields a much less pronounced effect of about 2 percentage points.

4.1.4 VOLUNTARY SAVING STRATEGY

In the baseline scenario, we set the saving strategy based on contributions declared in the survey (as a fraction of income). We keep that saving strategy fixed over time. It is possible that doing so exaggerates voluntary savings, as withdrawals from RRSPs and TFSAs are common in reality. We perform as a robustness check a series of simulations where we change, in proportional terms, this saving strategy to analyze how large a role voluntary saving strategies play when determining retirement readiness. Figure 11 shows the share of households who are ready for retirement as a function of contributions in proportion of what was declared in the survey. For example, 0.5 means that we simulated a saving strategy where households save half of what they saved in the baseline.

If households saved nothing in RRSPs, TFSAs and unregistered accounts, the fraction of households who are prepared for retirement would only decrease to 81% (and to 80% among the group who do have one or more such accounts). Hence, this reinforces the idea that voluntary savings are not critical to achieving, in aggregate, our definition of retirement preparedness, although it does have somewhat of an effect among the "treated" group (which, however, starts with a very high proportion of prepared households, at 89%).

4.1.5 THRESHOLDS FOR RETIREMENT READINESS

We use the same readiness thresholds as those used in the past by McKinsey (RRI of 80 for the first income quintile and 65 for others), but these are nevertheless somewhat arbitrary. Furthermore, although these values were based on a summary analysis of historical survey data, they may only reflect the actual, experienced consumption possibilities of past retirees, and not necessarily retirees' choices or preferences or optimality in sense. Hence, in Figure 12 we provide an analysis of how our estimate of the fraction prepared for retirement varies as we vary the readiness threshold used over a broad range. Here we use a uniform threshold for all quintiles of the income distribution, varying from an RRI of 50 to 90. Figure 12 shows the results – without a reference point, since the thresholds used in the baseline vary by income quintile and are not uniform.

Going from a threshold of 50 to 70 takes aggregate retirement readiness from over 95% of households being prepared to 82%. The fraction prepared would go down to 63% when imposing a threshold of 90. In the range that might be thought of as more relevant by most analysts and professionals, e.g. a consumption replacement ratio (RRI) of between 60 and 80, the aggregate fraction prepared moves from 90% to 73%.

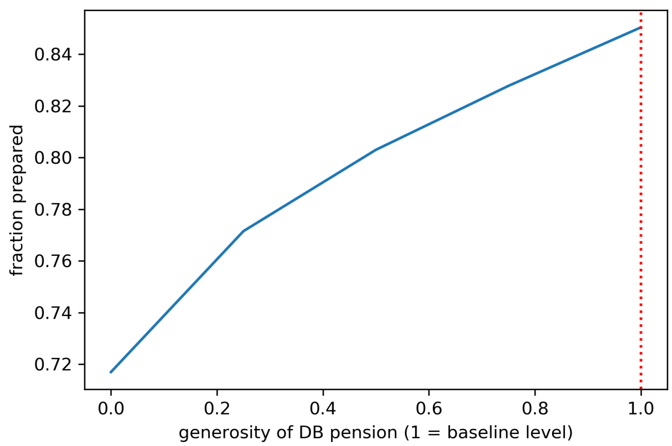

Figure 10 Sensitivity of Retirement Readiness to the Generosity of Defined Benefit RPPS

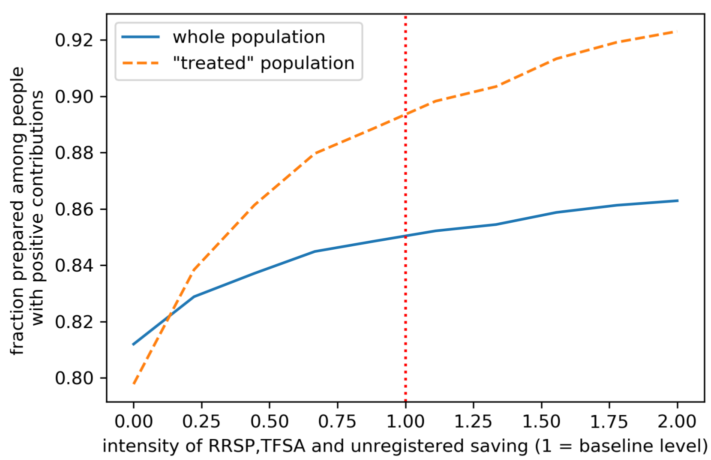

Figure 11 Sensitivity of Retirement Readiness to Intensity of Voluntary Savings Strategy

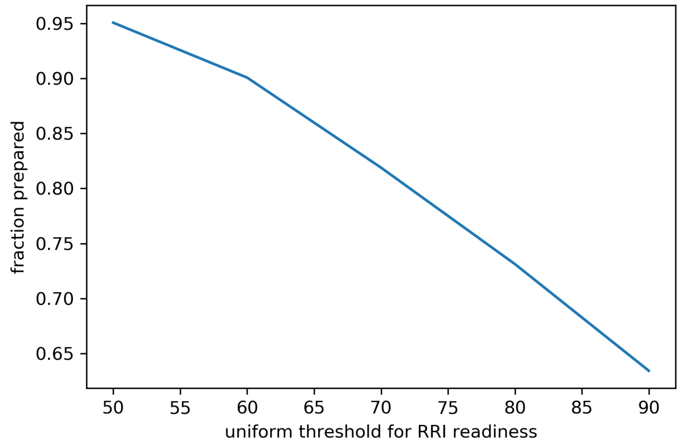

Figure 12 Sensitivity of Retirement Readiness to Thresholds Used

5 COMPARING RESULTS TO PREVIOUS ESTIMATES

The results obtained using the CPR model reported here are broadly in line with those published by McKinsey in the past (McKinsey 2012; 2015)). Indeed, using a similar preparation measure (65% of pre-retirement consumption for the top 80% of earners; 80% for the bottom 20%), we find using our stochastic model that approximately 84% of Canadian households aged 25-64 are well-prepared for retirement, at varying degrees (slightly more using the non-stochastic version). This compares to the 83% figure obtained most recently by McKinsey. As well, we find that the least prepared group is composed of households earning above the median income per person, but who have no RPP coverage and no savings.

The very small difference between 2014 (the year of the latest survey used by McKinsey) and 2018 may be attributable to important measurement and modelling differences. However, it is worth noting that the stochastic tool that is the CPR allows us to find that **probabilistically, the vast majority of households are on track to being prepared for retirement**: over a broad range of possible values and future paths for parameters such as interest rates and investment returns, **only 18.3% of "working age" Canadian households have a less than 80% chance of being prepared**.

Wolfson (2011) used a 75% consumption replacement threshold and, unsurprisingly, found that Canadians were less well-prepared. Our results are similar when using this same measure, though for a different population cohort altogether (he looks at individuals turning 65 between 2025 and 2030): a little over 20% of Canadians are "unprepared" for retirement by this metric. Wolfson argues that an index of 100 would better align with maintaining what economists refer to as the "marginal utility of money" – or the "value of money" to individuals – over the life cycle, but this assertion is in fact far from consensual (see section 1 above).

Baldwin (2016) reviews the above studies, and a few others. He finds that while results diverge somewhat between them, they actually converge when looking at young middle-income earners – concluding that their preparation level is low and declining over time. While we only look at a cross-section of Canadians, aged 25-64 in 2018, we also find that households – including the younger ones – earning a middle income and without RPP coverage are the least prepared. For instance, households whose primary earner is between 25 and 34 years old and were in the 2nd and 3rd quintiles of their age group were 3 to 4 percentage points less prepared on average – a difference that is less marked than in previous studies, therefore, with about 20% of these households being "unprepared" on average. Indeed, this age group as a whole is 80% prepared, only slightly less than the overall target population; as seen in Figure 6, having RPP coverage (or registered savings) is more strongly associated with being prepared.

6 EXAMPLE OF ALTERNATIVE SCENARIOS: CPP/QPP REFORM

Over the next decades, the Canada Pension Plan and the Quebec Pension Plan will see their generosity increased and will eventually replace 33% of career earnings (instead of 25%) up to a year's maximum pensionable earnings (YMPE) which will itself increase by 14%.

Contribution rates and the YMPE will also increase by 2025, hence increasing, in the long run, the actual income replacement rates of middle-income Canadians in particular. One of the policy motivations for the enhancement was to target those individuals without RPP coverage and with few other savings. In Table 11, we re-compute the average readiness probability by subgroup, this time again using the stochastic version of the model:

1. with the new CPP/QPP in place (as included in the baseline); and
2. turning off the CPP/QPP enhancement (labelled "old CPP" below).

Overall, the average readiness probability is 80% without the CPP/QPP enhancement, and 83.5% with the enhancement. As seen in the table, those without savings or RPP coverage (rows 1 and 3) gain the most from the enhancement. In row 3, the readiness probability increases because of the reform from 39.4% to 47.5% for those earning an above-median income but who have no RPP coverage and no savings – an 8 percentage point increase. There is also a smaller increase in readiness across the board for other groups. Hence, retirement preparedness is projected to increase, in particular in the targeted group, as a result of the CPP/QPP enhancement currently being implemented.

Other theoretical changes or reforms sometimes being discussed in public or in policy circles include changing eligibility ages for public pension programs. The impact of such changes on aggregate retirement preparedness can be analyzed with the CPR calculator for a given cohort of Canadians, with appropriate individual-level data.

As an illustration of this, Figure 13 depicts the effect of increasing from 60 to 65 years old the minimum eligibility age to claim CPP/QPP retirement benefits. In the context of the simulations reported in this document, this will affect all individuals who stated that they planned to retire before the CPP/QPP early claiming age (currently 60), since CPP/QPP claiming age is set at the latest of A) planned retirement age; and B) CPP/QPP early claiming age. Unsurprisingly, such a change increases the aggregate proportion of households who are "prepared" by nearly 3 percentage points, to over 86%.

Table 11 Effect of CPP/QPP Enhancement on Retirement Readiness

	Old CPP	Enhanced CPP
Below median income, no RPP or savings	82.8%	87.1%
Below median income, with RPP or savings	94.0%	95.8%
Above median income, no RPP or savings	39.4%	47.5%
Above median income, with private savings only	67.5%	72.3%
Above median income, with DC RPP and no savings	69.0%	75.0%
Above median income, with DC RPP and savings	79.2%	82.2%
Above median income, with DB RPP	86.8%	88.8%
Total – All sub-groups	80.0%	83.5%

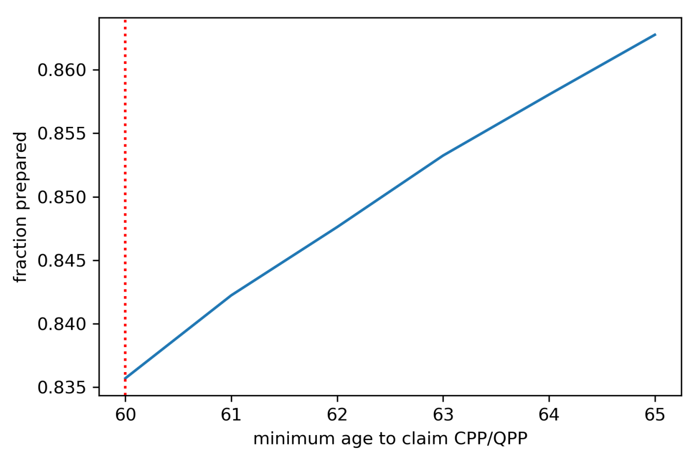

Figure 13 Sensitivity of Retirement Readiness to CPP/QPP Eligibility Age

7 CONCLUSION: KEY TAKE-AWAYS

7.1 THE MODEL

This report presents a new, detailed and soon-to-be made publicly available retirement preparedness calculator that includes an important, innovative stochastic component. The model provides aggregate retirement readiness figures for a cohort of the population, or for sub-groups thereof. It covers the following aspects:

- Household characteristics: age, composition current earnings, past DB plan coverage
- Initial asset and debt balances for most types of assets and debts
- State-of-the-art life-cycle modelling of future earnings paths/dynamics
- Projection of debt payment and savings strategies, as declared by survey respondents
- Flexible retirement time for both spouses, as planned by survey respondents
- Conversion of assets into annuities at the time of retirement, using actuarially fair factors
- Possibility of using housing and business wealth to fund retirement
- A wide range of possible values for a large number of parameters, such as returns on assets, interest rates and corresponding debt costs, and housing value

7.2 THE MAIN RESULTS

Using the stochastic version of the innovative Canadians' Preparedness for Retirement (CPR) calculator – which, for the purposes of this report, computes 25 simulations for each household and aggregates the results – the report finds the following core results, weighted using the 2016 Census.

⇒ About 84% of Canadian households aged 25 to 64 years old in 2018 were on track to being "financially prepared" for retirement.

⇒ The average preparation index is 117 but, as all averages do, this hides a wide variety of situations.

⇒ Lower income households are generally very well prepared – over 90% of households with an income per person below the median are projected to be "prepared".

⇒ Unsurprisingly, households most at risk of being "unprepared" largely fall into the sub-group with higher-than-median income, but no RPP or savings; the average wage income of the group deemed "prepared" is significantly lower than that of the "unprepared" group. Those with DB RPPs are better prepared than average.

⇒ Probabilistically, the vast majority of households are almost certain to be "prepared"; a very small minority face dire prospects, while about 7% of households face a 35% to 65% probability of being prepared for retirement. Only 18% of households have less than an 80% chance of being prepared.

7.3 SENSITIVITY ANALYSES AND ADDITIONAL RESULTS

In addition to the core results, several important sensitivity analyses have been carried out and their results, reported. In particular:

⇒ Assumptions regarding **investment returns** have a limited impact on retirement readiness; bringing the mean to zero or doubling it only affects aggregate preparedness by less than 5 percentage points in each direction.

⇒ Annuitizing **housing wealth** at retirement, and accounting for a rent of an equivalent-sized home, reduces retirement preparedness by about 20 percentage points in the baseline; even more so if house values increase by more than the mean value used. Downsizing significantly, e.g. by over 50% in value, would improve retirement preparedness.

⇒ Decreasing future **DB RPP generosity** by 25%, without changing other saving strategies, would decrease aggregate retirement preparedness by about 2%, implying that households covered by such plans are very well prepared.

⇒ Changing the **intensity of savings in RRSPs and TFSAs** would modestly affect aggregate preparedness. However, eliminating such savings among households who have them initially would decrease their average preparation by 9 percentage points, from 89% to 80%; doubling the intensity would modestly increase it, by about 3 percentage points.

⇒ Using different **consumption replacement thresholds** would change the retirement preparedness picture. For instance, using a uniform threshold of 70 regardless of income, instead of the ones used in the baseline, would bring aggregate retirement preparedness to 82%. Expectedly, increasing the threshold would further decrease retirement preparedness.

⇒ The **CPP/QPP reform** currently underway will have increased aggregate retirement preparedness by about 4 percentage points, and up to 8 percentage points for households earning above the median who have no savings or RPP coverage.

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