Office of the Superintendent of Financial Institutions Canada
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Presentation by Chief Actuary, Jean-Claude Ménard
Office of the Chief Actuary (OCA)
Office of the Superintendent of Financial Institutions Canada (OSFI)
to the
International Research Symposium
on the topic of: Mortality projections for Social Security Programs in Canada and its implications

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Good morning, By way of introduction, I am Jean-Claude Ménard, Chief Actuary of the Canada Pension Plan, the Old Age Security Program and federal public sector pension plans in Canada.

(Slide 2) Thank you for inviting me here today to talk about the Canadian mortality trends, the mortality experience by income and marital status and the mortality projections for Social Security Programs in Canada. I will conclude with the use of stochastic processes to measure uncertainty and an international comparison of projections made by social security actuaries around the world.

(Slide 3) Over the last century, life expectancy at birth has increased by an estimated 28 years in Canada with most of the change occurring before 1950. Most experts agree that the rapid increase in life expectancy at birth that occurred during the 20th century will not continue and that future increases in life expectancy will have to take place at older ages as opposed to younger ages.

(Slide 4) Since the early 1970s, male and female life expectancy at age 65 has increased by about two and a half years to 18 and 21 years for males and females, respectively. The gap between female and male life expectancies at age 65 has also narrowed but only more recently.

(Slide 5) Like many countries, the Canadian population has been aging at an increasing rate, especially since the inception of the Old Age Security (OAS) program in 1952. Since the OAS program provides a monthly retirement benefit to almost all Canadians aged 65 and over, its administrative database allows an accurate measurement of the level and trend in mortality experienced by the oldest portion of the Canadian population.

(Slide 6) In addition to studying the overall mortality of OAS beneficiaries by age and sex, this study also analyses mortality in terms of income. A high level of income is a long-term predictor of lower levels of mortality, and conversely, a low level of income is a long-term predictor of higher levels of mortality. However, the difference in mortality, according to the level of income, decreases with advancing age.

(Slide 7) This study also confirms that both married males and females experience better mortality than their single counterparts. However the differential is smaller for females. For the age group 65 to 69, married males experience mortality that is 17% lower than the aggregate mortality for this group, while at advanced ages, this factor reduces to 8%.

Single males experience mortality that is 55% higher than the aggregate mortality for the age group 65 to 69, while at advanced ages, this factor reduces to only 3%.

(Slide 8) The differential in life expectancy by marital status is much higher for males (between 3 and 4 years) than females (about 1 year). This table also shows that the differential between high and low income seniors is more pronounced for males, at about 4.5 years, compared to 3.5 years for females. Income level and marital status are therefore a better predictor of mortality for males than females. Lastly, OAS beneficiaries born outside of Canada have a greater life expectancy than those born in Canada.

(Slide 9) Since the CPP Actuarial Report of 1977, some thirty years ago, projected mortality rates have always been determined based on an analysis of Canadian and U.S. mortality experience generally consistent with the extensive mortality study used in the Social Security Administration Old-Age and Survivors Insurance and Disability Insurance Trustees Report. The projected mortality rates were based on the assumption that causes of death and general medical treatment in North America should not differ much in the future between the two countries and that the gap between U.S. and Canadian mortality should reduce over the projection period.

An independent panel of actuaries reviewed the previous Actuarial Report and released a report in March 2005. The Review Panel found that the Twenty-First Actuarial Report was prepared in accordance with professional standards and that the assumptions used by the Chief Actuary were, in aggregate, within the reasonable range. However, the Review Panel expressed some concern about the assumption that the gap between US and Canadian mortality rates will tend to narrow from 2026 to 2075. They believe that a gap will continue to exist between (lower) Canadian mortality rates and (higher) US mortality rates based on three advantages in Canadian society: access to universal health care, lower rates of obesity, and lower rates of poverty and less disparity of income. Therefore, it was decided to only use Canadian experience from the last 30 years to determine the assumed annual mortality improvement rates for the 75 year projection period of the actuarial report on the Canada Pension Plan.

(Slide 10) The following chart provides an overview of the average annual population-weighted mortality improvement rates in Canada for various subperiods over the 60 year period ended in 2004. Average annual mortality improvement rates have always been higher for females than for males except during the past 15 years. Although the female mortality improvement rates are still positive, the pace has slowed down in the past 15 years compared to the preceding 15 years. For the age group 65 to 89, the average annual mortality improvement rates have declined from 1.6% in the period 1974-1989 to 1.0% in the period 1989-2004. For males, the trend is the reverse. Average annual mortality improvement rates have increased from 1.2% to 1.7%.

(Slide 11) This table shows the improvement rates by sex and more detailed age groups over the last 30 years divided into two 15-year sub-periods. For people aged 65 and over, there was an acceleration of annual improvement rates for males (from 1% to 1.6%) and a deceleration for females (from 1.3% to 0.8%).

(Slide 12) This table shows the future female improvement rates that would result if the trend observed in the last 30 years were projected to continue over the next 30 years. This table was used to derive the ultimate improvement rates for females, set to apply after 2029. The ultimate annual improvement rate of 0.7% is derived from Statistics Canada central death rates by trending the last 30 years of female experience to the next 30 years. While the ultimate rate has always been derived from US mortality studies and adjusted for Canadian experience it is now based on a "30-30" method, which leads to results similar to those produced by the stochastic process employed for sensitivity testing.

(Slide 13) Mortality improvements are expected to continue in the future, but at a slower pace than observed in the past except for ages 90 and above, where improvements are assumed to be higher than in the past. Rates of improvement for the period 2005 to 2009, varying by age and sex, are assumed to be those experienced in Canada over the period 1989 to 2004. Improvement rates for years 2010 to 2028 are obtained by linear interpolation between the improvement rates of year 2009 and fixed improvement rates described above in respect of the period 2029 and thereafter.

(Slide 14) In Canada, cancer is the leading cause of death for the age group 45 to 64. Therefore, improvements will come mainly from medical breakthroughs. There is more room for male mortality to improve compared to female mortality because male mortality rates are higher. Assuming that males will eventually close the gap with females, we have assumed higher improvements for males than females for the next 25 years.

(Slide 15) For the age group 65 to 84, heart disease is the leading cause of death. Thus, improvements will come mainly from medical breakthroughs and lifestyle changes. Assuming that males will eventually close the gap with females, we have assumed higher improvements for males than females for the next 25 years.

(Slide 16) An ultimate improvement of 0.6% is assumed for the age group 85 to 89. For the age group 90+, the improvement is fixed at 0.4%, which is close to the experience over the last 15 years of females in the age group 85-89. As a result, mortality rates are assumed to decrease from 100 to 70 deaths per 1000 over the projection period for the age group 85 to 99.

(Slide 17) For the oldest, data quality is a major concern. The reduction in projected mortality rates is lesser than for other age groups, going from 340 to 270 deaths per 1000 over the projection period.

(Slide 18) The following graph shows the probability of survival for a male newborn from 1925 to 2075 based on period life tables. The "squaring" of the survival curve is the result of expected lifetimes increasing and the maximum age that can be attained being about 120 years. As indicated on the graph by the intersection of the vertical line at age

65 with the survival curves, the probability of reaching age 65 increased substantially in the past. Based on period life tables of 1925, males had a 58% probability of reaching age 65. This figure increased to 85% by 2005 and is projected to reach 92% by 2075.

(Slide 19) Despite a major increase in life expectancy at birth, the maximum lifespan did not increase significantly in the last century. Few people live beyond 110 years. Based on period life tables of 1925, about 70% of females could expect to die between the ages of 24 and 84; that is 15% of females died prematurely before age 24 while 15% died after age 84. Removing the 15% of the people in a cohort at the two extremities allows a better assessment of the costs associated with financing retirement. By 2005, this range had moved forward and narrowed to an age range of 71 to 94 years. This trend is expected to continue in the future but at a much slower pace compared to the past. In 2050, it is expected that 70% of females will die between the ages of 76 and 97.

While the probability of reaching age 65 has significantly increased in the past (from 60% to 91%), it is expected to only increase marginally in the future, reaching 95% by 2075. In my view, it is much more important to look at the probability of reaching age 85 in the future to properly assess the costs of pension plans. For females, the probability is expected to increase from half to two-third in 2075.

(Slide 21) For 2007 to 2050, Canadian life expectancy at birth (with assumed future mortality improvements) is projected to grow from 84.5 to 87.4 years for males and from 87.7 to 90.2 years for females. A narrowing of the gap between male and female life expectancies has been observed over the last 25 years in Canada. The yearly increase in life expectancy in the early years of the projection reflects the significant increase observed over the last 25 years. Thereafter, there is a projected slowdown in the increase in life expectancy consistent with the low rate of improvement in mortality assumed for years 2029 and thereafter.

Based on the mortality experience by age and sex of the last 79 years (1926 to 2004), a stochastic approach was used to generate low- and high-cost scenarios over the 75 year projection period. It was projected that, on average, the life expectancy of a male age 65 in 2050 will be in the range 17.8 years to 25.1 years with 95% probability. For a female age 65 in 2050, life expectancy is projected to be in the range 18.6 years to 27.9 years. Interestingly enough, the median of the 1000 life expectancies resulting from a stochastic process used to project 1000 future mortality rate paths was lower than our best-estimate projection by more than a year at birth and slightly lower at age 65. At the next session, Ms. Danita Pattemore will talk extensively on the applicability of stochastic processes in our actuarial report.

(Slide 22) The actuarial report on the Canada Pension Plan is based on the projection of its revenues and expenditures over a long period of time. Under a set of best-estimate assumptions, the most recent actuarial report confirms that the legislated contribution rate of 9.9% is sufficient to pay future expenditures and accumulate assets of $235 billion in 2015, or 5.2 times the expenditures.

Having said that, both the length of the projection period and the number of assumptions required ensure that actual future experience will not develop precisely in accordance with the best-estimate assumptions. For the first time, in the most recent actuarial report, many of the sensitivity tests are determined based on stochastic modeling techniques that estimate the probability distribution of the outcome for each of the main assumptions.

This chart shows the evolution of the asset to expenditure ratio under three scenarios: the best-estimate assumption and the two stochastically determined scenarios based on a 95% confidence interval. The result is that the minimum contribution rate required to finance the plan over a 75-year period could fall between 9.2% and 10.2%.

(Slide 23) The results of a survey on demographic and economic assumptions used by actuaries of various social security agencies was conducted by the Quebec Pension Board and first presented at the International Conference of Social Security Actuaries and Statisticians in Helsinki, Finland in May 2007.

In 2000, male life expectancy varied between 15.5 years for Finland and 17.5 years for Japan. Most countries anticipate an improvement of between 3 and 4 years during the next thirty years. The exceptions are Japan with less than 2 years, although current life expectancy is relatively high compared to other countries, and the United Kingdom with an improvement of almost 5 years. Thus in 2030, male life expectancy is projected to be between 18 years for the United States and 21 years for Switzerland.

(Slide 24) For women, life expectancy at age 65 varied between 19 years for the United Kingdom and 22.4 years for Japan in 2000. There is a great deal of variation among the anticipated life expectancies in 2030. It can be divided into three groups: The United States with the lowest anticipated life expectancy at 20 years, the United Kingdom, Finland, Sweden and Canada in the range of 22 to 23 years and Switzerland, Japan, France and Italy with a life expectancy exceeding 24 years. In most countries, the gap between male and female life expectancy reduces by approximately one year during the next thirty years, except for Japan where female life expectancy continues to grow at a higher rate than males.

To conclude, future mortality improvements are expected to emerge more slowly and mainly at older ages since mortality rates at younger ages are already very low. In the context of the Canada Pension Plan, more and more contributors are expected to reach the retirement age of 65 and CPP retirement beneficiaries are expected to receive their benefit for a longer period. Methodologies involving stochastic time series models have been developed in both Canada and the United States in order to illustrate the evolution, as well as volatility, of mortality rates. The main advantage of a stochastic projection is that it provides a reasonable quantification of the range of uncertainty around the best estimate projection.

Thank you. I will be pleased to answer any questions you might have.