The Canadian National Retirement Risk Index: Employing Statistics Canada’s LifePaths to Measure the Financial Security of Future Canadian Seniors

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Dans cet article, nous établissons un indice canadien de risque à la retraite (ICRR) – en anglais « Canadian National Retirement Risk Index ». Ce type d’indice, créé à l’origine par le Center for Retirement Research, du Boston College, permet d’établir la proportion d’individus actuellement en âge de travailler qui risquent de ne pas pouvoir maintenir leur niveau de vie à la retraite. Le système canadien de revenu de retraite a été très efficace en matière de réduction de la pauvreté chez les personnes âgées, mais les résultats de notre étude montrent qu’il s’est révélé un moyen beaucoup moins efficace pour aider les Canadiens à maintenir leur niveau de vie à la retraite. Nous observons que, depuis le début des années 2000, environ un tiers des retraités canadiens ont été capables de maintenir le niveau de consommation qu’ils avaient quand ils étaient sur le marché du travail – et que phénomène devrait s’accentuer de façon importante parmi les futurs retraités. La mise au point d’un ICRR arrive à point nommé, étant donné les préoccupations généralisées, actuellement au pays, à propos de l’incapacité du système de revenu de retraite actuel de répondre aux besoins. Plusieurs propositions ont été faites récemment dans le but d’élargir ou d’améliorer ce système, et un ICRR est un outil qui permettra de les évaluer. La méthode que nous avons utilisée pour créer cet ICRR est unique, exhaustive et des plus perfectionnées, étant donné l’utilisation que nous avons faite du modèle...
As the Canadian population ages and its baby boomers increasingly retire from the workforce, public anxiety has grown regarding the financial adequacy of public and private retirement resources in maintaining the standard of living of Canadians after retirement. Widespread concern has brought this issue to the forefront of both the federal and provincial policy agenda. For instance, three provincial task forces have recently recommended the installment of new provincial pensions plans to complement the federal public retirement income system.

The Canadian retirement income system is made up of three pillars: the government public pension programs, employer pension plans, and personal savings. The Canadian public pension programs consist of the universal Old Age Security (OAS), the income-tested Guaranteed Income Supplement (GIS), and the Canada/Quebec Pension Plans (C/QPP). The overall goals of the Canadian retirement income system are to protect seniors against poverty and to preserve their standard of living after retirement. Although all three components of public pensions contribute toward both goals, OAS and GIS benefits, being a minimal floor available to all Canadians despite their employment history, are more instrumental in satisfying the first goal, while C/QPP is earnings related and is more directly linked to the second goal.

Researchers have generally reported very favourable results when analyzing the progress of the antipoverty policy goal in Canada. Over the past
35 years, poverty among Canadian seniors has been
decreasing dramatically and is currently fluctuating
at around 6 percent (Veall 2007). Veall (2007)
showed that Canadian poverty has become low not
only by historical standards, but also by current
international standards. Numerous other authors
have arrived at similar conclusions (see Baker and
Gunderson 2005).

The reduction of senior poverty is a major suc-
cess story of the twentieth century for the Canadian
retirement income system (Osberg 2001), but
whether Canadians maintain their living standards
after retirement is largely unknown. The Canadian
public pension programs were designed with a
strong antipoverty emphasis—OAS and GIS bene-
fits alone are generally sufficient to keep Canadian
seniors out of poverty (Sarlo 2001). The emphasis on
maintaining living standards was secondary. C/QPP
was designed to replace up to only 25 percent of
the average industrial wage. The average income from
public pension benefits increases only modestly
with pre-retirement earnings (Moore 2010), and
Canadians wishing to maintain their living standards
after retirement are expected to have private savings
and/or employer pension plan benefits. There
is evidence that many Canadians will not have
adequate resources from these other two pillars of
the retirement income system. A substantial fraction
of Canadians are retiring with no financial savings
(Osberg 2001), and employer-sponsored pension
plan coverage is declining (Gougeon 2009).

Past published research that has comprehensively
looked at the Canadian retirement income system
as a whole, while understanding the role of each
income source, has largely addressed only the first
policy goal. The evaluation of the second policy
goal has received very little attention, as research
has been hindered by data limitations, particularly
longitudinal data that track an individual’s consump-
tion pre- and post-retirement. With the emergence
of better data and superior tools, it has only been in
the past few years that the second policy goal has
begun to be properly addressed (see, for instance,
LaRochelle-Cote, Myles, and Picot 2008; and
Moore 2009).

In the United States, the Center for Retirement
Research at Boston College has developed the
National Retirement Risk Index (NRRI), which
“measures the percentage of working-age house-
holds who are at risk of being financially unprepared
for retirement today and in coming decades”
(Munnell, Webb, and Delorme 2006, 1). The US
NRRI has garnered substantial national attention
since its release in 2006 and has attracted a variety
of audiences. Our objective is to build a Canadian
NRRI (Cdn NRRI) to investigate the continuity of
living standards produced by the Canadian retire-
ment income system. We consider that a person’s
financial retirement security is at risk if his/her aver-
age working-age consumption (adjusted for family
size) is reduced by over 10 percent after retirement.

To project the future, we employ Statistics
Canada’s LifePaths, a dynamic longitudinal micro-
simulation model of the Canadian population. We
built on this powerful research tool to produce a
more comprehensive and sophisticated Cdn NRRI
than would have been otherwise possible. For
instance, the Cdn NRRI includes all important
components of retirement consumption, including
housing wealth, non-registered wealth, registered
wealth, private and public pension plan benefits, and
the complex government tax and transfer system.

In building the Cdn NRRI, we abandoned many
conventional methodologies routinely employed
when measuring retirement income adequacy. First,
we did not develop a simplistic deterministic projec-
tion model, but chose a highly complex population
microsimulation model since it offered the most
realistic view of the future. These seemingly “black
box” models can create wariness for those who are
unfamiliar with microsimulation population mod-
elling, so we have dedicated the next section to a
very general description of LifePaths. Owing to the
depth of LifePaths, however, we direct the interested
reader to the LifePaths team for more information.
(see Appendix B). Second, we did not use universal, gross replacement rate targets to measure adequacy, as has been the case for the majority of studies in this line of research. Rather, we took a lifetime, family-level consumption approach. The third section explains the conventional approaches and justifies our methodology, which is further detailed in Appendix A.

The NRRI is attractive as it is a single, quantitative measure that compares the retirement preparedness of Canadians from different birth cohorts and economic welfare groups. Many well-known low-income measures exist that allow researchers and policy-makers to evaluate the status of the first policy goal, such as HRSDC’s Market Basket Measure (MBM) and Statistics Canada’s Low Income Cutoff (LICO) and Low Income Measure (LIM). The NRRI similarly provides a yardstick to assess the progress or failure of the second policy goal. Unlike the other measures that are backward looking, however, the NRRI is a forward-looking tool that reports on the financial condition of future Canadian retirees, which is important given that policy changes in this field often require much lead time to properly take effect. With the recent surge of proposals to extend and/or enhance public pensions, such as the provincial expert commission reports already noted, the development of a Cdn NRRI is timely as it provides a systematic and scientific means to quantify the impact of the proposed changes on the future retirement security of Canadians (we intend to explore such proposals in future work; see this paper’s last section).


In general terms, economic models are designed to illuminate complex processes using simplified frameworks. For instance, the original US NRRI relied mainly on spline regression models to project a working-aged individual’s financial assets at retirement (see Munnell, Webb, and Delorme 2006). Although using deterministic averages is common, it is not the ideal when projecting the future of an entire population. Above all, it does not account for the complexity and diversity among the life courses of individuals. For example, the true dynamics of an individual’s earnings lack the consistency that researchers habitually assume and are, in fact, quite volatile when real-world longitudinal data are examined (Moore 2009). When evaluating the adequacy of retirement income, it is important to realistically capture the dynamics of earnings as it is against earnings that adequacy is assessed. Further, the earnings modelling will shape the projected retirement income since C/QPP benefits and most employer pension plans are essentially an application of the program rules to individual earnings’ histories. Earnings also affect savings and taxes, which are both important factors in determining whether individuals will maintain their standard of living after retirement.

In contrast to general economic models, micro-simulation computer models endeavour to represent the complex behaviours and interactions among the microunits in a system. LifePaths, in particular, is a dynamic microsimulation computer model of the Canadian population developed by the Modelling Division at Statistics Canada. It builds an entire population by simulating the actions and interactions of individual units case by case. Figure 1 represents the evolution of a simulated life in LifePaths. This is a simplified flow chart for illustration purposes, and is not intended to convey the true complexity of LifePaths. We list only some of the components of LifePaths—marital status, fertility, education, employment, and migration. For each simulated life, LifePaths tracks the individual’s relevant characteristics, such as those listed in the first box. These characteristics enter as explanatory variables to determine the times until the occurrence of each possible event (arrow A). The event with the shortest wait time “wins” and, once it occurs, the individual’s characteristics are updated (arrow B). These characteristics then enter again as explanatory variables to determine the next event (arrow A).
continues until death, thus creating a complete life course with all of the necessary details for millions of simulated Canadians.

To illustrate the dynamic results of LifePaths, we present one example of a simulated life—a synthetic woman who was born in 1938 and died by 2008. She graduated from secondary school after a short dropout spell, but did not continue on to post-secondary. She married at age 23 and subsequently had four children. Her first husband died and shortly after that she entered a common-law union that then turned into a second marriage. She was widowed a second time at about age 64. Except around the period when her children were young, she was regularly employed for most of her adult life, although only one of her employers sponsored a defined benefit pension plan and her employment was terminated before meeting the vesting requirements. Her gross earnings ranged from approximately $40,000 to $85,000 over the course of her career, but she did not take meaningful advantage of RRSPs until her 50s when her annual contributions generally ranged from 5–15 percent of net earnings. The realism of this example is persuasive, particularly when compared to the conventional projection assumptions habitually adopted in retirement income adequacy studies (such as uninterrupted employment, steady wage growth, a fixed savings rate, constant and unconditional RPP coverage, retirement at age 65, unchanging marriage status, and the neglect of children). In summary,

LifePaths is a dynamic longitudinal micro-simulation model of individuals and families. Using behavioural equations estimated using a variety of historical micro-data sources, LifePaths creates statistically representative samples consisting of complete lifetimes of individuals. The model’s behavioural equations generate, at sub-annual resolution, the discrete events that together constitute an individual’s life history. In
addition to its longitudinal capabilities, a complete set of overlapping cohorts allows LifePaths to produce accurate and representative cross-sectional results from the year 1971 onwards.4

LifePaths integrates data from a comprehensive list of Canadian data sources to generate its rich life-course modelling. The principal advantage of being located in Statistics Canada is the enormous range of Canadian data that can be summarized and incorporated. The components of LifePaths include birth, death, migration, education (primary, secondary, post-secondary, and field of study), fertility, marital status (marriage, common-law unions, and divorce), household composition, employment (paid employment, self-employment, and not employed), and earnings (student earnings and career earnings). Finally, the latest version of LifePaths incorporates comprehensive life-course modelling of the most significant components of the Canadian retirement income system: OAS benefits, C/QPP benefits, GIS benefits, Spouse’s Allowance (SPA) benefits, and income from employer registered pension plans (RPPs) and from registered retirement savings plans (RRSPs). LifePaths also models the Canadian income tax system, including the various complex provisions relating particularly to seniors and retirement income. Numerous studies have employed LifePaths to address important questions about retirement income for Canadians (see Carr and Leonard 2009; Moore 2009; Rowe and Wolfson 2006; TD Bank Financial Group 2010; and Wolfson and Rowe 2000). There have also been positive expert evaluations of LifePaths’ modelling (for instance, see Baldwin 2006 and Horner 2008 for a review of the RPPs and RRSPs modules).

LifePaths enables researchers to broaden their scope for analysis by giving them the means to view and experiment with simulated populations that are representative of the diversity and complexity of the actual Canadian population. Like all models that use patterns in data to project demographic and economic trends into the future, however, LifePaths is subject to the limitations of the available data. In our application of LifePaths to the Cdn NRRI, the further the projection is into the future, the higher the uncertainty. For instance, the youngest group in our study was born in 1990 and has not yet entered the time period (age 35 until retirement) that we use to measure pre-retirement consumption. There are consequently no data on the experience of this group, and projections of their future behaviour are based primarily on the socioeconomic behaviour of older cohorts and projected trends. Further, like all models of this type, LifePaths is never “complete” in the sense that it will never reproduce the true complexity and diversity of real-life individuals.5

With respect to building the Cdn NRRI, the biggest shortcoming of the most recent publicly released version LifePaths is the absence of an individual’s non-registered wealth—the value of the primary residence, non-registered financial wealth, real estate assets, and owned businesses. Non-registered wealth can be an important element of an individual’s retirement resources (for instance, the sale of an owned business at retirement could generate substantial income). For the purposes of our study, this component was developed in a separate technical report by MacDonald and Chen (2010); Appendix B provides a sketch. The non-registered-wealth module has several weaknesses: it relied on only one data source (the 1999 Survey of Financial Security), and its simulated values were imputed at the time of retirement rather than modelled longitudinally for each year of life. Further, we modelled it as an add-on to LifePaths, and consequently it is not a fully integrated component of LifePaths (each non-registered-wealth source is modelled as a function of the variables generated by LifePaths, but the modelled values of non-registered wealth do not feed back into LifePaths and consequently do not affect any of LifePaths’ other modelled components).

The Cdn NRRI also does not include intra-family transfers. It is difficult to speculate how these transfers would affect our results, since they affect both pre- and post-retirement consumption. Parents, siblings, children, and the extended family
are all potential sources of financial support, in-kind gifts, and inheritance. Finding suitable data would be a large obstacle in trying to model this source of consumption. Moreover, it is not clear whether public policy-makers should consider these sources of consumption as a component of the retirement income system.

**Measuring Retirement Security with Lifetime Consumption**

To investigate the future financial security of Canadian seniors, we must decide how to measure “adequacy.” We consider that retirement income is adequate if the average level of consumption after retirement is no more than 10 percent lower than the average level of consumption before retirement. This *lifetime* measure of consumption is not the conventional approach to retirement income adequacy studies. For example, researchers using the “replacement rate” approach typically begin with a cross-sectional data sample of respondents reporting information on their financial situation at that point in time (such as their earnings for the past year, their accumulated employer pension benefits, and their personal savings). Researchers then project each respondent’s financial resources to “retirement” (usually age 65 for everyone), and determine the retirement income stream that would be available from this projected wealth. Employment earnings are also projected until retirement. If the projected retirement income satisfactorily “replaces” the projected pre-retirement employment earnings, then the respondent’s current retirement resources are deemed adequate. For the purposes of our study, there are seven significant problems with this traditional approach:

1. Most retirement income adequacy studies compare the individual’s projected replacement rate (projected retirement gross income as a percentage of projected pre-retirement gross earnings) to a universal, gross replacement rate “target” (for instance, the original US NRRI took this approach as did the recent *TD Economics* 2010 paper). There is, however, no universal gross replacement rate threshold that adequately maintains everyone’s standard of living at retirement, even when broken down by income group; rather, the appropriate target is sensitive to a variety of personal factors other than the individual’s level of income, such as his or her savings rate and the varying tax treatment on each source of income.

2. Retirement income is not fixed at the time of retirement. For example, an individual may retire at age 60, but he/she is not eligible to receive OAS benefits until age 65. In addition, if employer retirement pension benefits are not indexed to inflation, then a retiree’s benefits will decrease in real terms for each year of retirement. An individual’s retirement can span up to 40 years, particularly with the trend toward earlier ages of retirement and improvements in longevity; consequently, inflation can have a devastating effect on any nominally fixed income. In addition, spousal benefits are payable only after the death of a spouse, which could occur any time. A study on retirement income security would be incomplete if it considered financial security only at retirement and ignored the later years.

3. Earnings during a worker’s final years of employment are not necessarily representative of the worker’s standard of living; in fact, actual data reveal that employment income is much less stable from year to year than academics tend to assume (Moore 2009).

4. It is not realistic to assume that retirement is an event on which day a worker makes a complete shift from working income to retirement income sources. More and more, the transition from full-time employment to complete retirement is being taken in steps, with much overlap in between.

5. Assuming a fixed retirement age for all workers is unrealistic because, despite the financial
incentives to retire at a particular age(s), workers will retire at a variety of ages owing to other life factors such as health, the care of a spouse, and job loss. For instance, 27 percent of current Canadian retirees reported that health was their reason for retirement (Turcotte, Liu, and Schellenberg 2006). Further, 14 percent indicated that their jobs were downsized, 13 percent reported mandatory retirement policies, 8 percent retired to care for family members, and 6 percent were unemployed. From the 2000 Health and Retirement Study in the United States, 37 percent of the retirees felt that they were forced to retire because of unemployment or poor health, and their reported well-being was significantly lower than those whose retirement was voluntary (Bender 2004). As involuntary retirements have been observed to be the leading cause behind inadequate retirement savings (Hurd and Rohwedder 2005), it is clearly important to include this group of individuals when addressing the future financial retirement security of the population.

6. Although habitually ignored, family size is a material consideration when comparing income in retirement with pre-retirement. To illustrate, a couple with children requires more income than a couple without children to have the same standard of living. Extending this idea to lifetime consumption, a couple with a family requires less income once their adult children have left home to maintain their standard of living. Also, after retirement, the death of a spouse or a new marriage will affect the level of income necessary to sustain the household’s standard of living. A second important dimension of this topic is the economies of scale in a family’s consumption. For instance, a couple needs less than twice the income of a single person to achieve the same standard of living since a couple shares a residence and other consumption items and commodities.

7. Finally, in the conventional approach, retirement resources at a given, observed age are projected to a specified retirement age using deterministic, average factors that obscure all individual variability. In reality, however, individuals of the same age group with a particular level of retirement resources at one point in time will not have identical incomes after retirement. There will be significant heterogeneity during their remaining pre-retirement periods among their earnings, C/QPP and employer pension plan accruals, RRSP saving, and so on.

Having synthesized life-course data, we have the flexibility to measure the Cdn NRRI in the most theoretically sound manner and overcome the simplifying assumptions that are generally a result of limited data, inferior computer technology, and a shortage of financial and human resources. We avoid the problems arising from universal gross replacement rate targets (problem #1) by directly comparing each individual’s consumption before and after retirement. To overcome the second and third obstacles, we consider the lifetime consumption of the individual (age 35 until death), rather than his or her consumption solely at the time of retirement. As for the fourth and fifth difficulties, LifePaths produces a population of Canadians who exit the workforce at a variety of ages and in a variety of ways: workers could end their careers abruptly or reduce their workloads gradually. LifePaths incorporates the realistic complexity of retirement behaviour by modelling an individual’s income source—whether it be from employment, retirement savings, government transfers, or a combination of the three—so that it reflects the realistic heterogeneity found in actual data. As for the sixth issue, the Cdn NRRI measures consumption at a household level and applies a family scale adjustment (see upcoming equation 1). Regarding the seventh point, LifePaths generates realistic variability among individuals over their life courses.

We consider that a person is at risk if he or she is unable to maintain the greater part of pre-retirement consumption after retirement. Consumption is determined by the following variables (see Appendix A for precise formulas):

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• Pre-retirement gross income
  – wages and salaries, self-employment income, investment income, other money income (such as alimony, child support, scholarships, severance pay), government transfers (UI/El benefits, Canada Child Tax benefits, and other income from government sources such as social assistance, war veterans’ benefits, and workers’ compensation)

• Taxes
  – personal income taxes and federal payroll taxes

• Contributions to employer pension plan
  – contributions to registered pension plan made by either the employee or the employer on behalf of the employee

• Contributions to private registered savings
  – contributions to RRSP

• Investments/acquisitions of other private savings (non-registered), which include
  – financial wealth:
    o bank account deposits, mutual funds, bonds, stocks, and other investments or financial assets (such as t-bills and money held in a trust)
    o debt from credit cards, student loans, line of credit, and other debt (such as unpaid bills)
  – real estate other than the primary residence, its value and any mortgages owed on these properties
  – business equity
  – other retirement funds (deferred profit sharing plans, annuities, executive pension plans, and foreign pension plans)

• Mortgage payments on primary residence

• Government retirement benefits
  – income from OAS, GIS (both federal and provincial top-ups), SPA, C/QPP (retirement, survivor, and death benefits)

• Employer pension plan benefits
  – income from registered pension plan retirement and survivor benefits

• Withdrawals from private registered savings
  – withdrawals from RRSP and RRIF

• Withdrawals from other private savings (non-registered)

The individual under investigation is considered “at risk” if his/her average post-retirement consumption (from retirement until death) falls short of his/her pre-retirement consumption (from age 35 until retirement) by more than 10 percent:

\[
\left[ \frac{\sum_{x=AOR}^{AOD} \text{Post-retirement Consumption} \cdot \frac{CPI_x}{CPI_{AOR}}}{FSA_x} \right] \cdot \frac{(AOD - AOR + 1)}{(AOR - 35)} < 90\%
\]

where AOR is the age of retirement, AOD is the age of death, CPI\(_x\) is the consumer price index at age \(x\), which adjusts for inflation so that consumption is comparable from year to year, and FSA is the family size adjustment. Appendices A and B provide a lengthier description of our methodology and the underlying assumptions.

In equation (1), a person’s consumption can drop by up to 10 percent before he/she is deemed “at risk.” The original US NRRI chose a 10 percent threshold and described it as “a conservative standard by which to assess retirement readiness” (Munnell, Webb, and Delorme 2006, 11). It could also be seen as reflecting the financial advantages of retirement. For example, the increased leisure time of retirement provides an opportunity for more home-production—including food preparation and
more efficient shopping—effectively lowering the cost of maintaining the person’s pre-retirement standard of living; this trend has been observed both in Canada (Brzozowski and Lu 2006) and in the US (Aguiar and Hurst 2005). A second example is the cessation of work-related expenses, such as commuting costs and special clothing, although its impact could be small (Bernheim, Skinner, and Weinberg 2001). As the threshold is subjective, the next section tests the sensitivity of the results to this assumption.

The target population in the Cdn NRRI is the entire Canadian population with two exceptions: Canadians who die before reaching retirement, and immigrants who arrive after age 35 (see Appendix A for a further explanation).

Consumption includes the imputed value of rent. We assume, however, that “retirement preparedness” is the financial means to support retirement consumption without tapping housing wealth (such as downsizing or taking a reverse mortgage).

**The Canadian NRRI – Results and Discussion**

We begin this section by presenting three tables of results, and discuss the findings by subsection. Table 1 compares the retirement preparedness of Canadians from different birth cohorts and economic welfare groups, where each birth cohort spans seven years and we measure economic welfare using an individual’s average pre-retirement consumption. Table 2 shows the historical NRRI results for previously retired birth cohorts. Table 3 tests the sensitivity of the Cdn NRRI to the 10 percent threshold that we use to determine if an individual is “at risk.”

**Results by Income Group**

In Table 1, the risk index for the bottom third of working-age Canadians is relatively low at 14 percent. This suggests that the retirement income system does a good job in providing a baseline amount that preserves or possibly improves the standard of living for Canadian seniors with lower

### Table 1

**Percentage of Canadians “at Risk” of Inadequate Retirement Resources (i.e., the Cdn NRRI), by Birth Cohort and Economic Welfare Group**

<table>
<thead>
<tr>
<th>Birth Cohort</th>
<th>Bottom Third</th>
<th>Middle Third</th>
<th>Top Third</th>
<th>All</th>
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</thead>
<tbody>
<tr>
<td>Pre-boomers (1943–1950)</td>
<td>10%</td>
<td>31%</td>
<td>55%</td>
<td>32%</td>
</tr>
<tr>
<td>Early boomers (1951–1958)</td>
<td>11</td>
<td>33</td>
<td>57</td>
<td>34</td>
</tr>
<tr>
<td>Late boomers (1959–1966)</td>
<td>12</td>
<td>37</td>
<td>62</td>
<td>36</td>
</tr>
<tr>
<td>Early generation Xers (1967–1974)</td>
<td>15</td>
<td>41</td>
<td>65</td>
<td>40</td>
</tr>
<tr>
<td>Mid-generation Xers (1975–1982)</td>
<td>18</td>
<td>44</td>
<td>68</td>
<td>43</td>
</tr>
<tr>
<td>Late generation Xers (1983–1990)</td>
<td>20</td>
<td>46</td>
<td>70</td>
<td>45</td>
</tr>
<tr>
<td>All</td>
<td>14</td>
<td>39</td>
<td>63</td>
<td>39</td>
</tr>
</tbody>
</table>

Note: Cdn NRRI = Canadian National Retirement Risk Index.

Source: Authors’ compilation.
The Canadian National Retirement Risk Index  

pension programs (OAS, GIS, and C/QPP) were designed to provide a modest base upon which Canadians can build their retirement income. For many Canadians with lower pre-retirement economic welfare, Table 1 suggests that the public pension benefits are sufficient to maintain or possibly raise living standards after retirement. The public pension benefits were not intended, however, to sustain the standard of living of Canadians in general after retirement without private savings and employer pension benefits. Whereas the Canadian public pension programs are nearly universal and largely mandatory, the second and third pillars of the Canadian retirement income system are voluntary. The Cdn NRRI results suggest that RPP benefits and private savings from RRSPs and non-registered sources will not be sufficient for a substantial portion of Canadians and that their lifestyles will not be maintained after retirement.

The Canadian public pension programs’ emphasis on preventing poverty rather than maintaining living standards is particularly evident when we compare our results to the original US NRRI. Compared with Canada, the US public pension system puts less

<table>
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<th>Table 2</th>
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<tr>
<td>Historical Cdn NRRI for Previously Retired Birth Cohorts</td>
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<td>Source: Authors’ compilation.</td>
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<th>Table 3</th>
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<tr>
<td>Cdn NRRI by Birth Cohort for Various Definitions of “At Risk” (Drops in Average Consumption)</td>
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</tbody>
</table>

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<thead>
<tr>
<th>Drop in Average Consumption</th>
<th>0% Drop (Higher Standard)</th>
<th>Base Case (10% Drop)</th>
<th>20% Drop (Lower Standard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth Cohort</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Pre-boomers (1943–1950)</td>
<td>42%</td>
<td>32%</td>
<td>24%</td>
</tr>
<tr>
<td>Early boomers (1951–1958)</td>
<td>43</td>
<td>34</td>
<td>24</td>
</tr>
<tr>
<td>Late boomers (1959–1966)</td>
<td>46</td>
<td>36</td>
<td>27</td>
</tr>
<tr>
<td>Early generation Xers (1967–1974)</td>
<td>50</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Mid-generation Xers (1975–1982)</td>
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<tr>
<td>Late generation Xers (1983–1990)</td>
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<td>35</td>
</tr>
<tr>
<td>All</td>
<td>48</td>
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</table>

Source: Authors’ compilation.
emphasis on poverty prevention and, consequently, the relationship between economic welfare and risk was reversed in the US NRRI; that is, those in the lower income brackets were more likely to be at risk of an inadequate retirement income than households in a higher income bracket. In fact, 60 percent of Americans in the bottom third of the income distribution were at risk (Munnell, Webb, and Delorme 2009), while only 12 percent of Canadians in the bottom third of the economic welfare distribution are at risk (using corresponding birth cohorts). The results of the US NRRI were, however, much more level across the low, middle, and high income groups than are the Canadian results (60 percent, 47 percent, and 42 percent in the US for workers born between 1946 and 1972 compared to 12 percent, 35 percent, and 60 percent in Canada for our corresponding birth cohorts between 1943 and 1974). These results reflect the relatively greater weight that the US public pension system places on maintaining the living standards of Americans across the entire income distribution.

Results by Birth Cohort

Table 1 shows that each working-age birth cohort is at a higher risk of inadequate retirement resources than its predecessor.12 There are two primary driving forces behind this result.

• Income at the household level has been continuously improving owing to historical periods of real wage growth and rising labour force participation among women since the late 1950s.13 OAS and GIS/SPA benefits are adjusted, however, according to changes in the cost of living14 rather than household income growth. Consequently, OAS and GIS/SPA benefits are not keeping pace with pre-retirement economic welfare improvements and are playing an increasingly smaller role in maintaining the living standards of retiring Canadians.

• RPP coverage of the labour force has fallen in Canada and the take-up of RRSPs has not been sufficient to compensate (Moore 2010). These trends are projected to continue modestly into the future (see Appendix B). The current trend toward less employer pension plan coverage and more individual responsibility for retirement income is hindering the financial security of future Canadian seniors according to our results. The proportion of Canadian employees covered by defined benefit plans decreased from 41 percent to 30 percent from 1991 to 2006 (Gougeon 2009).15 Although the move away from employer-sponsored defined benefit plans has been far less dramatic than in the US (Brown and Liu 2001; Ontario Expert Commission on Pensions 2008), the Cdn NRRI projects that the overall outcome of this shift will increasingly produce inadequate retirement resources.

The trend of increasingly higher risk for future Canadian retirees is unfortunate since, up until the earlier years of the new millennium, retiring Canadians had been progressively better off than previous cohorts. In Table 2, the Cdn NRRI improved substantially from over one-third to one-quarter between the 1911–1918 birth cohort and the 1919–1926 and 1927–1934 birth cohorts. This suggests that Canadians retiring in the 1980s, 1990s, and the beginning of the new millennium were significantly better off than retirees before that time.16 The Cdn NRRI for the 1935–1942 birth cohort then rose to nearly 30 percent, showing a reversal of this progress. Several other studies have also reported a historical improvement in retirement income adequacy up until the new millennium. For instance, LaRochelle-Cote, Myles, and Picot (2008) showed that recently retired individuals in 1998 were better off than those in 1993 owing to the stability of the Canadian public pension programs along with increasing benefit levels from private pension sources (RPPs and RRSPs). Turcotte and Schellenberg (2006) similarly commented on the overall improvement of retirement income in Canada, reporting that average after-tax income increased by 18 percent in real terms for senior couples and by over 40 percent for singles between 1980 and 2003. More recently, Moore (2010) employed LifePaths to investigate
the past and future trend of replacement rates for retiring Canadians. He found that, on average, the capacity of income from RPPs, RRSPs, GIS, C/QPP, and OAS to replace pre-retirement consumption rose between 1966 and 1990, and remained relatively stable until 2005. It was only in recent years that the replacement rates have begun to decline, and this negative trend was projected to continue into the future. In addition to quantitative studies, the work of Alan, Atalay, and Crossley (2008) is a qualitative investigation that also gave a good account of retirees in the 1980s, 1990s, and the beginning of the new millennium. This qualitative study assessed the responses of Canadian retirees to questions of financial satisfaction in the Statistics Canada General Social Survey. The findings suggested that Canadian retirees in 1989, 1994, and 2002 had adequate financial resources, with the exception of those who retired involuntarily.

The US NRRI similarly suggested a negative financial security trend for future American seniors. Munnell and Soto (2005) concluded that retiring US citizens today are in “pretty good shape” after examining replacement rates of current retirees, but they also postulated that retirement income adequacy would decline as a result of anticipated lower replacement rates from US Social Security and less-certain income from employer pensions. The US NRRI supported this assertion, showing an increase in risk for each consecutive birth cohort (see Munnell, Webb, and Delorme 2009).

Sensitivity of the Results to “at Risk” Definition
Table 3 shows that the results are sensitive to our “at risk” definition (that is, an individual is at risk if his/her pre-retirement consumption drops by more than 10 percent after retirement). Each cohort is alike in their sensitivity to the threshold and we find that, in nearly every cohort, there is approximately a 1 percent inverse relationship between the threshold and the NRRI (for instance, the level of risk increases by approximately 10 percentage points when we raise the threshold to 20 percent).

FUTURE WORK
We built the Cdn NRRI with the goal of helping to inform policy analysis. Unlike most projection studies on retirement income adequacy, a powerful aspect of our approach in using LifePaths is our ability to test various “what if” scenarios with relative ease. We intend to make use of this strength in upcoming work, and the following are examples of possible avenues for investigation.

- We hope to use the Cdn NRRI to evaluate the most prominent suggestions to extend and/or enhance public pensions (see the first section for references to the proposals given by the provincial expert commissions).
- It is debatable whether public policy-makers should regard housing wealth as a component of retirement savings. We intend to look at the impact on the Cdn NRRI of retirees drawing on their housing wealth as a source of retirement income, such as through a reverse mortgage.
- We wish to analyze the impact of behavioural changes on the Cdn NRRI, such as higher savings rates, longer participation in the workforce, and slower decumulation of personal savings during retirement.
- We intend to model health and its associated costs so as to include its impact on the retirement preparedness of Canadians. Although the Canadian elderly are less burdened by the financial costs associated with hospital care, prescription drugs, and home care than Americans, these expenses can nevertheless become substantial (MacDonald, Andrews, and Brown 2010).
- We would like to measure the projected retirement security of Canadians against a minimum standard of living—that is, using an absolute threshold to investigate the future success of the Canadian retirement income system in alleviating poverty.
CONCLUSION

This article investigated the proportion of working-age Canadians who are at risk of not maintaining their standard of living in retirement. Building on Statistics Canada’s LifePaths dynamic population microsimulation model, we found that more than half of working-age Canadians with middle or high pre-retirement economic welfare are at risk of inadequate financial resources after retirement, while only 14 percent of those with lower economic welfare are at risk. Public pension benefits (OAS, GIS and C/QPP) are sufficient to maintain or possibly raise the living standards of many Canadians with lower economic welfare. On the other hand, Canadians with middle or high economic welfare require private savings and employer-sponsored pension plan benefits to maintain their standard of living after retirement. The Cdn NRRI finds that the RPP coverage and the take-up of private savings have not met this end, and will continue to not meet it, for a large portion of Canadians.

The Canadian NRRI projects that retirement income inadequacy will steadily increase. This is chiefly a result of the inability of the public pension benefits to keep pace with the improvements in pre-retirement economic welfare from one birth cohort to the next, as well as the prevailing trend away from traditional employer-sponsored pension plans.

Many proposals have recently emerged to extend and/or enhance Canadian public pensions, and upcoming Cdn NRRI work will test their effectiveness in reducing the risk of future retirement insecurity for Canadians.

NOTES

The findings reported in this paper are the responsibility of the authors and do not represent the opinion of Statistics Canada.

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3 Much of this example is taken directly from Geoff Rowe’s LifePaths presentation dated 29 May 2006 (slide 7).


5 Ibid.

6 See Palmer (2008) for an example of a study that determined target replacement rates, and Scholz and Seshadri (2009) for an argument against such measures.

7 For the purposes of calculating the Cdn NRRI, however, we are required to make some assumption about when “retirement” occurs so as to measure pre- and post-retirement consumption. Our assumption is not a fixed age but based on age and employment status (see Appendix A for further information).
This includes T4 earnings plus employer contributions to payroll taxes and registered pension plans.

"Imputed rent" is an economic term that accounts for the financial benefit of owning a home (Munnell, Webb, and Delorme 2006).

The equivalence scale that we employ is the square root of the family size. This is an approximation for the equivalence scale employed by the Statistics Canada Low-Income Measure, which has achieved a high level of acceptance.

Some caution should be taken when making comparisons between the Cdn and US NRRI rates. In addition to significant differences in their methodology and different ranges of years chosen for each birth cohort, the US NRRI assumed that households took a reverse mortgage on any housing equity at retirement. Owing to the nearly non-existent take-up of such financial instruments in Canada and other developed countries (Chiuri and Jappelli 2010), we assumed in this article that seniors do not tap housing equity in retirement, although we account for imputed rent. This assumption should produce higher NRRI rates. The Cdn NRRI rates by birth cohort were, however, significantly lower than those reported by the US NRRI (an average of 36 percent in the Cdn NRRI, if using similar birth cohorts, versus 43 percent in Munnell, Webb, and Delorme 2009), thus suggesting that Canadians are less at risk, in general, than Americans.

We included the pre-boomer cohort although its members could be working or retired at the time of this publication.

See Appendix B for details on how these items were projected into the future.

There have also been a number of ad hoc adjustments to GIS benefits over the last three decades.

The proportion covered by defined contribution plans increased slightly from 4 to 6 percent during the same period.

A principal explanation behind this result was the maturation of CPP benefits as well as the growing importance of RPP and RRSP benefits.

For further information on each component, see the third section of this paper.

See note 9 for a description of this term. In our study, the imputed rent is estimated to equal 4.6 percent of the value of the home; this formula is taken directly from the original US NRRI study. It is also the gross imputed rent computed by Davis, Lehnert, and Martin (2008) for Americans in 2000.

The cost of tuition is modelled in LifePaths, and we incorporated it as a form of savings although the appropriateness of this is debatable (regardless, its inclusion is not material since the Cdn NRRI does not begin measuring consumption until age 35).

REFERENCES


Appendix A

Consumption Formulas and LifePaths

This Appendix describes the consumption formulas underlying the Cdn NRRI. When the individual under investigation (the “dominant” individual) is between ages $x$ and $x + 1$, his/her family’s annual consumption equals

\[
C_x = PrRGI_x + IR_x + GRBfts_x RPPBfts_x + WRS_x + WOS_x
- Tax_x - CRPP_x - CRS_x - OS_x - MP_x - TF_x, \tag{2}
\]

where

- $PrRGI = \text{pre-retirement gross income,}$
- $IR = \text{imputed rent,}$
- $GRBfts = \text{government retirement benefits,}$
- $RPPBfts = \text{employer pension plan benefits (or registered pension plan benefits),}$
- $WRS = \text{withdrawals from private registered savings,}$
- $WOS = \text{withdrawals from other private savings (non-registered),}$
- $Tax = \text{personal income taxes and federal payroll taxes,}$
- $CRPP = \text{contributions to employer pension plan,}$
- $CRS = \text{contributions to private registered savings,}$
- $OS = \text{investments/acquisitions of other private savings (non-registered),}$
- $MP = \text{mortgage payments on primary residence, and}$
- $TF = \text{tuition fees.}$

The dominant individual is considered “at risk” if his/her average post-retirement consumption falls short of his/her pre-retirement consumption by more than 10 percent; that is

\[
\left[ \frac{\sum_{x=AOR}^{AOD} \frac{C_x}{FSA_x} \frac{CPI_{AOR}}{CPI_x}}{(AOD - AOR + 1)} \right] < 90\% \left[ \frac{\sum_{x=35}^{AOR-1} \frac{C_x}{FSA_x} \frac{CPI_{AOR}}{CPI_x}}{(AOR - 35)} \right], \tag{3}
\]
where AOR is the age of retirement (see below), AOD is the age of death, $\text{CPI}_x$ is the consumer price index at age $x$, whose role is to adjust consumption for inflation so that the annual values are comparable in real terms, and $FSA_x$ is the family size adjustment. Its formula is given by

$$FSA_x = \sqrt{\text{Family Size of dominant individual between ages } x \text{ and } x + 1}.$$

We choose age 35 as the time that consumption becomes somewhat more representative of permanent living standards. We do not include immigrants who arrive after age 35 because this would create missing years in their lifetime consumption and cause inconsistent “at risk” measurement across the population.

To draw the line between pre- and post-retirement consumption, we run into the question, “What is retirement?” With the growing popularity of phased retirements, the term “retirement” itself is subjective and not well defined. For example, one person could consider himself retired once taking up his pension, despite continuing to receive significant employment earnings, while another person could claim that she is not retired at very advanced ages because she continues to work, even if it is voluntary and minimal. Rather than make a statement on this theoretical question, LifePaths models the income sources. For the purpose of setting an age that we can compare consumption before and after, we assume that retirement occurs if an individual is older than age 55 and has been not employed for 12 months, or if he/she reaches age 65. This assumption is unavoidably subjective; fortunately, the effect of testing different retirement age assumptions was relatively modest.

Once people have retired, we exclude any employment income. To include working income after retirement would poorly test Canada’s retirement income system, since the concept of retirement preparedness is the ability to adequately replace employment earnings. Further, we do not assume that retirement preparedness includes the ability to support dependents after retirement; therefore, we exclude children in the family size adjustment once the dominant individual retires. Like the dominant individual, we do not include any of the spouse’s employment income in $C_x$ from equation (2) if the spouse has retired according to our definition. After retirement, we also do not include tuition fees, maternity/parental government EI benefits, or Canada Child Tax benefits.
APPENDIX B

Key Projection Assumptions

This section lists a few of the assumptions that are pivotal when projecting pre- and post-retirement consumption. Each module within LifePaths is vast and we recommend that interested readers avail themselves of this information directly from the LifePaths team at Statistics Canada. Even the most basic overview of this initiative occupies a full report (Statistics Canada 2010), and there are another dozen documents that describe the rich modelling of each of its components.

For its simulations of the past, LifePaths uses detailed behavioural equations and socioeconomic parameters that successfully reproduce the actual historical experience of individual Canadians. The result is a representative modelled population that is consistent with all available microdata on Canadians and sums to aggregate statistics. For the purpose of making conditional projections of the future, however, it is necessary to specify a projection scenario that establishes the many assumptions that must be made about the future. For this study, the principal author takes full responsibility for the projection scenario chosen. Some of the significant assumptions for the future are as follows:

• Medium demographic assumptions for fertility, mortality, and migration were taken from Statistics Canada’s official population projections (Statistics Canada 2005). This produces modest trends of increasing life expectancy and fewer children across future retirement cohorts.

• The marital transition patterns were projected based on the 2001 Census, which produces a modest trend away from marriage for future retirement cohorts.

• The increasing trend of women in the labour force that began in the late 1950s is assumed to peak with the 1990 birth cohort, and remain flat thereafter.

• We assumed that the historical trend of increasing levels of post-secondary educational attainment has levelled out after the 1980 birth cohort.

• Real wage growth and inflation assumptions were 1.3 percent and 2.5 percent per annum, respectively. These are the base assumptions made by the Chief Actuary of Canada in his most recent actuarial report on the Canada Pension Plan (Office of the Chief Actuary of Canada 2010).

• The future aggregate rate of return for each of the various asset classes held by RRSPs and defined contribution RPPs were set at their average real rate over the last 72 years (Bank of Canada Financial Market Statistics, available through CANSIM). The future aggregate gross real market rate of return is roughly 4 percent. The aggregate net real rate of return realized by individuals, after management expenses and performance penalties, is roughly 1 percent for RRSPs and 2.5 percent for defined contribution RPPs. It is worth stressing that these values are the aggregate economic assumptions that we chose in our projection scenario of the future; within LifePaths, however, there is considerable variation in the modelling of portfolio composition and the rates of return achieved across individuals.
• We assumed future trends of modestly lower levels of private sector RPP coverage and continuing movement from defined benefit to defined contribution RPPs in the private sector. We assumed that RPP coverage in the public sector remains stable.

• We assumed that the levels and patterns of RRSP saving by individuals relative to their earnings, observed in tax data over the past decade, continue into the future.

• The provisions of the public pension programs, and payroll and income tax systems, were set to remain as currently legislated.

A significant amount of sensitivity analysis was performed to evaluate the robustness of our results to the socioeconomic assumptions made. The results were generally only modestly sensitive to changes in these assumptions. They were most sensitive to substantial changes in the net real rate of return realized by individuals in their RRSPs and defined contribution RPPs. The study’s central finding—the substantial increase in the proportion of future retirees likely to experience a drop in their standard of living after retirement—was never challenged in the course of this sensitivity analysis.

As we explain in the second section, a missing feature of the most current publicly available version of LifePaths is non-registered wealth. As non-registered assets and debt are not trivial income sources for seniors, it was important that we include them in order to more fully capture the Canadian retirement income system. The following is a bullet-point description of the approach taken to build this module into the LifePaths model.

• The sources of non-registered wealth include the primary residence asset and debt, financial assets and debt, other real estate, and business equity.

• The value of each source is imputed at the time of retirement based on the characteristics of the synthesized individual using simple recursive modelling.

• To calculate the value of each source, imputation equations are simulated for both (1) the probability of receipt and (2) the distribution of its value (both with a stochastic component).

• The equations were estimated from the 1999 Survey of Financial Security.

• We assumed that assets and debts begin to be accumulated at age 35. We assumed that mortgage payments for the primary residence are a fixed nominal amount before retirement. For assets other than the primary residence, however, we assumed that individuals save a fixed proportion of their household consumption, thus implying that an individual’s ability to save is directly proportional to his/her disposable income.

• Aside from housing equity, we assumed that individuals choose to self-annuitize their non-registered assets and debt (more specifically, they withdraw a fixed amount of their net wealth each year, where the level is based on their expected lifespan at the time of retirement and a fixed gross rate of return of 6 percent). A critical problem when modelling retirement savings drawdown behaviour is data limitations: “The first cohort with substantial amounts of unannuitized pension wealth is only now entering retirement.
Little is known about the strategies they are using to manage the decumulation of that wealth” (Webb 2009, 14). Owing to the low rates of voluntary annuitization in Canada and around the world, we did not assume the purchase of a life annuity despite the nearly unanimous agreement among researchers that households should annuitize a substantial portion of their wealth to maximize the utility of their lifetime consumption (see MacDonald et al. 2010 for a discussion of retirement savings drawdown).

• We incorporated the value of housing wealth through the use of “imputed rent.” We assumed that mortgage debt on the primary household is paid off within five years of retirement.

• The LifePaths team is presently developing a housing equity module, which could be available for future work. In our current model, housing wealth and debt are computed at a particular point in time based on the characteristics of the synthesized individual. The new module would be longitudinal; that is, each synthesized individual would hold a particular level of housing wealth and debt for each year of his or her life course.

• A fuller description of a non-registered wealth module is given by MacDonald and Chen (2010).