Office of the Superintendent of Financial Institutions Canada
Office of the Chief Actuary

Bureau du surintendant des institutions financières Canada
Bureau de l'actuaire en chef

ACTUARIAL REPORT 27th (REVISED)

on the

CANADA PENSION PLAN

as at 31 December 2015

Canada

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22 September 2016

The Honourable William F. Morneau, P.C., M.P.
Minister of Finance
House of Commons
Ottawa, Canada
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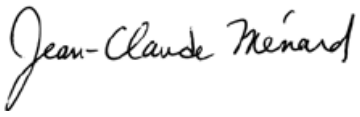
Dear Minister:

In accordance with section 115 of the *Canada Pension Plan*, which provides that an actuarial report shall be prepared every three years for purposes of the financial state review by the Minister of Finance and the ministers of the Crown from the provinces, I am pleased to submit the Twenty-Seventh Actuarial Report on the Canada Pension Plan, prepared as at 31 December 2015.

Yours sincerely,



Jean-Claude Ménard, F.S.A., F.C.I.A.
Chief Actuary

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I. Executive Summary

This is the 27th Actuarial Report since the inception of the Canada Pension Plan (CPP or the Plan) in 1966. It presents the financial state of the Plan as at 31 December 2015. The previous triennial report was the 26th Actuarial Report on the Canada Pension Plan as at 31 December 2012, which was tabled in the House of Commons on 3 December 2013. An independent panel of actuaries reviewed the 26th CPP Actuarial Report and released a report in May 2014. The Office of the Chief Actuary gave due consideration to the review panel's recommendations and action was taken accordingly.

Since the 26th CPP Actuarial Report, there have been no amendments to the *Canada Pension Plan* that have had a significant impact on the actuarial projections presented in this report.[1]

On 20 June 2016, the federal and provincial Ministers of Finance reached an agreement in principle to enhance the Canada Pension Plan. This 27th CPP Actuarial Report does not reflect the changes to the CPP resulting from the proposed enhancement. In accordance with subsection 115(2) of the *Canada Pension Plan*, once a Bill to enhance the CPP is introduced in the House of Commons, an actuarial report will be prepared that sets out the extent to which the enhancement affects the estimates contained in this 27th CPP Actuarial Report.

A. Purpose of the Report

This report has been prepared in compliance with the timing and information requirements of the *Canada Pension Plan*. Section 113.1 of the *Canada Pension Plan* provides that the Minister of Finance and ministers of the Crown from the provinces shall review the financial state of the CPP once every three years and may consequently make recommendations to change the benefits or contribution rates, or both. Section 113.1 identifies the factors the ministers consider in their review, including information to be provided by the Chief Actuary.

An important purpose of the report is to inform contributors and beneficiaries of the current and projected financial state of the Plan. The report provides information to evaluate the Plan's financial sustainability over a long period, assuming the legislation remains unchanged. Such information should facilitate a better understanding of the financial state of the Plan and the factors that influence costs, and thus contribute to an informed public discussion of issues related to the finances of the Plan.

B. Scope of the Report

Section II presents a general overview of the methodology used in preparing the actuarial estimates included in this report, which are based on the best-estimate assumptions described in section III. The results are presented in section IV and include the projections of the revenues, expenditures, and assets of the Plan over the next 75 years. Section V presents the reconciliation of the results with those presented in the 26th CPP Actuarial Report. Section VI presents a general conclusion about the financial state of the Plan, and section VII provides the actuarial opinion.

The various appendices provide supplemental information on the future financial condition of the Plan, the uncertainty of the results, including the impact that asset allocation and financial market

[1] The most recent amendments made to the *Canada Pension Plan* were according to the *Economic Action Plan 2013 Act, No. 1*, which received Royal Assent on June 26, 2013, and *An Act to amend the Canada Pension Plan and the Old Age Security Act (pension and benefits)*, which received Royal Assent on June 18, 2015. These amendments had no significant impact on the actuarial projections of the Plan.

volatility have on the financial state of the Plan as well as a sensitivity analysis of the key best-estimate assumptions based on deterministic and stochastic approaches, the Plan provisions, a detailed reconciliation of the results with the previous triennial report and a description of the data, assumptions, and methodology employed. In addition, Appendix F provides the actuarial adjustment factors for pre-65 and post-65 retirement pension take-up as calculated on the basis of this report and in accordance with subsection 115(1.11) of the *Canada Pension Plan*.

C. Main Findings

The main findings of the actuarial projections of the financial state of the Canada Pension Plan presented in this report are as follows.

- With the legislated contribution rate of 9.9%, contributions are projected to be more than sufficient to cover the expenditures over the period 2016 to 2020. Thereafter, a portion of investment income is required to make up the difference between contributions and expenditures. In 2050, it is projected that 26% of investment income will be required to pay for expenditures.
- With the legislated contribution rate of 9.9%, total assets are expected to increase significantly over the near term and then will continue increasing at a slower pace. Total assets are expected to grow from $285 billion at the end of 2015 to $476 billion by the end of 2025. The ratio of assets to the following year's expenditures is projected to remain relatively stable at a level of 6.5 over the period 2016 to the early 2030s and then grow overall thereafter to reach 7.4 in 2090.
- The minimum contribution rate to sustain the Plan is 9.79% of contributory earnings for the year 2019 and thereafter. The legislated rate of 9.9% applies to the first three years after the valuation year, that is, to the current review period of 2016-2018.
- With the minimum contribution rate of 9.79% applicable for 2019 and thereafter, the assets are expected to increase significantly but to a lower level than under the legislated contribution rate. The ratio of assets to the following year's expenditures is projected to decrease slightly from 6.5 in 2016 to 6.4 in 2028 and to be the same fifty years later in 2078.
- The average annual real rate of return on the Plan's assets over the 75-year projection period 2016 to 2090 is expected to be 3.9%.
- The number of contributors is expected to grow from 13.8 million in 2016 to 15 million by 2025. Under the legislated contribution rate of 9.9%, contributions are expected to increase from $47 billion in 2016 to $66 billion in 2025.
- The number of retirement beneficiaries is expected to increase from 5.1 million in 2016 to 10.2 million in 2050.
- The actuarial adjustment factors calculated on the basis of this report and in accordance with subsection 115(1.11) of the *Canada Pension Plan* are 0.6% per month for pre-65 retirement pension take-up and 0.7% per month for post-65 retirement pension take-up. These are the same as the current legislated factors for pre-65 and post-65 retirement pension take-up.

D. Uncertainty of Results

To measure the sensitivity of the long-term projected financial position of the Plan to future changes in the demographic and economic environments, a variety of sensitivity tests were performed. The tests and results are presented in detail in Appendix B of this report.

One of the tests performed focuses on the impact of the Plan's assets being invested in portfolios with different asset mixes than the best-estimate portfolio. The tests show that the minimum contribution rate varies between 9.4% and 11.0% depending on the proportions of fixed income securities versus equity and real asset securities of the portfolios. Those portfolios more heavily weighted toward fixed income (less risky) securities place upward pressure on the minimum contribution rate, whereas portfolios more heavily invested in equities and real assets (more risky) tend to lower the minimum contribution rate.

Sensitivity tests were also performed to measure the impact that market shocks could have on the financial sustainability of the Plan under the best-estimate portfolio and alternative investment portfolios. Investment portfolio shocks, whether positive or negative, can have an immediate and significant impact on the financial state of the Plan. The impact varies depending on the amount of risk present in the portfolio. A portfolio more heavily weighted toward equity will tend to experience larger changes in the minimum contribution rate (either positive or negative) and is more likely to experience severe portfolio shocks in market upswings and downturns. The upside of investing in a risky portfolio must be weighed against the downside risk and the probability of poor investment returns occurring. These tests show that the minimum contribution rate could vary between 9.2% and 10.3% depending on the magnitude of the investment shock and the degree of risk present in a portfolio.

Given the current economic environment and possible challenges faced in sustaining consistent economic growth, scenarios of low and high economic growth were considered as alternatives to the best-estimate scenario. The low economic growth scenario consists of assumed future lower participation rates held at their 2015 levels, lower job growth, lower real wage increases, higher unemployment, and earlier pension take-up compared to the best-estimate scenario, while the opposite is assumed for the high economic growth scenario. Under the low economic growth scenario, the minimum contribution rate would increase to 10.7%, while under the high economic growth scenario, the minimum contribution rate would decrease to 9.1%.

Key best-estimate assumptions were varied individually in order to measure the potential impact that long-term changes in those assumptions could have on the financial state of the Plan. The individual sensitivity tests show that the minimum contribution rate could deviate significantly, from 8.5% to 11.1%, compared to its best-estimate of 9.79%, if other than best-estimate assumptions were to be realized. Fertility is the most sensitive demographic assumption as it produces the widest range of the minimum contribution rate.

The last tests performed concern the aging of the population and how it may differ from the best-estimate projection. Two demographically based scenarios were developed that portray generally younger and older populations. These scenarios produced minimum contribution rates of 9.3% and 10.2%, respectively.

E. Conclusion

The results contained in this report confirm that the legislated contribution rate of 9.9% is sufficient to finance the Plan over the long term. The results also show that assets are projected to accumulate to $476 billion (i.e. 6.5 times the annual expenditures) by 2025.

The minimum contribution rate required to finance the Plan over the long term under this report is 9.79%, compared to 9.84% as determined for the 26th CPP Actuarial Report. Experience over the period 2013 to 2015 was better than anticipated overall, especially regarding benefits and investment returns. However, this is largely offset by higher projected life expectancies at age 65, lower assumed real wage increases, lower inflation expectations, and changes in investment assumptions. The net result of all changes since the 26th CPP Actuarial Report is an overall absolute decrease in the minimum contribution rate of 0.05%.

Under the 9.9% legislated contribution rate, the assets are projected to grow rapidly over the near term as contribution revenue is expected to exceed expenditures until 2020 inclusive. Assets will continue to grow thereafter until the end of the projection period, but at a slower pace, with the ratio of assets to the following year's expenditures expected to reach a level of 7.3 by 2050. Thus, despite the projected substantial increase in benefits paid as a result of an aging population, the Plan is expected to be able to meet its obligations throughout the projection period.

II. Methodology

The actuarial examination of the CPP involves projections of its revenues and expenditures over a long period of time, so that the future impact of historical and projected trends in demographic and economic factors can be properly assessed. The actuarial estimates in this report are based on the provisions of the *Canada Pension Plan* as at 31 December 2015, data regarding the starting point for the projections, and "best-estimate" assumptions regarding future demographic and economic experience.

The revenues of the Plan include both contributions and investment income. The projection of contributions begins with a projection of the working-age population. This requires assumptions regarding demographic factors such as fertility, migration, and mortality. Total contributory earnings are derived by applying labour force participation and job creation rates to the projected population and by projecting future employment earnings. This requires assumptions about various factors such as wage increases, an earnings distribution, and unemployment rates. Contributions to the Plan are obtained by applying the contribution rate to contributory earnings. Investment income is projected on the basis of the existing portfolio of assets, projected net cash flows (contributions less expenditures), and the assumptions regarding the future asset mix and rates of return on investments net of investment expenses.

Expenditures consist of the benefits paid out and operating expenses. Newly emerging benefits are projected by applying assumptions regarding retirement, disability, and death to the populations eligible for benefits, together with the benefit provisions and the earnings histories of the participants. The projection of total benefits, which includes the continuation of benefits already in pay at the valuation date, requires further assumptions. Operating expenses, excluding CPPIB operating expenses, are projected by considering the historical relationship between expenses and total employment earnings, while CPPIB operating expenses are considered in the determination of the rate of return.

The assumptions and results presented in the following sections make it possible to measure the financial state of the Plan in each projection year and to calculate the minimum contribution rate, which consists of two components. The first component is applicable to the Plan excluding the full funding provision for increased or new benefits, and is referred to as the "steady-state" contribution rate. The second component of the minimum contribution rate consists of the full funding rate for increased or new benefits.

A wide variety of factors influence both the current and projected financial position of the Plan. Accordingly, the results shown in this report differ from those shown in previous reports. Likewise, future actuarial examinations will reveal results that differ from the projections included in this report.

III. Best-Estimate Assumptions

A. Introduction

The information required by statute, which is presented in section IV of this report, requires making several assumptions regarding future demographic and economic trends. The projections included in this report cover a long period of time (75 years) and the assumptions are determined by putting more emphasis on historical long-term trends than on more recent short-term trends. These assumptions reflect the Chief Actuary's best judgment and are referred to in this report as the "best-estimate" assumptions. The assumptions were chosen to be, independently and in aggregate, reasonable and appropriate, taking into account certain interrelationships between them.

An independent panel of actuaries reviewed the 26th CPP Actuarial Report (the previous triennial report on the Plan) and released a report in May 2014. The findings of the review panel confirmed the professionalism and expertise of the staff of the Office of the Chief Actuary (OCA) in their work of projecting the financial state of the Plan. The review panel confirmed that the 26th CPP Actuarial Report was prepared in accordance with professional standards of practice and statutory requirements. The review panel found that the 26th CPP Actuarial Report was prepared using reasonable actuarial methods, and that the assumptions were, individually and in the aggregate, within the reasonable range. The review panel made a series of recommendations dealing with data, methodology, assumptions, and the communication of results.

The Government Actuary's Department of the United Kingdom selected the reviewers who were suitably qualified to carry out the review and provided the opinion that the work carried out for the review and the review report adequately addressed the issues set out in the terms of reference. For this 27th CPP Actuarial Report, the OCA gave due consideration to the review panel's recommendations and acted on them accordingly.

The Chief Actuary held a seminar in September 2015 on the long-term demographic, economic, and investment outlook for Canada to obtain opinions from a wide range of individuals with relevant expertise. Four experts in the fields of demography, economics, and investments were invited to present their views. Among the participants at the seminar were representatives from the OCA, federal departments including Employment and Social Development Canada and the Department of Finance, as well as representatives from provincial and territorial governments and other organizations. Representatives of the OCA also attended a seminar on the demographic, economic and financial outlook for 2015-2065 held by the Régie des rentes du Québec in October 2015. The various presentation materials from both seminars are available on OSFI's Web site.

Table 1 presents a summary of the most important assumptions used in this report compared with those used in the previous triennial report. The assumptions are described in more detail in Appendix E of this report.

Table 1 Best-Estimate Demographic and Economic Assumptions

Canada	27th Report (as at 31 December 2015)		26th Report (as at 31 December 2012)	
Total fertility rate	1.65 (2019+)		1.65 (2015+)	
Mortality	Canadian Human Mortality Database (CHMD 2011) with assumed future improvements		Canadian Human Mortality Database (CHMD 2009) with assumed future improvements	
Canadian life expectancy	Males	Females	Males	Females
at birth in 2016	86.7 years	89.7 years	86.3 years	89.3 years
at age 65 in 2016	21.3 years	23.7 years	21.1 years	23.5 years
Net migration rate	0.62% of population (2016+)		0.60% of population (2017+)	
Participation rate (age group 15-69)	77.5% (2035)		76.8% (2030)	
Employment rate (age group 15-69)	72.6% (2035)		72.1% (2030)	
Unemployment rate	6.2% (2025+)		6.0% (2023+)	
Rate of increase in prices	2.0% (2017+)		2.2% (2021+)	
Real wage increase	1.1% (2025+)		1.2% (2020+)	
Real rate of return	3.9% 75-year average		3.9% 75-year average	
Retirement rates for cohort at age 60	Males	34% (2016+)	Males	34% (2016+)
	Females	38% (2016+)	Females	38% (2016+)
CPP disability incidence rates (per 1,000 eligible)	Males	3.10 (2020+)	Males	3.32 (2017+)(1)
	Females	3.65 (2020+)	Females	3.77 (2017+)(1)

(1) The ultimate disability incidence rates assumption of the 26th CPP Actuarial Report has been adjusted based on the 2015 eligible population in order to compare with the assumption for this 27th CPP Actuarial Report on the same basis.

B. Demographic Assumptions

The population projections start with the Canada and Québec populations on 1 July 2015, to which are applied fertility, migration, and mortality assumptions. The relevant population for the Canada Pension Plan is the population of Canada less that of Québec and is obtained by subtracting the projected results for Québec from those for Canada. The population projections are essential in determining the future number of CPP contributors and beneficiaries.

1. Fertility

The first cause of the aging of the Canadian population is the large drop in the total fertility rate that occurred between the end of the baby boom period (mid-1940s to mid-1960s) and latter half of the 1980s. The total fertility rate in Canada has dropped rapidly from a level of about 4.0 children per woman in the late 1950s to 1.6 by the mid-1980s. The total fertility rate rose slightly in the early 1990s, but then generally declined to a level of 1.5 by the late 1990s. Canada is one of many industrialized countries that saw their fertility rates increase starting in the 2000s. By 2008, the total fertility rate for Canada reached 1.68. However, in some industrialized countries, including Canada, the total fertility rate has decreased since 2008, which could be attributable to the economic downturn experienced in recent years. As of 2011, the total fertility rate for Canada stood at 1.61.

Similar to Canada, the total fertility rate in Québec fell from a high of about 4.0 children per woman in the 1950s; however, the Québec rate fell to a greater degree, reaching 1.4 by the mid-1980s. The Québec rate then recovered somewhat in the early 1990s to over 1.6 and subsequently declined to below 1.5 by the late 1990s. There was a significant increase in the Québec rate in the

2000s, with the rate reaching 1.74 in 2008. However, similar to Canada's fertility rate, the fertility rate for Québec has been decreasing in recent years and stood at 1.62 in 2014.

The overall decrease in the total fertility rate since the 1950s occurred as a result of changes in a variety of social, medical, and economic factors. Although there have been periods of growth in the total fertility rates in recent decades, it is unlikely that the rates will return to historical levels in the absence of significant societal changes.

The assumed age-specific fertility rates of cohorts leads to an assumed total fertility rate for Canada that will increase from its 2011 level of 1.61 children per woman to an ultimate level of 1.65 in 2019. The assumed cohort rates for Québec lead to a total fertility rate for the province that will increase from its 2014 level of 1.62 to an ultimate level of 1.68 in 2019.

2. Mortality

Another element that has contributed to the aging of the population is the significant reduction in age-specific mortality rates. This can be best measured by the increase in life expectancy at age 65, which directly affects how long retirement benefits will be paid to beneficiaries. Male life expectancy without future mortality improvements (i.e. reductions in mortality) at age 65 increased by 39% between 1966 and 2011, rising from 13.6 to 18.9 years. For women, life expectancy at age 65 without future improvements increased by 29%, from 16.9 to 21.8 years over the same period. Although the overall gains in life expectancy at age 65 since 1966 are similar for males and females (about 5 years), about 60% of the increase occurred after 1991 for males, while for females, about 60% of the increase occurred by 1991.

Mortality improvements are expected to continue in the future but at a slower pace than most recently observed over the 15-year period ending in 2011. Further, it is assumed that, ultimately, mortality improvement rates for males will decrease to the same level as females. The analysis of the Canadian experience over the period 1921 to 2011, including the recent slowdown trends observed in mortality improvement rates for Old Age Security (OAS) beneficiaries, was combined with an analysis of the possible drivers of future mortality improvements. The 15-year average mortality improvement rates by age and sex for the period ending in 2011 are the starting point for the projected annual mortality improvement rates from 2012 onward. For ages 65 and over, the annual mortality improvement rates for 2012 to 2014 were estimated using the trends derived from the administrative data on OAS beneficiaries, representing 98% of the general population. For 2012 onward (2015 onward for ages 65 and over), the rates are assumed to gradually reduce to their ultimate levels in 2032. Considering future mortality improvements, life expectancy at age 65 in 2016 is 21.3 years for males, and 23.7 years for females. This represents an increase of 0.2 of a year in life expectancies at age 65 in 2016 for both males and females, relative to the 26th CPP Actuarial Report projections.

To project CPP benefits, the mortality rates for CPP retirement, survivor, and disability beneficiaries reflect actual experience for those segments of the population. Specific mortality experience for CPP beneficiaries is discussed further in Appendix E of this report.

3. Net Migration

Net migration (i.e. the excess of immigration over emigration) is unlikely to materially reduce the continued aging of the population unless (1) the level of immigration rises significantly above what has been observed historically and (2) the average age at immigration falls dramatically.

The net migration rate is assumed to increase from its current (2015) level of 0.55% of the population to an ultimate level of 0.62% of the population in year 2016 and to remain at that level thereafter. The ultimate rate of 0.62% corresponds to the average experience observed over the last 10 years. For the Québec population, the net migration rate averages 0.43% over the projection period.

4. Population Projections

Table 2 shows the population for three age groups (0-19, 20-64 and 65 and over) throughout the projection period. The ratio of the number of people aged 20-64 to those aged 65 and over is a measure that approximates the ratio of the number of working-age people to retirees. Because of the aging population, this ratio drops from 3.8 in 2016 to about half its value or 2.0 in 2075.

Table 2 Population of Canada less Québec
(thousands)

Year	Total	Age 0-19	Age 20-64	Age 65 and Over	Ratio of 20-64 to 65 and Over
2016	27,891	6,123	17,275	4,493	3.8
2017	28,202	6,143	17,398	4,660	3.7
2018	28,516	6,182	17,497	4,837	3.6
2019	28,833	6,235	17,572	5,026	3.5
2020	29,152	6,295	17,631	5,226	3.4
2021	29,471	6,366	17,678	5,427	3.3
2022	29,789	6,442	17,715	5,633	3.1
2025	30,732	6,657	17,803	6,272	2.8
2030	32,216	6,908	17,996	7,313	2.5
2035	33,545	7,090	18,481	7,973	2.3
2040	34,739	7,157	19,143	8,439	2.3
2050	36,935	7,371	20,300	9,264	2.2
2075	42,741	8,488	22,824	11,428	2.0

C. Economic Assumptions

The main economic assumptions for the Canada Pension Plan are: labour force participation rates, job creation rates, unemployment rates, and real increases in average employment earnings. For benefit and asset projections, two additional assumptions are required: the rate of increase in prices and real rates of return on invested assets.

One of the key elements underlying the best-estimate economic assumptions relates to the continued trend toward longer working lives. Older workers are expected to exit the workforce at a later age, which could alleviate the impact of the aging of the population on future labour force growth. However, despite the expected later exit ages, labour force growth is projected to weaken as the working-age population expands at a slower pace and baby boomers exit the labour force. As a result, labour shortages together with projected improvements in productivity growth are assumed to create upward pressure on real wages.

1. Labour Force

Employment levels vary with the rate of unemployment, and reflect trends in increased workforce participation by women, longer periods of formal education among young adults, as well as changing retirement patterns of older workers.

As the population ages, older age groups with lower labour force participation increase in size. As a result, the labour force participation rate for Canadians aged 15 and over is expected to decline from 65.8% in 2016 to 62.8% in 2035. A more useful measure of the working-age population is the participation rate of those aged 15 to 69, which is expected to increase from 74.3% in 2016 to 77.5% in 2035.

The increase in the participation rate for those aged 15 to 69 is mainly due to an assumed increase in participation rates for those aged 55 and over as a result of an expected continued trend toward longer working lives. Furthermore, labour shortages are expected to create attractive employment opportunities that will exert upward pressure on the participation rates for all age groups. It is also expected that future participation rates will increase with the aging of cohorts that have a stronger labour force attachment compared to previous cohorts due to higher education attainment. The cohort effect of stronger labour force attachment of women is expected to continue but at a much slower pace than in the past, resulting in a gradual narrowing of the gap between the age-specific participation rates of men and women.

As a result, the participation rates for females are projected to increase slightly more than for males. Overall, the male participation rate of those aged 15 to 69 is expected to increase from 78.4% in 2016 to 80.9% in 2035, while the female participation rate for the same age group is expected to increase from 70.2% in 2016 to 74.2% in 2035. Thereafter, the 2035 gap of 6.7% between males and females in this age group is expected to decrease to 6.6%.

The job creation rate (i.e. the change in the number of persons employed) in Canada was on average 1.6% from 1976 to 2015 based on available employment data, and it is assumed that the rate will be 0.6% in 2016. The job creation rate assumption is determined on the basis of expected moderate economic growth and an unemployment rate that is expected to increase from 6.9% in 2015 to 7.1% in 2016 before gradually decreasing to an ultimate level of 6.2% by 2025. The assumed job creation rate is on average about 0.8% from 2016 to 2020 and 0.7% from 2020 to 2025, which is slightly higher than the labour force growth rate. It is assumed that, starting in

2025, the job creation rate will follow the labour force growth rate, with both averaging 0.7% per year between 2025 and 2035, and 0.5% per year thereafter. The aging of the population is the main reason behind the expected slower long-term growth in the labour force and job creation rate.

2. Price Increases

Price increases, as measured by changes in the Consumer Price Index (CPI), tend to fluctuate from year to year. In 2011, the Bank of Canada and the Government renewed their commitment to keep inflation between 1% and 3% until the end of 2016. It is expected that this commitment will be renewed. In Canada, inflation was moderate at 1.1% in 2015. To reflect recent experience and the short-term expectation that inflation will remain subdued in coming quarters, the price increase assumption is set at 1.6% in 2016. Thereafter, the price increase assumption is set at 2.0%.

3. Real Wage Increases

Wage increases affect the financial balance of the Canada Pension Plan in two ways. In the short term, an increase in the average wage translates into higher contribution income, with little immediate impact on benefits. Over the long term, higher average wages produce higher benefits.

Increases in the nominal wage comprise increases in the real wage and increases in the level of prices ("inflation"). Put another way, the difference between nominal wage increases and inflation represents increases in the real wage, which is also referred to in this report as the "real wage increase". This increase affects the long-term projected financial state of the Plan.

There are five main factors that influence increases in the real wage, namely general productivity, the extent to which changes in productivity are shared between labour and capital, changes in the compensation structure offered to employees, changes in the average number of hours worked, and changes in labour's terms of trade. Labour's terms of trade measure how shifts in the prices of goods produced by workers (measured by the Gross Domestic Product (GDP) deflator) compare to shifts in the prices of goods consumed by workers (CPI).

Based on the experience of the first six months of 2016, the real increases in average annual earnings and average weekly earnings are assumed to be 0.2% and -0.5%, respectively for 2016. Thereafter, average annual and weekly earnings are assumed to increase at the same pace, with real wage increases projected to gradually rise to an ultimate value of 1.1% by 2025. The ultimate real wage increase assumption is developed taking into account the relationships described above, historical trends, and an assumed labour shortage. The ultimate real wage increase assumption combined with the ultimate price increase assumption results in an assumed annual increase in average nominal wages of 3.1% in 2025 and thereafter.

The assumptions regarding the increase in average real annual employment earnings and job creation rates result in projected average annual real increases in total Canadian employment earnings of about 1.7% for the period 2016 to 2035. After 2035, this decreases to about 1.6% on average over the remainder of the projection period, reflecting the assumed 1.1% real increase in annual wages and projected average 0.5% annual growth in the working-age population.

Given historical trends and the long-term relationship between increases in the average real annual employment earnings and the Year's Maximum Pensionable Earnings (YMPE), it is

assumed that the real wage increase assumption is also applicable to the increases in the YMPE from one year to the next.

4. Real Rates of Return on Investments

Real rates of return are the excess of the nominal rates of return over price increases and are required for the projection of revenue arising from investment income. A real rate of return is assumed for each year in the projection period and for each of the main asset categories in which CPP assets are invested. The assumed long-term real rate of return on CPP assets takes into account the assumed asset mix of investments as well as the assumed real rates of return for all categories of CPP assets. The real rates of return on investments are net of all investment expenses, including CPPIB operating expenses. The 75-year average real rate of return is assumed to be 3.9%.

For the period 2016 to 2024, the annual real rates of return are lower than the assumed ultimate real rate of return of 4.0% in 2025 due to lower expected bond returns during the period. Equity returns are assumed to be stable throughout the projection period, and an ultimate equity risk premium of 2.1% is assumed to be reached in 2025. The 3.9% 75-year average real rate of return on CPP assets is comparable to the average over the last 50 years of historical real rates of return for large pension plans.

Table 3 summarizes the main economic assumptions over the projection period.

Table 3 Economic Assumptions

				Labour Force (Canada)				
Year	Real Increase Average Annual Earnings	Real Increase Average Weekly Earnings (YMPE)	Price Increase	Participation Rate (Ages 15+)	Job Creation Rate	Unemployment Rate	Labour Force Annual Increase	Real Rates of Return on Investments
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
2016	0.2	-0.5	1.6	65.8	0.6	7.1	0.8	0.4
2017	0.6	0.6	2.0	65.6	1.0	6.9	0.7	3.0
2018	0.7	0.7	2.0	65.5	0.8	6.8	0.7	2.9
2019	0.8	0.8	2.0	65.3	0.8	6.7	0.7	3.1
2020	0.9	0.9	2.0	65.1	0.7	6.6	0.6	3.4
2021	1.0	1.0	2.0	64.9	0.7	6.5	0.6	3.5
2022	1.0	1.0	2.0	64.7	0.7	6.5	0.7	3.5
2023	1.1	1.1	2.0	64.5	0.7	6.4	0.6	3.6
2024	1.1	1.1	2.0	64.3	0.7	6.3	0.6	3.8
2025	1.1	1.1	2.0	64.0	0.7	6.2	0.6	4.0
2030	1.1	1.1	2.0	63.1	0.6	6.2	0.6	4.0
2035	1.1	1.1	2.0	62.8	0.8	6.2	0.8	4.0
2040	1.1	1.1	2.0	62.4	0.6	6.2	0.6	4.0
2050	1.1	1.1	2.0	61.8	0.3	6.2	0.3	4.0
2075	1.1	1.1	2.0	60.7	0.5	6.2	0.5	4.0

D. Other Assumptions

This report is based on several other key assumptions, such as retirement rates and disability incidence rates.

1. Retirement Rates

The retirement rates are determined on a cohort basis. The sex-distinct retirement rate for any given age and year from age 60 and above corresponds to the number of emerging (new) retirement beneficiaries divided by the product of the population and the retirement benefit eligibility rate for the given sex, age, and year. The unreduced pension age under the Canada Pension Plan is 65. However, since 1987 a person can choose to receive a reduced retirement pension as early as age 60. This provision has had the effect of lowering the average age at pension take-up. In 1986, the average age at pension take-up was 65.2, compared to about 62.4 over the decade ending in 2015.

In 2012, there was a significant increase observed in the retirement rates at age 60 for the cohort reaching age 60 that year. The retirement rates at age 60 in 2012 were 42% and 44% for males and females, respectively, compared to the corresponding rates of 32% and 35% in 2011. The observed increase in the retirement rates at age 60 in 2012 may have resulted from two provisions of the *Economic Recovery Act (stimulus)*. First, the work cessation test to receive the pension early (prior to age 65) was removed in 2012. As such, starting in 2012, individuals may receive a CPP retirement pension without having to stop working or materially reduce their earnings. The removal of the work cessation test may have thus led at least in part to the observed increase in retirement rates at age 60 in 2012. Second, greater reductions in early retirement pensions were scheduled to be phased in over a five-year period, starting in 2012. The anticipation of greater adjustments may have also contributed toward the observed increase in retirement rates at age 60 in 2012.

After 2012, the age 60 retirement rates gradually decreased to their pre-2012 levels as the higher actuarial adjustments were phased in and the effect of the removal of the work cessation test diminished. For cohorts reaching age 60 in 2016 and thereafter, the retirement rates are assumed to be 34% for males and 38% for females and 42% and 39% at age 65 in 2021 and thereafter, for males and females, respectively. These rates result in a projected average age at take-up of 62.9 in 2030.

2. Disability Incidence Rates

The sex-distinct disability incidence rate at any given age is the number of new disability beneficiaries divided by the total number of people eligible for the disability benefit. Based on the average experience over the period from 2004 to 2015, the ultimate overall incidence rates for the year 2020 and thereafter are assumed to be 3.10 per thousand eligible for males and 3.65 per thousand eligible for females. Between 2015 and 2020, the rates are assumed to gradually change from their 2015 levels (2.95 for males, 3.71 for females) to the ultimate assumptions.

The assumptions recognize that although current disability incidence rates are significantly below the levels experienced from the mid-1970s (for males) and early 1980s (for females) to the early-1990s for both sexes, incidence rates for both sexes have been relatively stable since 1997 as a result of administrative changes made to the disability program.

IV. Results

A. Overview

The key observations and findings of the actuarial projections of the financial state of the Canada Pension Plan presented in this report are as follows.

- With the legislated contribution rate of 9.9%, contributions are projected to be more than sufficient to cover the expenditures over the period 2016 to 2020. Thereafter, a portion of investment income is required to make up the difference between contributions and expenditures. In 2050, it is projected that 26% of investment income will be required to pay for expenditures.
- With the legislated contribution rate of 9.9%, total assets are expected to increase significantly over the near term and then will continue increasing at a slower pace. Total assets are expected to grow from $285 billion at the end of 2015 to $476 billion by the end of 2025. The ratio of assets to the following year's expenditures is projected to remain relatively stable at a level of 6.5 over the period 2016 to the early 2030s and then grow overall thereafter to reach 7.4 in 2090.
- With the legislated contribution rate of 9.9%, investment income, which represents 11% of revenues (i.e. contributions and investment income) in 2016, is projected to represent 30% of revenues in 2025. In 2050, investment income is projected to represent 33% of revenues. This clearly illustrates the importance of investment income as a source of revenues for the Plan.
- The minimum contribution rate to sustain the Plan is 9.79% of contributory earnings for the year 2019 and thereafter. The legislated rate of 9.9% applies to the first three years after the valuation year, that is, to the current review period of 2016-2018.
- With the minimum contribution rate of 9.79% applicable for 2019 and thereafter, the assets are expected to increase significantly but to a lower level than under the legislated contribution rate. Under the minimum contribution rate, the ratio of assets to the following year's expenditures is projected to decrease slightly from 6.5 in 2016 to 6.4 in 2028 and to be the same fifty years later in 2078.
- Although the pay-as-you-go rate is expected to increase steadily from 9.1% in 2016 to 12.1% by the end of the projection period due to the retirement of the baby boom generation and the continued aging of the population, the legislated contribution rate of 9.9% is sufficient to finance the Plan over the long term. The pay-as-you-go rate is the contribution rate that would need to be paid if there were no assets.
- Demographic changes will have a major impact on the ratio of workers to retirees; the ratio of the number of individuals in Canada less Québec aged 20 to 64 to those aged 65 and over is expected to fall from about 3.8 in 2016 to 2.2 in 2050.
- The number of contributors is expected to grow from 13.8 million in 2016 to 15 million by 2025. Under the legislated contribution rate of 9.9%, contributions are expected to increase from $47 billion in 2016 to $66 billion in 2025.

- The number of retirement beneficiaries is expected to increase from 5.1 million in 2016 to 10.2 million in 2050.
- There continues to be more female than male retirement beneficiaries, and by 2050 there is expected to be approximately 800,000 (or 17.0%) more female than male retirement beneficiaries.
- The proportion of retirement benefits relative to total expenditures is expected to increase from 77% in 2016 to 84% in 2050.
- Total expenditures are expected to grow rapidly from approximately $43 billion in 2016 to $70 billion in 2025.
- The average annual real rate of return on the Plan's assets over the 75-year projection period 2016 to 2090 is expected to be 3.9%.
- The actuarial adjustment factors calculated on the basis of this report and in accordance with subsection 115(1.11) of the *Canada Pension Plan* are 0.6% per month for pre-65 retirement pension take-up and 0.7% per month for post-65 retirement pension take-up. These are the same as the current legislated factors for pre-65 and post-65 retirement pension take-up.

B. Contributions

Projected contributions are the product of the contribution rate, the number of contributors, and the average contributory earnings. The contribution rate is set by law and is 9.9%.

The number of contributors by age and sex is directly linked to the assumed labour force participation rates applied to the projected working-age population and the job creation rates. Hence, the demographic and economic assumptions have a great influence on the expected level of contributions. In this report, the number of CPP contributors is expected to increase continuously throughout the projection period, but at a decreasing pace, from 13.8 million in 2016 to 15 million by 2025. The future increase in the number of contributors is limited due to the projected lower growth in the working-age population and labour force.

The growth in contributory earnings, which are derived by subtracting the Year's Basic Exemption (YBE) from pensionable earnings (up to the YMPE), is linked to the growth in average employment earnings through the assumption regarding annual increases in wages and is affected by the freeze on the YBE since 1998.

Contributions are expected to be $46.5 billion in 2016 as shown in Table 4, which presents the projected components of contributions. The projected YMPE is also shown, which is assumed to increase according to the real wage increase assumption. The YMPE is projected to increase from $54,900 in 2016 to $149,700 in 2050.

Since the legislated contribution rate is constant at 9.9% for the year 2016 and thereafter, contributions increase at the same rate as total contributory earnings over the projection period. Table 4 presents the projected number of CPP contributors, including CPP retirement beneficiaries who are working (i.e. "working beneficiaries"), their contributory earnings and contributions.

Table 4 Contributions

Year	Contribution Rate	YMPE	Number of Contributors	Contributory Earnings	Contributions
	(%)	($)	(thousands)	($ million)	($ million)
2016	9.9	54,900	13,784	469,849	46,515
2017	9.9	55,500	13,961	485,068	48,022
2018	9.9	56,900	14,117	504,277	49,923
2019	9.9	58,500	14,266	524,960	51,971
2020	9.9	60,100	14,391	545,491	54,004
2021	9.9	61,900	14,509	567,494	56,182
2022	9.9	63,700	14,628	590,033	58,413
2025	9.9	69,700	14,980	664,010	65,737
2030	9.9	81,300	15,469	803,264	79,523
2035	9.9	94,700	16,129	978,913	96,912
2040	9.9	110,300	16,757	1,187,616	117,574
2050	9.9	149,700	17,814	1,722,602	170,538
2075	9.9	321,100	20,296	4,241,948	419,953

C. Expenditures

The projected number of beneficiaries by type of benefit is given in Table 5, while

Table 6 presents information for male and female beneficiaries separately.

The number of retirement, disability, and survivor beneficiaries increases throughout the projection period. In particular, the number of retirement beneficiaries is expected to double by the year 2050 due to the aging of the population. Female retirement beneficiaries continue to outnumber their male counterparts, and by 2050 there is projected to be 800,000 or 17% more female than male beneficiaries. Over the same period, the number of disability and survivor beneficiaries is projected to increase but at a much slower pace than for retirement beneficiaries.

Table 7 shows the amount of projected expenditures by type. Projected expenditures in 2016 are $42.9 billion and reach $69.9 billion in 2025. Table 8 shows the same information but in millions of 2016 constant dollars.

Table 9 shows the projected expenditures by type expressed as a percentage of contributory earnings. These are referred to as the pay-as-you-go (or “paygo”) rates. A pay-as-you-go rate corresponds to the contribution rate that would need to be paid if there were no assets. Although the total pay-as-you-go rate is expected to increase significantly from its current level of 9.1% in 2016 to 12.1% by the end of the projection period, the legislated contribution rate of 9.9% is sufficient to finance the Plan over the projection period.

Table 5 Beneficiaries[1]
(thousands)

Year	Retirement[2],[3]	Disability[4]	Survivor[3],[4]	Children	Death[5]
2016	5,073	394	1,246	216	142
2017	5,270	400	1,265	219	146
2018	5,492	404	1,285	222	150
2019	5,722	408	1,306	226	154
2020	5,965	412	1,327	231	158
2021	6,201	415	1,349	234	163
2022	6,437	417	1,371	237	167
2025	7,138	419	1,443	251	183
2030	8,104	416	1,579	276	214
2035	8,766	438	1,729	302	250
2040	9,264	470	1,874	320	285
2050	10,247	524	2,076	325	335
2075	12,579	596	2,273	357	388

(1) Numbers of beneficiaries by sex in Table 6 may not sum to total numbers of beneficiaries shown in Table 5 due to rounding.
(2) The number given for retirement beneficiaries does not take into account that the retirement pension can be shared between spouses.
(3) A beneficiary who receives concurrently a retirement and a survivor's benefit is counted in each category.
(4) A beneficiary who receives concurrently a disability and survivor's benefit is counted in each category.
(5) This is the number of deceased contributors entitled to a death benefit during the given year.

Table 6 Beneficiaries by Sex[1]
(thousands)

	Males				Females			
Year	Retirement[2],[3]	Disability[4]	Survivor[3],[4]	Death[5]	Retirement[2],[3]	Disability[4]	Survivor[3],[4]	Death[5]
2016	2,463	181	237	85	2,610	214	1,008	57
2017	2,551	182	245	87	2,719	217	1,020	59
2018	2,652	184	254	89	2,840	220	1,031	61
2019	2,758	186	262	91	2,964	222	1,044	63
2020	2,870	188	271	93	3,094	224	1,056	65
2021	2,980	189	279	95	3,221	226	1,070	68
2022	3,089	190	287	97	3,347	227	1,084	70
2025	3,415	190	313	105	3,723	229	1,130	78
2030	3,853	187	355	120	4,251	229	1,224	94
2035	4,129	195	392	138	4,636	242	1,337	112
2040	4,323	209	422	154	4,941	261	1,453	131
2050	4,725	234	453	173	5,522	290	1,623	161
2075	5,826	265	491	197	6,753	331	1,782	191

(1) Numbers of beneficiaries by sex in Table 6 may not sum to total numbers of beneficiaries shown in Table 5 due to rounding.
(2) The number given for retirement beneficiaries does not take into account that the retirement pension can be shared between spouses.
(3) A beneficiary who receives concurrently a retirement and a survivor's benefit is counted in each category.
(4) A beneficiary who receives concurrently a disability and survivor's benefit is counted in each category.
(5) This is the number of deceased contributors entitled to a death benefit during the given year.

Table 7 Expenditures
($ million)

Year	Retirement[1]	Disability	Survivor	Children	Death	Operating Expenses[2]	Total
2016	32,950	4,058	4,433	496	329	612	42,877
2017	34,950	4,181	4,513	510	340	635	45,129
2018	37,207	4,315	4,613	528	351	659	47,673
2019	39,697	4,447	4,718	548	363	684	50,457
2020	42,362	4,571	4,827	571	376	709	53,416
2021	45,137	4,701	4,940	591	388	736	56,493
2022	47,986	4,820	5,060	613	401	764	59,644
2023	50,955	4,939	5,190	636	415	793	62,927
2024	54,035	5,060	5,331	661	430	823	66,340
2025	57,201	5,179	5,485	687	445	854	69,851
2026	60,425	5,295	5,652	714	461	885	73,432
2027	63,668	5,416	5,834	742	478	917	77,055
2028	66,949	5,536	6,031	772	496	951	80,735
2029	70,284	5,667	6,246	804	515	986	84,501
2030	73,638	5,819	6,480	838	534	1,022	88,331
2031	76,986	6,008	6,733	872	551	1,059	92,210
2032	80,306	6,225	7,005	906	569	1,099	96,111
2033	83,630	6,461	7,295	941	587	1,141	100,054
2034	87,012	6,710	7,604	977	605	1,184	104,093
2035	90,477	6,974	7,932	1,013	624	1,229	108,249
2036	94,044	7,243	8,278	1,048	641	1,275	112,528
2037	97,680	7,540	8,639	1,081	659	1,323	116,923
2038	101,379	7,861	9,016	1,114	677	1,374	121,421
2039	105,181	8,206	9,409	1,148	694	1,426	126,064
2040	109,139	8,558	9,817	1,180	711	1,480	130,885
2041	113,277	8,922	10,238	1,211	727	1,536	135,911
2042	117,589	9,299	10,670	1,241	742	1,594	141,134
2043	122,097	9,686	11,113	1,269	757	1,654	146,576
2044	126,833	10,080	11,567	1,298	771	1,716	152,264
2045	131,822	10,477	12,031	1,326	784	1,779	158,220
2050	161,100	12,463	14,450	1,460	836	2,124	192,433
2055	198,874	14,439	16,968	1,611	865	2,520	235,278
2060	244,892	16,400	19,673	1,805	877	2,987	286,634
2065	296,868	19,146	22,886	2,053	892	3,556	345,401
2070	357,536	22,996	27,013	2,334	924	4,265	415,068
2075	431,203	27,474	32,267	2,631	970	5,124	499,669
2080	520,919	32,752	38,548	2,944	1,015	6,139	602,316
2085	631,524	38,513	45,656	3,285	1,046	7,336	727,360
2090	766,198	44,896	53,464	3,682	1,058	8,748	878,046

(1) Retirement expenditures include expenditures related to post-retirement benefits for working beneficiaries.
(2) Plan operating expenses exclude CPPIB operating expenses, which are accounted for separately in the investment expenses assumption.

Table 8 Expenditures (millions of 2016 constant dollars)[1]

Year	Retirement[2]	Disability	Survivor	Children	Death	Operating Expenses[3]	Total
2016	32,950	4,058	4,433	496	329	612	42,877
2017	34,408	4,116	4,444	502	335	625	44,430
2018	35,935	4,167	4,455	510	339	636	46,044
2019	37,588	4,211	4,467	519	344	648	47,777
2020	39,325	4,243	4,480	531	349	658	49,587
2021	41,080	4,279	4,495	538	353	670	51,415
2022	42,817	4,302	4,515	546	358	682	53,219
2023	44,574	4,321	4,540	556	363	694	55,047
2024	46,342	4,340	4,572	567	369	706	56,895
2025	48,095	4,355	4,611	578	374	718	58,731
2026	49,810	4,365	4,659	589	380	730	60,531
2027	51,454	4,377	4,715	600	386	741	62,273
2028	53,044	4,386	4,778	612	393	753	63,967
2029	54,595	4,403	4,852	625	400	766	65,638
2030	56,079	4,431	4,935	638	407	778	67,268
2031	57,479	4,485	5,028	651	411	791	68,845
2032	58,782	4,557	5,127	663	416	804	70,351
2033	60,015	4,637	5,235	675	421	819	71,801
2034	61,217	4,721	5,350	687	426	833	73,235
2035	62,407	4,810	5,471	699	430	848	74,665
2036	63,595	4,897	5,597	709	433	862	76,095
2037	64,759	4,999	5,727	717	437	877	77,516
2038	65,893	5,109	5,860	724	440	893	78,920
2039	67,024	5,229	5,996	732	442	909	80,331
2040	68,183	5,346	6,133	738	444	925	81,768
2041	69,380	5,465	6,271	742	445	941	83,243
2042	70,609	5,584	6,407	745	446	957	84,747
2043	71,878	5,702	6,542	747	446	974	86,289
2044	73,202	5,818	6,676	749	445	990	87,880
2045	74,590	5,928	6,808	750	444	1,007	89,527
2050	82,563	6,387	7,406	748	428	1,089	98,621
2055	92,314	6,703	7,876	748	402	1,170	109,212
2060	102,959	6,895	8,271	759	369	1,256	120,509
2065	113,045	7,291	8,715	782	340	1,354	131,526
2070	123,313	7,931	9,317	805	319	1,471	143,155
2075	134,701	8,582	10,080	822	303	1,601	156,088
2080	147,386	9,266	10,907	833	287	1,737	170,416
2085	161,836	9,869	11,700	842	268	1,880	186,395
2090	177,839	10,421	12,409	855	246	2,030	203,799

(1) For a given year, the value in 2016 constant dollars is equal to the corresponding value in current dollars divided by the cumulative index of the indexation rates for benefits provided as of 2016 in the projections.
(2) Retirement expenditures include expenditures related to post-retirement benefits for working beneficiaries.
(3) Plan operating expenses exclude CPPIB operating expenses, which are accounted for separately in the investment expenses assumption.

Table 9 Expenditures as Percentage of Contributory Earnings

(pay-as-you-go rates)

Year	Retirement[1]	Disability	Survivor	Children	Death	Operating Expenses[2]	Total
	(%)	(%)	(%)	(%)	(%)	(%)	(%)
2016	7.01	0.86	0.94	0.11	0.07	0.13	9.13
2017	7.21	0.86	0.93	0.11	0.07	0.13	9.30
2018	7.38	0.86	0.91	0.10	0.07	0.13	9.45
2019	7.56	0.85	0.90	0.10	0.07	0.13	9.61
2020	7.77	0.84	0.88	0.10	0.07	0.13	9.79
2021	7.95	0.83	0.87	0.10	0.07	0.13	9.95
2022	8.13	0.82	0.86	0.10	0.07	0.13	10.11
2023	8.30	0.80	0.85	0.10	0.07	0.13	10.25
2024	8.46	0.79	0.83	0.10	0.07	0.13	10.38
2025	8.61	0.78	0.83	0.10	0.07	0.13	10.52
2026	8.76	0.77	0.82	0.10	0.07	0.13	10.65
2027	8.89	0.76	0.81	0.10	0.07	0.13	10.76
2028	9.00	0.74	0.81	0.10	0.07	0.13	10.85
2029	9.09	0.73	0.81	0.10	0.07	0.13	10.93
2030	9.17	0.72	0.81	0.10	0.07	0.13	11.00
2031	9.22	0.72	0.81	0.10	0.07	0.13	11.04
2032	9.25	0.72	0.81	0.10	0.07	0.13	11.07
2033	9.25	0.71	0.81	0.10	0.06	0.13	11.07
2034	9.25	0.71	0.81	0.10	0.06	0.13	11.07
2035	9.24	0.71	0.81	0.10	0.06	0.13	11.06
2036	9.25	0.71	0.81	0.10	0.06	0.13	11.07
2037	9.24	0.71	0.82	0.10	0.06	0.13	11.06
2038	9.23	0.72	0.82	0.10	0.06	0.13	11.05
2039	9.20	0.72	0.82	0.10	0.06	0.12	11.03
2040	9.19	0.72	0.83	0.10	0.06	0.12	11.02
2041	9.18	0.72	0.83	0.10	0.06	0.12	11.01
2042	9.17	0.73	0.83	0.10	0.06	0.12	11.01
2043	9.16	0.73	0.83	0.10	0.06	0.12	11.00
2044	9.17	0.73	0.84	0.09	0.06	0.12	11.01
2045	9.18	0.73	0.84	0.09	0.05	0.12	11.01
2050	9.35	0.72	0.84	0.08	0.05	0.12	11.17
2055	9.69	0.70	0.83	0.08	0.04	0.12	11.46
2060	10.03	0.67	0.81	0.07	0.04	0.12	11.74
2065	10.14	0.65	0.78	0.07	0.03	0.12	11.80
2070	10.14	0.65	0.77	0.07	0.03	0.12	11.78
2075	10.17	0.65	0.76	0.06	0.02	0.12	11.78
2080	10.23	0.64	0.76	0.06	0.02	0.12	11.83
2085	10.37	0.63	0.75	0.05	0.02	0.12	11.94
2090	10.53	0.62	0.73	0.05	0.01	0.12	12.07

(1) Retirement expenditures include expenditures related to post-retirement benefits for working beneficiaries.
(2) Plan operating expenses exclude CPPIB operating expenses, which are accounted for separately in the investment expenses assumption.

D. Financial Projections with Legislated Contribution Rate

1. Asset Projections at Market Value

Prior to 2001, CPP assets were valued at cost because they were traditionally limited to short-term investments and 20-year non-marketable bonds in the form of loans to provinces. With the creation of the CPPIB in 1997, excess cash flows are invested in the capital markets as of 1999. Those assets, as is usually the case for private pension plans, are valued at market. The market value of assets is $285,358 million as at 31 December 2015.

2. Projected Financial State

Table 10 presents historical results while Table 11 and Table 12 present the projected financial state of the CPP using the legislated contribution rate of 9.9% in current dollars and in 2016 constant dollars, respectively. The projected financial state of the CPP using the minimum contribution rate of 9.79% for the year 2019 and thereafter is discussed in section E.

Table 10 Historical Results

Year	PayGo Rate[1]	Contribution Rate	Contributions	Expenditures	Net Cash Flow	Investment Income	Assets at 31 Dec.[2]	Yield/ Return	Asset/ Expenditure Ratio
	(%)	(%)	($ million)	($ million)	($ million)	($ million)	($ million)	(%)	
1966	0.05	3.60	531	8	523	2	525	0.7	52.50
1970	0.45	3.60	773	97	676	193	3,596	6.2	24.13
1975	1.42	3.60	1,426	561	865	607	9,359	7.2	11.47
1980	2.72	3.60	2,604	1,965	639	1,466	18,433	8.7	7.64
1985	4.31	3.60	4,032	4,826	(794)	3,113	31,130	10.8	5.66
1986	4.20	3.60	4,721	5,503	(782)	3,395	33,743	10.9	4.73
1987	5.02	3.80	5,393	7,130	(1,737)	3,654	35,660	10.9	4.31
1988	5.41	4.00	6,113	8,272	(2,159)	3,886	37,387	11.0	3.98
1989	5.89	4.20	6,694	9,391	(2,697)	4,162	38,852	11.3	3.72
1990	5.82	4.40	7,889	10,438	(2,549)	4,386	40,689	11.4	3.53
1991	6.31	4.60	8,396	11,518	(3,122)	4,476	42,043	11.2	3.22
1992	7.07	4.80	8,883	13,076	(4,193)	4,497	42,347	11.0	2.97
1993	7.79	5.00	9,166	14,273	(5,107)	4,480	41,720	10.9	2.72
1994	8.33	5.20	9,585	15,362	(5,777)	4,403	40,346	11.0	2.52
1995	7.91	5.40	10,911	15,986	(5,075)	4,412	39,683	11.3	2.37
1996	8.71	5.60	10,757	16,723	(5,966)	4,177	37,894	11.0	2.16
1997	8.67	6.00	12,165	17,570	(5,405)	3,971	36,460	10.8	1.99
1998	8.11	6.40	14,473	18,338	(3,865)	3,938	36,535	10.9	1.94
1999	8.23	7.00	16,052	18,877	(2,825)	764	42,783	1.7	2.17
2000	7.69	7.80	19,977	19,683	294	4,446	47,523	9.9	2.32
2001	7.85	8.60	22,469	20,515	1,954	3,154	52,631	6.2	2.43
2002	8.16	9.40	24,955	21,666	3,289	187	56,107	0.3	2.47
2003	8.19	9.90	27,454	22,716	4,738	6,769	67,614	11.1	2.84
2004	8.29	9.90	28,459	23,833	4,626	6,475	78,715	8.9	3.15
2005	8.37	9.90	29,539	24,976	4,563	11,083	94,361	13.2	3.62
2006[3]	8.33	9.90	31,000	26,080	4,920	14,300	113,581	14.4	4.10
2007[3]	8.15	9.90	33,621	27,691	5,930	3,269	122,780	2.7	4.20
2008[3]	8.03	9.90	36,053	29,259	6,794	(18,350)	111,224	(14.2)	3.60
2009[3]	8.16	9.90	37,492	30,901	6,591	9,021	126,836	7.6	3.96
2010	8.83	9.90	35,885	32,023	3,862	11,804	142,502	8.9	4.23
2011	8.73	9.90	38,202	33,691	4,511	8,057	155,070	5.4	4.27
2012	8.84	9.90	40,682	36,321	4,361	15,664	175,095	9.7	4.66
2013	8.73	9.90	42,632	37,575	5,057	23,887	204,039	13.2	5.26
2014	8.70	9.90	44,181	38,808	5,373	32,136	241,548	15.2	5.91
2015	8.79	9.90	46,026	40,883	5,143	38,667	285,358	15.6	6.64

(1) The pay-as-you-go rates have been calculated using the historical contributory earnings, while the contributions are based on estimates made by the Department of Finance.

(2) Results for years 1966 to 1998 are on a cost basis, while results for years 1999 to 2015 are presented on a market value basis. If assets were shown at market value at the end of 1998, total assets would be $44,864 million instead of $36,535 million.

(3) Historical numbers for years 2006 to 2009 were revised to reflect a change in the methodology used to allocate fiscal year-end accounting adjustments. Since 2010, fiscal year-end adjustments are no longer allocated between two calendar years and are now included in the calendar year in which they are reported.

Table 11 Financial Projections
(9.9% contribution rate)

Year	PayGo Rate	Contribution Rate	Contributory Earnings	Contributions	Expenditures	Net Cash Flow	Investment Income	Assets at 31 Dec.	Return[1]	Asset/ Expenditure Ratio
	(%)	(%)	($ million)	($ million)	($ million)	($ million)	($ million)	($ million)	(%)	
2016	9.13	9.90	469,849	46,515	42,877	3,638	5,835	294,831	2.00	6.53
2017	9.30	9.90	485,068	48,022	45,129	2,893	15,110	312,834	5.02	6.56
2018	9.45	9.90	504,277	49,923	47,673	2,250	15,638	330,723	4.90	6.55
2019	9.61	9.90	524,960	51,971	50,457	1,514	17,069	349,306	5.07	6.54
2020	9.79	9.90	545,491	54,004	53,416	588	19,093	368,986	5.38	6.53
2021	9.95	9.90	567,494	56,182	56,493	(311)	20,412	389,087	5.45	6.52
2022	10.11	9.90	590,033	58,413	59,644	(1,231)	21,842	409,699	5.54	6.51
2023	10.25	9.90	614,202	60,806	62,927	(2,121)	23,097	430,675	5.57	6.49
2024	10.38	9.90	638,920	63,253	66,340	(3,087)	25,298	452,886	5.81	6.48
2025	10.52	9.90	664,010	65,737	69,851	(4,114)	27,605	476,377	6.03	6.49
2026	10.65	9.90	689,518	68,262	73,432	(5,170)	29,014	500,221	6.03	6.49
2027	10.76	9.90	715,971	70,881	77,055	(6,174)	30,439	524,485	6.03	6.50
2028	10.85	9.90	743,765	73,633	80,735	(7,102)	31,883	549,266	6.03	6.50
2029	10.93	9.90	772,832	76,510	84,501	(7,991)	33,363	574,639	6.03	6.51
2030	11.00	9.90	803,264	79,523	88,331	(8,808)	34,886	600,717	6.03	6.51
2031	11.04	9.90	834,862	82,651	92,210	(9,559)	36,447	627,605	6.03	6.53
2032	11.07	9.90	868,555	85,987	96,111	(10,124)	38,063	655,544	6.03	6.55
2033	11.07	9.90	903,980	89,494	100,054	(10,560)	39,746	684,730	6.02	6.58
2034	11.07	9.90	940,350	93,095	104,093	(10,998)	41,492	715,224	6.02	6.61
2035	11.06	9.90	978,913	96,912	108,249	(11,337)	43,322	747,209	6.02	6.64
2036	11.07	9.90	1,016,680	100,651	112,528	(11,877)	45,241	780,573	6.02	6.68
2037	11.06	9.90	1,056,703	104,614	116,923	(12,309)	47,246	815,510	6.02	6.72
2038	11.05	9.90	1,098,605	108,762	121,421	(12,659)	49,357	852,207	6.01	6.76
2039	11.03	9.90	1,142,737	113,131	126,064	(12,933)	51,588	890,862	6.01	6.81
2040	11.02	9.90	1,187,616	117,574	130,885	(13,311)	53,929	931,480	6.01	6.85
2041	11.01	9.90	1,233,988	122,165	135,911	(13,746)	56,391	974,124	6.02	6.90
2042	11.01	9.90	1,282,122	126,930	141,134	(14,204)	58,990	1,018,910	6.02	6.95
2043	11.00	9.90	1,332,514	131,919	146,576	(14,657)	61,723	1,065,976	6.02	7.00
2044	11.01	9.90	1,383,565	136,973	152,264	(15,291)	64,569	1,115,254	6.02	7.05
2045	11.01	9.90	1,436,430	142,207	158,220	(16,013)	67,547	1,166,788	6.02	7.09
2050	11.17	9.90	1,722,602	170,538	192,433	(21,895)	84,405	1,457,678	6.02	7.28
2055	11.46	9.90	2,052,424	203,190	235,278	(32,088)	104,335	1,799,883	6.02	7.35
2060	11.74	9.90	2,442,454	241,803	286,634	(44,831)	127,089	2,189,836	6.02	7.35
2065	11.80	9.90	2,926,409	289,714	345,401	(55,687)	153,538	2,644,967	6.02	7.38
2070	11.78	9.90	3,524,950	348,970	415,068	(66,098)	185,553	3,197,264	6.02	7.42
2075	11.78	9.90	4,241,948	419,953	499,669	(79,716)	224,534	3,869,318	6.02	7.46
2080	11.83	9.90	5,092,133	504,121	602,316	(98,195)	271,520	4,678,391	6.02	7.48
2085	11.94	9.90	6,091,572	603,066	727,360	(124,294)	327,105	5,633,298	6.02	7.46
2090	12.07	9.90	7,276,562	720,380	878,046	(157,666)	391,621	6,739,676	6.02	7.39

(1) Returns are net of all investment expenses.

Table 12 Financial Projections (millions of 2016 constant dollars)[1]

(9.9% contribution rate)

Year	PayGo Rate	Contribution Rate	Contributory Earnings	Contributions	Expenditures	Net Cash Flow	Investment Income	Assets at 31 Dec.
	(%)	(%)	($ million)	($ million)	($ million)	($ million)	($ million)	($ million)
2016	9.13	9.90	469,849	46,515	42,877	3,638	5,835	294,831
2017	9.30	9.90	477,551	47,278	44,430	2,848	14,876	307,986
2018	9.45	9.90	487,042	48,217	46,044	2,174	15,104	319,420
2019	9.61	9.90	497,077	49,211	47,777	1,434	16,163	330,753
2020	9.79	9.90	506,389	50,133	49,587	545	17,724	342,537
2021	9.95	9.90	516,485	51,132	51,415	(283)	18,577	354,115
2022	10.11	9.90	526,469	52,120	53,219	(1,098)	19,489	365,562
2023	10.25	9.90	537,289	53,192	55,047	(1,855)	20,205	376,744
2024	10.38	9.90	547,952	54,247	56,895	(2,647)	21,696	388,405
2025	10.52	9.90	558,304	55,272	58,731	(3,459)	23,210	400,541
2026	10.65	9.90	568,384	56,270	60,531	(4,262)	23,917	412,342
2027	10.76	9.90	578,617	57,283	62,273	(4,989)	24,599	423,867
2028	10.85	9.90	589,293	58,340	63,967	(5,627)	25,261	435,190
2029	10.93	9.90	600,317	59,431	65,638	(6,207)	25,916	446,365
2030	11.00	9.90	611,721	60,560	67,268	(6,708)	26,567	457,473
2031	11.04	9.90	623,318	61,709	68,845	(7,137)	27,212	468,578
2032	11.07	9.90	635,759	62,940	70,351	(7,411)	27,861	479,840
2033	11.07	9.90	648,714	64,223	71,801	(7,578)	28,523	491,376
2034	11.07	9.90	661,583	65,497	73,235	(7,738)	29,192	503,195
2035	11.06	9.90	675,209	66,846	74,665	(7,819)	29,882	515,391
2036	11.07	9.90	687,509	68,063	76,095	(8,031)	30,593	527,847
2037	11.06	9.90	700,563	69,356	77,516	(8,161)	31,323	540,659
2038	11.05	9.90	714,061	70,692	78,920	(8,228)	32,080	553,910
2039	11.03	9.90	728,182	72,090	80,331	(8,241)	32,873	567,681
2040	11.02	9.90	741,941	73,452	81,768	(8,316)	33,691	581,925
2041	11.01	9.90	755,796	74,824	83,243	(8,419)	34,538	596,634
2042	11.01	9.90	769,879	76,218	84,747	(8,529)	35,422	611,828
2043	11.00	9.90	784,449	77,660	86,289	(8,629)	36,336	627,539
2044	11.01	9.90	798,532	79,055	87,880	(8,825)	37,266	643,675
2045	11.01	9.90	812,788	80,466	89,527	(9,061)	38,221	660,214
2050	11.17	9.90	882,829	87,400	98,621	(11,221)	43,258	747,057
2055	11.46	9.90	952,704	94,318	109,212	(14,895)	48,431	835,478
2060	11.74	9.90	1,026,873	101,660	120,509	(18,848)	53,432	920,665
2065	11.80	9.90	1,114,357	110,321	131,526	(21,205)	58,466	1,007,186
2070	11.78	9.90	1,215,742	120,358	143,155	(22,797)	63,997	1,102,724
2075	11.78	9.90	1,325,113	131,186	156,088	(24,902)	70,141	1,208,710
2080	11.83	9.90	1,440,743	142,634	170,416	(27,783)	76,822	1,323,681
2085	11.94	9.90	1,561,044	154,543	186,395	(31,852)	83,825	1,443,606
2090	12.07	9.90	1,688,928	167,204	203,799	(36,595)	90,897	1,564,314

(1) For a given year, the value in 2016 constant dollars is equal to the corresponding value in current dollars divided by the cumulative index of the indexation rates for benefits provided as of 2016 in the projections.

Assets are projected to increase significantly over the near term, from $285 billion at the end of 2015 to $369 billion by the end of 2020. Contributions and investment income are projected to be higher than expenditures over that period. Thereafter, revenues (i.e. contributions and investment income) continue to be higher than expenditures but to a lesser extent over the long term as expenditures exceed contributions. This causes the assets to grow at a slower pace. The assets are projected to reach a level of $1,458 billion by 2050.

Table 13 shows in more detail the sources of the revenues required to cover the expenditures.

From Table 13, several conclusions can be drawn.

- The assets grow continuously over the projection period. During the period 2016 to 2020, contributions are more than sufficient to cover expenditures.
- From 2021 onward, a portion of investment income is required to fund net cash outflows. In 2050, 26% of investment income is required to pay for expenditures.
- Investment income, which represents 11% of revenues in 2016, will represent 30% in 2025. In 2050, investment income represents 33% of revenues. This clearly illustrates the importance of investment income as a source of revenues for the Plan.

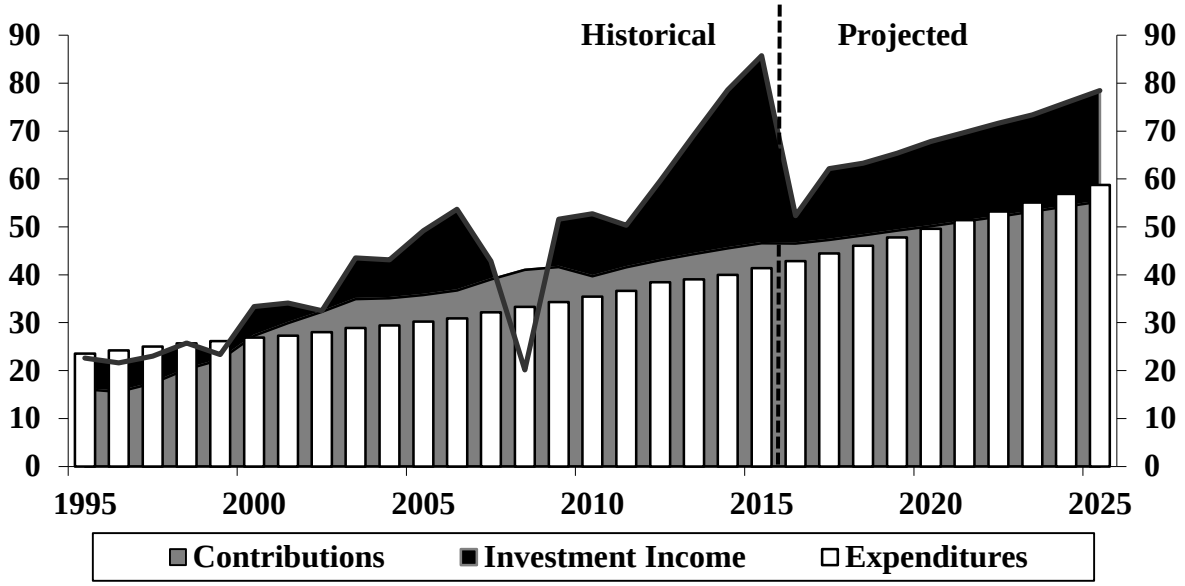
Table 13 Sources of Revenues and Funding of Expenditures

($ billion)

Year	Contributions	Expenditures	Shortfall	Investment Income	Total Revenues	Shortfall as % of Investment Income	Investment Income as % of Revenues
						(%)	(%)
2016	46.5	42.9	0.0	5.8	52.4	0.0	11.1
2017	48.0	45.1	0.0	15.1	63.1	0.0	23.9
2018	49.9	47.7	0.0	15.6	65.6	0.0	23.9
2019	52.0	50.5	0.0	17.1	69.0	0.0	24.7
2020	54.0	53.4	0.0	19.1	73.1	0.0	26.1
2021	56.2	56.5	0.3	20.4	76.6	1.5	26.7
2022	58.4	59.6	1.2	21.8	80.3	5.6	27.2
2023	60.8	62.9	2.1	23.1	83.9	9.2	27.5
2024	63.3	66.3	3.1	25.3	88.6	12.2	28.6
2025	65.7	69.9	4.1	27.6	93.3	14.9	29.6
2026	68.3	73.4	5.2	29.0	97.3	17.8	29.8
2027	70.9	77.1	6.2	30.4	101.3	20.3	30.0
2028	73.6	80.7	7.1	31.9	105.5	22.3	30.2
2029	76.5	84.5	8.0	33.4	109.9	24.0	30.4
2030	79.5	88.3	8.8	34.9	114.4	25.2	30.5
2031	82.7	92.2	9.6	36.4	119.1	26.2	30.6
2032	86.0	96.1	10.1	38.1	124.1	26.6	30.7
2033	89.5	100.1	10.6	39.7	129.2	26.6	30.8
2034	93.1	104.1	11.0	41.5	134.6	26.5	30.8
2035	96.9	108.2	11.3	43.3	140.2	26.2	30.9
2036	100.7	112.5	11.9	45.2	145.9	26.3	31.0
2037	104.6	116.9	12.3	47.2	151.9	26.1	31.1
2038	108.8	121.4	12.7	49.4	158.1	25.6	31.2
2039	113.1	126.1	12.9	51.6	164.7	25.1	31.3
2040	117.6	130.9	13.3	53.9	171.5	24.7	31.4
2041	122.2	135.9	13.7	56.4	178.6	24.4	31.6
2042	126.9	141.1	14.2	59.0	185.9	24.1	31.7
2043	131.9	146.6	14.7	61.7	193.6	23.7	31.9
2044	137.0	152.3	15.3	64.6	201.5	23.7	32.0
2045	142.2	158.2	16.0	67.5	209.8	23.7	32.2
2050	170.5	192.4	21.9	84.4	254.9	25.9	33.1
2055	203.2	235.3	32.1	104.3	307.5	30.8	33.9
2060	241.8	286.6	44.8	127.1	368.9	35.3	34.5
2065	289.7	345.4	55.7	153.5	443.3	36.3	34.6
2070	349.0	415.1	66.1	185.6	534.5	35.6	34.7
2075	420.0	499.7	79.7	224.5	644.5	35.5	34.8
2080	504.1	602.3	98.2	271.5	775.6	36.2	35.0
2085	603.1	727.4	124.3	327.1	930.2	38.0	35.2
2090	720.4	878.0	157.7	391.6	1,112.0	40.3	35.2

Chart 1 shows historical and projected revenues and expenditures for the period 1995 to 2025.

Chart 1 Revenues and Expenditures
(billions of 2016 constant dollars)



E. Financial Projections with Minimum Contribution Rate

The major reform package of the CPP agreed to by the federal, provincial, and territorial governments in 1997 included significant changes to the Plan's financing provisions.

- The introduction of *steady-state funding* to replace pay-as-you-go financing in order to build a reserve of assets and stabilize the ratio of assets to expenditures over time. Under steady-state funding, the ratio of assets to expenditures is currently projected to stabilize at a level of about 6.6. Investment income on the pool of assets would help pay benefits as the large cohort of baby boomers retires. This refers to paragraph 113.1(4)(c) of the *Canada Pension Plan*.

- The introduction of *full funding* which requires that changes to the CPP that increase or add new benefits be fully funded, i.e. that their costs be paid as the benefit is earned and that any costs associated with benefits that have been earned but not paid be amortized and paid for over a defined period of time consistent with common actuarial practice. This refers to paragraph 113.1(4)(d) of the *Canada Pension Plan*.

> **113.1(4)** *In conducting any review required by this section and in making any recommendations, ministers shall consider…*
>
> ***(d)*** *that changes to the Act that increase benefits or add new benefits must be accompanied by a permanent increase in the contribution rates to cover the extra costs of the increased or new benefits and by a temporary increase in the contribution rates for a number of years that is consistent with common actuarial practice to fully pay any unfunded liability resulting from the increased or new benefits.*

Both of these funding principles were introduced to improve fairness across generations. The move to steady-state funding eases some of the contribution burden on future generations, while under full funding each generation that receives benefit enrichments is more likely to pay for such enrichments in full so that the associated costs are not passed on to future generations.

Paragraphs 113.1(4)(c) and (d) have been part of the Plan since 1997, but prior to 2008 there were only regulations describing how to calculate the rate under the financing objective of paragraph 113.1(4)(c) (i.e. the steady-state contribution rate). However, as a result of the 2008 amendments to the Plan, the regulations regarding the calculation of contribution rates were amended to also set out the calculation of the contribution rate that the Ministers must consider under paragraph 113.1(4)(d) (i.e. the full funding rate).

1. Steady-State Contribution Rate

Subparagraph 115(1.1)(c)(i), of the *Canada Pension Plan*, as amended in 2008, requires the Chief Actuary to specify in the report a contribution rate for the first year after the review period and thereafter that is no lower than the lowest rate that will result in the ratio of the assets to the following year's expenditures of the Plan remaining generally constant over the foreseeable future. The lowest contribution rate that will meet this requirement is referred to as the steady-state contribution rate.

The steady-state contribution rate calculation is specifically defined in the regulations as the lowest level contribution rate applicable after the end of the review period, to the nearest 0.001%, that results in the projected asset/expenditure ratio of the Plan being the same in the 10th and 60th years following the end of the review period. For this report, the end of the review period is 2018. Therefore, the steady-state contribution rate is applicable for 2019 and thereafter and the relevant years for the determination of the steady-state contribution rate are 2028 and 2078. The resulting steady-state contribution rate is rounded to the nearest 0.01% and is 9.79% for the year 2019 and thereafter for this report.

The steady-state contribution rate is calculated separately from the full funding rate, which provides for the funding of increased or new benefits in accordance with the full funding requirements of paragraph 113.1(4)(d) of the *Canada Pension Plan*. However, where the full funding rate is deemed to be nil in accordance with the *Calculation of Contribution Rates Regulations, 2007* for the Plan, as it is determined for this report, the improvement in benefits is financed entirely by the steady-state approach.

2. Full Funding Rate of New or Increased Benefits

The full funding contribution rate for the 2008 amendments (in respect to disability benefits) was determined under the previous actuarial report, the 26th CPP Actuarial Report as at 31 December 2012, to be below 0.02% and thus deemed to be zero for all years 2013 and thereafter in accordance with the *Calculation of Contribution Rates Regulations, 2007*. For this 27th CPP Actuarial Report, the full funding rate is likewise deemed to be zero for all years 2016 and thereafter, with the improvements in disability benefits financed entirely by the steady-state contribution rate.

3. Minimum Contribution Rate

The minimum contribution rate is the sum of the Plan's rounded steady-state contribution rate and the rounded full funding rate. For this report, the minimum contribution rate has been determined to be 9.79% for the year 2019 and thereafter. The minimum contribution rate equals the Plan's steady-state contribution rate of 9.79%, since the rate to fully fund the 2008 amendments to the Plan is deemed to be zero. As a result, the corresponding funding for the 2008 amendments is included within the steady-state rate of 9.79%.

The insufficient rates provisions in subsections 113.1(11.05) to 113.1(11.15) of the *Canada Pension Plan* may result in adjustments to the legislated contribution rate and, perhaps, benefits in pay if the federal and provincial governments make no recommendation to either increase the legislated rate or maintain it in the case that the minimum contribution rate exceeds the legislated rate. In respect of the current triennial review, the minimum contribution rate is less than the legislated rate of 9.9%, and thus the insufficient rates provisions do not apply. Therefore, in the absence of specific action by the federal and provincial governments, the legislated contribution rate will remain at 9.9% for the year 2016 and thereafter.

The results presented in Table 14 are based on the best-estimate assumptions but use the minimum contribution rate of 9.79% for the year 2019 and thereafter as opposed to the currently scheduled contribution rate of 9.9% for those years. As the minimum contribution rate is equal to the steady-state contribution rate for this report, the projected asset/expenditure ratios shown in Table 14 for the years 2028 and 2078 are about the same, at a level of 6.4. The financial projections under the legislated rate of 9.9% were previously presented in Table 11, and include projections of the asset/expenditure ratios under that rate.

Table 14 Financial Projections - Minimum Contribution Rate of 9.79%

Year	PayGo Rate	Contribution Rate	Contributory Earnings	Contributions	Expenditures	Net Cash Flow	Investment Income	Assets at 31 Dec.	Asset/ Expenditure Ratio
	(%)	(%)	($ million)	($ million)	($ million)	($ million)	($ million)	($ million)	
2016	9.13	9.90	469,849	46,515	42,877	3,638	5,835	294,831	6.53
2017	9.30	9.90	485,068	48,022	45,129	2,893	15,110	312,834	6.56
2018	9.45	9.90	504,277	49,923	47,673	2,250	15,638	330,723	6.55
2019	9.61	9.79	524,960	51,394	50,457	937	17,053	348,712	6.53
2020	9.79	9.79	545,491	53,404	53,416	(12)	19,043	367,743	6.51
2021	9.95	9.79	567,494	55,558	56,493	(935)	20,326	387,133	6.49
2022	10.11	9.79	590,033	57,764	59,644	(1,880)	21,714	406,968	6.47
2023	10.25	9.79	614,202	60,130	62,927	(2,797)	22,925	427,096	6.44
2024	10.38	9.79	638,920	62,550	66,340	(3,790)	25,067	448,373	6.42
2025	10.52	9.79	664,010	65,007	69,851	(4,844)	27,309	470,838	6.41
2026	10.65	9.79	689,518	67,504	73,432	(5,928)	28,655	493,565	6.41
2027	10.76	9.79	715,971	70,094	77,055	(6,961)	30,012	516,615	6.40
2028	***10.85***	***9.79***	***743,765***	***72,815***	***80,735***	***(7,920)***	***31,382***	***540,077***	***6.39***
2029	10.93	9.79	772,832	75,660	84,501	(8,841)	32,781	564,017	6.39
2030	11.00	9.79	803,264	78,640	88,331	(9,691)	34,217	588,543	6.38
2031	11.04	9.79	834,862	81,733	92,210	(10,477)	35,684	613,750	6.39
2032	11.07	9.79	868,555	85,032	96,111	(11,079)	37,197	639,867	6.40
2033	11.07	9.79	903,980	88,500	100,054	(11,554)	38,770	667,083	6.41
2034	11.07	9.79	940,350	92,060	104,093	(12,033)	40,395	695,445	6.42
2035	11.06	9.79	978,913	95,836	108,249	(12,413)	42,096	725,127	6.44
2036	11.07	9.79	1,016,680	99,533	112,528	(12,995)	43,874	756,007	6.47
2037	11.06	9.79	1,056,703	103,451	116,923	(13,472)	45,728	788,263	6.49
2038	11.05	9.79	1,098,605	107,553	121,421	(13,868)	47,676	822,072	6.52
2039	11.03	9.79	1,142,737	111,874	126,064	(14,190)	49,732	857,615	6.55
2040	11.02	9.79	1,187,616	116,268	130,885	(14,617)	51,884	894,881	6.58
2041	11.01	9.79	1,233,988	120,807	135,911	(15,104)	54,143	933,920	6.62
2042	11.01	9.79	1,282,122	125,520	141,134	(15,614)	56,523	974,829	6.65
2043	11.00	9.79	1,332,514	130,453	146,576	(16,123)	59,021	1,017,728	6.68
2044	11.01	9.79	1,383,565	135,451	152,264	(16,813)	61,614	1,062,529	6.72
2045	11.01	9.79	1,436,430	140,626	158,220	(17,594)	64,321	1,109,257	6.74
2050	11.17	9.79	1,722,602	168,643	192,433	(23,790)	79,497	1,370,375	6.84
2055	11.46	9.79	2,052,424	200,932	235,278	(34,346)	97,059	1,670,713	6.82
2060	11.74	9.79	2,442,454	239,116	286,634	(47,518)	116,509	2,002,267	6.72
2065	11.80	9.79	2,926,409	286,495	345,401	(58,906)	138,369	2,376,346	6.63
2070	11.78	9.79	3,524,950	345,093	415,068	(69,975)	164,038	2,816,558	6.54
2075	11.78	9.79	4,241,948	415,287	499,669	(84,382)	194,273	3,334,213	6.43
2078	***11.80***	***9.79***	***4,735,335***	***463,589***	***558,792***	***(95,203)***	***214,705***	***3,683,343***	***6.35***
2080	11.83	9.79	5,092,133	498,520	602,316	(103,796)	229,253	3,931,397	6.29
2085	11.94	9.79	6,091,572	596,365	727,360	(130,995)	268,414	4,596,509	6.09
2090	12.07	9.79	7,276,562	712,375	878,046	(165,671)	310,524	5,307,660	5.82

Table 15 shows the progression of the minimum contribution rate over time under the best-estimate assumptions of this report.

Table 15 Progression of Minimum Contribution Rate over Time

Valuation Year[1]	Target Years[2]	Steady State Target A/E ratio[3]	Minimum Contribution Rate	Years Minimum Contribution Rate Applicable[4]	Average PayGo Rate Over Target Years Period
2015	2028 and 2078	6.40	9.79%	2019+	11.39%
2018	2031 and 2081	6.43	9.80%	2022+	11.44%
2021	2034 and 2084	6.52	9.81%	2025+	11.49%
2024	2037 and 2087	6.64	9.82%	2028+	11.54%
2027	2040 and 2090	6.80	9.84%	2031+	11.60%

(1) Reports are prepared as at 31 December of the valuation year. Any changes to the steady-state rate as a result of a valuation are effective following the triennial review period. That is, for the current valuation as at 31 December 2015, any changes to the steady-state rate will become effective 1 January 2019.

(2) Target years refer to the beginning and end of the 50-year interval over which the steady-state contribution rate is determined. This rate is the lowest level rate that results in the asset/expenditure (A/E) ratio being the same in the two target years. For a given triennial review period of the Plan, the target years are 13 and 63 years after the valuation year. For this report, the valuation year is 2015 and thus the target years are 2028 to 2078.

(3) The steady-state target A/E ratio is the ratio obtained in the target years relating to the determination of the corresponding steady-state contribution rate. Where the ratios in the target years do not match exactly, the ratio presented pertains to the first target year.

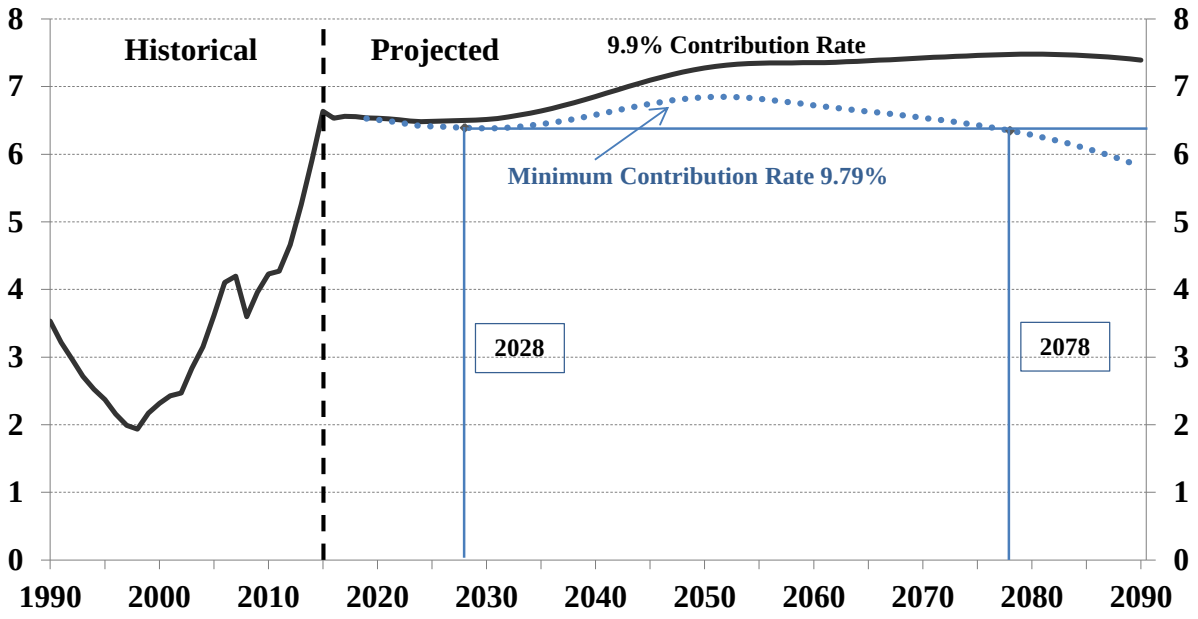
(4) The legislated contribution rate of 9.9% is assumed to apply for all years prior to the period the minimum contribution rate is applicable for a given valuation.

As shown in Table 15, the minimum contribution rate is relatively stable over the periods considered. If the best-estimate assumptions of this report are realized, the minimum contribution rate will increase between 0.01% and 0.02% for each of the next four reports and will remain below the legislated contribution rate of 9.9%. Thus, the current legislated contribution rate is projected to be sufficient over subsequent reports as long as the best-estimate assumptions remain the same and Plan experience does not deviate materially from the assumptions.

An important measure of the Plan's financial state is the ratio of assets at the end of one year to the expenditures of the next year. As can be seen in Chart 2, under the legislated contribution rate of 9.9%, this ratio is projected to remain relatively stable at a level of 6.5 over the period 2016 to the early 2030s. Thereafter, it continues to rise overall to a value of 7.4 in 2090.

As the legislated rate of 9.9% is greater than the minimum contribution rate of 9.79%, the asset to expenditure ratios under the legislated rate are higher than the ratios under the minimum contribution rate. The asset to expenditure ratios under the minimum contribution rate for years 2019 and thereafter are shown in Chart 2 for comparison. The ratios under the minimum contribution rate in years 2028 and 2078 are equal, at a value of about 6.4, since the minimum contribution rate is equal to the steady-state contribution rate as determined for this report. The projected initial slowdown in the growth of the ratio until the early 2030s is caused by the retirement of the baby boom generation, which increases the cash outflows of the Plan. The existence of a large pool of assets enables the Plan to absorb the increased outflow and maintain the contribution rate at 9.9%.

Chart 2 Asset/Expenditure Ratio
(9.9% contribution rate)



V. Reconciliation with Previous Report

A. Introduction

The results presented in this report differ from those previously projected for a variety of reasons. Differences between the actual experience for 2013 through 2015 and that projected in the 26th CPP Actuarial Report are addressed in section B below. Since historical results provide the starting point for the projections shown in this report, these historical differences between actual and projected experience have an effect on the projections. The impact of experience since the last triennial valuation of the Plan (that is, the experience update from the period 2013-2015) and changes in the assumptions and methodology on the minimum contribution rate are addressed in section C. Detailed reconciliations of the projected pay-as-you-go rates and the minimum contribution rate are presented in Appendix D.

B. Experience Update – 2013 to 2015

The major components of the change in the CPP assets from 31 December 2012 to 31 December 2015 are summarized in Table 16.

Contributions during the period 2013 to 2015 were about $833 million higher than expected, mainly as a result of higher than anticipated growth in total employment earnings. This represents a deviation from the expected results of about 0.6%.

Expenditures during the period were $1.8 billion lower than expected. This represents a deviation from the expected results of about -1.5%. The difference between actual and expected expenditures is mainly due to an over-projection of retirement benefits, survivor benefits, and operating expenses that outweighs an under-projection of disability benefits. The details by type of expenditure are given in Table 17.

Investment income was 248% higher than anticipated due to the strong investment performance over the period. As a result, the change in assets was $70 billion or 175% higher than expected over the period. The resulting assets as at 31 December 2015 are 33% higher than projected under the 26th CPP Actuarial Report.

Table 16 Change in Assets - 31 December 2012 to 31 December 2015(1)
(cost accrual basis, $ million)

			Difference	% Change
	Actual	Expected(2)	Actual – Expected	Difference/ Expected
Assets at 31 December 2012	**175,095**	**175,095**	**0**	**0.0%**
+ Contributions	132,839	132,006	833	0.6%
- Expenditures	117,267	119,064	(1,797)	(1.5%)
+ Investment Income	94,690	27,212	67,478	248%
Change in Assets	110,263	40,154	70,109	174.6%
Assets at 31 December 2015	**285,358**	**215,249**	**70,109**	**32.6%**

(1) Components may not sum to totals due to rounding.
(2) Expected contributions, expenditures, and investment income shown are as per the projections of the 26th CPP Actuarial Report as at 31 December 2012.

Table 17 Summary of Expenditures - 2013 to 2015(1)
($ million)

	Actual	Expected(2)	Difference Actual – Expected	% Change Difference/ Expected
Retirement	88,257	89,545	(1,288)	(1.4%)
Disability	11,975	11,911	64	0.5%
Survivors	12,888	13,177	(289)	(2.2%)
Children	1,550	1,575	(25)	(1.6%)
Death	963	964	(1)	(0.1%)
Operating Expenses	1,633	1,892	(259)	(13.7%)
Total Expenditures	**117,267**	**119,064**	**(1,797)**	**(1.5%)**

(1) Components may not sum to totals due to rounding.
(2) Expected expenditures shown are as per the projections of the 26th CPP Actuarial Report as at 31 December 2012.

C. Changes in the Minimum Contribution Rate

Table 18 presents the main elements of change in the minimum contribution rate since the 26th CPP Actuarial Report and shows an overall decrease in the rate. Experience over the period 2013 to 2015 was better than anticipated overall, especially regarding benefits and investment returns, which lowered the minimum contribution rate. Changes made to the assumptions regarding benefits also act to lower the minimum contribution rate. However, these reductions in the rate are largely offset by higher projected life expectancies at age 65, lower assumed real wage increases, lower inflation expectations, and changes in investment assumptions. A more detailed reconciliation of changes in the minimum contribution rate is provided in Table 32 in Appendix D of this report.

Table 18 Reconciliation of Changes in Minimum Contribution Rate[1,2]

(% of contributory earnings)

	Minimum Contribution Rate
26th CPP Actuarial Report - After Rounding	**9.84**
26th CPP Actuarial Report - Before Rounding	**9.838**
Improvements in Methodology	(0.008)
Experience (2013 to 2015)	(0.337)
Changes in Demographic Assumptions	0.056
Changes in Benefit Assumptions	(0.013)
Changes in Economic Assumptions	0.190
Changes in Investment Assumptions	0.076
(Change in funding target from 2025‑2075 to 2028-2078)	(0.006)
Rate before Rounding	9.795
Rounded Rate, in accordance with CPP Regulations	9.79
27th CPP Actuarial Report	9.79

(1) Components may not sum to totals due to rounding.

(2) For each triennial CPP actuarial report, the minimum contribution rate is determined for all years following the three-year review period in which the report is prepared, with the legislated contribution rate applied during the review period. For the 26th CPP Actuarial Report, the minimum contribution rate was determined for the year 2016 and thereafter, with the legislated rate of 9.9% applied for the 2013-2015 review period. For the 27th CPP Actuarial Report, the minimum contribution rate is determined from 2019 onward, with 9.9% applied for 2016-2018.

VI. Conclusion

The results contained in this report confirm that the legislated contribution rate of 9.9% is sufficient to finance the Plan over the long term. The results also show that assets are projected to accumulate to $476 billion (i.e. 6.5 times the annual expenditures) by 2025.

The minimum contribution rate required to finance the Plan over the long term under this report is 9.79%, compared to 9.84% as determined for the 26th CPP Actuarial Report. Experience over the period 2013 to 2015 was better than anticipated overall, especially regarding benefits and investment returns. However, this is largely offset by higher projected life expectancies at age 65, lower assumed real wage increases, lower inflation expectations, and changes in investment assumptions. The net result of all changes since the 26th CPP Actuarial Report is an overall absolute decrease in the minimum contribution rate of 0.05%.

To measure the sensitivity of the long-term projected financial position of the Plan to changes in the future demographic and economic outlook, a number of sensitivity tests were performed. Sensitivity tests on key assumptions and an analysis of the impact of financial market volatility and choice of asset allocation show that the minimum rate could deviate significantly from its best-estimate value of 9.79% if other than best-estimate assumptions were to be realized.

Under the 9.9% legislated contribution rate, the assets are projected to grow rapidly over the near term as contribution revenue is expected to exceed expenditures until 2020 inclusive. Assets will continue to grow thereafter until the end of the projection period, but at a slower pace, with the ratio of assets to the following year's expenditures expected to reach a level of 7.3 by 2050. Thus, despite the projected substantial increase in benefits paid as a result of an aging population, the Plan is expected to be able to meet its obligations throughout the projection period.

The projected financial state of the Canada Pension Plan presented in this report is based on the assumed demographic and economic outlook over the long term. Therefore, it remains important to review the Plan's long-term financial state on a regular basis by producing periodic actuarial reports. For this purpose, as required by the *Canada Pension Plan*, the next such review will be as at 31 December 2018.

VII. Actuarial Opinion

In our opinion, considering that this 27th Actuarial Report was prepared pursuant to the *Canada Pension Plan*:

- the data on which this report is based are sufficient and reliable;
- the assumptions used are, individually and in aggregate, reasonable and appropriate; and
- the methods employed are appropriate for the purposes of this report.

Based on the results of this valuation, we hereby certify that the minimum contribution rate to finance the Canada Pension Plan without further increase is 9.79% for the year 2019 and thereafter.

This report has been prepared, and our opinions given, in accordance with both accepted actuarial practice in Canada, in particular, the General Standards of Practice of the Canadian Institute of Actuaries, and internationally accepted actuarial practice as provided by the International Standards of Actuarial Practice for General Actuarial Practice (ISAP 1) and Financial Analysis of Social Security Programs (ISAP 2) of the International Actuarial Association.

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Chief Actuary

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Senior Actuary

Ottawa, Canada
22 September 2016

Appendix A – Financing the Canada Pension Plan

I. Historical Background

The retirement system in Canada has been designed as a three-tier system. First, the Old Age Security (OAS) program provides for a minimum floor benefit based on age and residence in Canada. Second, the CPP and QPP cover most individuals with employment earnings. Finally, individuals may be covered by registered pension plans (RPPs) as well as pooled registered pension plans (PRPPs), and can invest in individual registered retirement savings plans (RRSPs) and tax-free saving accounts (TFSAs) to supplement their retirement income.

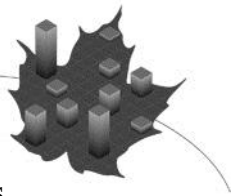
Each tier is financed using a different approach: the OAS program is financed through general tax revenues on a pay-as-you-go basis, the CPP/QPP are partially funded based on contributions on employment earnings, and RPPs, PRPPs, RRSPs, and TFSAs are intended to be fully funded. The variety in both the sources and methods of financing enables the Canadian retirement income system to be less vulnerable, and thus more resilient, to changes in economic and demographic conditions compared to systems that are less varied in their provision of retirement income.

The CPP was initially established as a pay-as-you-go plan with a small reserve fund worth about two years of benefits. At the time of the Plan's inception, demographic and economic conditions were characterized by a younger population (higher fertility rates and lower life expectancies), rapid growth in wages and labour force participation, and low rates of return on investments. These conditions made prefunding the scheme unattractive and pay-as-you-go financing more appropriate. Growth in total earnings of the workforce and thus contributions were sufficient to cover growing expenditures without requiring large increases in the contribution rate. Plan assets were invested primarily in long-term non-marketable securities of provincial governments at lower than market rates, thus providing the provinces with a relatively inexpensive source of capital to develop needed infrastructure.

However, changing conditions over time, including lower birth rates, increased life expectancies, and lower real wage growth led to increasing Plan costs. These factors, in combination with higher market returns, made fuller funding more attractive and appropriate. By the mid-1980s, the net cash flow (contributions less expenditures) had turned negative and part of the Plan's investment income was required to meet the shortfall. The shortfall continued to grow, which eventually caused the assets of the reserve fund to start to fall by the mid-1990s.

In the December 1993 (15th) Actuarial Report on the CPP, the Chief Actuary projected that the pay-as-you-go contribution rate (expenditures as a percentage of contributory earnings) would increase to 14.2% by 2030. It was further projected that if changes were not made to the Plan, the reserve fund would be exhausted by 2015. The Chief Actuary identified five factors responsible for the increasing costs of the Plan, namely: lower birth rates, higher life expectancies than projected, lower productivity than expected, benefit enrichments, and increased numbers of Canadians claiming disability benefits for longer periods.

In response to these developments, amendments were made in 1998 to gradually increase the level of CPP funding by increasing contribution rates over the short term, reducing the growth of benefits over the long term, and investing net cash flows in the private markets through the CPPIB to achieve higher rates of return. It was also decided that any future increases to or additions of new benefits under the Plan should be fully funded. The reform package agreed to by



the federal and provincial governments in 1997 thus included significant changes to the Plan's financing provisions:

- The introduction of ***steady-state funding*** to replace pay-as-you-go financing in order to build a reserve of assets and stabilize the ratio of assets to expenditures over time. Under steady-state funding, the ratio of assets to expenditures is currently projected to stabilize at a level of about 6.4. Investment income on this pool of assets is projected to help pay benefits when the large cohort of baby boomers retires. This refers to section 113.1(4)(c) of the *Canada Pension Plan*.
- The introduction of ***full funding*** that requires that changes to the CPP that increase or add new benefits be fully funded, i.e. that their costs be paid as the benefit is earned and that any costs associated with benefits that have already been earned must be amortized and paid for over a defined period of time consistent with common actuarial practice. This refers to section 113.1(4)(d) of the *Canada Pension Plan*.

Both of these funding objectives were introduced to improve fairness across generations. The move to steady-state funding eases some of the contribution burden on future generations, and under full funding each generation that will receive benefit enrichments is more likely to pay for such enrichments in full so that the associated costs are not passed on to future generations.

The combination of steady-state funding and full funding supports the objective of the 1997 reform package to improve the financial long-term sustainability of the Plan so that the CPP will be affordable and sustainable for future generations.

II. Balance Sheet

The CPP balance sheet presented in this section is prepared using an open group approach. An open group is defined as one that includes all current and future participants of a plan, where the plan is considered to be ongoing into the future, that is, over an extended time horizon. This means that future contributions of current and new participants and their associated benefits are included in order to determine whether current assets and future contributions will be sufficient to pay for all future expenditures. This is compared to a closed group that includes only current participants of the Plan, with no new entrants permitted and no new benefits accrued.

The choice of the methodology used to produce a social security system's balance sheet is mainly determined by the system's financial approach. Partially funded plans like the CPP represent a social contract where, in any given year, current contributors allow the use of their contributions to pay current beneficiaries' benefits. This social contract creates claims for current and past contributors to contributions of future contributors. As such, the proper assessment of the financial sustainability of partially funded plans by means of their balance sheets should reflect these claims. The open group approach does account explicitly for these claims by considering the benefits and contributions of both the current and future plan participants. In comparison, the closed group methodology does not reflect these claims since only current participants are considered.

To determine the actuarial liability of the Plan under the open group approach, future expenditures with respect to current and future Plan participants are first projected over a 150-year period using the best-estimate assumptions described in Appendix E. Next, these total projected expenditures are discounted using the projected rate of return on CPP assets to determine their present value. This is the actuarial liability under the open group approach.

To determine the assets of the Plan under the open group approach, future contributions of current and future contributors are first projected over a 150-year period using the best-estimate assumptions described in Appendix E and the legislated rate of 9.9%. These total projected contributions are then discounted using the projected rate of return on CPP assets to determine their present value. This present value is added to the Plan's current assets to obtain the total assets of the Plan under the open group approach.

The actuarial position of the Plan as at 31 December 2015 and 31 December 2025 under the open group approach is presented in Table 19. To obtain the asset excess (shortfall) of the Plan, the Plan's actuarial liability is deducted from the assets at the valuation date.

Table 19 CPP Balance Sheet (Open Group Approach)

	As at 31 December 2015	As at 31 December 2025
	($ billion)	($ billion)
Assets	2,547.4	3,489.3
Actuarial Liability	2,546.1	3,495.8
Asset Excess (Shortfall)	1.3	(6.6)
Assets as Percentage of Liability	100.1%	99.8%

The Plan is intended to be long-term and enduring in nature, a fact that is reinforced by the federal, provincial, and territorial governments' joint stewardship through the established strong governance and accountability framework of the Plan. Therefore, if the Plan's financial sustainability is to be measured based on its asset excess or shortfall, it should be done so on an open group basis that reflects the partially funded nature of the Plan, that is, its reliance on both future contributions and invested assets as means of financing its future expenditures. The inclusion of future contributions and benefits with respect to both current and future participants in the assessment of the Plan's financial state confirms that the Plan is able to meet its financial obligations over the long term[1,2].

III. Internal Rates of Return

The internal rate of return is, with respect to a group of CPP participants born in a given year (i.e. a cohort), the unique interest rate resulting from the equality of:

- the present value of past and future contributions (both employer and employee portions) paid or expected to be paid by and in respect of that cohort, and
- the present value of past and future benefits earned or expected to be earned by that cohort.

Accordingly, actual internal rates of return cannot be determined until the last member of the cohort has died. However, they can be estimated based on the historical and projected experience of the cohort. Internal rates of return are dependent on many assumptions as to future experience, such as those regarding the age at pension take-up, life expectancy, the actuarial adjustment factor applied to the pension, and the working beneficiaries provision. The internal rates of return are calculated on the basis of the best-estimate assumptions of this report and using the legislated contribution rate of 9.9%.

1 As at 31 December 2015, under the closed group approach, the actuarial liability of the Plan is equal to $1,171.1 billion, the assets are $285.4 billion, and the assets shortfall is equal to $885.7 billion.

2 The 2016 current service cost of the Plan is estimated to be $30.3 billion or 6.4% of contributory earnings.

The results presented in Table 20 are rates based solely on contributions paid and benefits received; that is, operating expenses associated with each cohort are excluded. Results are shown on two bases, as both nominal and real internal rates of return. To determine the real internal rates of return, both contributions and benefits were first adjusted to remove the impact of price increases.

Table 20 Internal Rates of Return by Cohort
(annual percentages, 9.9% contribution rate)

Birth Year	Nominal	Real
1950	7.0	4.2
1960	5.2	3.1
1970	4.4	2.4
1980	4.3	2.3
1990	4.3	2.3
2000	4.4	2.3
2010	4.4	2.3

The internal rates of return for cohorts born after about 1970 are stable, which confirms that the Plan in its current form is a sustainable and a fair retirement savings vehicle. Earlier cohorts are shown to receive higher value from the CPP, since they began their contributions before the current partial funding regime was implemented.

Appendix B – Uncertainty of Results

I. Introduction

The future income and outgo of the Canada Pension Plan depend on many demographic and economic factors, including fertility, mortality, migration, the labour force, average earnings, inflation, retirement patterns, disability rates, and investment returns. The income will depend on how these factors affect the size and composition of the working-age population and the level and distribution of earnings. Similarly, the outgo will depend on how these factors affect the size and composition of the beneficiary population and the general level of benefits.

The projected long-term financial state of the Plan is based on best-estimate assumptions; the objective of this section is to illustrate the sensitivity of the long-term projected financial position of the Plan to changes in the future demographic and economic outlook.

Section II examines the sensitivity of the Plan to different asset allocations. Six alternative investment portfolios are described, along with the volatility of each portfolio and the resulting impact on the Plan's minimum contribution rate. The impact of financial market volatility on the financial state of the Plan is explored in section III. Severe one-time financial shocks are applied to three investment portfolios with the purpose of quantifying the long-term impact on the minimum contribution rate.

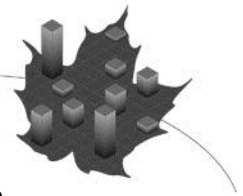
Section IV next presents sensitivity tests on individual long-term assumptions based on a combination of judgment and stochastic modeling techniques.

Finally, sections V and VI build on the individual sensitivity tests performed in section IV by combining various assumptions of the individual sensitivity tests to create scenarios of high and low economic growth and younger and older populations. The combination of the individual test assumptions is not meant to necessarily create probable scenarios, but rather to show the possible impacts from different economic environments and overall compositions of the population relative to the best-estimate scenarios.

II. Sensitivity of Investment Policy

The CPPIB was created in 1997 with the object "to invest its assets with a view to achieving a maximum rate of return, without undue risk of loss, having regard to the factors that may affect the funding of the Canada Pension Plan and the ability of the Canada Pension Plan to meet its financial obligations on any given business day", as stated in the *Canada Pension Plan Investment Board Act*. The purpose of the CPPIB is to meet this mandate while mitigating risk through the diversification of investments in equities and other asset classes with the aim of achieving higher returns. Over time, the role of the CPPIB will continue to become increasingly important as assets are expected to grow rapidly over the near term with contributions to the Plan projected to exceed expenditures until 2020 inclusive. After 2020, it is projected that an increasing proportion of investment income will be required to meet expenditures. Although net cash flows (contributions less expenditures) are projected to be negative after 2020, asset growth is still expected to continue.

Historically, equities have shown greater volatility than fixed income instruments (such as bonds), volatility being a measure of the magnitude of fluctuation in returns. Similarly, long-term bonds have historically shown greater volatility than shorter fixed income instruments. For instance, in the fifty, twenty-five, and ten years ending in 2015, the volatility (standard deviation) of Canadian



equity returns (indicated by the S&P/TSX Total Return Index) was 16.5%, 16.5%, and 18.7%, respectively, as given in the Canadian Institute of Actuaries' Report on Canadian Economic Statistics 1924 – 2015. This compares with the volatility of returns of long-term federal bonds (10+ years) of 10.5%, 9.9%, and 8.7% and with the volatility of returns of medium-term federal bonds (5-10 years) of 7.5%, 6.9%, and 5.5% over the same periods. Higher volatility of a security's returns implies a greater risk since the range of possible outcomes of returns widens. Hence, equities are viewed as being more risky than bonds and long-term bonds are viewed as being more risky than medium- or short-term bonds.

Historically, the higher volatility of equities compared to bonds has also been rewarded with higher returns. This describes the key risk-reward relationship, whereby investors seek a higher level of return over the long term, or an equity risk premium, in exchange for assuming a higher level of risk. Nevertheless, over the short term, the potential for lower returns exists along with that for higher returns due to the higher level of volatility.

Investing in a greater proportion of equities requires assuming a higher level of risk and hence the possibility of realizing a wider range of returns. Conversely, investing in lower risk fixed income instruments will tend to produce lower returns. Further, by accepting lower returns with lower risk, investment objectives may not be achieved.

Table 21 shows the impact that various investment portfolios would have on the Plan's real rate of return and minimum contribution rate, as well as the volatility present in each portfolio. Notwithstanding the ultimate asset mixes shown below, for each portfolio the fixed income component includes 1% cash and the same amount of non-marketable bonds as the best-estimate portfolio.

Table 21 Investment Policy Impact on Minimum Contribution Rate

	Ultimate Asset Mix			Expected 75-Year Average Real Rate of Return	Expected One-Year Standard Deviation	Minimum Contribution Rate[1]
Portfolio	Fixed Income	Equity	Real Assets			
	(%)	(%)	(%)	(%)	(%)	(%)
1[2]	100	0	0	1.9	8.9	10.99
2[3]	100	0	0	2.6	8.2	10.62
3	60	35	5	3.1	7.1	10.34
4	40	45	15	3.5	9.1	10.07
BE	**20**	**55**	**25**	**3.9**	**11.4**	**9.79**
5	10	65	25	4.1	12.8	9.60
6[4]	0	100	0	4.3	15.7	9.45

(1) The minimum contribution rate in this table refers to the rate applicable for 2019 and thereafter.
(2) Assumes the portfolio is invested fully in long-term Government of Canada bonds.
(3) Assumes the portfolio is invested in a diversified bond portfolio consisting of federal, provincial and corporate bonds.
(4) The Fixed Income allocation is not zero until 2043 due to the presence of non-marketable bonds.

Portfolio 1 is assumed to consist solely of long-term federal bonds and as such, a low return is expected. This portfolio's volatility (one-year standard deviation) is relatively low for an undiversified portfolio. Under this scenario, the low risk investments would cause the minimum contribution rate to increase to 10.99%. Portfolio 2 is assumed to be a marketable bond portfolio

consisting of long-term federal, provincial and corporate bonds. This portfolio produces a higher real rate of return and lower volatility compared to Portfolio 1 because of the diversification through different bond classes. However, the expected return of Portfolio 2 is still not sufficient to maintain the current 9.9% contribution rate. As for Portfolio 1, Portfolio 2 is a low risk, low return portfolio. These two portfolios demonstrate the necessity of higher investment returns and thus, the incurrence of higher risk, in order to maintain the minimum contribution rate at a level below the legislated rate of 9.9%. This could be achieved by including equities in the investment portfolio.

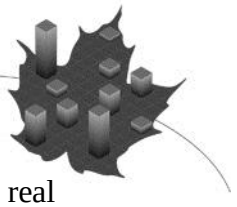
The remaining portfolios are diversified portfolios that consist of fixed income, equity (Canadian, foreign and emerging markets) and real assets. Portfolio 3 is more diversified than the first two portfolios with 40% in variable income securities (equity and real assets). This diversification increases the expected real rate of return earned on the portfolio while reducing the volatility compared to the first two portfolios, since the three broad asset classes are not perfectly correlated and since the average term to maturity of the fixed income portfolio is reduced. Portfolio 4 is even more diversified with 60% of the portfolio invested in equities and real assets. However, it is only slightly riskier than the first three portfolios due to the fact that the higher volatility from increased investment in variable income securities is partially compensated through greater diversification and by a reduction in the fixed income's average term to maturity. The lower average term to maturity of bonds of Portfolio 4 more closely reflects actual investments by the CPPIB and is better positioned for an expected increase in bond yields. However, despite increased real returns and similar risks compared to the first two portfolios, portfolios 3 and 4 are still not sufficient to maintain the minimum contribution rate at a level below the legislated rate of 9.9%.

Portfolios 5 and 6 are considered to be more risky than the best-estimate portfolio, because they consist of substantial investments in variable income securities (90% and 100%, respectively) and consequently, have higher volatility. While both portfolios may produce returns that result in the minimum contribution rate being at or below the legislated contribution rate of 9.9%, such portfolios have a greater likelihood of earning poor investment returns when market downturns occur (as demonstrated in the next section). By investing in a less risky portfolio with a lower degree of volatility, the minimum contribution rate can still be maintained at or below 9.9%.

The best-estimate portfolio (BE) is invested 20% in fixed income, 55% in equity and 25% in real assets in the long term. Such a portfolio produces an expected average annual real return of 3.9% over the next 75 years with a one-year standard deviation of 11.4%. By observing the volatility of each of the portfolios in Table 21, it can be concluded that a certain degree of risk must be undertaken in order to earn a sufficient return. An asset allocation such as the best-estimate portfolio demonstrates that the 75-year average annual real return of 3.9% can be achieved with a moderate degree of risk. The benefit of an increased return produced by the riskier portfolios (5 and 6) does not seem to outweigh the accompanying increase in risk. This aligns with the investment objective of the CPPIB which is to invest its assets with a view to achieving a maximum rate of return, without undue risk of loss.

III. Financial Market Tail Events

This section analyzes the impacts that tail events in portfolio returns could have on the minimum contribution rate. To illustrate this, portfolio returns other than the best estimate are assumed to occur in 2018 for various investment portfolios. Two alternative portfolios were selected from



section II to show the potential impacts of a less risky portfolio (Portfolio 4: 45% equity, 15% real assets, 40% fixed income) and a riskier one (Portfolio 5: 65% equity, 25% real assets, 10% fixed income) in relation to the best-estimate portfolio (55% equity, 25% real assets, 20% fixed income).

In this illustration, it is assumed that the returns of the three portfolios follow a normal distribution. The standard deviation for each portfolio is given in Table 21 in section II. The expected nominal returns for the year 2018 are given in Table 22. Returns at two probability levels were selected to analyze: 1/10 and 1/50. The probabilities of earning those returns can be thought of as once every 10 and 50 years, respectively. Since the normal distribution has two tails, a left tail and a right tail, both were examined. The left tail event is the occurrence of a nominal return such that the probability of earning that return or less is equal to 1/10 (or 1/50). The right tail event is the occurrence of a nominal return such that the probability of earning that return or more is equal to 1/10 (or 1/50).

For each portfolio, a nominal return is calculated for 2018 at the two probability levels. Following the various portfolio returns in 2018, it is assumed that the returns revert to their best-estimate values from 2019 onward. The nominal returns and the resulting impact on the minimum contribution rates are given in Table 22.

Table 22 Impact of Various Portfolio Returns and Portfolios (2018)

		Portfolio 4		Best-Estimate Portfolio		Portfolio 5	
		Expected Nominal Return in 2018	MCR[1]	Expected Nominal Return in 2018	MCR[1]	Expected Nominal Return in 2018	MCR[1]
		3.9%	10.07%	4.9%	9.79%	5.8%	9.60%
Probability of Return[2]	Tail	(%)	Impact on MCR (%)	(%)	Impact on MCR (%)	(%)	Impact on MCR (%)
1/10	Left	(7.8)	0.12	(9.7)	0.18	(10.6)	0.22
	Right	15.6	(0.12)	19.5	(0.18)	22.2	(0.22)
1/50	Left	(14.8)	0.19	(18.5)	0.28	(20.5)	0.36
	Right	22.6	(0.19)	28.3	(0.28)	32.1	(0.36)

(1) Minimum contribution rate.
(2) The probability of earning the positive returns in the table corresponds to the probability that the annual return is greater than or equal to the indicated return. Similarly, the probability of earning the negative portfolio return corresponds to the probability of earning the indicated return or less.

Once every ten years, the best-estimate portfolio is expected to experience a nominal return of -9.7% or less as well as a nominal return of +19.5% or more. As a result, the minimum contribution rate could increase or decrease by at least 0.18 percentage points.

If a smaller probability is considered, then one can expect the results to be more extreme and the impact on the minimum contribution rate to be larger. For a once every fifty years event, the left tail event for the best-estimate portfolio is a nominal return of -18.5% or less while the right tail event is a nominal return of +28.3% or more. As a result of these two tail events, the minimum contribution rate could increase or decrease by at least 0.28 percentage points.

Portfolio 4, the lower-risk portfolio, has the lowest proportion of variable income securities and thus, the lowest volatility compared to the best-estimate portfolio and Portfolio 5. As such, the tail events for this portfolio are less extreme than for a riskier portfolio when considering the same

probability levels. It then follows that the impact on the minimum contribution rate is less when compared to a riskier portfolio.

Portfolio 5 has a greater proportion of variable income securities compared to the other two portfolios and thus the highest volatility. As such, the left and right tail events for Portfolio 5 are more extreme. As a result, the impact on the minimum contribution rate is larger when the portfolio shocks occur. Once every fifty years, a nominal return of -20.5% or less may occur resulting in an absolute increase of at least 0.36 percentage points to the minimum contribution rate. Although such an event is not common, the immediate impact on the financial state of the Plan would be significant.

Investment portfolio shocks, whether positive or negative, can have an immediate and significant impact on the financial state of the Plan. The impact varies depending on the amount of risk present in the portfolio. A portfolio more heavily weighted toward variable income securities will likely experience greater changes in market upswings and downturns, and the minimum contribution rate under such a portfolio will likewise change to a significant degree. The upside of investing in a risky portfolio must be weighed against the downside risk and the associated probability of poor investment returns occurring.

IV. Individual Sensitivity Tests

This actuarial report on the Canada Pension Plan is based on the projection of its revenues and expenditures over a long period of time. The information required by statute, which is presented in the Results section of this report, has been derived using best-estimate assumptions regarding future demographic and economic trends. The key best-estimate assumptions, i.e. those for which changes within a reasonable range have the most significant impact on the long-term financial results, are described in Appendix E. 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. Individual sensitivity tests have been performed that consist of projecting the financial state of the Plan using alternative assumptions.

With the exception of the mortality rates and labour market tests, which use purely deterministic models based on judgment, the individual assumption sensitivity tests are developed using a combination of judgment and stochastic modeling techniques. All of the tests are described in the sections below.

Stochastic modeling techniques estimate the probability distribution of an outcome for each selected assumption, and these distributions are used to quantify a range of possible outcomes. The fluctuation in each variable other than the rate of return on investments is projected by using standard time-series modeling, a method designed to make inferences based on historical data. The fluctuation in the rate of return on investments is based on a normal distribution of returns and is projected using historical correlations between asset classes, historical standard deviations, and expected returns for each asset class.

With the time series approach, a variable is modeled by an equation that captures a relationship between current and prior years' values of the variable. A year-by-year random variation consistent with the variation observed in the historical period is then introduced. Parameters for the equations are estimated using historical data for periods that range between 25 years and 53 years. Each time-series equation is designed such that, in the absence of random variation, the expected value of the variable is equal to the value assumed under the best-estimate assumption.

For the stochastically analyzed assumptions, a minimum of 10,000 outcomes are generated for each year in the projection period. Although the yearly outcome of each variable will fluctuate, it is the average outcome over the projection period that will determine the financial condition of the Plan. Therefore, an 80% confidence interval is calculated for the cumulative average of each assumption to determine, with 80% probability, the range of possible outcomes over the entire 75-year projection period. If a shorter projection period were to be considered, such as ten or fifteen years, one could expect the average 80% confidence interval to be wider since the outcomes will not have had enough time to stabilize. The upper and lower values of the 80% confidence interval are used as the low-cost and high-cost assumptions, or vice versa depending on the assumption, for these individual sensitivity tests.

The results should be interpreted with caution and a full understanding of the inherent limitations of stochastic modeling. Results are very sensitive to model specifications, degrees of interdependence among variables, and the historical periods used for the parameters estimates. For some variables, using the variations exhibited in relatively recent or, conversely, earlier historical periods may not provide a realistic representation of the potential variation for the future. Furthermore, additional variability could result from incorporating statistical approaches that would more fully model change in the long-range central tendencies of the variables. The historical periods chosen for most variables are relatively homogeneous and do not reflect substantial shifts. The time-series modeling reflects what occurred in these historical periods. As a result, the variation indicated in this section should be viewed as the minimum plausible variation for the future. Structural shifts, as predicted by many experts and as seen in prior centuries, are not reflected in the current models. Rather, the projection models or time series are adjusted to reflect the best judgment over a long period.

The sensitivity tests were performed by varying most of the key assumptions individually in a manner consistent with the results of the stochastic analysis and by keeping the remaining assumptions at their best-estimate levels. Each sensitivity test was categorized as either a low-cost scenario or a high-cost scenario. In the low-cost scenarios, the alternative assumptions have the effect of reducing the minimum contribution rate. Conversely, assumptions for the high-cost scenarios increase the minimum contribution rate.

The alternative assumptions selected are intended to represent a wide range of potential long-term experience. However, the individual results cannot simply be combined because a change in any one particular assumption may have an impact on other assumptions to various degrees.

Table 23 summarizes the alternative assumptions used in the individual sensitivity tests. It is followed by a brief discussion of each assumption and the impact that the variation in each assumption has on the results.

Table 23 Individual Sensitivity Test Assumptions

	Canada	Low-Cost		Best-Estimate		High-Cost	
1	Total fertility rate	2.00		1.65		1.30	
2	Mortality: Canadian life expectancy at age 65 in 2050 with future improvements[1]	Males	20.9	Males	23.3	Males	25.8
		Females	23.2	Females	25.6	Females	27.9
3	Net migration rate	0.66%		0.62%		0.58%	
4	Labour Market:						
	Participation rate (aged 15-69)[1]	82.7% (2035)		77.5% (2035)		73.7% (2035)	
	Unemployment rate[1]	4.2%		6.2%		8.2%	
	Average CPP retirement benefit take-up age[1]	63.7 (2040)		62.7 (2040)		61.7 (2040)	
5	Rate of increase in prices	2.5%		2.0%		1.5%	
6	Real wage increase	1.8%		1.1%		0.4%	
7	75-year average real rate of return	5.6%		3.9%		2.2%	
8	CPP disability incidence rates (per 1,000 eligible)	Males	2.30	Males	3.10	Males	3.90
		Females	2.80	Females	3.65	Females	4.50

(1) For these tests, a deterministic instead of a stochastic approach was used to derive the low- and high-cost estimates.

A. Fertility Rate

The best estimate assumption is that the total fertility rate for Canada will increase slightly from its 2011 level of 1.61 to an ultimate level of 1.65 in 2019. Based on historical fertility experience of the last 40 years (1972 to 2011), a stochastic approach was used to generate the low and high cost scenarios over the 75 year projection period. Factors such as higher labour force participation of women, later entry into marriages or common-law relationships, higher and longer periods of education, as well as others, make it unlikely that high fertility rates such as those experienced during the post-WWII baby boom period will be seen again in the future. Therefore, the experience period selected for the stochastic analysis excludes periods of high fertility rates.

It was projected that the average total fertility rate throughout the 75 year projection period will be in the range 1.3 to 2.0 with 80% probability. Instead, if a 15-year projection period is considered, then the average total fertility rate will be in the range 1.5 to 1.8.

The low-cost assumption has the total fertility rate increasing to an ultimate level of 2.0 in 2019, which is lower than the national population replacement rate. The total Canadian fertility rate has not been above 2.0 since 1972. Under this scenario, the population grows to a level in 2050 that is 8.1% higher than under the best-estimate assumption. In addition, a higher ultimate total fertility rate leads to a younger population. Thus, the dependency ratio, defined as the ratio of those aged 65 and over to the working-age population (20-64), is 0.44 (or approximately 2.3 workers per retiree) in 2050 compared to a dependency ratio of 0.46 (or approximately 2.2 workers per retiree) under the best-estimate assumption.

The high-cost assumption has the total fertility rate decreasing to an ultimate level of 1.3 in 2019. This is similar to the recent total fertility rates of Italy and Japan. Under this scenario, the population grows much more slowly, to a level in 2050 that is 7.7% lower than under the

best-estimate assumption. A lower ultimate total fertility rate leads to an older population. In this scenario, the dependency ratio increases from the best-estimate value of 0.46 (or 2.2 workers per retiree) in 2050 to 0.49 (or 2.0 workers per retiree).

B. Mortality Rates

The calendar year life expectancies (without assumed future mortality improvements) at age 65 in 2011 are 18.9 years for males and 21.8 years for females. The best-estimate scenario provides for future mortality improvements, such that the cohort life expectancy at age 65 in 2011 is 20.8 years for males (or 1.9 years higher than the calendar year life expectancy), and 23.4 years (or 1.6 years higher) for females. The best-estimate ultimate value of the mortality improvement rates is 0.8%, which is reached in 2032. The following two sensitivity tests represent alternatives for the assumed mortality improvement rates.

Under the low-cost scenario, mortality is assumed to improve at a slower rate than under the best-estimate scenario, reflecting that current level of mortality improvements might not be sustainable. The ultimate value of the mortality improvement rates is reduced to 0% in 2032 representing an absolute reduction of 0.8%. For years between 2011 and 2032, improvement rates gradually decrease from the year 2011 rates, corresponding to the average annual mortality improvement rates experienced over the last 15-year period ending in 2011, to 0%. As a result, the population grows to a level in 2050 that is 1.7% lower than under the best-estimate assumption. In addition, the dependency ratio decreases to 0.44 (or 2.3 workers per retiree) compared to a best-estimate of 0.46 (or 2.2 workers per retiree) due to lower life expectancies as well as lower projected number of retirees compared to the working-age population.

Under the high-cost scenario, mortality is assumed to improve at a faster pace than under the best-estimate scenario. The ultimate value of the mortality improvement rate is doubled compared to the best-estimate value and corresponds to 1.6%, representing an absolute increase of 0.8%. As a result, the population grows to a level in 2050 that is 1.6% higher than under the best-estimate assumption. In addition, the dependency ratio increases to 0.49 (or 2.1 workers per retiree) due to higher projected life expectancies as well as higher projected numbers of retirees compared to the working-age population.

Table 24 presents the life expectancies that would result in 2050 from the different rates of improvement.

Table 24 Life Expectancy in 2050 under Alternative Assumptions[(1)]
(Canada)

		Low Cost	Best Estimate	High Cost
At Birth	Males	82.0	89.1	94.7
	Females	85.4	91.8	96.7
At Age 65	Males	20.9	23.3	25.8
	Females	23.2	25.6	27.9

(1) These are cohort life expectancies that take into account future improvements in mortality of the general population and therefore differ from calendar year life expectancies, which are based on the mortality rates of the given attained year.

If no future mortality improvements are assumed at all after 2011, projected life expectancies would remain at their 2011 calendar year value for all future years and the minimum contribution rate would decrease to 8.99%. The difference of 0.80% between the minimum contribution rate of

9.79% under the best-estimate scenario and the rate of 8.99% represents the cost of improving longevity.

C. Net Migration Rate

Under the best-estimate assumption, the net migration rate (which assumes no growth in the number of non-permanent residents) is assumed to increase from its current (2015) level of 0.55% of the population to an ultimate level of 0.62% of the population in the year 2016.

A stochastic approach was used to generate low- and high-cost scenarios over the 75-year projection period based on the net migration experience of the last 44 years (1972 to 2015). It is projected that average net migration (assuming no growth in non-permanent residents) throughout the entire projection period will be in the range of 0.58% to 0.66% of the population with 80% probability. If a 15-year projection period is considered, then the average net migration would be in the range of 0.53% to 0.71% of the population.

The low-cost assumption has net migration reaching a level of 0.66% of the population in 2016 and remaining at that level thereafter. This is close to the average net migration rate over the five-year period ending in 2014. Under this scenario, the population grows to a level in 2050 that is 1.8% higher than under the best-estimate assumption. As well, the dependency ratio of those aged 65 and over to the working-age population (20-64) changes very little from the best estimate of 0.46 (or 2.2 workers per retiree) in 2050.

The high-cost assumption has net migration reaching a level of 0.58% of the population in 2016 and remaining at that level thereafter. This is close to the average net migration rate experienced during the 1990s. Under this scenario, the population grows more slowly, to a level in 2050 that is 1.7% lower than under the best-estimate assumption. As well, the dependency ratio is 0.47 (or approximately 2.1 workers per retiree), which is slightly higher than the best estimate. The dependency ratio only changes slightly under both the low- and high-cost assumptions compared to the best-estimate, since the impact in each case depends on the age distribution of the immigrants and emigrants. Since for this report, both groups, those aged 65 and above and those aged 20 to 64, are projected to be affected similarly by net migration, there is very little change in the dependency ratio.

D. Labour Market

Employment levels are reflected in the actuarial projection model through the assumptions made regarding the level of labour force participation and job creation rates by year, age and sex. These rates vary not only with the rate of unemployment, but also reflect trends in increased workforce participation by women, longer periods of formal education among young adults, and trends in the retirement patterns of older workers.

This sensitivity test analyzes the impact of stronger and weaker labour demand on the cost of the Plan.

Under the best-estimate scenario, the job creation rate assumption is determined on the basis of expected moderate economic growth and an unemployment rate that is expected to gradually decrease from 2016 level of 7.1% to an ultimate rate of 6.2% by 2025. Furthermore, the participation rates for all age groups are expected to increase due to the attractive employment opportunities resulting from labour shortages and the aging of cohorts with stronger labour

attachments, especially for women and individuals with higher education attainment. The assumed increase in participation rates of those aged 55 and over is even more significant, given that it is also affected by the expected continued trend toward delayed retirement. Under the best-estimate scenario, the participation rate of those aged 15 to 69 is expected to increase from 74.3% in 2016 to 77.5% in 2035.

For cohorts reaching age 60 in 2016 and thereafter, the retirement rates at age 60 are assumed to be 34% and 38% in 2016 and thereafter, and the retirement rates at age 65 are assumed to be 41% and 39% in 2021 and thereafter for males and females, respectively. These rates result in a projected average age at take-up of 62.7 in 2040.

A deterministic model (instead of a stochastic model) was used to generate the low-cost and high-cost scenarios for these assumptions, since a stochastic model would not accurately reflect the assumed future trends in labour force participation and unemployment. The labour shortages and the trend toward delayed retirement are unlike any labour situation experienced in the past, and thus the historical data do not reflect any substantial shifts like the one being projected. Therefore, it was decided to use judgment in determining the low and high cost assumptions for participation rates, unemployment and retirement rates.

Under the strong labour demand scenario, the job creation rate is robust resulting in a lower unemployment level, higher labour force participation rates, and later retirement due to the availability of employment and unwillingness to incur early retirement penalties. Such an environment has the effect of lowering the minimum contribution rate. For this low-cost scenario, the job creation rates are assumed to increase at a faster pace than under the best-estimate scenario, resulting in an unemployment rate of 4.2% in 2025 and thereafter. In addition, ultimate male participation rates in 2035 are assumed to increase more than expected as a result of a higher than anticipated impact of the labour shortage and the delayed retirement trend on future labour market participation. Furthermore, the ultimate gap in 2035 between male and female participation rates is equal to 3.4% as opposed to 6.7% under the best-estimate scenario. This results in an overall participation rate of 82.7% for those aged 15 to 69 in 2035. The lower unemployment rate and higher participation rate are assumed to encourage CPP participants to ask for their CPP retirement benefits at a later age. Therefore, by 2035, retirement rates at age 60 are assumed to gradually decrease to levels that are 20 percentage points lower than the best estimates, i.e. 14% and 18% for males and females, respectively. This results in an increase in a projected average age at take-up from 62.7 to 63.7 in 2040.

Under the weaker labour demand scenario, the job creation rate is lower resulting in a higher unemployment level and lower labour force participation rates. Insufficient employment opportunities are likely to force Plan contributors to ask for their CPP retirement benefit at an earlier age regardless of the early retirement reduction. Such an environment results in a higher minimum contribution rate. For this high-cost scenario, the job creation rates are assumed to increase at a slower pace than under the best-estimate scenario, resulting in an unemployment rate of 8.2% in 2025 and thereafter. In addition, male and female participation rates are assumed to remain constant at their 2015 levels. This results in an overall participation rate of 73.7% for those aged 15 to 69 in 2035. The higher unemployment rate and lower participation rate are assumed to encourage CPP participants to ask for their CPP retirement benefits at an earlier age. Therefore, by 2035, retirement rates at age 60 are assumed to gradually increase to levels that are 20 percentage points higher than the best estimate, i.e. 54% and 58% for males and females,

respectively. This results in a decrease in a projected average age at take-up from 62.7 to 61.7 in 2040.

For both low- and high-cost scenarios, the proportions of working beneficiaries were adjusted compared to the best-estimate scenario in order to reflect the change in retirement behavior.

E. Price Increases

Higher price increases result in a lower minimum contribution rate for the CPP. Indeed, although a higher rate of increase in prices produces higher CPP expenditures, this increase in cost is outweighed by higher nominal contributory earnings and thus, higher contributions.

For the best-estimate projections, the annual rate of price increase is assumed to be 1.6% in 2016, 2.0% in 2017, and to remain at that level thereafter.

Based on the overall inflation rate experience over the last 33 years (1983 to 2015), a stochastic approach was used to generate the low- and high-cost scenarios over the 75-year projection period. The Bank of Canada has been successful in its inflation targeting policies, implemented in the early 1990s, that have resulted in price increases being mostly contained in the 1% to 3% target range with little volatility. Although central banks might not always be able to control inflation, recent monetary policies in Canada and around the world make it unlikely that very high price increase periods such as the ones after the Second World War and in the 1970s will reoccur. Therefore, the chosen experience period covers periods of both moderately high and low inflation but excludes periods of extremely high inflation seen in earlier years. It was projected that the average annual rate of price increase during the 75-year projection period will be in the range 1.5% to 2.5% with 80% probability. Instead, if a 15-year projection period is considered, then the average annual rate of price increase will be in the range 1.0% to 2.9%.

For the low-cost scenario, the annual rate of price increase is assumed to rise to 2.5% in 2017 and remain at that level thereafter. This level of inflation is comparable to the average of the 1960s and over the last three decades.

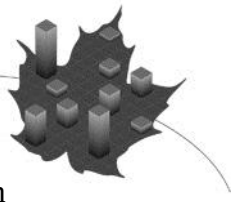
For the high-cost scenario, the annual rate of price increase is assumed to be 1.5% in 2017 and remain at that level thereafter. This level of inflation is comparable to the average of the mid-to-late 1990s.

F. Real Wage Increase

Wage increases affect the financial balance of the CPP in two ways. In the short-term, an increase in the average wage translates into higher contribution income with little immediate impact on benefits. Over the longer term, higher average wages produce higher benefits.

An ultimate real wage increase of 1.1% has been assumed for the year 2025 and thereafter for the best-estimate projections. The ultimate real wage increase assumption, combined with the ultimate price increase assumption of 2.0%, yields the assumption for the ultimate nominal annual increase in wages of 3.1% in 2025 and thereafter. During the initial years of the projection period, the real wage increase is assumed to rise gradually to its ultimate level.

Based on the overall real wage experience of the last 53 years (1962 to 2014), a stochastic approach was used to generate the low- and high-cost scenarios over the 75-year projection period. It was projected that the average real wage increase throughout the 75-year projection



period will be in the range 0.4% to 1.8% with 80% probability. Instead, if a 15-year projection period is considered, then the average real wage increase will be in the range -0.2% to 2.2%.

For the low-cost scenario, the assumed real wage increase rises to an ultimate level of 1.8% in 2025. For the high-cost scenario, the assumed real wage increase is held constant at a level of 0.4% for 2017 and thereafter.

G. Rate of Return on Investments

In accordance with the policy of investing CPP assets in a diversified portfolio, the 75-year average annual real rate of return on investments is projected to be 3.9% under the best-estimate assumptions. Using the assumed asset mix of this report and based on historical correlations and standard deviations of returns by asset classes, a stochastic approach was used to generate the low- and high-cost scenarios over the 75-year projection period. It was projected that the average annual real rate of return during the 75-year projection period will be in the range 2.2% to 5.6% with 80% probability. Instead, if a 15-year projection period is considered, then the average annual real rate of return will be in the range -0.2% to 7.4%.

For the low-cost scenario, the average annual real rates of return on investments are assumed to be 1.7% higher than under the best-estimate assumptions for the projection period, averaging 5.6% over the next 75 years. For the high-cost scenario, the annual real rates of return on investments are assumed to be 1.7% lower than under the best-estimate assumptions for the projection period, averaging 2.2% over the next 75 years.

The real rates of return do not affect either expenditures or contributory earnings. However, beginning in 2021 when net cash flows of the Plan are projected to turn negative, a portion of investment income will be required to pay Plan benefits. Thus, sufficient real rates of return are required to produce investment income large enough to both cover the necessary portion of Plan expenditures and continue increasing the assets of the Plan.

H. Disability Rates

The best-estimate projections assume that disability incidence rates will remain at levels comparable to what has been experienced in recent years. The aggregate ultimate rate of incidence for the year 2020 and later is 3.10 new disability beneficiaries per year among 1,000 eligible workers for males and 3.65 per thousand for females, on average.

Based on the overall disability incidence rate experience of the last 46 years (1970 to 2015), a stochastic approach was used to generate the low- and high-cost scenarios over the 75-year projection period. It was projected that the average annual disability incidence rate for males over the 75-year projection period will be in the range 2.30 to 3.90 per 1,000 eligible workers with 80% probability. For females, the range of disability incidence rates is 2.80 to 4.50 per 1,000 eligible workers.

For the low-cost scenario, disability incidence rates are assumed to reach ultimate levels in 2020 of 2.30 per thousand for males and 2.80 per thousand for females. Other than in recent years for male incidence rates, neither male nor female incidence rates have been below 3.0 since the early 1970s (on a year 2015 eligible population-adjusted basis for comparison purposes).

For the high-cost scenario, disability incidence rates are assumed to reach ultimate levels in 2020 of 3.90 per thousand for males and 4.50 per thousand for females. These rates are lower than the high levels experienced in the 1980s and early 1990s.

I. Results

Under each scenario, the contribution rate was projected to follow the current schedule through 2018, and a new minimum contribution rate was determined for 2019 and thereafter. Table 25 summarizes the minimum contribution rate and pay-as-you-go rates under each of the scenarios. In addition, the table presents the first year that expenditures exceed contributions.

Table 25 Sensitivity of Minimum Contribution Rate
(percentages)

	Assumption	Scenario	Minimum Contribution Rate[1]	First Year Expenditures Exceed Contributions[2]	Pay-As-You-Go Rates	
					2025	2050
		Best Estimate	9.79	2020	10.52	11.17
1	Total Fertility Rate	Low Cost	9.40	2019	10.52	10.59
		High Cost	10.22	2023	10.52	11.83
2	Mortality Rates	Low Cost	9.46	2019	10.51	10.83
		High Cost	10.10	2022	10.53	11.49
3	Net Migration Rate	Low Cost	9.72	2020	10.47	11.03
		High Cost	9.86	2021	10.57	11.31
4	Labour Market	Low Cost	9.47	2020	9.88	10.60
		High Cost	10.14	2020	11.20	11.69
5	Price Increases	Low Cost	9.67	2020	10.42	11.01
		High Cost	9.93	2021	10.61	11.35
6	Real Wage Increase	Low Cost	9.31	2019	10.28	10.05
		High Cost	10.32	2022	10.95	12.51
7	Real Rate of Return on Investments	Low Cost	8.54	2019	10.52	11.17
		High Cost	11.05	2032	10.52	11.17
8	Disability Rates	Low Cost	9.62	2020	10.39	10.97
		High Cost	9.97	2021	10.65	11.38

(1) The minimum contribution rate in this table refers to the rate applicable for 2019 and thereafter.
(2) Projections use the minimum contribution rate.

As shown in Table 25, the valuation results are more sensitive to some assumptions than to others when there are changes in long-term expectations. Fertility is the most sensitive demographic assumption as shown by the wide range of the minimum contribution rate. If the total fertility rate were to decrease to a level of 1.3 in 2019 and remain at that level thereafter, the minimum contribution rate would increase to 10.22%. If instead the total fertility rate increased to an ultimate level of 2.0 for all years 2019 and thereafter, the minimum contribution rate would decrease to 9.40.

The most sensitive economic assumptions are the real wage increase and the real rate of return on investments. If an ultimate real wage increase of 1.8% is assumed for 2025 and thereafter, the minimum contribution rate would decrease to 9.31%. However, if an ultimate real wage increase of 0.4% is assumed for 2017 and thereafter, the minimum contribution rate would increase to 10.32%.

Real rates of return can fluctuate greatly from year to year and can have a significant impact on the minimum contribution rate. If an average annual real rate of return over the next 75 years is assumed to be 5.6%, the minimum contribution rate decreases to 8.54%. However, if the average

annual real rate of return over the next 75 years is assumed to be 2.2%, the minimum contribution rate increases to 11.05%.

Unlike the minimum contribution rate, the pay-as-you-go rates are not affected by the assumed rates of returns on investments. Although the minimum contribution rate and pay-as-you-go rates tend to move in the same direction, the ultimate pay-as-you-go rates do not stabilize under some of the sensitivity tests. In such cases, while the minimum contribution rates shown in Table 25 would be adequate throughout the projection period, they could still result in significant increases or decreases in the ratio of assets to expenditures in later years.

It should be noted that once the low- and high-cost assumptions reach their ultimate values, they are held constant for the rest of the 75-year projection period and the Plan is assumed to remain in its current form. This may not be realistic. As new demographic and economic trends in society emerge, it may be necessary to update the Plan in order to reflect a new demographic or economic reality with the objective of maintaining affordability and intergenerational equity.

Table 26 summarizes the first year that expenditures exceed contributions and the projected impact on the ratio of the assets to the following year's expenditures under each of the alternative sets of assumptions if the current scheduled contribution rate of 9.9% continues to apply in years 2016 and thereafter.

Table 26 Sensitivity of Funding Levels
(9.9% contribution rate)

	Assumption	Scenario	First Year Expenditures Exceed Contributions	Asset/Expenditure Ratio		
				2025	2050	2090
		Best Estimate	2021	6.49	7.28	7.39
1	Total Fertility Rate	Low Cost	2021	6.49	7.68	13.19
		High Cost	2021	6.49	6.87	0.77
2	Mortality Rates	Low Cost	2021	6.50	7.97	13.12
		High Cost	2021	6.47	6.67	3.20
3	Net Migration Rate	Low Cost	2021	6.51	7.51	8.33
		High Cost	2021	6.47	7.05	6.42
4	Labour Market	Low Cost	2026	6.87	9.66	11.18
		High Cost	2020	6.13	5.14	2.77
5	Price Increases	Low Cost	2022	6.54	7.75	9.11
		High Cost	2021	6.44	6.79	5.54
6	Real Wage Increase	Low Cost	2021	6.54	8.70	12.61
		High Cost	2020	6.37	5.50	N/A[(1)]
7	Real Rate of Return on Investments	Low Cost	2021	7.52	14.07	47.47
		High Cost	2021	5.58	3.42	N/A[(2)]
8	Disability Rates	Low Cost	2022	6.64	8.04	10.01
		High Cost	2021	6.34	6.54	4.85

(1) Assets depleted by 2086.
(2) Assets depleted by 2075.

V. High and Low Economic Growth

The current local and global economic environments pose a series of challenges for Canada to sustain consistent economic growth. Persistent low interest rates, slow and uncertain recovery from the 2008-09 slowdown, slow productivity growth, as well as demographic pressures from an ageing population could adversely affect the Canadian economy. While under the best-estimate scenario, moderate and sustainable economic growth is assumed, different scenarios of long-term high and low economic growth were considered. These alternative economic growth scenarios comprise combinations of the individual sensitivity test assumptions pertaining to the labour market and real wage increases.

Under the high economic growth scenario, the job creation rates are assumed to increase at a faster pace than under the best-estimate scenario, resulting in an unemployment rate of 4.2% in 2025 and thereafter. In addition, the assumed ultimate male participation rates in 2035 are set at higher levels than the best estimates, and the assumed ultimate gap in 2035 between male and female participation rates is set equal to 3.4% as opposed to 6.7% under the best-estimate scenario. This results in an overall participation rate of 82.7% for those aged 15 to 69 in 2035.

The lower unemployment rate and higher participation rate are assumed to encourage individuals to ask for their CPP retirement benefits at a later age. Therefore, by 2035, retirement rates at age 60 are assumed to gradually decrease to levels that are 20 percentage points lower than the best estimates, i.e. 14% and 18% for males and females, respectively. This results in an increase in the projected average age at pension take-up from 62.7 to 63.7 in 2040. Finally, the real wage increase is assumed to be 1.8% as opposed to 1.1% under the best-estimate scenario. The high economic growth scenario results in total employment earnings in 2035 being 19% higher compared to the best estimate.

Under the low economic growth scenario, the job creation rates are assumed to increase at a slower pace than under the best-estimate scenario, resulting in an unemployment rate of 8.2% in 2025 and thereafter. In addition, male and female participation rates are assumed to remain constant at their 2015 levels. This results in an overall participation rate of 73.7% for those aged 15 to 69 in 2035.

The higher unemployment rate and lower participation rate are assumed to encourage individuals to ask for their CPP retirement benefits at an earlier age. Therefore, retirement rates at age 60 are assumed to gradually increase to levels in 2035 that are 20 percentage points higher than the best estimate, i.e. 54% and 58% for males and females, respectively. This results in a decrease in a projected average age at take-up from 62.7 to 61.7 in 2040. Finally, the real wage increase is assumed to be 0.4% compared to 1.1% under the best-estimate scenario. The low economic growth scenario results in the total employment earnings in 2035 being 16% lower compared to the best estimate.

Table 27 presents a summary of the assumptions used in the sensitivity analysis of economic growth and the resulting minimum contribution rates. The minimum contribution rates are 9.05% and 10.72% for the high and low economic growth scenarios, respectively.

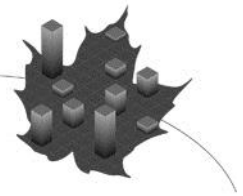


Table 27 High and Low Economic Growth Sensitivity Tests

Canada	High Economic Growth	Best-Estimate	Low Economic Growth
Participation Rate (age group 15-69)	82.7% (2035)	77.5% (2035)	73.7% (2035)
Unemployment Rate	4.2%	6.2%	8.2%
Average CPP Retirement Benefit Take-up Age	63.7 (2040)	62.7 (2040)	61.7 (2040)
Real Wage Increase	1.8%	1.1%	0.4%
Minimum Contribution Rate(1)	**9.05%**	**9.79%**	**10.72%**

(1) The minimum contribution rate in this table refers to the rate applicable for 2019 and thereafter.

VI. Younger and Older Populations

Demographic and labour force assumptions are modified in this section with the purpose of projecting younger and older populations compared to the best estimate. However, these alternative populations do not necessarily reflect probable scenarios. Using the demographic assumptions of the individual sensitivity tests, two alternative scenarios were examined. The first scenario is classified as the younger population scenario, since the ratio of retirees to workers is lower than under the best-estimate assumptions. The second scenario has a ratio of retirees to workers that is higher than the best-estimate and is referred to as the older population scenario. Once the two populations were created, the labour force participation rates were modified to align with the new populations.

The demographic assumptions anticipated in these scenarios were determined using the low- and high-cost assumptions regarding fertility, mortality, and migration rates, as well as the labour force participation rates pertaining to the low- and high-cost labour market tests described in section IV.

The choice of assumptions will always remain subjective to a certain extent and one could always argue that the range of possible projected outcomes presented herein is not realistic. However, one must keep in mind that these alternative scenarios are only presented to provide a reasonable range of possible future outcomes for the cost of the Plan.

A. Younger Population

Under the younger population scenario, it is assumed that the ultimate total fertility rate is 2.0 per woman for both Canada and Québec. Mortality improvement rates are assumed to increase at a much slower pace than under the best-estimate scenario. The result is that life expectancies at age 65 decrease from their projected best-estimate by approximately 2.5 years for both males and females by 2050. Finally, net migration to Canada is assumed to reach a level of 0.66% of the population in the year 2016.

The combination of these younger population assumptions results in a dependency ratio of those aged 65 and over to the working-age population (20-64) of about 0.41 (or 2.4 workers per retiree) in 2050. This is 12% lower than under the best-estimate scenario where the ratio reaches a level of 0.46 (or 2.2 workers per retiree) in 2050. Under this younger population scenario, the population grows more rapidly, to a level in 2050 that is 8.2% higher compared to the best-estimate scenario.

It is assumed that under a better demographic outlook a possible labour shortage would be less severe. As a result, it is assumed that the labour force participation rates would be lower, especially at the younger and older ages.

B. Older Population

Under the older population scenario, it is assumed that the ultimate total fertility rate is 1.3 per woman for both Canada and Québec. Mortality improvement rates are assumed to increase at a faster pace than under the best-estimate scenario. The result is that life expectancies at age 65 increase from their projected best-estimate levels by approximately 2.5 years for both males and females by 2050. Finally, net migration to Canada is assumed to fall to a level of 0.58% of the population in the year 2016.

The combination of these older population assumptions results in a dependency ratio of those aged 65 and over to the working-age population (20-64) of about 0.52 (or 1.9 workers per retiree) in 2050. This is 12% higher than under the best-estimate scenario where the dependency ratio reaches a level of 0.46 (or 2.2 workers per retiree) in 2050. Under this older population scenario, the population grows more slowly, to a level in 2050 that is 7.8% lower compared to the best-estimate scenario.

It is assumed that with a poorer demographic outlook a possible labour shortage would be more severe. For this purpose, it is assumed that the labour force participation rates would be higher, especially at the older ages.

C. Results

Table 28 presents a summary of the assumptions used in this sensitivity analysis and the resulting minimum contribution rates. The minimum contribution rates are 9.33% and 10.23% for the younger and older population scenarios, respectively.

Table 28 Younger and Older Populations Sensitivity Test Assumptions

Canada	Younger Population		Best-Estimate		Older Population	
Total fertility rate	2.00		1.65		1.30	
Mortality:						
Canadian life expectancy at age 65 in	Males	20.9	Males	23.3	Males	25.8
2050 with future improvements	Females	23.2	Females	25.6	Females	27.9
Net migration rate	0.66%		0.62%		0.58%	
Participation rate (age group 15-69)	74% (2035)		78% (2035)		83% (2035)	
Minimum Contribution Rate[(1)]	**9.33%**		**9.79%**		**10.23%**	

(1) The minimum contribution rate in this table refers to the rate applicable for 2019 and thereafter.

Appendix C – Summary of Plan Provisions

I. Introduction

The *Canada Pension Plan* came into force on 1 January 1966. Since its inception, the CPP has been amended several times, the most recent occasion as a result of *An Act to amend the Canada Pension Plan and the Old Age Security Act (pension and benefits)*, which received Royal Assent on June 18, 2015. This Appendix presents a summary of the provisions of the Plan inclusive of all amendments. The legislation shall prevail if there is a discrepancy between it and this summary.

II. Participation

The CPP includes virtually all members of the labour force in Canada, including both employees and self-employed persons between the ages of 18 and 70 with employment earnings, other than those covered by the Québec Pension Plan (QPP). The main exceptions are persons with annual earnings lower than $3,500 (the Year's Basic Exemption, defined below), members of certain religious groups, and other persons who qualify under excepted employment. It should be noted that the CPP covers all members of the Canadian Forces and the Royal Canadian Mounted Police, including those residing in the province of Québec. The persons to whom a CPP disability pension is payable are not required to contribute.

Effective 1 January 2012, those persons in receipt of a CPP retirement pension who are aged less than 65 and who continue to work will be required to contribute to the Plan and will earn post-retirement benefits. Beneficiaries aged 65 or older who continue to work will not be required to contribute but may choose to do so. In any case, contributions are not permitted upon attaining age 70. This working beneficiaries provision is described further below.

III. Definitions

A. Year's Maximum Pensionable Earnings (YMPE)

The YMPE for a calendar year is the limit to which employment earnings are subject to contributions for purposes of the Plan. The YMPE increases each year to the extent warranted by the percentage increase, as at 30 June of the preceding year, in the 12-month average of the average weekly earnings of the Industrial Aggregate (as published by Statistics Canada). If the amount so calculated is not a multiple of $100, the next lower multiple of $100 is used. The YMPE is set at $54,900 in 2016.

B. Year's Basic Exemption (YBE)

The YBE for a calendar year is the minimum employment earnings required to participate in the Plan. As well, contributions are waived on earnings up to the YBE inclusive. The YBE is $3,500 in 2016.

C. Contributory Period

The contributory period is the number of months from attainment of age 18 or from 1 January 1966, if later, to the earliest of the month in which the contributor dies, the month before the one in which the retirement pension commences and the month before the one in which the contributor reaches 70 years of age, less the number of months during which the contributor received a CPP or QPP disability benefit (including the three-month waiting period), or during which the contributor had at least one eligible child under seven years of age and had earnings for

that year lower than the YBE. The contributory period excludes periods on or after 1 January 2012 during which beneficiaries contribute while in receipt of a retirement pension.

D. Pension Index

The Pension Index for a given calendar year is equal to the Consumer Price Index averaged over the 12-month period ending with October of the preceding year; however, the Pension Index of a given year may not be less than the previous year's Pension Index.

IV. Contribution Rates

From 1966 to 1986, the annual rate of contribution applicable to contributory earnings was 1.8% for employees (and the same amount for their employers) and 3.6% in respect of self-employed earnings. This combined employer-employee contribution rate of 3.6% was subject to an annual increase of 0.2 percentage points from 1987 to 1996, attaining 5.6% in the last year of that period.

Table 29 shows that the combined employer-employee contribution rates from 1997 to 2003 increased in steps to reach a rate of 9.9% by 2003, with no subsequent increases scheduled thereafter.

Table 29 Contribution Rates

Year	Contribution Rate (%)
1997	6.0
1998	6.4
1999	7.0
2000	7.8
2001	8.6
2002	9.4
2003+	9.9

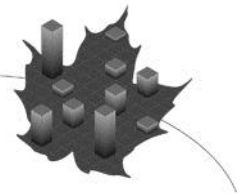
The legislation gives the federal and provincial ministers of finance the authority to make changes to the contribution rates through regulation, in connection with a triennial review. However, year-over-year contribution rate increases cannot exceed 0.2 percentage points; beyond that, legislation is required.

If a triennial actuarial report projects a minimum contribution rate in excess of the scheduled (legislated) rate and the finance ministers do not make a recommendation to either increase the legislated rate or maintain it, the insufficient rates provisions of the *Canada Pension Plan* would apply. The contribution rate would then be increased in stages and a possible temporary freeze on inflation adjustments to benefits in pay would apply.

V. Retirement Pension

A. Eligibility Requirements

A person aged 60 or over becomes eligible for a retirement pension upon application, provided contributions have been made during at least one calendar year. Prior to 2012, a work cessation test applied in order for a retirement pension to become payable before age 65. This test required individuals who applied to take their CPP retirement benefit early (i.e. before age 65) to either stop working or materially reduce their earnings both in the month immediately preceding and the month of benefit take-up. The month following the start of pension payment, an individual could return to work and/or earn more without affecting the eligibility for or amount of the benefit.



However, no further contributions to the CPP were allowed once benefits started being paid. There was no work cessation test for those aged 65 or older.

As of 1 January 2012, the work cessation test has been removed and no longer applies. Also commencing 1 January 2012, individuals aged less than 65 who choose to work in Canada outside of Québec while receiving a CPP or QPP retirement pension are required, along with their employers, to contribute to the CPP. Working beneficiaries aged 65 or older are given the option of continuing to contribute to the Plan; however, employers of those opting to do so are also required to contribute. The contributions from working beneficiaries are applied toward providing a post-retirement benefit only and do not affect eligibility for other CPP benefits. Upon attaining age 70, contributions are no longer permitted under the Plan.

B. Amount of Pension

The initial amount of the monthly retirement pension payable to a contributor under the Plan is based on his or her entire history of pensionable earnings during the contributory period. The retirement pension is equal to 25% of the average of the YMPE for the year of his or her retirement and the four previous years, referred to as the Maximum Pensionable Earnings Average (MPEA), adjusted to take into account the contributor's pensionable earnings. For this purpose, the contributor's pensionable earnings for any given month are indexed by the ratio of the MPEA for the year of retirement to the YMPE for the year to which the given month belongs.

Some periods with low pensionable earnings may be excluded from the calculation of benefits by reason of pensions commencing after age 65, disability, child-rearing for a child less than seven years of age, and the general drop-out provision.

The general drop-out provision allows for a number of years with low or zero earnings to be dropped from the calculation of the retirement benefit. For example, for someone who took his/her retirement benefit at age 65 and before 2012, the provision allowed for 15% of the number of months with the lowest earnings (up to a maximum of about seven years) to be dropped from the calculation of the benefit. The general drop-out provision increased to 16% on 1 January 2012 and further increased to 17% on 1 January 2014. As a result, currently about eight years of low or nil earnings (one more year than under the previous 15% general drop-out provision) may be dropped from the calculation of the retirement benefit for those contributors who take their benefit at age 65. The actual drop-out percentage that applies is based on the year of benefit take-up. The increase in the general drop-out provision increases the retirement pension, as well as the CPP disability and survivor pensions, since the determination of these benefits depend on the retirement pension.

The maximum monthly retirement pension at age 65 in 2016 is $1,092.50.

C. Adjustment for Early or Postponed Retirement Benefit

The retirement pension is subject to an actuarial adjustment that depends on the year and contributor's age at commencement of the retirement pension. The retirement pension is permanently adjusted downwards or upwards by a factor for each month between age 65 and the age when the pension commences or, if earlier, age 70. Prior to 2011, the adjustment factor for both pre-65 and post-65 pension take-up was 0.5% per month. Starting in 2011, the adjustment factors were changed in order to be restored to their actuarially fair values. For contributors who take their retirement benefit early (before age 65), the adjustment factor gradually increased to 0.6% per month over the five-year period 2012 to 2016. For those who take their benefit after age

65, the factor gradually increased to 0.7% per month over the three-year period 2011 to 2013. The new pension adjustment factors were set according to the following schedule:

Table 30 New Legislated Pension Adjustment Factors

Effective date	Pre-65 Downward Monthly Adjustment Factor	Post-65 Upward Monthly Adjustment Factor
1 January 2011	0.50%	0.57%
1 January 2012	0.52%	0.64%
1 January 2013	0.54%	0.70%
1 January 2014	0.56%	0.70%
1 January 2015	0.58%	0.70%
1 January 2016	0.60%	0.70%

The downward pension adjustment factor of 0.6% per month, applicable for the year 2016 and thereafter, will result in a pension that is reduced by 36% for pension take-up at age 60 (compared to a reduction of 30% based on the factor of 0.5%). The upward factor of 0.7% per month, applicable for 2013 and thereafter, will result in a pension increased by 42% for pension take-up at age 70 (compared to an increase of 30% based on the factor of 0.5%).

In accordance with subsection 115(1.11) of the *Canada Pension Plan*, the Chief Actuary shall calculate the pension adjustment factors and specify them in every third triennial CPP Actuarial Report, commencing with the CPP Actuarial Report as at 31 December 2015. As such, in accordance with the legislation, the pension adjustment factors on the basis of this 27th CPP Actuarial Report are provided in Appendix F of this report.

D. Working Beneficiaries

Prior to 2012, those who received a CPP retirement pension and then returned to work (i.e. working beneficiaries) did not pay contributions and therefore did not continue to build their CPP pension. Commencing 1 January 2012, individuals under the age of 65 who receive either a CPP or QPP retirement pension and continue to work in Canada outside of Québec are required, along with their employers, to contribute to the Plan. Working beneficiaries aged 65 to 69 are not required to contribute, but are given the option to do so. Employers of those working beneficiaries opting to contribute are also required to contribute.

The contributions paid by working beneficiaries provide for a post-retirement benefit that is earned at a rate of 1/40 of the maximum retirement pension under the CPP per year of additional contributions and is adjusted for the earnings level and age of the contributor. Contributions paid by working beneficiaries toward accruing the post-retirement benefit do not affect eligibility for other CPP benefits. In addition, pensionable earnings of working beneficiaries do not qualify for credit splitting.

A post-retirement benefit becomes payable the year following the year in which contributions are made, and multiple post-retirement benefits may accumulate over time. The total pension payable resulting from the combination of the retirement pension and post-retirement benefit may be greater than the maximum CPP or QPP pension payable. As for the CPP retirement pension, the post-retirement benefit is payable for a beneficiary's lifetime and is increased in accordance with inflation each January 1st.

The maximum monthly post-retirement benefit at age 65 in 2016 is $27.31.

VI. Disability Benefit

A. Eligibility Requirements

A person is considered disabled if he or she is determined to be suffering from a severe and prolonged mental or physical disability. A disability is considered severe if by reason of it the person is regularly incapable of pursuing any substantially gainful occupation; a disability is considered prolonged if it is likely to be long-continuing and of indefinite duration or likely to result in death.

A person who becomes disabled prior to age 65 and is not receiving a CPP retirement pension is eligible for a disability benefit provided that contributions have been made, at the time of disablement, for at least four of the previous six calendar years, counting years included wholly or partly in the contributory period. Contributions must be on earnings that are not less than 10% of the YMPE rounded, if necessary, to the next lower multiple of $100. Since 2008, contributors with 25 or more years of contributions to the Plan can meet the eligibility requirement with contributions in three of the last six years.

B. Amount of Pension

The amount of monthly benefit payable is the sum of a flat-rate portion ($471.43 in 2016) depending only on the year in which the benefit is payable and an earnings-related portion equal, when it commences, to 75% of the retirement pension under the Plan that would be payable at the onset of disability if the contributory period ended on that date and no actuarial adjustment applied. The automatic conversion of a disability benefit into a retirement pension at age 65 is based on the pensionable earnings at the time of disablement, price-indexed to age 65. In other words, the indexing from the time of disablement to age 65, which determines the initial rate of the retirement pension, is in line with increases in prices rather than wages.

In the case that both a disability and survivor benefit are payable, the monthly amount of the disability benefit is reduced. The maximum monthly disability benefit in 2016 is $1,290.81.

VII. Survivor Benefit

A. Eligibility Requirements

A legal spouse, a separated legal spouse not cohabiting with a common-law partner, or a common-law partner of a deceased contributor, is eligible for a survivor benefit if the following conditions are met as at the date of the contributor's death:

- The deceased contributor must have made contributions during the lesser of ten calendar years, or one-third of the number of years included wholly or partly in his or her contributory period, but not for less than three years.
- If the surviving spouse is the separated legal spouse of the deceased contributor, there must be no cohabiting common-law partner at the time of death. If the survivor is the common-law partner of the deceased contributor, the couple must have cohabited for not less than one year immediately before the death of the contributor. If the common-law partner is of the same-sex as the deceased contributor, the death must have occurred on or after 17 April 1985.
- The surviving spouse or common-law partner must have dependent children, be disabled, or be at least 35 years of age. A surviving spouse or common-law partner with dependent

children means a surviving spouse who wholly or substantially supports a child of the deceased contributor where the child is under age 18, aged 18 or over but under age 25 and attending school full-time, or aged 18 or over and disabled, having been disabled without interruption since attaining age 18 or the time of the contributor's death, whichever occurred later.

B. Amount of Pension

The amount of the monthly survivor benefit depends on the age of the survivor at the date of the contributor's death, the survivor's disability status, and the presence of dependent children. In the case that both a survivor and retirement benefit are payable, the monthly amount of the survivor's benefit is reduced. The following five cases are relevant:

1. New Survivor Age 45 to 65

The amount of monthly benefit payable until the surviving spouse or common-law partner attains age 65 is composed of two portions: a flat-rate benefit depending only on the year in which the survivor benefit is payable ($183.93 in 2016), and an earnings-related benefit depending initially only on the contributor's record of pensionable earnings under the Plan as at the date of death. The initial earnings-related portion (maximum of $409.69 in 2016) is equal to 37.5% of either the retirement pension of the deceased contributor if he or she had been receiving a pension, or the retirement pension that would have been payable to the deceased contributor if the contributory period had ended at the time of death, with no actuarial adjustment in either case.

2. New Survivor under Age 45

An eligible spouse or common-law partner, without dependent children and not disabled, who becomes widowed before age 35 is not entitled to a survivor's benefit but may be entitled at a later date if she or he becomes disabled (see 4) or attains age 65 (see 5). If such a survivor is between 35 and 45 years of age, she or he is entitled to a benefit amount calculated as described in 1 above but reduced (until the earlier of disablement or attainment of age 65) by 1/120 of such an amount for each month that the new survivor's age is less than 45.

3. New Survivor under Age 45 with Dependent Child(ren)

An eligible spouse or common-law partner who becomes widowed prior to age 45 and with dependent children is entitled to a survivor benefit calculated as in 1 above. Under certain circumstances, the survivor benefit is reduced or even discontinued when the survivor no longer has any dependent children. If the survivor is then under age 45 and not disabled, she or he is considered to be a new survivor entitled only to the benefit in accordance with 2 above.

4. Disabled Survivor under Age 65

An eligible surviving spouse or common-law partner under age 65 is entitled to a survivor benefit calculated as in 1 above whenever she or he is disabled. If the disabled surviving spouse or common-law partner recovers from disability before age 45, the survivor benefit is discontinued or reduced to what it would be for a new survivor in accordance with 2 above.

5. Survivor Age 65 or Over

At age 65, or upon becoming widowed at a later age, an eligible surviving spouse or common-law partner is entitled to a monthly benefit equal to 60% of either the retirement pension (maximum

of $655.50 in 2016) of the deceased contributor if he or she had been receiving a pension, or the retirement pension that would have been payable to the deceased contributor if the contributory period had ended at the time of death, with no actuarial adjustment in either case.

VIII. Death Benefit

A lump sum benefit is payable to the estate of a deceased contributor if the eligibility rules for survivor benefits are met. The amount of the death benefit is equal to the lesser of six times the monthly amount of retirement pension under the Plan accrued or payable in the year of death, adjusted to exclude any actuarial adjustments, and ten percent of the YMPE for the year of death, subject to a maximum of $2,500.

IX. Child Benefits

Each child under age 18 and each full-time student aged 18 to 25 who is dependent on a contributor eligible for a CPP disability benefit or was dependent on a deceased contributor who satisfied the contribution requirement for a survivor benefit is entitled to a flat-rate monthly benefit ($237.69 in 2016). Furthermore, a child may receive more than one child benefit simultaneously.

X. Inflation Adjustments

All monthly CPP benefits are increased in accordance with inflation each year. Benefits are multiplied on 1 January of each calendar year by the ratio of the Pension Index applicable for that calendar year to the Pension Index for the preceding year.

XI. Credit Splitting

Pensionable earnings may be split between divorced or separated couples (legal spouses or common-law partners) for each month the couple lived together. Pensionable earnings are used to establish eligibility for CPP benefits and to calculate the amounts of benefits. Contributors may obtain a credit split even if they have remarried. However, pensionable earnings cannot be split for any year in which the total earnings of the former couple do not exceed twice the YBE. Credit splitting also does not apply for any period of cohabitation during which a former spouse or common-law partner received a CPP retirement pension.

XII. Pension Sharing

Couples (legal spouses or common-law partners) in an ongoing relationship may voluntarily (at the request of one of them) share their CPP retirement pensions corresponding to the number of years during which they cohabited. This applies provided both spouses have reached the minimum age requirement to receive a retirement pension. Sharing is possible even if only one of the spouses has participated in the Plan. Pension sharing ceases upon separation, divorce, or death.

Appendix D – Detailed Reconciliations with Previous Report

The results presented in this report differ from those previously projected for a variety of reasons. Differences between the actual experience from 2013 through 2015 and that projected in the 26th CPP Actuarial Report for the same period were addressed in the Reconciliation with Previous Report section of this report. Since historical results provide the starting point for the projections shown in this report, these historical differences between actual and projected experience have an effect on the projections. The impact of the experience update and changes in the assumptions and methodology that have significantly changed the projected results are addressed in this section.

The pay-as-you-go rate, which is the ratio of expenditures to contributory earnings in a given year, is an important measure of the cost of the CPP and corresponds to the contribution rate that would need to be paid if there were no assets. One way of understanding the differences between the best-estimate projections in this report and those presented in the 26th CPP Actuarial Report is to look at the effects of various factors on the pay-as-you-go rates. The most significant effects are identified in the reconciliation presented in Table 31 and the discussion below.

The experience update had the effect of reducing the pay-as-you-go rates in the short and medium term mainly due to better than anticipated economic and benefits experience compared to the 26th CPP Actuarial Report. The impacts on the pay-as-you-go rates from the experience over the period 2013 to 2015 are shown inTable 31. In particular:

- The population was lower than expected due to lower than expected number of births and migration and higher number of deaths, which increase the pay-as-you-go rates over the projection period.
- Overall lower than expected benefit expenditures that resulted from an over-projection of retirement and survivor benefits and operating expenses outweighing an under-projection of disability benefits leads to a decrease in the pay-as-you-go rates over the near to medium term.
- Higher than anticipated growth in total employment earnings decreases the pay-as-you-go rates. This combined with the decrease due to the benefit expenditures experience more than offsets the increase from demographic experience over the near to medium term.

Changes made to the key assumptions since the previous triennial report were outlined in Table 1. The effects of these changes on the pay-as-you-rates are also shown in Table 31 and are summarized below.

- The assumed total fertility rates are similar to those assumed in the previous triennial report, and as such, have little impact on the pay-as-you-go rates.
- The assumed level of net migration is higher than in the previous triennial report, and this decreases the pay-as-you-go rates, because the higher growth in total contributory earnings outweighs the ultimate increase in expenditures.
- The higher mortality improvement rates at ages 85 and older assumed for this report increase the pay-as-you-go rates, because beneficiaries are expected to receive their benefits over longer periods of time.
- Changes in retirement benefit-related assumptions increase the pay-as-you-go rate in the medium to long term.

- The reductions in the assumed disability incidence rates reduce the pay-as-you-go rates over the projection period.
- The higher assumed labour force participation and employment rates decrease the pay-as-you-go rates, although the effect diminishes with time as the higher employment translates into higher benefit entitlements.
- The change in the real wage increase assumption causes the pay-as-you-go rates to rise due to the lower increase in contributory earnings compared to the previous triennial report.
- The lower assumed inflation rate has the effect of increasing the pay-as-you-go rates. Although a lower rate of increase in prices produces lower CPP expenditures, this decrease in cost is outweighed by the lower nominal contributory earnings.

Some other assumptions, which are described in Appendix E, were also changed. For example, the proportion of contributors married or in a common-law relationship at time of death and the experience adjustment factors used in the projection of benefits were revised to reflect more recent experience. Overall, the changes in these other assumptions had the effect of slightly decreasing the projected pay-as-you-go rates over the long term.

Factors that lead to changes in the pay-as-you-go rates do not always have comparable effects on the minimum contribution rate. Furthermore, while the investment experience and assumptions have no effect on the pay-as-you-go rates, they may have a significant impact on the minimum contribution rate. Investment income was 248% higher than anticipated over the period 2013 to 2015 due to the strong performance of financial markets over that period. This results in an absolute decrease of 0.29% in the minimum contribution rate, as shown in Table 32. Regarding the real rates of return assumptions, changes compared to the previous triennial report include lower portfolio real rates of return over the short term due to an assumed increase in bond yields. In addition, real rates of return for bonds and equities are lower over the projection period. However, these changes are partially offset by higher real rates of returns on real assets and modifications to the asset mix that increase the proportion of assets invested in equities and real assets. A reconciliation of the change in the minimum contribution rate of 9.84% as presented in the 26th CPP Actuarial Report to the minimum contribution rate of 9.79% for this report is provided in Table 32.

A progression of the minimum contribution rate over time based on target years of future triennial valuation reports and using the best-estimate assumptions of this report is shown in Table 15 of the Results section of this report. As shown in that table, the minimum contribution rate is projected to remain relatively stable over time.

Table 31 Reconciliation of Changes in Pay-As-You-Go Rates[(1)]

(% of contributory earnings)

		2016	2025	2050	2075
26th CPP Actuarial Report		9.19	10.28	11.01	11.45
I.	**Improvements in Methodology**	**0.04**	**0.00**	**(0.04)**	**(0.04)**
II.	**Experience Update (2013-2015)**				
	Demographic	0.08	0.05	(0.03)	0.06
	Economic	(0.06)	(0.02)	(0.01)	(0.01)
	Benefits	(0.20)	(0.14)	(0.02)	0.00
	Subtotal:	**(0.18)**	**(0.10)**	**(0.06)**	**0.05**
III.	**Changes in Assumptions**				
	Fertility	0.00	0.00	0.01	0.02
	Net Migration	0.00	(0.04)	(0.08)	(0.04)
	Mortality	0.00	0.03	0.12	0.15
	Retirement	0.01	0.13	0.04	0.02
	Disability	0.00	(0.04)	(0.07)	(0.06)
	Labour Market	(0.01)	(0.02)	(0.03)	0.01
	Real Wage Increase	0.07	0.27	0.23	0.21
	Price Increases	0.02	0.02	0.06	0.06
	Other Assumptions	(0.02)	(0.03)	(0.03)	(0.02)
	Subtotal:	**0.07**	**0.33**	**0.26**	**0.33**
Total of I to III		**(0.06)**	**0.24**	**0.16**	**0.33**
27th CPP Actuarial Report		**9.13**	**10.52**	**11.17**	**11.78**

(1) Components may not sum to totals due to rounding.

Table 32 Reconciliation of Changes in Minimum Contribution Rate[1,2]

(% of contributory earnings)

	Minimum Rate
26th CPP Actuarial Report - After Rounding	**9.84**
26th CPP Actuarial Report - Before Rounding	**9.838**
I. Improvements in Methodology	**(0.008)**
II. Experience Update (2013-2015)	
Demographic	0.034
Economic	(0.007)
Benefits	(0.073)
Investments	(0.291)
Subtotal:	**(0.337)**
III. Changes in Assumptions	
Fertility	0.008
Net Migration	(0.042)
Mortality	0.089
Retirement	0.068
Disability	(0.054)
Labour Market	(0.003)
Real Wage Increase	0.148
Price Increases	0.045
Real Rates of Return	0.076
Other Assumptions	(0.027)
Subtotal:	**0.308**
IV. Others (Change in Funding Targets from 2025-2075 to 2028-2078)	**(0.006)**
Total of I to IV	**(0.043)**
Rate before Rounding	**9.795**
Rounded Rate, in Accordance with CPP Regulations	**9.79**
27th CPP Actuarial Report	**9.79**

(1) Components may not sum to totals due to rounding.

(2) For each triennial CPP actuarial report, the minimum contribution rate is determined for all years following the three-year review period in which the report is prepared, with the legislated contribution rate applied during the review period. For the 26th CPP Actuarial Report, the minimum contribution rate was determined for the year 2016 and thereafter, with the legislated rate of 9.9% applied for the 2013-2015 review period. For the 27th CPP Actuarial Report, the minimum contribution rate is determined from 2019 onward, with 9.9% applied for 2016-2018.

Appendix E – Assumptions and Methodology

I. Introduction

This section describes the assumptions and methodology that underlie the financial projections in the Results section of this report.

Future cash flows are projected over a long period of time, i.e. 75 years, and depend on assumptions such as those regarding fertility, mortality, migration, labour force participation, job creation, unemployment, inflation, employment earnings, and investment returns. These assumptions form the basis for the projections of future income and expenditures of the Plan. Over the years, the cumulative difference between the revenues from contributions and investment income and the expenditures of the Plan generates the accumulated assets. The ratio of the end-of-year assets to the following year's expenditures is then calculated and used to determine the steady-state contribution rate, which is the lowest contribution rate that, in the long term, would generally stabilize the ratio of assets to expenditures. The steady-state contribution rate is determined in this way before the consideration of any full funding requirement for increased or new benefits. The full funding rate is determined independently of the steady-state rate. It is added to the steady-state rate to produce the minimum contribution rate.

Although the demographic and economic assumptions have been developed using the available information, the resulting estimates should be interpreted with caution. These estimates are not intended to be predictions, but rather projections of the future financial state of the CPP.

II. Demographic Projections

Both the historical and projected populations of Canada less Québec are required for the calculation of future CPP contributions and benefits of the relevant cohorts of contributors and beneficiaries.

The populations of Canada and Québec as at 1 July 2015 are used as a starting point. The populations are then projected by age and sex from one year to the next by adding births and net migrants and subtracting deaths. Applying the fertility, migration, and mortality assumptions to the starting population develops the annual numbers of births, net migrants, and deaths. The relevant population for the CPP, which is the population of Canada less Québec, is obtained by subtracting the projected population of Québec from the projected population of Canada.

The population covered by the CPP pertains to Canada less Québec, but includes all members of the Canadian Forces (CF) and the Royal Canadian Mounted Police (RCMP). Consequently, the approach used above to determine the CPP population does not make an explicit allowance for the members of the CF or RCMP residing in Québec or outside Canada. However, provision for this group is made implicitly through the development of the number of people with earnings and the proportion of contributors as described in section III of this Appendix.

A. Initial Population as at 1 July 2015

The starting point for the demographic projections is based on the most recent Statistics Canada population estimates as at 1 July 2015 for Canada and Québec, by age and sex. The estimates are based on the 2011 Census. The estimates are adjusted by ungrouping ages 100 and older into individual ages using the observed distribution of Old Age Security program beneficiaries by age for ages 100 and older.

B. Fertility Rates

There are two definitions for the fertility rate: the total (or synthetic) fertility rate and the cohort fertility rate. The total fertility rate for a year is the average number of children that would be born to a woman in her lifetime if she experienced the age-specific fertility rates observed in, or assumed for, that calendar year. It is calculated as the sum of age group rates multiplied by their respective spans. In comparison, the cohort fertility rate is the average number of children born to a woman in her lifetime, for women born in a specific year.

The age-specific fertility rates are followed as these cohorts transition through age groups, giving a better idea of trends and variations between different generations over time. This is why fertility rates by age group (cohort rates) are used as the basis for the fertility rate assumption. Each age group was studied independently of other age groups. Although the historical cohort rates are used to set the assumption for the future, it is nonetheless useful and informative to consider the historical progression of the total fertility rates. Over time, the trends in the cohort rates are reflected in the total fertility rates.

The total fertility rate in Canada has declined significantly since the baby boom period, when the rate peaked at nearly 4.0 children per woman in the late 1950s. The baby bust period that followed in the mid-1960s pulled down the total fertility rates by the mid-1980s to a record low of 1.6 children per woman. The total fertility rate rose slightly in the early 1990s, but then generally declined to a level of 1.5 by the late 1990s. Canada is one of many industrialized countries that saw their total fertility rates increase starting in the 2000s. By 2008, the total fertility rate for Canada had reached 1.68. However, in some industrialized countries, including Canada, the total fertility rate has decreased since 2008, which could be attributable to the economic downturn experienced in recent years. In 2011, the total fertility rate for Canada was 1.61.

Similar to Canada, the total fertility rate in Québec fell from a high of 4.0 children per woman in the 1950s; however, the Québec rate fell to a greater degree, reaching 1.4 by the mid-1980s. The Québec rate then recovered somewhat in the early 1990s to over 1.6 and subsequently declined to below 1.5 by the late 1990s. There was a significant increase in the Québec rate since the year 2000, with the rate reaching 1.74 by 2008. In 2006, the Québec rate exceeded Canada's level for the first time since 1958. However, similar to Canada's fertility rate, the fertility rate for Québec has been decreasing in recent years. In 2014, the total fertility rate for Québec was 1.62.

Historically, the cohort fertility rates in Canada and Québec have steadily declined for the last 30 years. For females born in 1941 who reached the end of their childbearing years (turned age 49) in 1990, the cohort rates were 2.61 and 2.28 for Canada and Québec, respectively. However, for females reaching the end of their childbearing years in 2011 (born 1962), the Canada and Québec cohort fertility rates were 1.80 and 1.62.

Fertility rates are affected by many factors, including social attitudes, reproductive technologies, and economic conditions. It is assumed for this report that the recent economic downturn has caused a temporary downward effect on total fertility rates, with couples choosing to postpone having any or more children until economic conditions improve. This effect was taken into consideration along with historical trends in age-specific fertility rates over the last 10 years. The short periods of growth in the fertility rates that have occurred in recent decades are assumed to be temporary in nature, rather than having any long-term effects.

While the gap between Canada's and Quebec's fertility rates has been steadily decreasing, it has not completely disappeared. Consequently, unlike the 26th CPP Actuarial Report, it is assumed that a gap will be maintained. In this report, as a result of projecting age-specific cohort rates, it is thus assumed that the total fertility rate from 2019 onward for Canada will be 1.65 children per woman, which is the same ultimate rate as was assumed for the 26th CPP Actuarial Report. The total fertility rate from 2019 onward for Québec is assumed to be 1.68 children per woman, which is higher than the assumed rate in the 26th CPP Actuarial Report.

Finally, in accordance with the average experience over the last 10, 20, and 30 years, the assumed ratio of male to female newborns is 1.053, which is essentially the same as for the 26th CPP Actuarial Report. The cohort fertility rates per woman, together with each cohort's age-specific rates, all based on the year of birth of a woman, are shown in Table 33. Table 34 shows the projected age-specific and total fertility rates by calendar year for Canada. Chart 3 shows the historical and projected total and cohort fertility rates for Canada.

Table 33 Cohort Fertility Rates by Age and Year of Birth
(Canada)

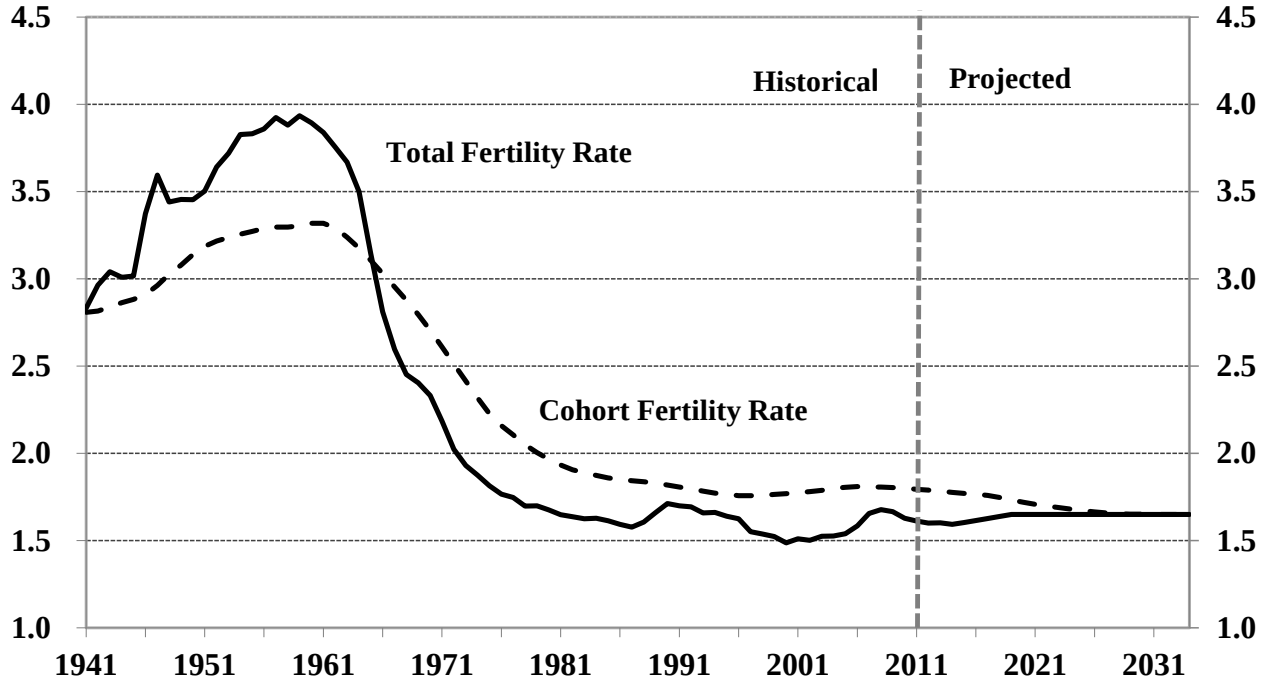
Year of Birth of Woman[1]	Annual Fertility Rates by Age Group (per 1,000 women)							Cohort Fertility Rates per Woman[2]
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
1960 – 1964	27.4	84.9	119.4	85.9	33.6	6.9	0.4	1.79
1965 – 1969	24.0	78.5	113.9	85.8	40.1	9.2	0.8	1.76
1970 – 1974	24.6	72.2	100.0	95.8	50.6	12.2	1.0	1.78
1975 – 1979	25.0	60.9	97.4	107.0	54.4	17.1	1.0	1.81
1980 – 1984	18.7	51.0	100.6	107.7	62.6	17.1	1.0	1.79
1985 – 1989	13.7	51.2	93.1	114.5	62.6	17.1	1.0	1.77
1990 – 1994	14.2	40.0	90.1	114.5	62.6	17.1	1.0	1.70
1995 – 1999	10.3	35.1	90.1	114.5	62.6	17.1	1.0	1.65
1999 – 2003	9.7	35.1	90.1	114.5	62.6	17.1	1.0	1.65
2000 – 2004+	9.5	35.1	90.1	114.5	62.6	17.1	1.0	1.65

(1) Ranges for years of birth correspond to the oldest to youngest ages for an age group. For example, in the first row of the table, 1960 is the year of birth for those aged 19, 24, 29, etc., 1961 is the year of birth for those aged 18, 23, 28, etc., and so forth.
(2) Fertility rates below and to the right of the dotted line are projected.

Table 34 Fertility Rates for Canada

Year	Annual Fertility Rates by Age Group (per 1,000 women)							Total
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
2016	10.0	38.0	91.9	110.4	57.7	14.2	0.9	1.62
2017	9.8	37.1	91.3	111.8	59.3	15.2	0.9	1.63
2018	9.7	36.1	90.7	113.2	61.0	16.1	1.0	1.64
2019+	9.5	35.1	90.1	114.5	62.6	17.1	1.0	1.65

Chart 3 Historical and Assumed Total and Cohort Fertility Rates for Canada(1)



(1) Cohort fertility rates are based on the age of a woman being 30 in a given calendar year.

C. Mortality

For this report, the mortality rate projections start from the 2011 mortality rates of the Canadian Human Mortality Database (CHMD). According to the CHMD, life expectancies at birth in 2011 for males and females in Canada were 79.5 and 83.7 years, respectively, without any assumed future improvements in mortality (i.e. reductions in mortality).

The average annual mortality improvement rates experienced in Canada over the 15-year period from 1996 to 2011 by age and sex were used as the basis for projecting annual mortality improvement rates from 2012 onward. For ages 65 and over, the annual mortality improvement rates for 2012 to 2014 were projected using the trends derived from the administrative data on Old Age Security (OAS) beneficiaries, representing 98% of the general population. Improvement rates by age and sex for years 2012 to 2031 (2015 to 2031 for ages 65 and over) were determined by cubical interpolation between:

- the improvement rates of year 2011 (2014 for ages 65 and over), and
- the ultimate improvement rates described below in respect of the period 2032 and thereafter.

For the year 2032 and thereafter for Canada, the ultimate annual rates of mortality improvement vary by age only and not by sex or calendar year. The ultimate mortality improvement rates are derived using a combination of backward- and forward-looking approaches. The analysis of the Canadian experience over the period from 1921 to 2011, including the recent slowdown trends observed in mortality improvement rates for OAS beneficiaries, was combined with an analysis of the possible drivers of future mortality improvements. Mortality improvement rates for males at most ages are currently higher than those for females but are assumed to decrease to the same

level as female rates from 2032 onward. The mortality improvement rates for Québec are assumed to be the same as for Canada from 2015 onward.

The ultimate rate for both sexes for ages 0 to 89 is set at 0.8% per year from 2032 onward for Canada and Québec. For ages above 89, the ultimate improvement rate is set to reduce from 0.5% for the age group 90-94 to 0.2% for those aged 95 and older.

Table 35 shows the initial (2012-2014), intermediate (2015-2031) and ultimate (2032+) assumed annual mortality improvement rates for Canada. The mortality improvement rates shown for 2012-2014 and 2015-2031 represent the average rates over these periods.

Table 35 Annual Mortality Improvement Rates for Canada

	Males			Females		
Age	**2012-2014[(1)]**	**2015-2031[(1)]**	**2032+**	**2012-2014[(1)]**	**2015-2031[(1)]**	**2032+**
	(%)	(%)	(%)	(%)	(%)	(%)
0	0.7	0.7	0.8	0.4	0.6	0.8
1-14	3.5	1.9	0.8	2.5	1.5	0.8
15-44	2.1	1.2	0.8	1.2	1.0	0.8
45-64	1.9	1.2	0.8	1.2	1.0	0.8
65-74	2.9	1.6	0.8	1.9	1.3	0.8
75-84	2.8	1.6	0.8	2.1	1.3	0.8
85-89	2.0	1.3	0.8	1.7	1.2	0.8
90-94	1.3	0.9	0.5	1.2	0.9	0.5
95+	0.4	0.3	0.2	0.5	0.4	0.2

(1) The mortality improvement rates shown for 2012-2014 and 2015-2031 represent average rates over these periods.

The resulting projected mortality rates in Table 36 indicate a continuous decrease in mortality rates over the long term. For example, the mortality rate at age 65 for males is expected to decrease from about 11 deaths per thousand people in 2016 to 6 deaths per thousand people by 2075. The gap in mortality rates between males and females at each age is also expected to decrease over the projection period.

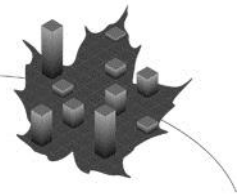


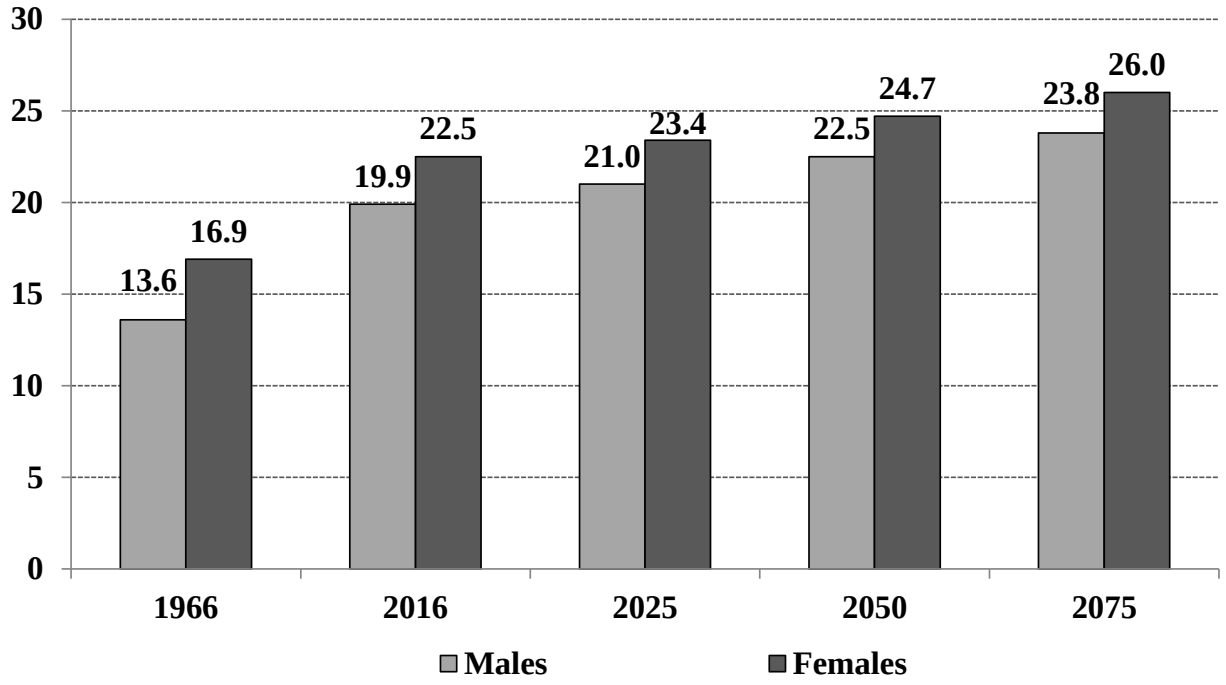
Table 36 Mortality Rates for Canada
(annual deaths per 1,000 people)

	Males				Females			
Age	**2016**	**2025**	**2050**	**2075**	**2016**	**2025**	**2050**	**2075**
0	5.08	4.75	3.89	3.18	4.19	3.97	3.25	2.66
10	0.07	0.05	0.04	0.03	0.07	0.06	0.05	0.04
20	0.60	0.52	0.43	0.35	0.28	0.26	0.22	0.18
30	0.66	0.58	0.47	0.39	0.36	0.33	0.27	0.22
40	1.11	0.98	0.80	0.66	0.68	0.61	0.50	0.41
50	2.75	2.48	2.02	1.66	2.02	1.90	1.56	1.27
60	6.83	5.91	4.80	3.93	4.41	3.92	3.19	2.61
65	10.52	8.96	7.26	5.94	6.91	6.08	4.94	4.04
70	16.53	13.94	11.29	9.23	11.13	9.81	7.98	6.52
75	26.55	22.31	18.06	14.77	18.17	15.93	12.95	10.59
80	45.30	38.27	30.99	25.35	31.29	27.36	22.23	18.19
85	81.84	70.66	57.35	46.91	58.20	51.32	41.75	34.15
90	144.13	128.95	109.66	93.87	110.80	99.88	85.02	72.78
100	343.68	328.08	305.27	284.76	299.32	285.31	265.43	247.60

Chart 4 shows the historical and projected life expectancies at age 65 since the Plan's inception in 1966, based on each given year's mortality rates (i.e. without future mortality improvements). Table 37 shows the projected Canadian life expectancies at various ages for the specified calendar years, also based on each given year's mortality rates (without future improvements). Table 38 is similar to Table 37, the only difference being that it takes into account the assumed mortality improvements after the specified calendar years (with future improvements). Given the continuing trend in increased longevity, Table 38 is considered to be more realistic than Table 37, especially for the older ages. At the same time, the extended length of the projection period increases the uncertainty of the results presented in Table 38 for younger ages.

From 2016 to 2075, Canadian life expectancy at age 65 (with assumed future mortality improvements) is projected to grow from 21.3 to 24.7 years for males and from 23.7 to 26.8 years for females, as shown in Table 38. The yearly increase in life expectancies at age 65 in the early years of the projection reflects the significant increase observed over the last decades. Thereafter, there is a projected slowdown in the increase in life expectancies consistent with the lower rate of improvement in mortality assumed for 2032 and thereafter.

Chart 4 Life Expectancies at Age 65 for Canada, without improvements after the year shown(1)



(1) These are calendar year life expectancies based on the mortality rates of the given attained year.

Table 37 Life Expectancies for Canada, without improvements after the year shown(1)

	Males				Females			
Age	**2016**	**2025**	**2050**	**2075**	**2016**	**2025**	**2050**	**2075**
0	80.7	82.2	84.2	86.1	84.5	85.6	87.4	89.0
10	71.2	72.7	74.6	76.4	74.9	76.0	77.7	79.2
20	61.4	62.8	64.8	66.5	65.0	66.1	67.8	69.3
30	51.8	53.2	55.1	56.8	55.2	56.2	57.9	59.4
40	42.1	43.5	45.3	47.0	45.4	46.5	48.1	49.6
50	32.8	34.1	35.8	37.4	35.9	36.9	38.5	39.9
60	24.0	25.2	26.8	28.2	26.8	27.8	29.2	30.5
65	19.9	21.0	22.5	23.8	22.5	23.4	24.7	26.0
70	16.0	17.0	18.4	19.6	18.3	19.2	20.4	21.6
75	12.4	13.3	14.5	15.6	14.4	15.2	16.3	17.3
80	9.2	9.9	10.9	11.9	10.9	11.5	12.5	13.3
85	6.5	7.0	7.8	8.5	7.8	8.2	9.0	9.7
90	4.5	4.8	5.3	5.7	5.3	5.6	6.1	6.6
100	2.1	2.2	2.4	2.5	2.4	2.5	2.7	2.8

(1) These are calendar year life expectancies based on the mortality rates of the given attained year.

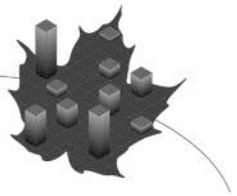


Table 38 Life Expectancies for Canada, with improvements after the year shown[(1)]

	Males				Females			
Age	**2016**	**2025**	**2050**	**2075**	**2016**	**2025**	**2050**	**2075**
0	86.7	87.4	89.1	90.6	89.7	90.3	91.8	93.0
10	76.5	77.2	78.9	80.4	79.6	80.1	81.6	82.9
20	66.0	66.6	68.4	69.9	69.0	69.6	71.1	72.5
30	55.6	56.3	58.0	59.6	58.6	59.2	60.7	62.1
40	45.3	45.9	47.6	49.2	48.2	48.8	50.3	51.7
50	35.2	35.9	37.5	39.1	38.1	38.6	40.1	41.5
60	25.7	26.4	27.9	29.3	28.4	28.9	30.3	31.6
65	21.3	21.9	23.3	24.7	23.7	24.3	25.6	26.8
70	17.1	17.7	19.0	20.2	19.3	19.8	21.0	22.2
75	13.2	13.8	14.9	16.0	15.2	15.6	16.7	17.8
80	9.7	10.2	11.2	12.1	11.3	11.8	12.7	13.6
85	6.8	7.2	7.9	8.7	8.0	8.4	9.1	9.9
90	4.6	4.9	5.3	5.8	5.4	5.7	6.2	6.6
100	2.1	2.2	2.4	2.5	2.4	2.5	2.7	2.8

(1) These are cohort life expectancies that take into account assumed future improvements in mortality of the general population and therefore differ from calendar year life expectancies, which are based on the mortality rates of the given attained year.

D. Net Migration

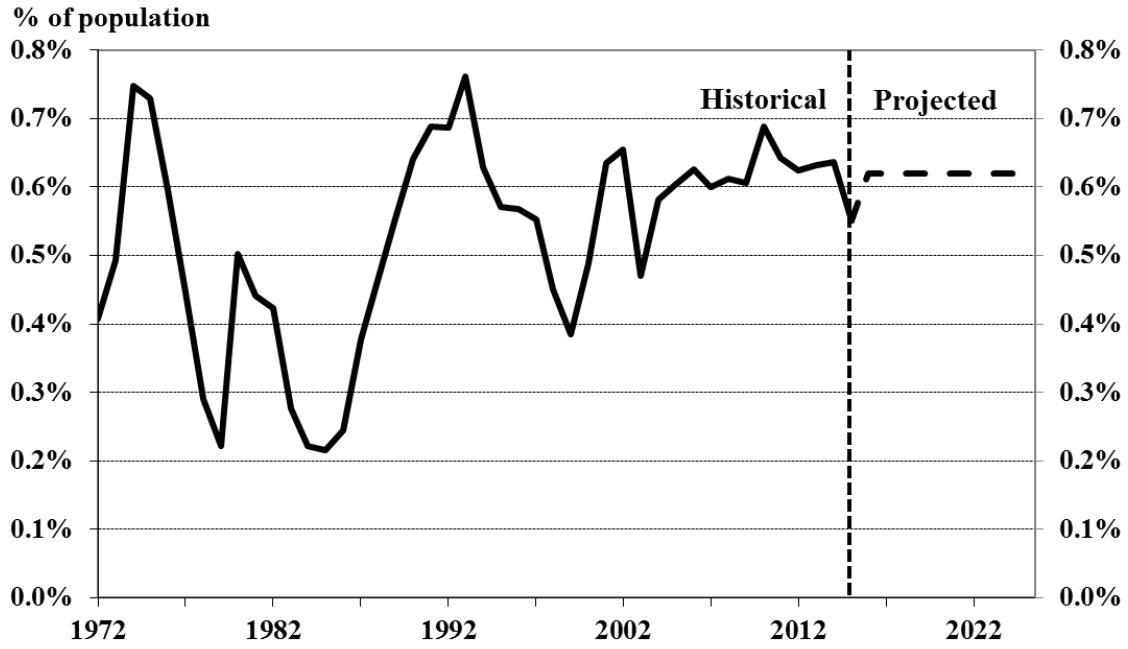
Immigration and emigration are generally recognized as being volatile parameters of future population growth since they are subject to a variety of demographic, economic, social and political factors. During the period from 1972 to 2015, annual immigration to Canada varied between 84,000 and 271,000, annual emigration from Canada fluctuated between 40,000 and 86,000, and the annual number of returning Canadians fluctuated between 14,000 and 39,000.

During the period from 1972 to 2015, the annual net increase in the number of non-permanent residents fluctuated between -71,000 and 141,000. The number of non-permanent residents increased each year from 1999 to 2014, but then decreased in 2015. The government recently introduced several modifications to the Temporary Foreign Workers Program, making it more difficult for employers to hire temporary foreign workers. It is expected that these changes will result in there being no annual growth in the number of non-permanent residents in the future, that is, an annual net increase of zero. The immigration application process also changed in 2015 with the introduction of the Express Entry program. It is possible that the related administrative changes led to the significant decrease in immigration levels from 0.64% in 2014 to 0.55% in 2015.

However, it is assumed that higher immigration levels, in line with the government's policies, will resume as early as 2016. Therefore, the 2015 net migration rate of 0.55% of the population is expected to increase to 0.62% in 2016 and to remain stable at that level for the remainder of the projection period. The ultimate level of 0.62% generally corresponds to the average experience over the last 10 years and assumes that there will be no growth in the number of non-permanent residents. Chart 5 shows the net migration (immigration less emigration, plus the number of returning Canadians) experience since 1972 and the assumed rate for the future.

To project Québec's population, the same migration components of immigration, emigration and returning Canadians are considered. An additional component consisting of the net interprovincial emigration for Québec is also included. These assumptions result in a net migration rate averaging 0.43% over the projection period for Québec. The distributions of immigrants, emigrants, and returning Canadians by age and sex used for the demographic projections were derived from Statistics Canada data averaged over the period 2006 to 2015.

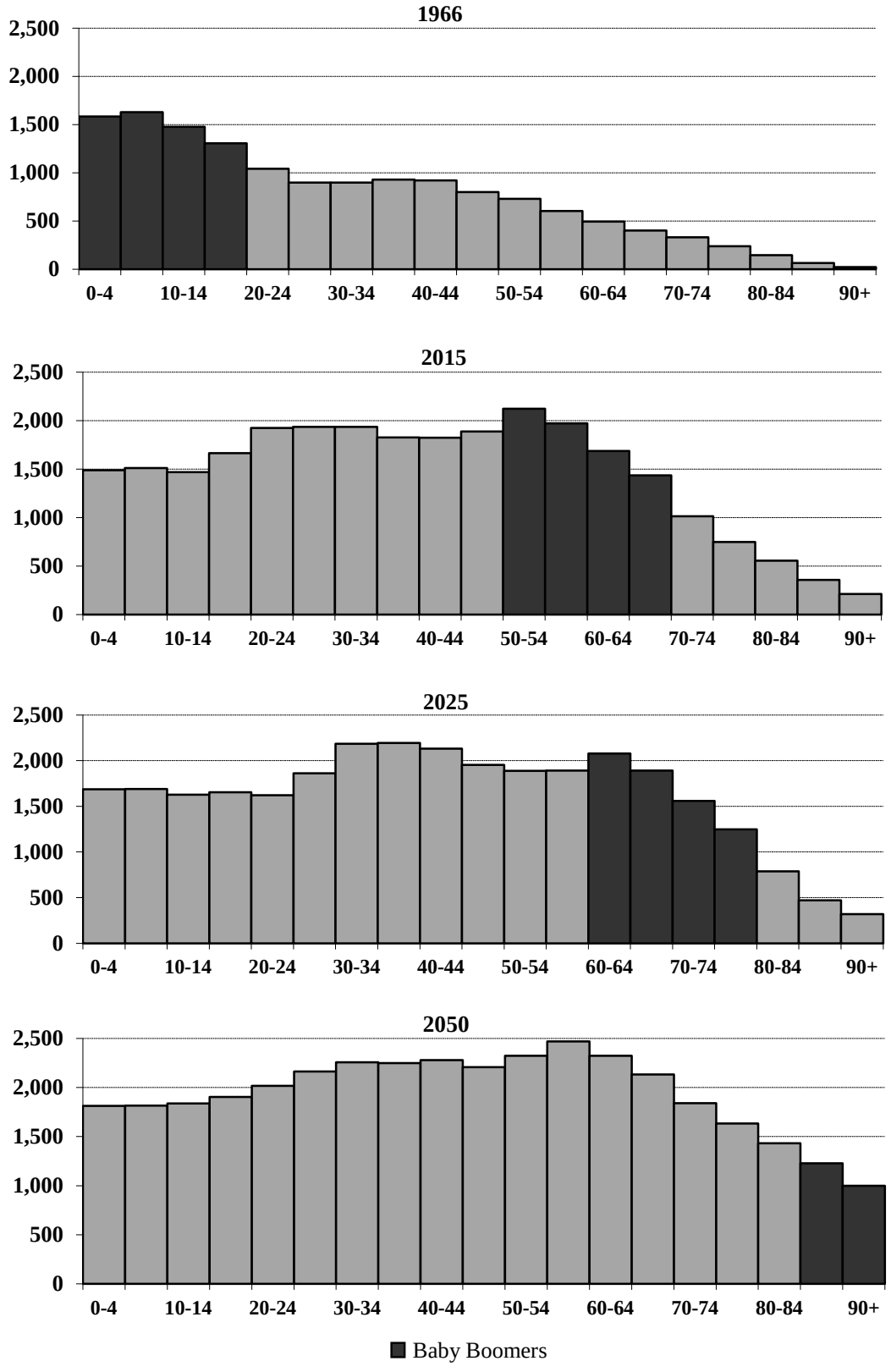
Chart 5 Net Migration Rate
(Canada)



E. Projected Population and its Characteristics

The evolution of the Canada less Québec population age distribution since the inception of the Plan is shown in Chart 6. One can easily observe that the triangular shape of the 1960s has become more rectangular over time. This is projected to continue and indicates an aging population. The effects of the baby boom, baby bust, and echo generations can be seen. The chart also reveals that the number of people aged 85 and over is expected to increase dramatically over the coming decades.

Chart 6 Age Distribution of the Population of Canada less Québec
(thousands)



The population of Canada as at 1 July 2015 is 35.9 million, while the population of Canada less Québec is 27.6 million. Table 39 and Table 40 present the projected populations of Canada and Canada less Québec as at 1 July for selected age groups and years, while Chart 7 shows the evolution of the total population of Canada less Québec and of those aged 20 to 64 from 1975 to 2075. Table 41 shows the variations in the relative proportions of various age groups for Canada less Québec throughout the projection period. The proportion of people aged 65 and over is expected to increase significantly from 16.1% of the total population in 2016 to 26.7% by 2075. The number of people aged 65 and older as a proportion of the number of people aged 20 to 64 close to doubles over the same period, from 26.0% in 2016 to 50.1% by 2075. This proportion significantly affects the ratio of benefits to contributions under the CPP.

Table 39 Population of Canada by Age
(thousands)

Year	0-17	18-69	70+	0-19	20-64	65+	Total
2016	6,985	25,212	4,020	7,838	22,383	5,997	36,218
2017	7,045	25,330	4,217	7,867	22,509	6,216	36,592
2018	7,115	25,446	4,409	7,921	22,603	6,446	36,970
2019	7,201	25,554	4,597	7,994	22,666	6,691	37,351
2020	7,294	25,654	4,786	8,074	22,709	6,950	37,733
2021	7,388	25,750	4,977	8,167	22,739	7,209	38,115
2022	7,475	25,849	5,170	8,264	22,754	7,476	38,494
2025	7,706	26,089	5,816	8,539	22,774	8,298	39,611
2030	7,942	26,420	6,975	8,816	22,925	9,597	41,337
2035	8,063	26,750	8,037	8,992	23,483	10,374	42,850
2040	8,060	27,556	8,572	9,042	24,255	10,892	44,189
2050	8,315	29,163	9,142	9,280	25,492	11,848	46,620
2075	9,400	32,309	11,322	10,509	28,296	14,227	53,032

Table 40 Population of Canada less Québec by Age
(thousands)

Year	0-17	18-69	70+	0-19	20-64	65+	Total
2016	5,447	19,443	3,001	6,123	17,275	4,493	27,891
2017	5,489	19,560	3,153	6,143	17,398	4,660	28,202
2018	5,540	19,675	3,301	6,182	17,497	4,837	28,516
2019	5,605	19,785	3,443	6,235	17,572	5,026	28,833
2020	5,676	19,888	3,588	6,295	17,631	5,226	29,152
2021	5,748	19,989	3,734	6,366	17,678	5,427	29,471
2022	5,815	20,092	3,882	6,442	17,715	5,633	29,789
2025	6,003	20,348	4,382	6,657	17,803	6,272	30,732
2030	6,229	20,701	5,286	6,908	17,996	7,313	32,216
2035	6,360	21,040	6,144	7,090	18,481	7,973	33,545
2040	6,382	21,744	6,613	7,157	19,143	8,439	34,739
2050	6,599	23,204	7,132	7,371	20,300	9,264	36,935
2075	7,592	26,052	9,097	8,488	22,824	11,428	42,741

Chart 7 Population of Canada less Québec
(millions)

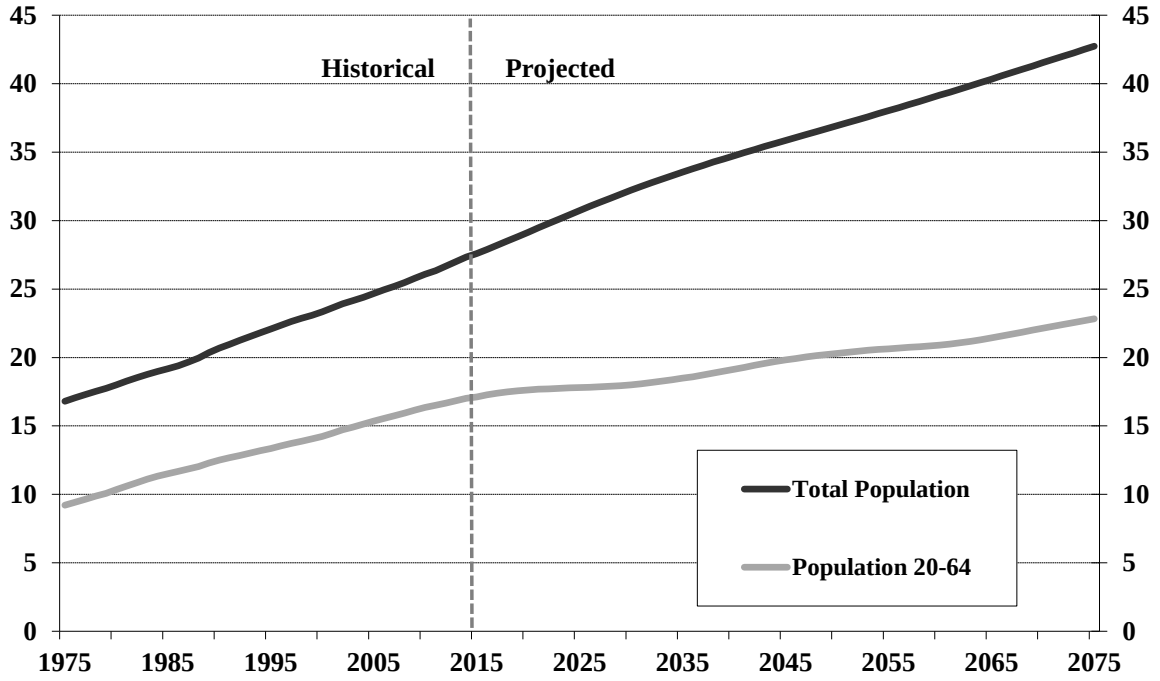


Table 41 Analysis of Population of Canada less Québec by Age

Year	% of Total Population			% of Total Population			Age 65 + as % of Age 20-64
	0-17	18-69	70+	0-19	20-64	65+	
2016	19.5	69.7	10.8	22.0	61.9	16.1	26.0
2017	19.5	69.4	11.2	21.8	61.7	16.5	26.8
2018	19.4	69.0	11.6	21.7	61.4	17.0	27.6
2019	19.4	68.6	11.9	21.6	60.9	17.4	28.6
2020	19.5	68.2	12.3	21.6	60.5	17.9	29.6
2021	19.5	67.8	12.7	21.6	60.0	18.4	30.7
2022	19.5	67.4	13.0	21.6	59.5	18.9	31.8
2025	19.5	66.2	14.3	21.7	57.9	20.4	35.2
2030	19.3	64.3	16.4	21.4	55.9	22.7	40.6
2035	19.0	62.7	18.3	21.1	55.1	23.8	43.1
2040	18.4	62.6	19.0	20.6	55.1	24.3	44.1
2050	17.9	62.8	19.3	20.0	55.0	25.1	45.6
2075	17.8	61.0	21.3	19.9	53.4	26.7	50.1

Table 42 shows the components of population growth, which is defined as the projected number of births plus net migrants less the projected number of deaths for Canada less Québec from 2016 to 2075, and Chart 8 presents these figures graphically for the next 50 years. For Canada less

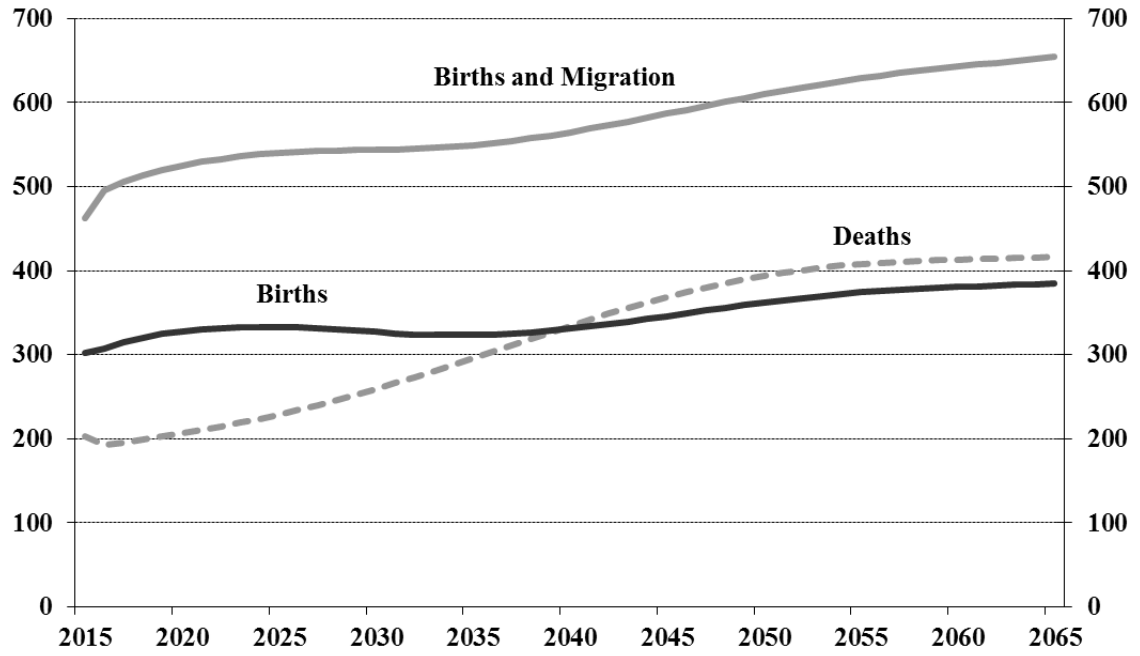
Québec, the number of births is projected to exceed deaths until 2039. Thereafter, all population growth is projected to come from migration.

Over the period 2016 to 2023, the population of Canada less Québec is projected to grow by about 1.1% per year. The annual growth slows to about 0.7% between the late 2030s and early 2040s and to 0.6% thereafter. The population of Canada less Québec is expected to reach 42.7 million by 2075.

Table 42 Births, Net Migrants, and Deaths for Canada less Québec
(thousands)

Year	Population 1st July	Births	Net Migrants	Deaths	Change in Population	Annual Percentage Change 20-64	65+	Total
						(%)	(%)	(%)
2016	27,891	307	189	192	303	0.9	3.8	1.1
2017	28,202	315	191	196	310	0.7	3.7	1.1
2018	28,516	320	193	199	314	0.6	3.8	1.1
2019	28,833	325	195	203	317	0.4	3.9	1.1
2020	29,152	328	197	206	319	0.3	4.0	1.1
2021	29,471	330	199	210	319	0.3	3.8	1.1
2022	29,789	332	201	214	318	0.2	3.8	1.1
2025	30,732	333	207	229	311	0.1	3.6	1.0
2030	32,216	327	217	259	285	0.3	2.6	0.9
2035	33,545	324	226	296	254	0.6	1.5	0.8
2040	34,739	331	234	334	231	0.7	1.0	0.7
2050	36,935	362	248	393	216	0.4	1.1	0.6
2075	42,741	404	286	448	242	0.6	0.6	0.6

Chart 8 Components of Population Growth for Canada less Québec
(thousands)



III. Economic Projections

The list of assumptions required to project the various economic indices, as well as CPP contributions and expenditures is quite extensive. The following sections cover the more important assumptions.

The economic outlook rests on the assumed evolution of the labour market, that is, labour force participation, employment, unemployment, inflation, and the increase in average employment earnings. Rates of return on CPP assets reflect the financial markets and are part of the investment assumptions described in section IV of this Appendix. All of these factors must be considered together and form part of an overall economic perspective.

A. Economic Perspective

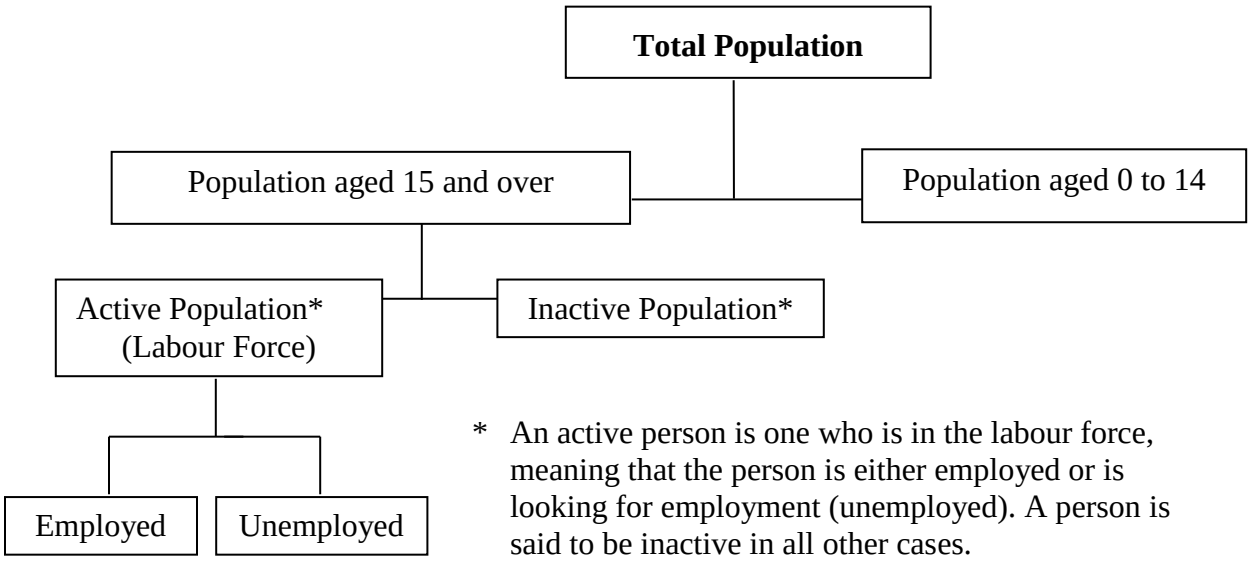
The future revenues and expenditures of the CPP depend on many demographic and economic factors. It is important to define the individual economic assumptions in the context of a long-term overall economic perspective. For this report, it is assumed that, despite the modest pace of recovery from the last economic downturn and an uncertain economic outlook for major foreign economies, a moderate and sustainable growth in the Canadian economy will persist throughout the projection period.

The actuarial examination of the CPP involves the projection of its revenues and expenditures over a long period of time. Although best judgment is used regarding future economic trends, it is nonetheless difficult to anticipate all of the social and corresponding economic changes that may occur during the projection period. There will always be some degree of uncertainty. The projected aging of the population combined with the retirement of the baby boom generation over the next few decades will certainly create significant social and economic changes. It is possible that the evolution of the working-age population, especially the active population, will be quite different from what has been historically observed and what has been assumed for the purpose of this report.

B. Labour Market

Chart 9 shows the main components of the labour market that are used to determine the number of earners and contributors by age, sex, and calendar year.

Chart 9 Components of the Labour Market



The number of earners is defined as the number of persons who had earnings during a given calendar year. The earners become contributors if they have earnings during the year above the Year's Basic Exemption (YBE) and they are between the ages of 18 and 70. This refers to all earners excluding working beneficiaries aged 65 to 70. For the latter group, contributing to the CPP is optional.

The proportion of earners and contributors assumptions (described in this section and section F) rely on the projected active population given in this report. The projected effect of working beneficiaries is reflected in all these assumptions.

1. Active Population

The overall labour force participation rates in Canada (the active population expressed as a proportion of the population aged 15 and over) from 1976 to 2015 clearly show a narrowing of the gap between male and female rates. Although the increase in participation rates of females aged 15 to 69 has slowed down since the mid-2000s, the increase was significant over the previous decades. Furthermore, participation rates for those aged 55 and older have increased significantly over the last decade for both men and women.

In 1976, overall male participation was about 78% compared to only 46% for females, which represents a gap of 32%. This gap has narrowed to 9% in 2015. It is assumed that females will continue to narrow the gap in participation rates but at a slower pace, with the gap gradually reducing to about 8% by 2035. In addition, over the next two decades, it is assumed that the participation of males and females aged 55 and over will continue to increase. Tables 43 to 46 provide projections of the active and employed populations and associated participation, employment, and unemployment rates for Canada.

Table 43 Active Population (Canada, ages 15 and over)

Year	Population[1]			Active Population			Employed		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
		(thousands)			(thousands)			(thousands)	
2016	14,549	14,988	29,537	10,259	9,171	19,430	9,478	8,573	18,051
2017	14,691	15,129	29,820	10,334	9,240	19,575	9,570	8,654	18,224
2018	14,832	15,270	30,102	10,403	9,306	19,709	9,643	8,723	18,366
2019	14,976	15,414	30,390	10,471	9,369	19,840	9,717	8,789	18,506
2020	15,119	15,557	30,676	10,535	9,431	19,966	9,787	8,854	18,641
2021	15,264	15,704	30,968	10,599	9,495	20,094	9,856	8,922	18,778
2022	15,414	15,855	31,269	10,664	9,562	20,226	9,927	8,992	18,918
2025	15,867	16,315	32,182	10,851	9,761	20,612	10,131	9,203	19,334
2030	16,573	17,045	33,618	11,133	10,086	21,219	10,396	9,507	19,903
2035	17,266	17,771	35,036	11,510	10,505	22,015	10,748	9,903	20,651
2040	17,896	18,457	36,353	11,861	10,827	22,687	11,073	10,207	21,280
2050	18,878	19,542	38,420	12,421	11,315	23,737	11,597	10,668	22,265
2075	21,517	22,230	43,746	13,905	12,648	26,552	12,983	11,924	24,906

(1) Adjusted to the basis used by Statistics Canada in its Labour Force Survey.

Table 44 Labour Force Participation, Employment, and Unemployment Rates (Canada, ages 15 and over)

Year	Labour Force Participation Rate			Employment Rate			Unemployment Rate		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
		(%)			(%)			(%)	
2016	70.5	61.2	65.8	65.1	57.2	61.1	7.6	6.5	7.1
2017	70.3	61.1	65.6	65.1	57.2	61.1	7.4	6.3	6.9
2018	70.1	60.9	65.5	65.0	57.1	61.0	7.3	6.3	6.8
2019	69.9	60.8	65.3	64.9	57.0	60.9	7.2	6.2	6.7
2020	69.7	60.6	65.1	64.7	56.9	60.8	7.1	6.1	6.6
2021	69.4	60.5	64.9	64.6	56.8	60.6	7.0	6.0	6.5
2022	69.2	60.3	64.7	64.4	56.7	60.5	6.9	6.0	6.5
2025	68.4	59.8	64.0	63.9	56.4	60.1	6.6	5.7	6.2
2030	67.2	59.2	63.1	62.7	55.8	59.2	6.6	5.7	6.2
2035	66.7	59.1	62.8	62.2	55.7	58.9	6.6	5.7	6.2
2040	66.3	58.7	62.4	61.9	55.3	58.5	6.6	5.7	6.2
2050	65.8	57.9	61.8	61.4	54.6	58.0	6.6	5.7	6.2
2075	64.6	56.9	60.7	60.3	53.6	56.9	6.6	5.7	6.2

Table 45 Labour Force Participation Rates (Canada)

	Males				Females			
Age Group	**2016**	**2025**	**2035**	**2050**	**2016**	**2025**	**2035**	**2050**
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
15-19	49.0	53.0	55.0	55.0	51.8	55.0	58.0	58.0
20-24	77.7	81.0	82.0	82.0	75.6	78.0	80.0	80.0
25-29	89.2	91.0	92.0	92.0	81.1	83.0	86.0	86.0
30-34	92.5	93.0	94.0	94.0	80.6	83.0	85.0	85.0
35-39	92.9	94.0	94.0	94.0	82.2	84.0	86.0	86.0
40-44	92.6	93.0	94.0	94.0	83.6	86.0	87.0	87.0
45-49	91.2	93.0	93.0	93.0	84.2	86.0	87.0	87.0
50-54	88.2	90.0	91.0	91.0	81.8	83.0	85.0	85.0
55-59	79.9	82.0	84.0	84.0	68.9	72.0	75.0	75.0
60-64	60.4	62.0	64.0	64.0	48.4	52.0	54.0	54.0
65-69	32.2	34.0	35.0	35.0	20.4	22.0	23.0	23.0
70 and Over	10.2	11.0	12.0	12.0	4.5	5.5	6.0	6.0
15-69	78.4	79.3	80.9	80.3	70.2	71.5	74.2	73.5
15 and Over	**70.5**	**68.4**	**66.7**	**65.8**	**61.2**	**59.8**	**59.1**	**57.9**

Given that participation rates start to decline mostly after age 50, the aging of the population will exert downward pressure on the overall labour force participation rate in Canada. If current participation rates by age and sex were to apply throughout the projection period, the effect of population aging alone would cause the overall participation rate from Table 44 to fall from 65.8% in 2016 to 58.4% in 2050, instead of 61.8% as projected under the best-estimate assumptions. However, it is expected that a number of factors will contribute toward partially offsetting the decline that results from population aging.

The main assumption underlying the future overall participation rate is a significant increase in participation rates for those aged 55 and over as a result of an expected continued trend toward longer working lives. Government policies aimed at increasing participation rates of older workers, the removal of the work cessation test to receive the CPP retirement pension prior to age 65, the increase in life expectancy, and possible insufficient retirement savings are assumed to encourage older workers to delay their retirement and exit the labour force at a later age.

However, despite the assumed future increase in participation rates of older workers and a reliance on skilled immigrant workers, it is still expected that there will be moderate labour shortages in the future as the working-age population expands at a slower pace and as baby boomers retire and exit the labour force. The participation rates for all age groups are expected to increase due to the attractive employment opportunities resulting from labour shortages.

It is also expected that future participation rates will increase with the aging of cohorts that have a stronger labour force attachment compared to previous cohorts. The stronger labour force attachment of later cohorts is attributable to different reasons, including higher attained education. The aging of more educated workers with higher labour force attachment, and the exit from the workforce of less educated older workers is expected to create upward pressure on participation rates. Over the shorter term, the participation rates of younger age groups are assumed to

gradually increase to their pre-recession levels. Finally, although historical increases in participation rates for women are not expected to continue in the future, their participation rates are expected to increase faster than the participation rates for men.

Based on the foregoing, the participation rates of both men and women are expected to increase over the projection period from their 2015 levels for all age groups, especially for those aged 55 and over. Nonetheless, these increases in participation rates are not sufficient to offset the decrease in the overall participation rate due to the demographic shift.

For the purpose of projecting the participation rates, the projection period has been divided into three periods: 2016 to 2025, 2025 to 2035, and from 2035 onward. From 2016 to 2025, and from 2025 to 2035, the projected participation rates are based on the expected impact of the above-mentioned factors through time for each age group and sex. From 2035 onward, the participation rates are held constant. This long-term assumption combined with a slow growth in the working-age population, results in a low rate of growth of approximately 0.5% for the Canadian active population (that is, the labour force) after 2035.

2. Employment

In Canada, the average annual job creation rate (i.e. the change in the number of persons employed) has been about 1.6% since 1976. However, this rate has varied over the years. It is assumed that the job creation rate will be 0.6% in 2016 and the unemployment rate 7.1%, based on the most recent experience and various economic forecasts. It is further assumed that over the short term, the job creation rate will be slightly higher than the labour force growth rate, so that the unemployment rate slowly decreases from its 2016 level of 7.1%.

Over the long term, the job creation rate is assumed to be the same as the labour force growth of 0.5%. This is projected to occur since the unemployment rate is not expected to fall below 6.2%, which is in line with various economic forecasts and reflects moderate economic growth. It is assumed that the unemployment rate will be slightly higher than in the 26th CPP Actuarial Report, reaching 6.2% by 2025 and remaining at that level thereafter.

Table 46 shows the projected number of employed persons, aged 18 to 69, in Canada.

Table 46 Employment of Population (Canada, ages 18 to 69)

	Population		Employed		Employment Rate	
Year	Males	Females	Males	Females	Males	Females
	(thousands)		(thousands)		(%)	
2016	12,612	12,600	9,115	8,276	72.3	65.7
2017	12,669	12,661	9,198	8,353	72.6	66.0
2018	12,725	12,720	9,261	8,416	72.8	66.2
2019	12,778	12,776	9,321	8,475	72.9	66.3
2020	12,826	12,828	9,378	8,532	73.1	66.5
2021	12,870	12,879	9,433	8,588	73.3	66.7
2022	12,917	12,931	9,486	8,645	73.4	66.9
2025	13,031	13,057	9,632	8,813	73.9	67.5
2030	13,186	13,234	9,812	9,066	74.4	68.5
2035	13,342	13,408	10,068	9,399	75.5	70.1
2040	13,741	13,815	10,358	9,676	75.4	70.0
2050	14,533	14,630	10,862	10,125	74.7	69.2
2075	16,110	16,198	12,090	11,278	75.0	69.6

Given that the CPP covers contributors in all provinces except Québec, economic assumptions were developed for Québec, and the results for Canada less Québec were derived. Table 47 and Table 48 show the projected active population, number of employed, and labour force participation rates for Canada less Québec.

Table 47 Active Population (Canada less Québec, ages 15 and over)

	Population[(1)]			Active Population			Employed		
Year	Males	Females	Total	Males	Females	Total	Males	Females	Total
	(thousands)			(thousands)			(thousands)		
2016	11,144	11,515	22,659	7,918	7,068	14,986	7,340	6,613	13,953
2017	11,264	11,636	22,900	7,987	7,135	15,122	7,421	6,689	14,110
2018	11,383	11,758	23,141	8,051	7,200	15,251	7,488	6,755	14,243
2019	11,505	11,883	23,388	8,115	7,264	15,378	7,555	6,820	14,375
2020	11,626	12,007	23,632	8,175	7,325	15,500	7,619	6,884	14,503
2021	11,748	12,132	23,880	8,235	7,387	15,621	7,682	6,948	14,630
2022	11,872	12,261	24,133	8,295	7,450	15,745	7,745	7,013	14,758
2025	12,248	12,651	24,899	8,464	7,637	16,101	7,927	7,207	15,134
2030	12,839	13,276	26,115	8,717	7,927	16,644	8,164	7,480	15,644
2035	13,431	13,905	27,336	9,040	8,293	17,333	8,466	7,825	16,291
2040	13,981	14,510	28,491	9,350	8,580	17,930	8,755	8,097	16,852
2050	14,876	15,507	30,383	9,875	9,045	18,920	9,246	8,535	17,781
2075	17,241	17,945	35,186	11,199	10,251	21,450	10,484	9,672	20,156

(1) Adjusted to the basis used by Statistics Canada in its Labour Force Survey.

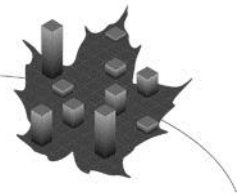


Table 48 Labour Force Participation Rates (Canada less Québec)

	Males				Females			
Age Group	**2016**	**2025**	**2035**	**2050**	**2016**	**2025**	**2035**	**2050**
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
15-19	47.7	52.2	54.4	54.5	50.7	54.1	57.7	57.7
20-24	77.7	80.7	81.7	81.7	74.2	77.2	79.4	79.5
25-29	89.8	91.3	92.0	92.0	80.7	82.7	86.0	86.0
30-34	92.6	93.0	94.0	94.0	79.6	82.2	84.5	84.5
35-39	92.7	94.0	94.0	94.0	81.1	83.2	85.5	85.5
40-44	92.8	92.7	94.0	94.0	82.5	85.2	86.2	86.2
45-49	91.4	93.3	93.0	93.0	83.2	85.1	86.2	86.3
50-54	88.2	90.0	91.0	91.0	81.0	82.2	84.5	84.5
55-59	80.1	82.3	84.6	84.5	69.4	72.8	76.4	76.3
60-64	61.7	63.2	65.1	65.1	50.3	54.4	56.1	56.0
65-69	34.6	36.6	37.0	37.0	22.7	24.2	24.9	24.8
70 and Over	11.1	11.7	12.6	12.6	5.0	6.0	6.3	6.3
15-69	78.7	79.7	81.2	80.6	70.0	71.6	74.3	73.6
15 and Over	**71.0**	**69.1**	**67.3**	**66.4**	**61.4**	**60.4**	**59.6**	**58.3**

3. Number of Earners

The number of earners for any given year, namely anyone who had employment earnings during the year, is always more than the employed population and sometimes even close to the labour force because it includes all individuals who had earnings at any time during the year, whereas the employed population only indicates the average number of employed in any given year. The projected number of earners is obtained by a regression based on a highly correlated historical relationship between the number of employed persons and the number of earners over the period 1976 to 2013. Table 49 shows the projected average number of employed persons and the projected number and proportion of earners (relative to the population) aged 18 to 69, for Canada less Québec. The projected number and proportion of earners shown in Table 49 pertain to all earners, including those who are CPP retirement beneficiaries. The effect of CPP retirement beneficiaries with earnings, that is, working beneficiaries, is discussed more in detail in section V-E of this Appendix.

Table 49 Employment of Population (Canada less Québec, ages 18 to 69)

	Population		Employed		Earners		Proportion of Earners (earners as % of population)	
Year	Males	Females	Males	Females	Males	Females	Males	Females
	(thousands)		(thousands)		(thousands)		(%)	
2016	9,701	9,742	7,053	6,378	7,888	7,140	81.3	73.3
2017	9,757	9,803	7,126	6,450	7,970	7,234	81.7	73.8
2018	9,812	9,863	7,185	6,512	8,036	7,318	81.9	74.2
2019	9,865	9,920	7,242	6,571	8,102	7,401	82.1	74.6
2020	9,914	9,974	7,296	6,628	8,161	7,463	82.3	74.8
2021	9,961	10,028	7,347	6,683	8,217	7,523	82.5	75.0
2022	10,010	10,082	7,397	6,739	8,273	7,585	82.6	75.2
2025	10,132	10,216	7,536	6,900	8,430	7,764	83.2	76.0
2030	10,296	10,405	7,705	7,132	8,611	8,010	83.6	77.0
2035	10,455	10,585	7,928	7,426	8,845	8,327	84.6	78.7
2040	10,802	10,942	8,184	7,673	9,136	8,607	84.6	78.7
2050	11,523	11,681	8,654	8,097	9,678	9,089	84.0	77.8
2075	12,938	13,113	9,750	9,141	10,879	10,227	84.1	78.0

C. Annual Increase in Prices (Inflation Rate)

The inflation rate assumption is needed to determine the Pension Index for any given calendar year. It is also used in the determination of the annual nominal increase in average employment earnings, the Year's Maximum Pensionable Earnings, and the nominal rates of return on investments.

Price increases, as measured by changes in the Consumer Price Index, tend to fluctuate from year to year. Over the last 50 years, the trend was generally upward through the early 1980s then downward until the introduction of the inflation-control targets in the early 1990s, at which point inflation began to stabilize. The average annual increases in the CPI over the 50, 20 and 10-year periods ending in 2015 were 4.1%, 1.9% and 1.7%, respectively. In 2011, the Bank of Canada reaffirmed its objective of keeping the inflation rate within a control range of 1% to 3%, with a target of 2%, until the end of 2016.

In Canada, inflation was moderate at 1.1% in 2015. To reflect recent experience and the short-term expectation that inflation will remain subdued in the coming quarters, the price increase assumption is set at 1.6% in 2016. It is expected that the Bank of Canada will maintain its inflation target policy, and as such, the assumption is set at 2.0% for the year 2017 and thereafter. The 2.0% inflation rate corresponds to the average forecast from various economists and falls in the middle of the Bank of Canada control range. It is kept constant for the entire projection period. The 2.0% inflation rate assumption is lower than the assumption of 2.2% used in the 26th CPP Actuarial Report but is close to the average level of inflation that has been experienced over the last two decades.

D. Real Wage Increases

The assumed increase in average annual employment earnings (AAE) is used to project the total employment earnings of CPP contributors, while the assumed increase in Average Weekly Earnings (AWE) is used to project the increase in the YMPE from one year to the next. The difference between real (net of inflation) increases in the AWE and the AAE has been relatively small over the period from 1966 to 2014, that is, an absolute difference of approximately 0.03% per year. For several years in the 1990s this difference was more pronounced; however, the real increases in AAE and AWE have shown a tendency to converge toward each other over time. Taking these factors into consideration, the real increases in AWE and AAE are assumed to be the same for 2017 and thereafter.

The real wage increase has fluctuated significantly from year to year. For example, the ten-year average annual real wage increase, as measured by the difference between the increases in the nominal AWE and the CPI, was 0.1% for the period ending in 2005 and 0.9% for the period ending in 2015. The average annual real wage increase was also 0.9% for the 49-year period ending in 2015.

The real wage increase can also be measured using the difference between the increase in the nominal average wage and the CPI. In this case, the nominal average wage is defined as the ratio of the total nominal earnings to total civilian employment in the Canadian economy as a whole. Historically, the nominal average wage increase has been similar to the nominal AAE increase, and therefore it is assumed that they can be used interchangeably.

The real wage increase is related to the growth in total labour productivity as follows:

> *Real Wage Increase = Growth in Labour Productivity + Growth in Compensation Ratio + Growth in Earnings Ratio + Growth in Average Hours Worked + Growth in Price Differential.*

In addition to the factors included in the above equation, labour demand has a significant impact on real wage increases. Real wages are subject to downward pressure as the demand for workers decreases. On the other hand, one could expect upward pressure on wages if the size of the labour force fails to keep pace with a growing economy.

Labour productivity in the above equation is defined as the ratio of the real Gross Domestic Product (GDP) to total hours worked in the Canadian economy. The average annual growth in labour productivity was 1.7% for the 53-year period ending in 2014 and 0.9% for the 14-year period ending in 2014. Long-term productivity is expected to increase as a result of anticipated labour shortages and the government's policies aimed at enhancing productivity growth. At the same time, increasing labour force participation rates of older workers and a reliance on immigration for future labour force growth are expected to moderate the labour shortage and its impact on productivity. Labour productivity growth of 1.2% is assumed for the long term.

The compensation ratio is the ratio of the total compensation received by workers to the nominal GDP. Changes in the compensation ratio reflect the extent to which changes in productivity are shared between labour and capital. The compensation ratio has decreased on average by 0.1% per year for the 53-year period ending in 2014 with a more significant decrease between 1992 and 2000 (an average decrease of 0.8% per year). However, starting in 2000 the compensation ratio stabilized with a negligible average decrease over the period 2000 to 2014. It is assumed that there will be no growth in the compensation ratio over the long term.

The earnings ratio is the ratio of total workers' earnings, defined as the sum of total wages, salary disbursements, and total self-employment earnings, to total compensation. Changes in the earnings ratio reflect changes in the compensation structure offered to employees. The historical decline in the earnings ratio of 0.2% per year from 1961 to 2014 has been primarily due to the faster growth in supplementary labour income, such as employer contributions to pension plans, health benefit plans, the CPP, and the Employment Insurance program, compared to earnings. Given that a significant portion of the historical decrease in the earnings ratio can be explained by the increase in CPP contributions resulting from the increase in the contribution rate from 3.6% in 1986 to 9.9% in 2003, the earnings ratio is not expected to decline as fast as it has in the past. However, as a result of the aging of the population, it is expected that the cost of pension plans and health programs will continue to increase in the future and exert downward pressure on the earnings ratio. Based on the foregoing, it is assumed that the long-term earnings ratio will decline by 0.1% per year.

The average hours worked is defined as the ratio of total hours worked to total employment in the Canadian economy. The average annual growth rate for average hours worked was -0.3% over the 53-year period ending in 2014. The decrease in the average hours worked was significant between 1976 and 1983, with an average annual decrease over that period of 0.7% per year. Despite short-term fluctuations, the average hours worked stabilized after 1983, with an average decrease of 0.1% per year between 1983 and 2014. In the future, the assumed steady increases in productivity and the higher participation rates of older workers, who generally work fewer hours, could continue to apply negative pressure on the average hours worked. However, higher wages due to productivity gains may encourage workers to work longer hours, and the assumed future increases in life expectancy may encourage older workers to work longer hours than in the past. It is assumed that in the long term, the average hours worked will remain at its 2014 level.

Finally, the price differential or "labour's terms of trade" is the ratio of the GDP deflator (defined as the ratio of nominal to real GDP) to the CPI. Including this ratio is necessary because labour productivity is expressed in real terms by using real GDP, while current dollar earnings are converted to real earnings using the CPI. The average annual growth in the price differential was 0.1% between 1961 and 2014. However, during this period, the price differential experienced significant fluctuations. It increased at an average rate of 1.1% per year between 1961 and 1976 and decreased at an average rate of 0.6% per year between 1976 and 2002. In more recent years, the decline has reversed, such that between 2002 and 2014 the price differential increased by 0.5% per year. This recent trend is due to Canada's improving international terms of trade. However, it is not clear for how long such growth could be sustained. It is assumed that the long-term price differential will remain stable after 2014.

The result of the foregoing discussion is that the assumed real wage increase is 1.1% per year over the long term. Table 50 summarizes the historical information and the assumptions described above.

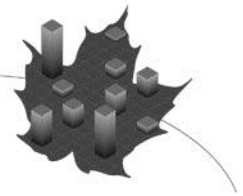


Table 50 Real Wage Increase and Related Components(1)

	1961-2014 Average	1990-2014 Average	2000-2014 Average	Ultimate Assumption
Labour Productivity Growth	**1.7%**	**1.3%**	**0.9%**	**1.2%**
+ Compensation Ratio Growth	-0.1%	-0.2%	0.0%	0.0%
+ Earnings Ratio Growth	-0.2%	-0.2%	-0.2%	-0.1%
+ Average Hours Worked Growth	-0.3%	-0.2%	-0.3%	0.0%
+ Price Differential Growth	0.1%	0.1%	0.3%	0.0%
Real Wage Increase	**1.2%**	**0.7%**	**0.7%**	**1.1%**

(1) Components may not sum to totals due to rounding.

Based on the experience of the first six months of 2016, the real increases in average annual earnings and average weekly earnings are assumed to be 0.2% and -0.5%, respectively for 2016. Thereafter, average annual and weekly earnings are assumed to increase at the same pace, with real wage increases projected to gradually rise to an ultimate value of 1.1% by 2025. This is consistent with the assumed moderate economic growth implicitly reflected in the assumption on the unemployment rate, which is expected to decrease until it reaches its ultimate level of 6.2% in 2025.

Table 51 shows the assumptions regarding the annual increases in prices, real AAE, and real AWE.

Table 51 Inflation, Real AAE and AWE Increases

Year	Price Increases	Real Increases Average Annual Earnings (AAE)	Real Increases Average Weekly Earnings (AWE), (YMPE)
	(%)	(%)	(%)
2016	1.60	0.20	-0.50
2017	2.00	0.60	0.60
2018	2.00	0.70	0.70
2019	2.00	0.80	0.80
2020	2.00	0.90	0.90
2021	2.00	1.00	1.00
2022	2.00	1.03	1.03
2023	2.00	1.05	1.05
2024	2.00	1.08	1.08
2025+	2.00	1.10	1.10

E. Average Annual Earnings, Pensionable Earnings and Total Earnings

Average annual earnings are projected by taking into account past and expected structural demographic changes as well as the narrowing of the gap between average female and male employment earnings. As part of these projections, the average annual earnings of working beneficiaries are also taken into account. The ratio of female to male average employment earnings stood at about 48% in 1966 and was 75% in 2013. This ratio is projected to increase to 85% by 2050. Table 52 shows the projected average annual earnings by age group and sex for selected years.

Table 52 Average Annual Earnings (Canada less Québec, ages 18 to 69)

Age Group	Males			Females		
	2016	2025	2050	2016	2025	2050
	($)	($)	($)	($)	($)	($)
20-24	25,709	32,589	69,238	18,845	24,446	54,364
25-29	43,127	54,557	114,348	33,264	43,762	98,092
30-34	53,030	66,547	139,008	38,948	51,411	116,609
35-39	58,457	73,316	153,265	43,527	57,381	129,956
40-44	60,669	76,216	159,336	46,365	61,035	137,516
45-49	60,912	76,561	160,288	47,046	61,784	139,039
50-54	60,453	76,138	159,279	46,900	61,346	138,073
55-59	56,630	70,986	148,677	43,351	57,078	128,606
60-64	47,080	60,982	127,962	34,783	47,481	107,602
65-69	37,292	50,494	104,256	25,457	36,255	82,447
All Ages	**50,008**	**63,674**	**132,484**	**37,932**	**50,481**	**112,952**

Total earnings are the product of average earnings and the number of earners. Table 53 shows the projected average earnings and number of earners for each sex, the resulting total earnings, and the annual percentage increase in total earnings for Canada less Québec. The ultimate annual increase in total earnings is set to reach about 3.7%. This nominal increase comprises an ultimate inflation rate of 2.0%, real wage growth of 1.1%, and population growth for the age group 18 to 69 of 0.6%.

Table 53 Total Earnings (Canada less Québec, ages 18 to 69)

Year	Average Annual Earnings		Earners		Total Earnings	Annual Increase in Total Earnings
	Males	Females	Males	Females		
	($)	($)	(thousands)	(thousands)	($ million)	(%)
2016	50,008	37,932	7,888	7,140	665,273	2.7
2017	51,201	39,054	7,970	7,234	690,581	3.8
2018	52,477	40,247	8,036	7,318	716,258	3.7
2019	53,841	41,510	8,102	7,401	743,409	3.8
2020	55,292	42,841	8,161	7,463	770,959	3.7
2021	56,842	44,254	8,217	7,523	800,019	3.8
2022	58,454	45,724	8,273	7,585	830,397	3.8
2025	63,674	50,481	8,430	7,764	928,702	3.8
2030	73,587	59,516	8,611	8,010	1,110,373	3.7
2035	85,124	70,068	8,845	8,327	1,336,397	3.8
2040	98,549	82,280	9,136	8,607	1,608,556	3.8
2050	132,484	112,952	9,678	9,089	2,308,810	3.5
2075	281,032	245,696	10,879	10,227	5,569,956	3.7

Average pensionable earnings are computed by removing from average annual earnings the earnings of those earning less than the YBE and the portion of earnings in excess of the YMPE. Such removal is made using the distributions of earners and earnings, which are based on individual earnings statistics. The average pensionable earnings by age, sex, and calendar year

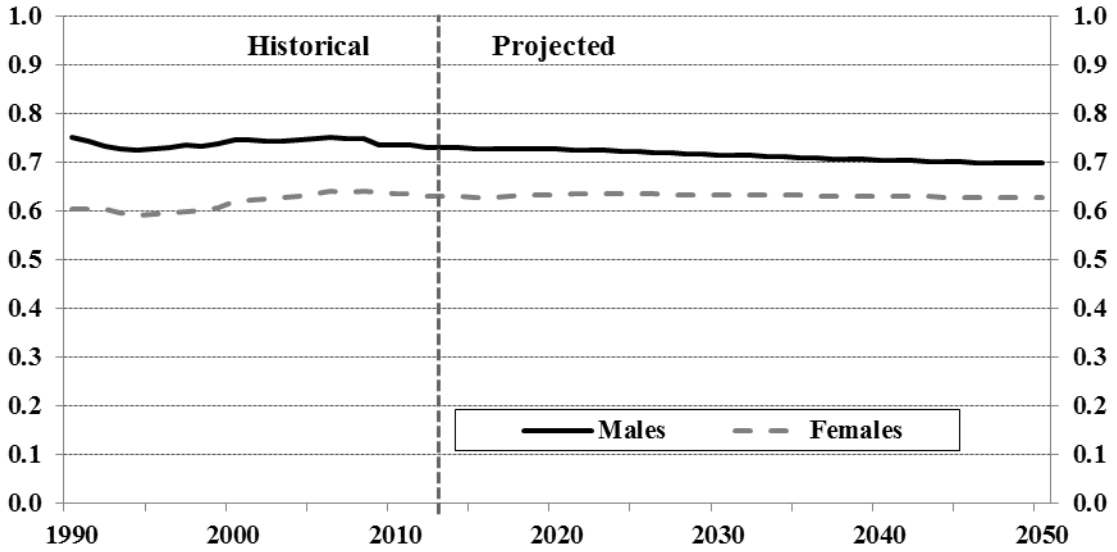
used in the calculation of the average contributory earnings correspond to the average portion of individual employment earnings below the YMPE for a cohort of earners earning more than the YBE. For 2016, the YMPE and YBE are respectively $54,900 and $3,500. The YMPE is increased annually based on the average industrial aggregate wage in Canada as published by Statistics Canada. Table 54 shows the projected average pensionable earnings by age and sex for selected years.

Table 54 Average Pensionable Earnings (Canada less Québec)

	Males			Females		
Age Group	**2016**	**2025**	**2050**	**2016**	**2025**	**2050**
	($)	($)	($)	($)	($)	($)
20-24	26,082	32,501	66,783	20,658	26,084	55,148
25-29	37,364	46,977	97,671	32,156	41,127	87,954
30-34	41,706	52,409	109,665	35,095	44,889	96,372
35-39	43,419	54,610	114,748	37,084	47,419	101,837
40-44	43,944	55,322	116,383	38,416	49,141	105,582
45-49	44,066	55,485	116,788	38,898	49,766	107,059
50-54	43,883	55,267	116,146	38,873	49,645	106,696
55-59	42,051	52,746	110,081	37,059	47,346	101,133
60-64	39,456	49,716	103,054	33,863	43,894	93,849
65-69	34,810	44,063	90,464	28,692	37,118	78,883
All Ages	**39,533**	**49,953**	**103,595**	**34,055**	**43,785**	**92,967**

The evolution of the ratio of average pensionable earnings for males and females as a percentage of the YMPE is shown in Chart 10. The freezing of the YBE has the effect that, over time, fewer and fewer workers are exempt from participating in the CPP. This, in turn, has the effect of increasing the number of earners with low earnings participating in the Plan. The ratio reduces over time for males mainly due to this YBE effect. For females, the ratio is stable as the YBE effect is offset by the greater increase in their average pensionable earnings.

Chart 10 Ratio of Average Pensionable Earnings to Maximum



F. Contributions

Contributions are determined by multiplying together the number of contributors, average contributory earnings, and the contribution rate.

1. Proportion of Contributors

In order to be considered a contributor in any given calendar year, one must have employment earnings exceeding the YBE. Accordingly, the proportion of contributors is determined by multiplying the proportion of earners by the complement of the proportion of earners earning up to the YBE. This last proportion is determined for each age, sex, and calendar year by expressing the YBE as a percentage of average employment earnings and using the distributions of earners and their earnings. These distributions were determined using earnings statistics from 2011 to 2013 and are assumed to remain constant in the future. Starting in 2012, the proportion of contributors is adjusted to reflect working beneficiaries. Table 55 presents the proportions of contributors by selected age groups and years for males and females.

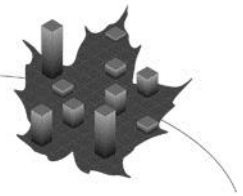


Table 55 Proportions of Contributors by Age Group

	Males			Females		
Age Group	**2016**	**2025**	**2050**	**2016**	**2025**	**2050**
	(%)	(%)	(%)	(%)	(%)	(%)
20-24	76.7	83.2	87.5	72.4	79.1	85.5
25-29	86.6	89.1	91.7	76.3	80.8	86.4
30-34	86.6	88.5	90.9	74.6	80.0	85.0
35-39	87.4	90.5	91.7	75.9	80.7	84.7
40-44	86.9	87.6	89.3	77.6	81.1	83.9
45-49	86.9	89.5	90.4	79.1	82.6	85.3
50-54	80.5	84.5	86.3	75.5	79.1	82.5
55-59	74.9	78.3	81.1	65.1	70.0	74.0
60-64	57.0	60.1	63.5	45.8	50.6	54.1
65-69	20.2	21.8	22.9	13.9	15.4	16.4
All Ages	**75.2**	**77.3**	**79.7**	**66.6**	**69.9**	**73.8**

2. Average Contributory Earnings

Average contributory earnings, which also reflect working beneficiaries, are determined for each age, sex, and year by subtracting the YBE from the average pensionable earnings shown in Table 54. Table 56 shows the resulting average contributory earnings by age group and sex for selected years.

Table 56 Average Contributory Earnings

	Males			Females		
Age Group	**2016**	**2025**	**2050**	**2016**	**2025**	**2050**
	($)	($)	($)	($)	($)	($)
20-24	22,582	29,001	63,283	17,158	22,584	51,648
25-29	33,864	43,477	94,171	28,656	37,627	84,454
30-34	38,206	48,909	106,165	31,595	41,389	92,872
35-39	39,919	51,110	111,248	33,584	43,919	98,337
40-44	40,444	51,822	112,883	34,916	45,641	102,082
45-49	40,566	51,985	113,288	35,398	46,266	103,559
50-54	40,383	51,767	112,646	35,373	46,145	103,196
55-59	38,551	49,246	106,581	33,559	43,846	97,633
60-64	35,956	46,216	99,554	30,363	40,394	90,349
65-69	31,310	40,563	86,964	25,192	33,618	75,383
All Ages	**36,033**	**46,453**	**100,095**	**30,555**	**40,285**	**89,467**

3. Total Contributory Earnings

Contributory earnings for each given age, sex, and year are calculated as the product of the proportion of contributors, average contributory earnings, and the corresponding population. Total contributory earnings for each year are obtained by summing contributory earnings for each age and sex in that year.

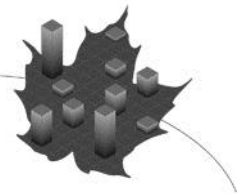
Total contributory earnings are then adjusted upward to take into account the non-refundable portion of employer contributions arising generally in respect of (1) employees with multiple employers during a given year, (2) employees earning less than the YBE during a given year, and (3) employees who work only part of the year and do not have full access to the YBE. The amount of non-refundable employer contributions increases total CPP contributions, which indicates higher underlying contributory earnings.

The records of earnings from Service Canada, the annual report on contributors published by the Department of Employment and Social Development Canada, and the information from the Canada Revenue Agency on CPP contribution refunds were used to calculate the adjustment. The adjustment is about 1.9% in 2016 and decreases to 1.8% over the projection period to account for the YBE being frozen at $3,500.

Annual contributions are equal to the product of adjusted contributory earnings and the contribution rate. The contribution rate is set by law and has been 9.9% since 2003. Table 57 presents the projected components of total unadjusted contributory earnings, the total adjusted contributory earnings, as well as the projected YMPE.

Table 57 Total Adjusted Contributory Earnings

	Unadjusted Average Contributory Earnings			Contributors		Total Adjusted Contributory Earnings	Annual Increase in Total Adjusted Contributory Earnings
Year	Males	Females	YMPE	Males	Females		
	($)	($)	($)	(thousands)	(thousands)	($ million)	(%)
2016	36,033	30,555	54,900	7,298	6,486	469,849	3.3
2017	36,658	31,232	55,500	7,379	6,583	485,068	3.2
2018	37,652	32,165	56,900	7,447	6,670	504,277	4.0
2019	38,757	33,184	58,500	7,511	6,755	524,960	4.1
2020	39,883	34,232	60,100	7,570	6,821	545,491	3.9
2021	41,122	35,367	61,900	7,624	6,885	567,494	4.0
2022	42,370	36,522	63,700	7,678	6,950	590,033	4.0
2025	46,453	40,285	69,700	7,836	7,143	664,010	3.9
2030	54,233	47,447	81,300	8,043	7,426	803,264	3.9
2035	63,205	55,714	94,700	8,333	7,797	978,913	4.1
2040	73,621	65,274	110,300	8,647	8,111	1,187,616	3.9
2050	100,095	89,467	149,700	9,188	8,626	1,722,602	3.6
2075	215,502	194,395	321,100	10,440	9,856	4,241,948	3.7



IV. Investment Assumptions

A. Investment Strategy

The CPPIB invests funds according to its own investment policies that take into account the needs of contributors and beneficiaries, as well as financial market constraints. For the purpose of this report, the investments have been grouped into three broad categories: equities, fixed income securities, and real assets. Equities consist of Canadian, foreign developed market, and emerging market equities. Fixed income securities consist of federal, provincial and corporate bonds, and short-term investments. Real assets include such categories as real estate and infrastructure.

The total assets of the CPP portfolio ($285.4 billion as at 31 December 2015) consist of amounts invested by the CPPIB ($282.6 billion) the amount held in the CPP Account ($31 million) and amounts receivable ($2.8 billion). As at 31 December 2015, the asset mix of the CPPIB consisted of 52% equities, 28% fixed income securities, and 20% real assets. Since the previous actuarial valuation, the CPPIB approved a new CPP reference portfolio which consists of 85% global equity and 15% Canadian government nominal bonds[1].

The CPP reference portfolio is not necessarily representative of the actual holdings of the CPPIB. Therefore, the initial CPP portfolio asset mix is derived using the actual amount held in the CPP Account, amounts receivable, and investments reported by the CPPIB as at 31 December 2015. The initial asset mix of the CPP portfolio as at 31 December 2015 consists of 52% equities, 28% fixed income securities, and 20% real assets. It is assumed that investment in real assets, which accounted for only 10% of the portfolio in 2009, will continue to grow, reaching 25% of the portfolio in 2021. Bond yields are expected to gradually increase over the next nine years. Thus, bond returns are assumed to be low over that period. The allocation to fixed income securities is assumed to decline from 28% at the end of 2015 to 20% in 2021, while the allocation to equities is assumed to increase from 52% to 55% in 2020.

This report provides a projection over the next 75 years. As such, a long-term asset mix assumption is required. As the CPP matures and the Plan's participants age, the ratio of contributors to beneficiaries will decrease, and the proportion of investment income required to pay benefits will increase. Starting in 2021, it is expected that contributions will be insufficient to cover all expenditures, and that a portion of investment income will be required to cover the contribution shortfall. The contribution shortfall will be small as a proportion of total assets at the beginning (0.1% in 2021) and will increase as the Plan matures, reaching 1.5% of total assets in 2050.

Over the period 2022 to 2025, it is expected that the assumed asset mix of 55% equities, 20% fixed income securities, and 25% real assets will generate enough investment income through fixed income security coupons to cover the contribution shortfall. After 2025, investment income from fixed income security coupons, dividends on equities, and real assets are assumed to be sufficient to cover the larger shortfall, such that the risk that assets of the CPP portfolio have to be sold at an inopportune time to cover expected contribution shortfalls is minimal. Thus, the assumed ultimate asset mix of the CPP portfolio consists of 55% equities, 20% fixed income securities, and 25% real assets, which differs from the actual CPPIB asset mix as at 31 December 2015 in order to reflect an expected increase over time in allocations to real assets and equities, consistent with the new CPP reference portfolio. The assumed ultimate asset mix

[1] The previous CPP reference portfolio consisted of 65% equity and 35% debt.

differs from the CPP reference portfolio target asset mix, reflecting additional asset classes that are part of the actual asset mix of the CPP portfolio. The assumed ultimate asset mix is equivalent to a portfolio invested 67.5% in equities and 32.5% in fixed income securities, assuming real assets behave half like equities and half like fixed income securities.

Table 58 shows the assumed asset mix of the CPP portfolio for selected years of the projection period.

Table 58 Asset Mix

	Equity			Fixed Income Securities			Real Assets (Real Estate and Infrastructure)
Year	Canadian	Foreign Developed Market	Emerging Market	Marketable Bonds	Non-Marketable Bonds	Short Term	
	(%)	(%)	(%)	(%)	(%)	(%)	(%)
2016	6	40	6	18	9	1	20
2017	6	41	6	17	8	1	21
2018	7	41	6	15	8	1	22
2019	7	41	6	15	7	1	23
2020	8	41	6	14	6	1	24
2021	8	41	6	14	5	1	25
2025	8	41	6	16	3	1	25
2030	8	41	6	17	2	1	25
2035	8	41	6	17	2	1	25
2040	8	41	6	18	1	1	25
2046	8	41	6	19	0	1	25

B. Investment Income

In general, investment income from a given asset within a portfolio is the product of the market value of that asset and its projected nominal rate of return (which is obtained by adding the applicable projected real rate of return, as described in section C below, to the projected inflation rate).

The investment income of the CPP is based on the assumed real rate of return applicable to each type of asset, projected inflation, and the projected asset mix and cash flows. Investment income is also adjusted downward to recognize investment expenses (discussed in section D).

C. Real Rates of Return

For comparison purposes with the discussion and assumptions described in this section, the following Table 59 presents the average annual real rates of return based on Canadian dollars for various asset classes as well as inflation levels for periods ending 31 December 2015. Table 59 was prepared based on the Canadian Institute of Actuaries' *Report on Canadian Economic Statistics 1924 – 2015*.

Table 59 Historical Inflation and Real Rates of Return by Asset Type

Length of Period ending 31 December 2015 (years)	25	50	65	75
	(%)	(%)	(%)	(%)
Level of Inflation	1.9	4.1	3.6	3.7
Real Return on Canadian Equity	6.3	4.6	5.8	6.4
Real Return on U.S. Equity	8.5	5.9	7.5	7.5
Real Return on Canadian Real Estate	6.7	n/a	n/a	n/a
Real Yield on Long-Term Federal Bonds	3.4	3.2	3.0	2.4
Real Return on Long-Term Federal Bonds	7.0	4.0	3.1	2.5
Average Real Return on Diversified Portfolios	6.6	4.4	n/a	n/a

Real rates of return are required for the projection of revenue arising from investment income. They are assumed for each year of the projection period and for each of the main asset categories in which CPP assets are invested. All real rates of return described in this section are shown before reduction for assumed investment expenses.

In addition, the assumed real rate of return for each asset class includes an allowance for rebalancing and diversification to take into account the beneficial effect of reduced volatility that comes from diversification within a portfolio. If the expected rates of return for each asset class were not increased to reflect their respective share of this allowance, then the expected long-term portfolio rate of return calculated as the weighted average rate of return of each asset class would be underestimated.

The real rates of return were developed by looking at historical returns (expressed in Canadian dollars) and adjusting the returns upward or downward to reflect expectations that differ from the past. Future currency variations will impact the real rates of return over the projection period, creating gains and losses. However, as the projection period is 75 years, these gains and losses are expected to offset each other over time. Thus, it is assumed that currency variations will not have an impact on the real rates of return.

Real Rates of Return on Assets under the Management of the CPPIB

As discussed earlier, CPPIB assets are invested in three broad categories of investments: equities, fixed income securities, and real assets. The projected annual real rates of return for each of these asset classes have been determined by taking into consideration the current economic environment, various economic forecasts, as well as historical experience.

The future outlook is based on the assumption that, over the short term, federal bond yields are expected to increase, since their recent low levels were prompted mainly by large government economic stimulus interventions and a flight to quality assets following the global recession of 2008-2009. The projected real rates of return for different types of investments also reflect that projections are over a 75-year time horizon and thus, should be generally consistent with the long-term averages of real rates of return.

With the exception of fixed income securities, real rates of return for all asset classes are assumed to be constant for the entire projection period. The current context of extremely low bond yields and the general expectation that bond yields will increase over the coming years are reflected in the expected real rates of return for fixed income securities. A constant real rate of return is assumed for the more volatile asset classes, reflecting the difficulty in projecting yearly market returns.

1. Fixed Income Securities

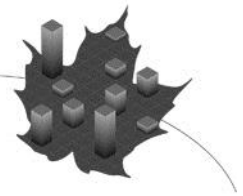
As at 31 December 2015, the CPPIB had 28% of its portfolio invested in fixed income securities, split between a non-marketable bond portfolio composed of bonds with various terms to maturity, representing loans made to the provinces, and a marketable bond portfolio consisting of federal, provincial and corporate bonds.

Non-Marketable Bond Portfolio and Rollover Rates (Loans to Provinces)

The non-marketable bond portfolio at the end of 2015 represented 9% of all CPP assets. The provinces are allowed to roll over at maturity for a further 20-year term any bonds that were purchased prior to the 1997 CPP amendments (that came into effect on 1 January 1998). In lieu of exercising their statutory rollover right, an agreement between the provinces and the CPPIB permits each province to repay a bond and contract a replacement bond or bonds for a term of at least five years, with a total principal amount not exceeding the principal amount of the maturing bond and total successive terms not more than 30 years. During the 17-year period 1999 to 2015, 67% of provincial bonds available for rollover were rolled over. The rollover proportion increases to 98% when considering the three-year period from 2013 to 2015, and to 100% when considering only 2015. Using this rollover experience and considering current stakeholders' balance sheets, it is assumed that the rollover rate will be approximately 98% for 2016 and thereafter. The last non-marketable bond is expected to mature in 2042.

On the basis of the average long-, medium-, and short-term experience of the spread between the annual yields on federal and provincial bonds, the current outlook of the economy, and data on rollovers since 1999, a spread over the federal yield was determined for each province. The initial spreads on rollover bonds are set at the actual market spreads at the end of 2015 for provincial bonds issued by the given province. The ultimate spreads, applicable starting at the end of 2024, are set at the average spreads for the 10-year period ending in 2009 for provincial bonds issued by a given province. Spreads over the last six years (2010-2015) were abnormally high due to the current extremely low federal bond yield environment and were thus ignored in the determination of the ultimate spreads. The ultimate annual long-term real federal yield is assumed to be 2.6%, as discussed in the following section. This is consistent with the long-term average of long-term real federal yields. The weighted long-term average spread for all provinces is approximately 55 basis points. Therefore, an ultimate annual real yield of approximately 3.15% for provincial rollover bonds is assumed for 2024 and thereafter.

The real rate of return of the non-marketable bond portfolio is calculated by taking into consideration any coupon payments made throughout the year, as well as the change in the market value of the portfolio due to changes in the assumed yield rates and in the term to maturity of each bond. Coupons paid and redemption values of bonds at maturity are assumed to be reinvested in the marketable bond portfolio.



Marketable Bond Portfolio

As the non-marketable bond portfolio matures over the next three decades, it is assumed that the proceeds will be invested in marketable bonds and that the marketable bond portfolio will consist of federal, provincial and corporate bonds in varying proportions. The initial asset mix of the marketable bond portfolio is estimated from the CPPIB's 31 December 2015 financial statements; that is, 55% federal, 11% provincial and 34% corporate bonds.

It is assumed that the CPPIB will purchase a variety of federal, provincial, and corporate bonds in proportions consistent with the CPPIB's investment strategy. It is also assumed that maturing non-marketable bonds will be mostly reinvested in provincial bonds, compared to other bond types. It is thus assumed that the ultimate marketable bond mix applicable for 2026 and thereafter will be composed of 40% federal, 35% provincial and 25% corporate bonds.

The real yield on long-term federal bonds as at 31 December 2015 is about 0.4% and is assumed to gradually increase to 2.6% by 2025 and remain at that level thereafter (2.8% in the previous valuation). The real yields for federal bonds of shorter maturities as well as for provincial and corporate bonds are based on the real yield on long-term federal bonds adjusted based on historical spreads. The initial spreads over the real yield on federal long-term bonds are based on spreads prevailing as at 31 December 2015 and reflect the current economic environment. The assumed average maturity of federal, provincial, and corporate bonds are estimated based on the CPPIB's holdings as at 31 December 2015 and are assumed to remain constant throughout the projection period. The assumed real rate of return of the marketable bond portfolio once bond yields have stabilized is lower than the corresponding assumed real rate of return of the previous actuarial report (2.7% instead of 2.9% before investment expenses).

The real rate of return for the marketable bond portfolio is calculated for each year using the proportion invested in each bond type and the bonds' real rates of return. The expected real rates of return for individual bonds take into account the coupons and market value fluctuations due to the expected movement of their respective yield rates. Since the long-term federal bond yield is assumed to increase between 2016 and 2024 and only stabilize at the end of 2024, bond returns are quite low for the first nine years of the projection. The assumed ultimate real rate of return for long-term federal bonds is 2.6% starting at the end of 2024. The assumed average ultimate real rates of return for federal, provincial, and corporate bonds of various maturities are 2.1%, 2.6% and 3.5%, respectively. An ultimate real rate of return of 2.7% is assumed for the marketable bond portfolio for 2025 and thereafter.

Short-Term Investments and the CPP Account

The CPP Account is established in the Accounts of Canada to record the transactions of the Plan and amounts transferred to and from the CPPIB. Historically, the CPP Account, held by the federal Department of Finance, consisted of an operating balance and short-term investments. The assets of the CPP Account not needed to meet immediate Plan obligations were transferred to the CPPIB in monthly installments between September 2004 and August 2005. As such, the balance in the CPP Account is now minimal, serving only as a flow-through account with investments solely in short-term securities. The Account is assumed to earn a real rate of return of 1.0% for 2025 and thereafter. The CPPIB's short-term investments are also assumed to earn a real rate of return of 1.0% for 2025 and thereafter. The initial assumed real rate of return is lower, reflecting the current environment, with a smooth transition assumed from the initial to the ultimate assumption of 1.0%.

2. Equity

The CPPIB assets invested in equities are currently diversified among Canadian, foreign developed, and emerging market equities. In the derivation of the real rates of return for these equity investments, consideration was given to the long-term equity risk premiums for the respective equity classes. The rates of return also include dividends from the equities and market value fluctuations. No distinction is made between realized and unrealized capital gains.

Consistent with the assumption that risk taken must be rewarded, equity real rates of returns are developed by adding an equity risk premium to the long-term federal bond real rate of return. The historical equity risk premium over long-term government bond returns for 21 countries, representing almost 90% of global stock market value, for the 116-year and 50-year periods ending in 2015 were 3.2% and 0.8% respectively (3.3% and 0.4% for Canada)[1]. Historical equity risk premiums over the 116-year period were higher than expected due to several non-repeatable factors (mainly diversification and globalization). As a result, the long-term expected equity risk premium is assumed to be lower than what was realized in the past 116 years. However, the equity risk premium is assumed to be higher in the first nine years of the projection, reflecting assumed low bond returns over the same period, before reaching an assumed ultimate rate of 2.1% for Canadian and foreign developed markets. The equity risk premium for emerging market equities is expected to be 100 basis points higher than for Canadian and foreign developed market equities, reflecting the additional risk inherent with investments in emerging countries.

As described in the previous section, the annual long-term federal bond real rate of return is set at 2.6% for 2025 and thereafter. The real rates of return are thus projected at 4.7% for developed market equities and 5.7% for emerging market equities throughout the projection period.

3. Real Assets

Real assets such as real estate and infrastructure are considered to be a hybrid of debt and equity. These assets are assumed to equally share characteristics of corporate bonds and developed market equities. Hence, the assumed return on real assets is composed of half the return on corporate bonds of various maturities and half the return on developed market equities. Considering the inherent difficulties in modeling short-term returns for volatile assets, real rates of return for real assets are projected to be 4.2% throughout the projection period.

Table 60 summarizes the assumed real rates of return by asset type throughout the projection period, before reduction for investment expenses.

[1] Source: Elroy Dimson, Paul Marsh and Mike Staunton, Credit Suisse Global Investment Returns Yearbook 2016.

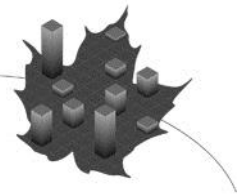


Table 60 Real Rates of Return by Asset Type (before investment expenses)

Year	Equity			Fixed Income Securities			Real Assets (Real Estate and Infrastructure)	Total Real Rate of Return[1]
	Canadian	Foreign Developed Market	Emerging Markets	Marketable Bonds	Non-Marketable Bonds	Short Term		
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
2016	4.7	4.7	5.7	(0.9)	1.1	(1.1)	4.2	0.6[2]
2017	4.7	4.7	5.7	(1.1)	(0.5)	(1.3)	4.2	3.2
2018	4.7	4.7	5.7	(1.9)	(1.7)	(1.2)	4.2	3.1
2019	4.7	4.7	5.7	(1.4)	(1.2)	(0.8)	4.2	3.3
2020	4.7	4.7	5.7	(0.5)	(0.1)	(0.4)	4.2	3.6
2021	4.7	4.7	5.7	(0.3)	0.0	(0.1)	4.2	3.7
2022	4.7	4.7	5.7	0.2	0.3	0.2	4.2	3.7
2025	4.7	4.7	5.7	2.7	3.2	1.0	4.2	4.2
2030	4.7	4.7	5.7	2.7	3.2	1.0	4.2	4.2
2035	4.7	4.7	5.7	2.7	2.7	1.0	4.2	4.2
2040	4.7	4.7	5.7	2.7	2.0	1.0	4.2	4.2
2046	4.7	4.7	5.7	2.7	0.0	1.0	4.2	4.2

(1) The assumed total real rate of return is shown before reduction for investment expenses. The assumed total real rate of return net of expenses is obtained by reducing the total real rate of return by 20 basis points.

(2) The assumed total real rate of return of 0.6% for 2016 is based on an initial assumed rate of 3.3% adjusted to reflect the investment experience of the first six months of the year.

D. Investment Expenses

Starting with the 26th CPP Actuarial Report, CPPIB operating expenses are applied as a reduction to the rates of return, while CPP operating expenses arising from the Department of Employment and Social Development Canada, the Canada Revenue Agency, Public Services and Procurement Canada, the Office of the Superintendent of Financial Institutions Canada, and the Department of Finance Canada are treated as expenditures. Over the last three calendar years, CPPIB's total investment expenses consisting of operating expenses, transaction costs, and investment management fees have averaged 0.94% of assets. The majority of those investment expenses were incurred through active management decisions. Considering the recent increase in investment expenses, it is assumed that going forward CPPIB investment expenses will be 1.00% of assets.

The active management objective is to generate returns in excess of those from the CPP reference portfolio, after reduction for the additional expenses incurred from active management. Thus, the additional returns from a successful active management program should equal at least the cost incurred to pursue active management. For the purpose of this report, it is assumed that the additional returns generated by active management will equal the additional expenses incurred from active management. Those expenses are assumed to be 0.8%, which is the difference between the assumed total investment expenses of 1.00% and the investment expenses of 0.2% that would be incurred from passive management of the portfolio, given that part of the portfolio is invested in real estate and infrastructure. The assumed investment expenses of 0.2% represent $583 million and $915 million in years 2016 and 2025, respectively.

The next section shows the overall rate of return on CPP assets net of investment expenses.

E. Overall Rate of Return on CPP Assets

The best-estimate rate of return on total assets is derived from the weighted average assumed rate of return on all types of assets, using the assumed asset mix proportions as weights. For the calendar year 2016, the best-estimate rate of return is adjusted to reflect the experience over the first six months of the year. In addition, the best-estimate rate of return is increased to reflect additional returns due to active management and reduced to reflect all investment expenses. The ultimate real rate of return is developed as follows:

	Nominal	Real
Weighted average rate of return (before investment expenses)	6.2%	4.2%
Additional rate of return due to active management	0.8%	0.8%
Expected investment expenses		
Expenses due to passive management	-0.2%	-0.2%
Additional expenses due to active management	-0.8%	-0.8%
Total expected investment expenses	-1.0%	-1.0%
Ultimate rate of return	**6.0%**	**4.0%**

The resulting nominal and real rates of return for each projection year are shown in Table 61. The projected average annual real rate of return over the next 75 years is 3.9%.

Table 61 Annual Rates of Return on CPP Assets

Year	Nominal	Real
	(%)	(%)
2016	2.0	0.4
2017	5.0	3.0
2018	4.9	2.9
2019	5.1	3.1
2020	5.4	3.4
2025+	6.0	4.0
Average over:		
2016-2020	4.5	2.6
2016-2025	5.1	3.1
2016-2090	5.9	3.9

It is expected that the 75-year average annual real rate of return on investments (period 2016-2090) will be 3.9%, net of all investment expenses, unchanged compared to the previous valuation. The real rates of return over the first nine years of the projection are on average 0.4% lower than assumed in the previous valuation for the corresponding years. The real rate of return on assets takes into account the assumed asset mix as well as the assumed real rates of return for all categories of assets. The nominal returns projected are the sum of the assumed level of inflation and the real returns.

Using the variable real rates of return on assets in the previous table is equivalent to using a flat real discount rate of 3.9% for the purpose of calculating the minimum contribution rate.

V. Expenditures

The approach used in this report to project future benefits paid is based on macrosimulation, which means that the projections rely on grouped data. The amount of benefit expenditures is determined by taking into account the administrative agreement between the Canada Pension Plan and the Québec Pension Plan for beneficiaries who contributed to both plans.

The initial average annual retirement pension of all persons born in a given calendar year, split by sex, is obtained for the cohort by summing for each year over the contributory period the product of the proportion of contributors and the average pensionable earnings deemed to apply to the cohort, dividing this sum by the number of years included in the contributory period, and then multiplying by 25%.

All benefit projections are done using 1966 as the starting point instead of the beginning of the statutory projection period (2016). This is done for the following reasons:

- The valuation methodology can be validated for the historical period up to the valuation year (1966 to 2015) by comparing for that period the projected values (contributions, benefits, beneficiaries, etc.) with actual experience.
- The projection of those benefits already in pay as at the valuation date (31 December 2015) is fully integrated with the projection of benefits emerging after that date using adjustment factors (ratios) of past experience relative to projections up to 2015, thus ensuring full consistency between past experience and the future.

The estimated number of beneficiaries in pay and average monthly benefits payable as at 31 December 2015 are shown in Table 62.

Table 62 Pensions Payable as at 31 December 2015

	Number of Beneficiaries in pay		Average Monthly Benefit	
Benefit Type	**Males**	**Females**	**Males**	**Females**
	(in thousands)		($)	($)
Retirement	2,307	2,446	659	449
Survivor				
- Aged less than 65	51	171	342	405
- Aged 65 and over	147	710	109	355
Disability	151	179	921	842

	Number of Beneficiaries in pay	Average Monthly Benefit
Benefit Type	**Males and Females**	**Males and Females**
	(in thousands)	($)
Orphan	59	235
Disabled Contributor's Child	76	235

A. Adjustments to Proportion of Contributors and Pensionable Earnings

The effect of credit-splitting of unadjusted pensionable earnings between spouses or common-law partners in the event of divorce or separation is accounted for by adjusting the projected proportion of contributors and average pensionable earnings of the respective spouses or common-law partners.

The average pensionable earnings used to determine the initial amounts of the retirement pensions are also adjusted to exclude the earnings of those who are already receiving their retirement pension. The resulting adjusted proportion of contributors and average pensionable earnings for benefit computation purposes appear in Table 63 and Table 64, respectively.

Table 63 Proportion of Contributors (adjusted for benefit computation purposes)

Age Group	Males			Females		
	2016	2025	2050	2016	2025	2050
	(%)	(%)	(%)	(%)	(%)	(%)
20-24	77.6	83.9	88.1	75.8	82.0	87.3
25-29	88.0	90.4	92.8	81.6	85.2	89.4
30-34	88.7	90.4	92.6	80.6	84.7	88.6
35-39	89.5	92.1	93.2	81.3	85.1	88.2
40-44	88.8	89.5	91.0	81.9	84.7	87.0
45-49	88.5	90.9	91.7	82.3	85.4	87.7
50-54	82.4	86.1	87.8	78.1	81.5	84.5
55-59	76.4	79.7	82.4	67.7	72.3	76.1
60-64	58.0	61.2	64.6	47.4	52.1	55.7
65-69	20.2	21.8	22.9	13.9	15.4	16.4
All Ages	**74.4**	**76.0**	**78.4**	**68.2**	**70.7**	**74.0**

Table 64 Average Pensionable Earnings (adjusted for benefit computation purposes)

Age Group	Males			Females		
	2016	2025	2050	2016	2025	2050
	($)	($)	($)	($)	($)	($)
20-24	25,482	31,883	65,803	20,272	25,767	54,815
25-29	35,764	45,242	94,936	31,283	40,256	86,734
30-34	39,258	49,780	105,261	34,105	43,975	95,016
35-39	41,081	52,150	110,412	36,129	46,546	100,378
40-44	41,971	53,107	112,402	37,500	48,136	103,702
45-49	42,401	53,714	113,602	38,152	49,008	105,613
50-54	42,294	53,568	113,126	38,063	48,793	105,120
55-59	40,629	51,190	107,293	36,192	46,408	99,392
60-64	39,492	49,514	103,322	34,668	44,392	94,981
65-69	34,192	43,230	89,062	30,065	38,407	81,136
All Ages	**37,999**	**48,264**	**100,796**	**33,393**	**43,120**	**91,883**

B. Benefit Eligibility Rates

As described in Appendix C (Plan Provisions), eligibility for benefits varies according to the type of benefit. Benefit eligibility rates (the proportions of the population eligible for benefits, for each age and sex) are used in the valuation process for the computation of historical retirement rates, disability incidence rates, as well as survivor, death, and children's benefits of all types.

Benefit eligibility rates for retirement, disability, and survivor benefits are computed using regression formulae that were developed to closely reproduce historical eligibility rates observed from the CPP records of earnings data over the period 1966 to 2013. The projected eligibility rates take into account the applicable eligibility rules for each type of benefit, the proportion of contributors, and the length of the contributory period for existing and future cohorts of earners.

The disability and survivor benefit eligibility rates developed as above must be adjusted for the purpose of computing the earnings-related portion of these two types of benefits. Table 65 shows the resulting eligibility rates for the various benefit types by sex and age for selected years. The retirement eligibility rates for some ages and years are greater than 100% due to individuals who contributed to the CPP and then left the country with no further information available as to their state. Since these individuals are not counted in the population, the retirement eligibility rates can be higher than 100%.

Table 65 Benefit Eligibility Rates by Type of Benefit

	Retirement Benefit Eligibility Rate at Age 65		Survivor/Death Benefit Eligibility Rate at Age 65	
Year	**Males**	**Females**	**Males**	**Females**
2016	1.07	1.03	1.01	0.71
2017	1.06	1.03	1.01	0.72
2018	1.06	1.02	1.01	0.73
2019	1.05	1.02	1.01	0.74
2020	1.05	1.02	1.01	0.75
2021	1.04	1.01	1.01	0.76
2022	1.04	1.01	1.01	0.76
2025	1.02	1.01	1.00	0.78
2030	1.01	1.00	0.99	0.80
2035	1.00	0.99	0.98	0.82
2040	1.01	1.00	0.98	0.82
2050	1.01	1.00	0.97	0.83
2075	1.02	1.01	0.99	0.85

	Survivor/Death Benefit Eligibility Rate at Ages 20-64		Disability Benefit Eligibility Rate at Ages 20-64	
Year	**Males**	**Females**	**Males**	**Females**
2016	0.80	0.71	0.74	0.64
2017	0.81	0.72	0.74	0.65
2018	0.81	0.73	0.75	0.66
2019	0.82	0.73	0.76	0.66
2020	0.82	0.74	0.76	0.67
2021	0.82	0.74	0.76	0.67
2022	0.82	0.74	0.76	0.67
2025	0.84	0.76	0.78	0.69
2030	0.85	0.77	0.79	0.72
2035	0.86	0.79	0.80	0.73
2040	0.87	0.80	0.80	0.74
2050	0.88	0.81	0.80	0.74
2075	0.89	0.83	0.81	0.76

C. Average Earnings-Related Benefit

The average earnings-related benefit is used in the calculation of the total emerging earnings-related benefit expenditures for a given calendar year, for each sex, and all relevant ages.

The gross (i.e. before taking into account the drop-out provisions and earnings index) average earnings-related benefit is determined by sex and calendar year for each attained age from 18 to 70 as the product of the retirement benefit proportion (25%), the MPEA, and the ratio of:

- the sum over all years in the elapsed contributory period (i.e. from age 18 to the attained age) of the ratio in each year of:
    - the average pensionable earnings of contributors (the product of the proportion of contributors and the average pensionable earnings, both components adjusted for benefit computation purposes),
    - to the YMPE
- to the number of years in the elapsed contributory period at the attained age.

The earnings-to-YMPE ratios that have to be dropped from the numerator of the gross average earnings-related benefit described above, in respect of an individual, are the lowest ratios for a number of years equal to the sum of the child-rearing period, disability period, and general drop-out period. However, since the general approach is based on macrosimulation (aggregate), there is no explicit way of determining the lowest ratios for each individual that would have to be dropped from the numerator to account for the drop-out provisions. Consequently, a formula was developed to help determine the lowest earnings ratios that can be dropped. The formula is based on the length of the contributory period, the general drop-out percentage, the child-rearing period expressed as a percentage of the elapsed contributory period, and the average proportion of contributors over the elapsed contributory period.

The average period that must be dropped from the elapsed contributory period (the denominator of the gross average earnings-related benefit described above) is computed as the sum of the three periods determined in respect of the disability, child-rearing, and general drop-out provisions.

The average earnings-related benefit is finally determined by adjusting the gross average earnings-related benefit determined above for the drop-out provisions.

Table 66 shows the resulting projected average earning-related benefit as a percentage of the maximum benefit at ages 60 and 65 by sex and year of birth for various cohorts of contributors. The average earnings-related benefit for males at age 65 as a percentage of the maximum is about 12 to 14 percentage points lower than at age 60 due to the fact that males who take their benefit at age 65 have a longer contributory period and an historical lower earnings profile than those who take an early benefit at age 60. For females, the difference between age 60 and 65 is less pronounced. The earnings-related benefits for males as a percentage of the maximum are expected to generally decrease over time because of the lower participation and pensionable earnings (as a proportion of the YMPE) of younger contributors in the early years of their contributory period. For females, this decline is offset by the expected higher earnings of future female cohorts. As a result, the gap between the male and female average earnings-related benefits is expected to decrease over time.

Table 66 Average Earnings-Related Benefit as Percentage of Maximum Benefit

	Average Earnings-Related Benefit (%)			
	Males		Females	
Year of Birth	Age 60	Age 65	Age 60	Age 65
1950	79	66	59	52
1951	79	66	59	53
1952	80	66	62	53
1953	79	66	62	53
1954	79	65	62	54
1955	78	65	62	54
1960	75	63	61	53
1965	72	60	60	52
1970	72	59	61	52
1980	72	60	63	53
1990	73	60	64	54
2000	74	61	66	56
2010	73	61	66	56
2020	73	60	66	56

D. Retirement Expenditures

For each cohort of contributors taking their retirement pension at a given age starting from age 60 or above in each of the calendar years starting in 1967, an average retirement benefit was computed to determine the emerging retirement benefit expenditures. The average retirement benefit is computed by age, sex, and calendar year of emergence of the pension as the product of:

- the assumed proportion of contributors electing to opt for their retirement benefit;
- the actuarial adjustment factor in connection with the flexible retirement age provision; and
- the average earnings-related benefit.

The assumed proportions by age, sex, and calendar year of contributors electing to start receiving the retirement pension at a given age were determined by taking into account the assumed future work patterns of earners aged 60 and over and the corresponding CPP experience from 1996 to 2015. These proportions correspond to the ratio of the number of emerging retirement beneficiaries to the product of the population and the retirement benefit eligibility rate (i.e. the ratio of the number of new retirement beneficiaries to the eligible population).

The retirement rates are determined on a cohort basis. The sex-distinct retirement rate for any given age and year from age 60 and above corresponds to the number of emerging (new) retirement beneficiaries divided by the product of the population and the retirement benefit eligibility rate for the given sex, age, and year. The unreduced pension age under the Canada Pension Plan is 65. However, since 1987 a person can choose to receive a reduced retirement pension as early as age 60. This provision has had the effect of lowering the average age at pension take-up. In 1986, the average age at pension take-up was 65.2, compared to about 62.4 over the decade ending in 2015.

In 2012, there was a significant increase observed in the retirement rates at age 60 for the cohort reaching age 60 that year. The retirement rates at age 60 in 2012 were 42% and 44% for males and females, respectively, compared to the corresponding rates of 32% and 35% in 2011. The observed increase in the retirement rates at age 60 in 2012 may have resulted from two provisions of the *Economic Recovery Act (stimulus)*. First, the work cessation test to receive the pension early (prior to age 65) was removed in 2012. As such, starting in 2012, individuals may receive a CPP retirement pension without having to stop working or materially reduce their earnings. The removal of the work cessation test may have thus led at least in part to the observed increase in retirement rates at age 60 in 2012. Second, greater reductions in early retirement pensions were scheduled to be phased in over a five-year period, starting in 2012. The anticipation of greater adjustments may have also contributed toward the observed increase in retirement rates at age 60 in 2012.

After 2012, the age 60 retirement rates gradually decreased to their pre-2012 levels as the higher actuarial adjustments were phased in and the effect of the removal of the work cessation test diminished. Retirement rates at age 60 for the cohort reaching age 60 in 2015 are 41% and 44% for males and females, respectively. For cohorts reaching age 60 in 2016 and thereafter, the retirement rates are assumed to be 34% for males and 38% for females and 42% and 39% at age 65 in 2021 and thereafter, for males and females, respectively. These rates reflect trends in recent experience. The rates result in a projected average age at take-up of 62.9 in 2030.

For each year in the projection period after 2015, the retirement rates for ages 61 to 64 are determined based on the observed averages over the five-year period ending in 2015 but excluding 2012. The retirement rates for ages 66 and above are also determined based on the observed averages over the five-year period ending in 2015. Most contributors elect to commence receiving their retirement pensions on or before age 65, with only a small proportion of contributors electing to start their pensions after that age.

The rates at age 65 are derived such that the sum of the retirement rates for each cohort is 100%. With this approach, it is implicitly assumed that all eligible contributors will have applied for their retirement pension before they reach age 75. Table 67 shows the projected retirement rates by age for both males and females.

Table 67 Retirement Rate (2016+)

Age	Cohort aged 60 in 2016+	
	Males	Females
	(%)	(%)
60	34.0	38.0
61	5.5	6.0
62	4.0	4.5
63	4.0	4.0
64	6.0	5.0
65	41.6	39.1
66	1.3	1.0
67	0.9	0.6
68	0.6	0.5
69	0.8	0.5
70	0.7	0.4
71	0.6	0.4
Total	**100.0**	**100.0**

The retirement pension expenditures for each year following the year of benefit take-up for a given age, sex, and cohort is computed as the product of:

- the population of retirement beneficiaries at emergence;
- the relevant annualized average rate of retirement pension payable during the year of emergence (described earlier);
- the probability of survival from the emergence age to the attained age; and
- the Pension Index, which recognizes the annual inflation adjustment to a pension each 1 January after the pension's emergence.

The mortality rates of CPP retirement beneficiaries used in the projections vary by age, sex, calendar year, and level of emerging pension. The mortality rates were developed based on CPP retirement beneficiaries' mortality experience over the period 1966 to 2013, the June 2015 actuarial study on the mortality of CPP retirement and survivor beneficiaries (*Canada Pension Plan Mortality Study: Actuarial Study No. 16* by the Office of the Chief Actuary) and the mortality improvement assumptions for the general population in this report. The resulting mortality rates and life expectancies are shown in Tables 68, 69, and 70.

Table 68 Mortality Rates of Retirement Beneficiaries
(annual deaths per 1,000)

	Males				Females			
Age	2016	2025	2050	2075	2016	2025	2050	2075
60	5.7	4.9	4.0	3.3	2.8	2.5	2.1	1.7
65	11.0	9.4	7.6	6.2	6.6	5.8	4.8	3.9
70	17.3	14.6	11.8	9.7	11.4	10.0	8.2	6.7
75	27.7	23.3	18.9	15.5	18.5	16.2	13.2	10.8
80	47.3	39.9	32.4	26.6	32.3	28.2	22.9	18.8
85	84.7	73.1	59.4	48.6	58.2	51.3	41.7	34.1
90	148.6	133.0	113.1	96.9	109.5	98.7	83.9	71.8

Table 69 Life Expectancies of Retirement Beneficiaries, with future improvements (1)

	Males				Females			
Age	2016	2025	2050	2075	2016	2025	2050	2075
60	25.5	26.1	27.6	29.0	28.5	29.0	30.4	31.7
65	20.9	21.6	23.0	24.4	23.7	24.2	25.5	26.8
70	16.8	17.4	18.7	19.9	19.2	19.8	21.0	22.2
75	12.9	13.5	14.6	15.7	15.1	15.6	16.7	17.8
80	9.5	10.0	10.9	11.9	11.3	11.8	12.7	13.6
85	6.6	7.0	7.7	8.4	8.0	8.4	9.2	9.9
90	4.4	4.7	5.1	5.6	5.4	5.7	6.2	6.6

(1) These are cohort life expectancies that take into account assumed future improvements in mortality of the general population and therefore differ from calendar year life expectancies, which are based on the mortality rates of the given attained year.

Table 70 Life Expectancies of Retirement Beneficiaries by Level of Pension (2016), with future improvements(1)

	CPP Level of Pension as % of Maximum				CPP Level of Pension as % of Maximum			
	Males				Females			
Age	< 37.5%	37.5-75%	75-100%	100%	< 37.5%	37.5-75%	75-100%	100%
60	23.9	24.6	25.7	26.8	27.8	28.5	29.1	29.6
65	20.0	20.2	21.1	22.1	23.2	23.7	24.2	24.8
70	16.2	16.2	16.8	17.6	18.9	19.2	19.5	20.1
75	12.5	12.5	12.9	13.5	14.9	15.1	15.3	15.7
80	9.2	9.2	9.5	9.8	11.2	11.3	11.4	11.8
85	6.4	6.4	6.6	6.8	8.0	8.0	8.1	8.4
90	4.3	4.3	4.4	4.5	5.4	5.4	5.4	5.6

(1) These are cohort life expectancies that take into account assumed future improvements in mortality of the general population and therefore differ from calendar year life expectancies, which are based on the mortality rates of the given attained year.

The amounts of all retirement pensions payable during any given calendar year are obtained by simply summing the annual expenditures applicable for the year as described above, in respect of all age and sex cohorts having emerged in the given and all previous calendar years.

Based on comparisons between actual experience and projections for 1966 to 2015, experience adjustment factors are applied to all future emerging retirement pensions calculated using the

methodology previously described, and are shown in Table 71. A final calibration factor based on experience for the benefits in pay is further applied to all future benefits in pay. Table 72 shows the projected number of new retirement beneficiaries along with their projected average monthly retirement benefits by sex and year.

Table 71 Retirement Benefit Experience Adjustment Factors

	Age at Emergence		
	60-65	66 and Over	All Ages
Males	0.98	0.75	0.97
Females	0.97	0.88	0.97

Table 72 New Retirement Pensions

	Number of Beneficiaries			Average Monthly Pension		
Year	**Males**	**Females**	**Total**	**Males**	**Females**	**Total**
				($)	($)	($)
2016	172,480	175,013	347,493	642.75	510.03	575.91
2017	167,063	173,348	340,412	648.56	519.06	582.62
2018	182,401	186,862	369,263	664.51	534.13	598.53
2019	188,063	193,235	381,297	677.84	548.54	612.31
2020	197,649	201,415	399,064	690.21	561.61	625.30
2021	197,492	200,319	397,811	698.34	571.77	634.60
2022	199,375	202,296	401,671	714.87	588.64	651.30
2025	204,452	207,186	411,637	764.62	639.87	701.83
2030	192,837	196,952	389,789	868.58	745.49	806.39
2035	184,198	191,497	375,695	1,006.74	872.63	938.38
2040	190,978	200,753	391,731	1,176.07	1,028.38	1,100.38
2050	229,865	240,268	470,134	1,604.52	1,420.82	1,510.63
2075	244,096	254,599	498,696	3,478.30	3,169.16	3,320.47

E. Post-Retirement Benefits

The working beneficiaries provision came into effect on 1 January 2012. Under this provision, individuals younger than age 65 who receive the CPP retirement benefit and work, as well as their employers, are required to make CPP contributions. Contributing to the Plan is voluntary for retirement beneficiaries aged 65 to 69 who continue to work, but employers of those opting to continue to contribute to the CPP are required to contribute also. Contributions to the Plan are not permitted upon attaining age 70. Contributions from working beneficiaries are applied toward providing a post-retirement benefit with the result that the total pension received from the combination of the retirement pension and the post-retirement benefit could exceed the maximum pension payable under the CPP. The post-retirement benefit is earned at a rate of $1/40^{th}$ of the maximum pension amount for each year of additional contributions post-benefit take-up and is adjusted for the earnings level and age of the beneficiary. Assumptions related to working beneficiaries presented in this section are developed using Canada Revenue Agency and Service Canada data for years 2012 and 2013.

Table 73 presents the assumed share of CPP retirement beneficiaries who work and contribute to the CPP in the year of and years following pension take-up, by age and sex. This assumption is kept constant for the entire projection period. The figures in this table reflect that not all working beneficiaries contribute to the CPP, due to the following:

- having earnings less than the YBE, and
- opting out of contributing between ages 65 and 69.

Table 73 Proportion of CPP Retirement Beneficiaries who are Contributors

	Year of Retirement Pension Up-Take		After Year of Retirement Pension Up-Take	
Age	**Males**	**Females**	**Males**	**Females**
60	40%	30%	0%	0%
61	55%	45%	56%	49%
62	55%	45%	49%	38%
63	55%	45%	42%	32%
64	95%	65%	39%	28%
65	24%	19%	34%	22%
66	52%	48%	16%	11%
67	43%	43%	10%	7%
68	43%	38%	9%	5%
69	36%	28%	6%	4%

In order to project the additional contributions that will result from working beneficiaries, an assumption is required with respect to their average contributory earnings (i.e., average earnings between the YBE and YMPE on which contributions are made). For both males and females, the average contributory earnings of working beneficiaries for years after the year of retirement are assumed to be between 20% and 35% lower than the contributory earnings of contributors who are not beneficiaries, depending on the age and sex. The resulting average annual contributory earnings of working beneficiaries are presented in Table 74.

Table 74 Average Contributory Earnings of Working Beneficiaries

	Below Age 65		Age 65 and Above	
Year	**Males**	**Females**	**Males**	**Females**
	($)	($)	($)	($)
2016	30,883	23,256	29,496	21,778
2017	31,633	24,066	30,041	22,423
2018	32,513	24,889	30,847	23,111
2019	33,556	25,840	31,798	23,913
2020	34,575	26,814	32,789	24,753
2021	35,727	27,892	33,896	25,683
2022	36,883	29,000	34,955	26,570
2025	40,516	32,460	38,344	29,472
2030	46,856	38,155	44,357	34,629
2035	53,793	44,175	50,888	40,057
2040	62,686	52,050	59,166	47,046
2050	86,662	73,539	81,879	66,385
2075	185,043	159,987	174,877	144,592

Around 450,000 working beneficiaries started to contribute in 2012, generating about $1.0 billion in additional contributions in that year. The corresponding post-retirement benefits started to be payable the year after, in 2013, and totaled about $63 million.

Table 75 shows the projected number of working beneficiaries with their contributions and resulting post-retirement benefits by year. The contributions from working beneficiaries are projected to be about $1.3 billion in 2016 and $5.1 billion in 2050. The projected number of working beneficiaries who contribute, their earnings, and contributions are reflected in all other tables in this report that present contributors, earnings, and contributions projections, unless otherwise indicated. Similarly, the post-retirement benefits are presented in combination with the retirement benefits as total retirement expenditures in all other tables in this report where expenditures are shown by type of benefit.

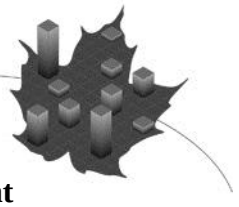


Table 75 Working Beneficiaries – Contributors, Contributions, and Post-Retirement Benefits

Year	Number of Contributing Working Beneficiaries	Total Contributions	Total Post-Retirement Benefits
	(000s)	($ million)	($ million)
2016	519	1,328	324
2017	529	1,387	416
2018	544	1,465	515
2019	560	1,558	619
2020	576	1,654	730
2021	590	1,753	847
2022	601	1,848	971
2023	611	1,943	1,101
2025	625	2,120	1,381
2030	588	2,320	2,154
2035	562	2,561	2,942
2040	580	3,084	3,736
2050	694	5,127	5,601
2075	746	11,873	14,624

F. Disability Expenditures

The general approach used to estimate disability pensions is to compute the value of benefits emerging by age and sex each year starting in 1970 as the product of:

- the population;
- the probability of being eligible for disability benefits;
- the actual or assumed disability incidence rate; and
- the annual amount of the benefit (flat-rate and average earnings-related benefits).

The value of the emerging earnings-related benefit by age and sex is equal to 75% of the average retirement earnings-related benefit. These emerging benefits are then projected by age and sex for each future year until termination (due to recovery, death, or attainment of age 65) using the disability termination rates for the appropriate duration and the Pension Index. Historical and projected disability incidence rates are shown in Chart 11 and Table 76, respectively.

Chart 11 Historical Disability Incidence Rates
(per 1,000 eligible)

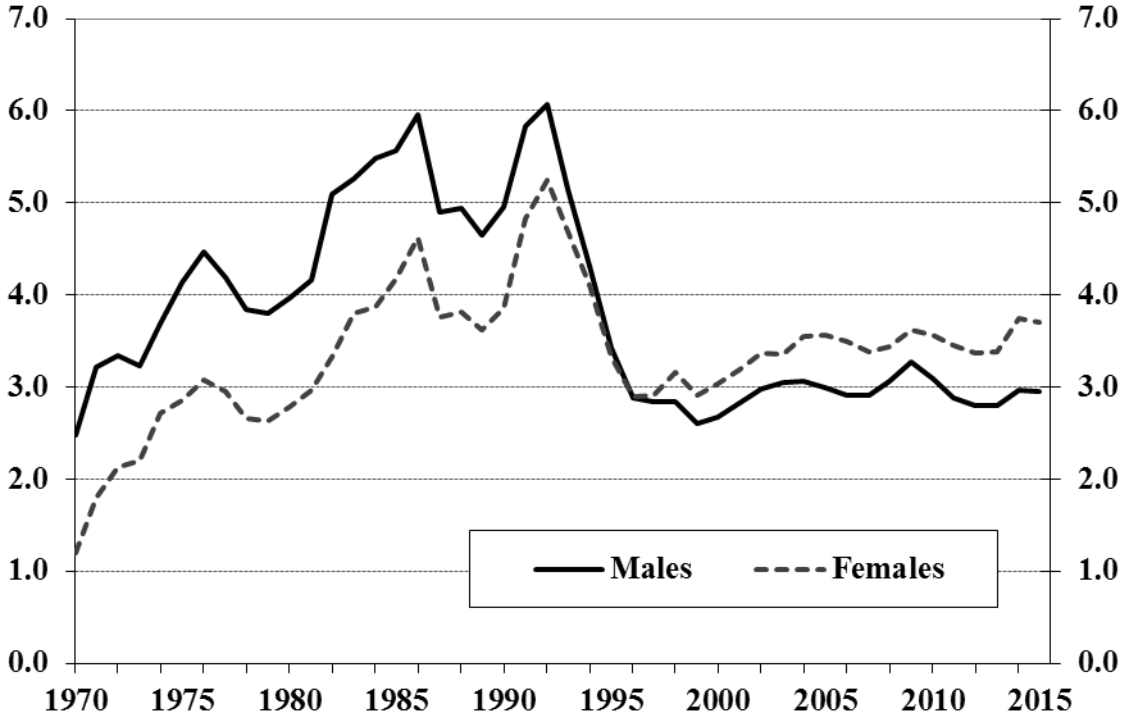


Table 76 Ultimate Disability Incidence Rates (2020+)[(1)]
(per 1,000 eligible)

Age	Males	Females
25	0.33	0.27
30	0.51	0.73
35	0.89	1.49
40	1.43	2.32
45	2.07	3.05
50	3.69	4.82
55	6.83	7.28
60	10.76	10.76
61	11.43	11.71
62	12.16	12.74
63	12.92	13.87
64	13.74	15.10
All Ages	**3.10**	**3.65**

(1) The disability incidence rates shown are adjusted by the eligible population in 2015.

It can be seen from Chart 11 that the incidence of new CPP disability cases (i.e. the number of new cases as a proportion of the eligible population) generally increased from 1970 to the early 1990s. The annual rate of change in incidence rates was particularly acute between 1989 and the

recession of the early 1990s. After reaching a peak in 1992, disability incidence rates then declined rapidly during the 1990s and have remained relatively stable since the early 2000s up to recently. The decline after 1992 reflects the economic recovery that occurred following the 1990-91 recession as well as the administrative changes put in place in the mid-1990s. The following changes to the CPP disability program contributed to the reduction in disability incidence rates:

- beginning in 1994, the CPP administration initiated a range of measures designed to effectively manage the growing pressure on the disability program;
- in September 1995, the guidelines for the determination of disabilities were revised to put the emphasis back on a medical basis and to de-emphasize the use of socioeconomic factors. The guidelines are used at all levels in the determination process, thus greatly increasing consistency in decision-making;
- implementation of more stringent eligibility rules since 1998;
- increased reassessments of the disability status;
- expansion of vocational rehabilitation services; and
- implementation of a formal quality assurance program.

After considering the above factors and the fact that the overall female incidence rate has been higher than the overall male incidence rate since 1996, the aggregate (all ages combined using the 2015 population for weights) ultimate incidence rate for 2020 and thereafter is projected to be 3.10 and 3.65 per thousand eligible for males and females, respectively. These projected ultimate aggregate rates are then distributed by age in accordance with the 2015 eligible population for each sex. The projected ultimate aggregate rates take into account the adjustments for the 2008 amendments to the Plan and correspond to the average experience over the past ten to fifteen years ending in 2015 (on a 2015 eligible population adjusted basis).

For the year 2015, the male and female disability incidence rates are determined to be 2.95 and 3.71 per thousand eligible, respectively. After 2015, the male and females rates are assumed to gradually reach their assumed aggregate ultimate levels of 3.10 and 3.65, respectively for the year 2020 and thereafter. The projected disability termination rates presented in Table 77 apply by age, sex, and duration of disability (i.e. receipt of the disability benefit) on an attained calendar year basis. The average graduated experience over the period 2000 to 2014 is used to produce base year rates for 2013 from which termination rates are projected for 2016 and thereafter. For 2016 and subsequent calendar years, the disability termination rates are projected for each sex by age at onset of disability and duration of disability, based on expected corresponding recovery and mortality improvement rates.

Both recovery and mortality improvement rates for disability beneficiaries are assumed to trend to ultimate levels by 2020. Recovery improvement rates are assumed to trend to an ultimate level of 0% (i.e. recovery rates are assumed to be constant after 2020), since the degree to which recovery from disability occurs can vary significantly by age, sex, and year. Mortality improvement rates of disability beneficiaries are assumed to trend to an ultimate level of 0.8%, which is consistent with the assumed ultimate mortality improvement rate for the general CPP population aged younger than 90.

Table 77 Disability Termination Rates in 2016 and 2030

(per 1,000 people)

2016

	Males						Females					
Age	1st Year	2nd Year	3rd Year	4th Year	5th Year	6+ Year	1st Year	2nd Year	3rd Year	4th Year	5th Year	6+ Year
30	45	49	62	48	44	27	36	50	46	41	41	26
40	47	50	48	34	31	20	35	51	42	28	27	18
50	71	76	53	39	34	24	52	63	48	28	21	16
60	82	78	54	42	41	0	56	61	38	28	26	0

2030

	Males						Females					
Age	1st Year	2nd Year	3rd Year	4th Year	5th Year	6+ Year	1st Year	2nd Year	3rd Year	4th Year	5th Year	6+ Year
30	41	47	61	47	42	26	33	48	45	41	41	26
40	42	46	46	33	29	18	31	49	41	27	26	17
50	63	72	51	37	32	22	47	60	47	26	19	15
60	73	72	50	39	37	0	50	56	35	25	24	0

Based on comparisons of actual results and projections for 1966 to 2015, experience adjustment factors are applied to all future emerging disability pensions calculated using the methodology described above. These factors appear in Table 78.

Table 78 Disability Benefit Experience Adjustment Factors

	Number	Average Benefit
Males	1.00	0.94
Females	1.00	0.90

Table 79 shows the projected number of new disability beneficiaries along with their projected average disability benefit by sex and year.

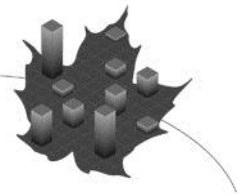


Table 79 New Disability Pensions

Year	Number of Beneficiaries			Average Monthly Pension			Average Pension as % of Maximum	
	Males	Females	Total	Males	Females	Total	Males	Females
				($)	($)	($)	(%)	(%)
2016	19,163	20,737	39,900	993.82	898.29	944.17	77.0	69.6
2017	19,678	20,931	40,609	1,009.07	914.22	960.18	76.7	69.5
2018	20,304	21,294	41,598	1,026.90	932.78	978.72	76.5	69.5
2019	20,806	21,604	42,409	1,045.53	952.20	997.99	76.3	69.5
2020	21,132	21,740	42,872	1,065.50	972.72	1,018.45	76.0	69.4
2021	21,159	21,857	43,016	1,087.02	994.48	1,040.00	75.8	69.4
2025	21,475	22,659	44,134	1,193.44	1,098.43	1,144.66	75.2	69.2
2030	21,680	23,398	45,079	1,356.59	1,252.74	1,302.69	74.8	69.0
2035	22,794	24,905	47,699	1,548.30	1,432.73	1,487.96	74.6	69.0
2040	24,326	26,509	50,834	1,766.67	1,638.95	1,700.07	74.3	68.9
2050	26,436	28,303	54,739	2,299.02	2,143.34	2,218.53	73.6	68.6
2075	29,223	31,872	61,095	4,467.71	4,189.07	4,322.35	71.7	67.2

G. Survivor Expenditures

Starting in 1968, the number of male and female contributor deaths, derived from the demographic projections for each individual aged 18 and over, is multiplied by the survivor eligibility rates and the proportion of contributors married or in a common-law partnership at the time of death to produce the number of survivor beneficiaries emerging by age, sex, and calendar year.

For each age and sex, the actual proportions of contributors married or in a common-law relationship at the time of death are determined from benefit statistics. The smoothed averages from recent experience over the years 2012 to 2014, with further adjustments for younger and older ages, are used to determine the assumed proportions for future years. On the basis of the trends shown over the period 2002 to 2014, the proportions are extrapolated to 2017 and kept constant thereafter. These proportions account for benefits extended to same-sex couples. Values are shown in Table 80.

For the purpose of projecting emerging survivor pensions, the number of spousal deaths by sex and calendar year was categorized by the age of the surviving spouse using the age distributions of spouses, and each resulting number was multiplied by:

- the annual amount of the benefit (flat-rate and average earnings-related benefits);
- the probability of the deceased contributor being eligible for a survivor benefit;
- the appropriate factor taking into account the reductions to survivor pensions in respect of survivors emerging under age 45 without dependent children and who are not disabled; and
- if applicable, the appropriate factor taking into account the limits applying to combined survivor-disability pensions and/or to combined survivor-retirement pensions.

The value of the emerging earnings-related survivor benefit is equal to 37.5% or 60% of the average retirement earnings-related benefit depending on whether the surviving spouse or

common-law partner is under age 65 or aged 65 or older. It is further adjusted to account for the fact that eligibility rules are more stringent for survivor benefits than for retirement benefits.

All survivor pensions emerging by year, age, and sex of the surviving spouse or common-law partner are then projected to each subsequent year using the Pension Index and assumed mortality rates to reflect the higher mortality of widows and widowers as compared to that of the general population. The assumed survivor mortality rates are developed based on survivor beneficiaries' mortality experience over the period 1966 to 2013, the June 2015 actuarial study of the mortality of CPP retirement and survivor beneficiaries (*Canada Pension Plan Mortality Study: Actuarial Study No. 16* by the Office of the Chief Actuary) and the mortality improvement assumptions for the general population in this report.

Based on comparisons of actual results and projections for 1966 to 2015, experience adjustment factors are applied to survivor pensions, calculated using the methodology described above. Survivor experience adjustment factors reflect both methodology and assumption adjustments. The adjustment factors for the number of survivors and average amounts of benefits correspond to the average of the last five known values (2011-2015) and are shown in Table 81. The projected number of new survivor beneficiaries and average monthly survivor pensions by sex for selected years are shown in Table 82.

Table 80 Proportion of Contributors Married or in Common-Law Relationship at Death

Age	Males	Females
	(%)	(%)
20	3	1
30	20	26
40	47	60
50	56	63
60	61	59
70	68	53
80	68	33
90	51	11

Table 81 Survivor Benefit Experience Adjustment Factors

	Number	Average Benefit
Widows	1.01	0.98
Widowers	0.97	0.82

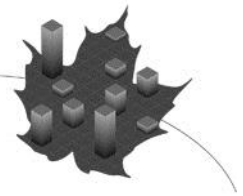


Table 82 New Survivor Pensions

Year	Number of Beneficiaries			Average Monthly Pension	
	Under 65	65 and Over	Total	Under 65	65 and Over
				($)	($)
2016	22,216	52,941	75,157	411.01	302.99
2017	22,405	54,779	77,184	417.89	304.17
2018	22,379	56,369	78,748	425.34	305.84
2019	22,447	58,057	80,504	433.23	307.57
2020	22,432	59,839	82,271	441.51	310.39
2021	22,378	61,728	84,106	450.47	313.94
2022	22,269	63,720	85,989	460.37	319.53
2025	22,210	70,382	92,592	492.84	341.37
2030	21,931	83,266	105,197	555.23	390.55
2035	21,695	96,044	117,739	629.83	452.90
2040	21,658	106,014	127,672	717.89	524.69
2050	21,843	115,224	137,067	937.56	695.49
2075	20,319	128,155	148,474	1,836.80	1,462.20

H. Death Expenditures

The amount of lump sum death benefits payable each year starting in 1968 is determined by age and sex as the product of:

- the number of deaths, derived for individuals aged 18 and over, consistent with the population data and projections;
- 50% of the average annual earnings-related benefit (the lump sum death benefit is equivalent to six months of retirement pension) reduced, using the maximum retirement pension and the assumed distribution of average retirement pensions, to allow for the provision limiting the death benefit to a maximum of 10% of the YMPE for the year of death prior to 1998 and to $2,500 thereafter; and
- the proportion of the deceased contributor's earnings eligible for survivor benefits.

Based on the comparison of actual results and projections for the years 1966 to 2015, experience adjustment factors were derived. To account for the maximum death benefit, which is set at $2,500 for 1998 and thereafter, initial adjustment factors for average benefits are set at their current level and then are gradually increased to a value of one for the year 2030 and thereafter for both males and females. Table 83 shows the experience adjustment factors, and Table 84 shows the projected number of death benefits by sex for selected years.

Table 83 Death Benefit Experience Adjustment Factors

	Initial		Ultimate	
	Number	Average Benefit	Number	Average Benefit
Males	0.91	0.97	0.91	1.00
Females	0.99	0.90	0.99	1.00

Table 84 Number of Death Benefits

Year	Males	Females	Total
2016	84,829	57,071	141,900
2017	86,791	59,106	145,897
2018	88,622	61,114	149,736
2019	90,684	63,246	153,930
2020	92,760	65,425	158,185
2021	94,883	67,680	162,563
2022	97,066	70,030	167,096
2025	104,812	77,926	182,738
2030	120,370	93,686	214,056
2035	137,659	112,121	249,780
2040	153,513	131,286	284,799
2050	173,462	161,217	334,679
2075	197,187	191,170	388,356

I. Children's Expenditures

The number of disabled contributor's child and orphan benefits emerging each year starting in 1970 and 1968, respectively, are determined using the assumed fertility rates to correspond to the number of children of emerging beneficiaries of disability and/or survivor pensions. The resulting number of emerging child beneficiaries by age, sex, and calendar year are thereafter projected from one year to the next, incorporating the following reasons for termination of benefits:

- attainment of age 25 by the child;
- ceasing full-time attendance at school while over age 18; and
- regarding disabled contributor's child benefits only, termination (by reason of recovery, death, or attainment of age 65) of the parent's disability benefits.

Total children's benefits are then obtained for any given calendar year as the product of the aggregate number of child beneficiaries who emerged before and during the year and survived to the applicable year, and the applicable annualized amount of the child flat-rate benefit obtained by adjusting the 2016 rate in accordance with the Pension Index.

Based on historical data from 1966 to 2015, the assumption for the number of children under age 18 is adjusted by a factor of about 0.90 for both disabled contributors' children and orphans. The assumption for the number of children aged 18 and over attending school full-time is adjusted by a factor of about 0.62 for both disabled contributors' children and orphans. Table 85 shows the projected number of new children's benefits by type and year.

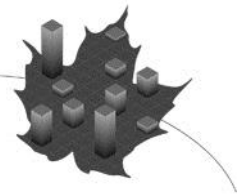


Table 85 New Children's Benefits

Year	Disabled Contributor's Child	Orphans	Total
2016	13,469	8,098	21,567
2017	13,832	8,313	22,145
2018	14,362	8,363	22,725
2019	14,945	8,513	23,458
2020	15,461	8,616	24,077
2021	15,718	8,634	24,352
2022	15,960	8,646	24,606
2025	17,266	8,994	26,260
2030	19,063	9,540	28,602
2035	20,733	10,039	30,771
2040	21,748	10,269	32,017
2050	22,315	9,866	32,180
2075	25,766	9,348	35,114

J. Operating Expenses

The operating expenses of the CPP have historically arisen from different sources including the Department of Employment and Social Development Canada, the Canada Revenue Agency, Public Services and Procurement Canada, the Office of the Superintendent of Financial Institutions Canada, the Department of Finance Canada, and the CPPIB. In response to a recommendation made by the independent peer reviewers of the 25th CPP Actuarial Report, operating expenses of the CPPIB are now included in the investment expenses assumption, starting with the previous actuarial report. In the calendar year 2015, operating expenses from all sources other than the CPPIB amounted to about $544 million.

Based on recent experience from 2006 to 2015, the annual operating expenses (excluding the CPPIB) were on average 0.092% of total annual employment earnings, and were 0.083% in 2015. In light of the above, it is assumed that the CPP operating expenses will represent 0.092% of total annual earnings for 2016 and thereafter, which equals the average over the last 10 years.

For this report, the total employment earnings basis used in the determination of the assumption and projection of operating expenses include earnings from working beneficiaries for years 2012 and thereafter since the working beneficiaries provision took effect in 2012.

Table 86 shows total operating expenses as a percentage of total earnings over the last three years 2013 to 2015 as well as their projected values.

Table 86 Operating Expenses[1]
($ million)

Year	Operating Expenses	Total Earnings[2]	Operating Expenses as % of Total Earnings
			(%)
2013	603	614,964	0.098
2014	491	632,380	0.078
2015	543	647,935	0.084
2016	612	665,273	0.092
2017	635	690,581	0.092
2018	659	716,258	0.092
2020	709	770,959	0.092
2025	854	928,702	0.092
2030	1,022	1,110,373	0.092
2040	1,480	1,608,556	0.092
2050	2,124	2,308,810	0.092

(1) Starting with the 26th CPP Actuarial Report, CPPIB operating expenses are not included in Plan operating expenses, but are accounted for separately in the investment expenses assumption.
(2) Total earnings used to project operating expenses include earnings from working beneficiaries.

VI. Net Assets as at 31 December 2015

The total assets of the CPP at the end of any given year throughout the projection period are simply determined by adding together the total assets at the end of the previous year, projected investment income and contribution revenues of the given year and then subtracting the projected benefits and operating expenses of the given year.

The actual value of the CPP assets on a market value accrual basis as at 31 December 2015 was $285,358 million. This is the sum of the CPP Account ($31 million) and the CPPIB invested assets ($282,571 million) for a total of $282,602 million before being adjusted by the amounts receivable minus amounts payable. The CPP Account was established to record the contributions, interest, pensions, other benefits and operating expenses. It also records the amounts transferred to and received from the CPPIB. The receivables include the contributions due but not yet deposited into the CPP Account, benefit overpayments, and net transfers between the CPP and the QPP for dual contributors. The amounts payable include operating expenses, pensions and other benefits, as well as amounts due to the Canada Revenue Agency. Table 87 reconciles the assets as at 31 December 2015.

Table 87 Net Assets as at 31 December 2015

($ million)

CPP Account	31
CPPIB Invested Assets	282,571
Subtotal CPP Account and CPPIB Invested Assets	**282,602**
Plus Amounts Receivable	
Contributions	3,056
Benefit Overpayments	67
Net Transfers Due from QPP	99
Minus Amounts Payable	
Operating Expenses	5
Pensions and Other Benefits	281
Amounts Due to the Canada Revenue Agency	180
Net Assets	**285,358**

Appendix F – Actuarial Adjustment Factors

For the CPP retirement pension, actuarial adjustment factors are applied for early (pre-65) and late (post-65) pension take-up. The factors were recently changed to restore them to their actuarially fair values. The current legislated actuarial adjustment factor for early pension take-up is 0.6% for each month between the start of the pension and age 65, and the factor for late pension take-up is 0.7% for each month between age 65 and the start of the pension.

According to the CPP legislation, the adjustment factors must be periodically calculated and specified in actuarial reports on the Plan. Specifically, subsection 115(1.11) of the *Canada Pension Plan* states*:*

"In the first report prepared after 2015 and in every third report that follows, the Chief Actuary shall specify, in reference to the adjustment factors fixed under subsection 46(7), the factors as calculated according to a methodology that he or she considers appropriate; the Chief Actuary may also, if he or she considers it necessary, specify the factors in any report prepared under subsection (1) after 2015."

As such, this 27th CPP Actuarial Report as at 31 December 2015, prepared in 2016, is the first report to specify the calculated factors in accordance with the legislation. The factors will next be calculated and specified no later than in the CPP actuarial report as at 31 December 2024.

The actuarial adjustment factors determined on the basis of this 27th CPP Actuarial Report, rounded to the nearest 0.1%, are 0.6% for early pension take-up and 0.7% for late pension take-up. These factors represent maximum pension adjustments of 36% at age 60 and 42% at age 70 (five years or 60 months of adjustment prior to or after age 65).

The methodology used to calculate the factors on the basis of this 27th CPP Actuarial Report, along with the unrounded estimates of the factors, will be provided in an upcoming actuarial study by the OCA, which is expected to be published in 2017.

Appendix G – Acknowledgements

Service Canada provided statistics on the Canada Pension Plan contributors, beneficiaries, and assets.

The CPP Investment Board provided data on the Canada Pension Plan assets.

Statistics Canada provided information on Canadian demographic and economic variables.

The Canadian Human Mortality Database (CHMD) created by the Department of Demography, Université de Montréal has been used for the historical mortality data.

The Canada Revenue Agency provided information on Canada Pension Plan contributors and contributions.

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