



# **Canada Pension Plan Actuarial Adjustment Factors**

**as specified in the:**  
**27<sup>th</sup> Actuarial Report on the  
Canada Pension Plan as at 31 December 2015**

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## I. Executive Summary

### A. Purpose

The flexible retirement provisions of the *Canada Pension Plan* were introduced in January 1987. These provisions allowed individuals to start their retirement pension as early as age 60. Prior to 1987, the take-up of the retirement pension could occur no earlier than age 65.<sup>1</sup> With the flexible retirement provisions, a basic monthly pension taken before or after age 65 became subject to an actuarial adjustment.

The adjustments were calculated based on actuarial adjustment factors (AAFs), which were initially set at 0.5% per month. Pensions taken early (pre-65) were adjusted downward by 0.5% per month for each month between age 65 and the age at which the pension commenced, but no earlier than age 60. Similarly, pensions taken late (post-65) were adjusted upward by 0.5% per month for each month between age 65 and the age at which the pension commenced, subject to a maximum interval of five years for pensions commencing on or after age 70. The maximum adjustment to a pension, downward or upward, was 30%, representing five years (60 months) at 0.5% per month.

In accordance with the *Economic Recovery Act (stimulus)* of 2009, the AAFs were increased starting in 2011 in order to restore them to their appropriate values. As of January 2016, the adjustment factors are 0.6% per month for early pension take-up and 0.7% per month for late pension take-up. As before, the adjustments apply up to five years before or after age 65 (between ages 60 and 70). As such, the maximum downward adjustment for early pension take-up is now 36%, and the maximum upward adjustment for late pension take-up is 42%.

Furthermore, a requirement of a periodic review of the factors was added to the CPP legislation in 2009. 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.”

The “first report prepared after 2015” stated in the legislation refers to the 27<sup>th</sup> *Actuarial Report on the Canada Pension Plan as at 31 December 2015* (CPP27). The calculated factors are specified in that report as follows:

“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.”

The purpose of this study is to describe the methodology used to calculate these factors and to provide the unrounded estimates of the factors. This study is based on the best-estimate

assumptions of CPP27 modified as appropriate in order to develop labour market environments associated with the take-up of the CPP retirement pension at selected ages.

## **B. Scope**

The sections of this study are as follows. The introduction to the study in section II discusses the historical evolution of the CPP AAFs. Section III describes the methodology used to develop the AAFs, and section IV describes the modifications made to the best-estimate assumptions of CPP27 to produce the AAFs under three different alternative sets of scenarios. The results of the study are then presented in section V. The next section VI presents a sensitivity analysis of the AAFs determined under the second alternative set to changes in certain key demographic, economic, and investment assumptions. The conclusion of the study follows in section VII. Lastly, three appendices in section VIII provide a summary of the best-estimate assumptions of CPP27, the references used, and a list of the contributors to this study.

The words “benefit” or “pension” with or without the qualifier “retirement” are used interchangeably in this study and refer to the CPP retirement pension. The word “retire” used in the study means to start receiving the CPP pension.

## **C. Methodology Overview and Main Findings**

- The underlying principle of the methodology used in this study is to determine the AAFs that result in the steady-state contribution rate (SSCR) of the Plan<sup>2</sup> remaining the same whether all the Plan’s contributors start their retirement benefit at age 60, 65, or 68, where it is assumed that the changes in retirement behaviour associated with collective pension take-up at any of these ages would follow from certain changes in the labour market environment. Three plausible alternative sets of pension take-up scenarios for ages 60, 65 and 68 are considered to provide a reasonable range of AAFs.
- The post-65 (ages 65 to 70) AAF for each alternative is derived based on the actuarial adjustment<sup>3</sup> at age 68. This age was selected as representing the maximum age by which most individuals start their retirement pension, since less than 2% of CPP participants ask for their pension after age 68.
- For collective pension take-up at age 60, the alternatives define progressively weaker labour market environments associated with labour force participation rates held at their year 2015 values and an increasing unemployment rate. For collective pension take-up (i.e. by all CPP contributors) at ages 65 and 68, the three alternatives define progressively stronger labour market environments associated with higher labour force participation rates and a lower unemployment rate.
- The AAFs determined under the methodology used in this study are deemed to be appropriate, since the methodology recognizes all of the benefits and financing provisions of the Plan as well as aligns retirement benefit take-up behaviour with the labour market environment for each of the alternatives. This methodology provides a range of simple approximate AAFs for ages before and after age 65.

- The AAFs for retirement pension take-up before 65 are determined to be 0.56%, 0.58%, and 0.61% per month under Alternatives I, II, and III, respectively. The AAFs determined for pension take-up after 65 are 0.71%, 0.70%, and 0.70% under Alternatives I, II, and III, respectively. The factors for each alternative round to the legislated AAFs of 0.6% per month and 0.7% per month for pre-65 and post-65 pension take-up, respectively.
- Sensitivity analysis performed in this study (in respect of Alternative II) indicates that changes to certain key demographic, economic, and investment assumptions result in a certain degree of volatility in the AAFs. However, the resulting AAFs determined under the different assumptions remained reasonably close to their values under Alternative II as well as to the legislated values. This is especially true for the pre-65 factors for early pension take-up. As most individuals opt to start their CPP pension on or before age 65, the pre-65 factors are expected to have the largest impact on the retirement behaviour of CPP participants and thus on the financial state of the Plan.

#### **D. Conclusion**

The actuarial adjustments made to the CPP retirement benefits are necessary to take account of both the length of time that contributions are made to the Plan and the length of time over which benefits are received. Currently, the amount of the CPP retirement pension is adjusted downward by a factor of 0.6% for each month (or 7.2% for each year) that the retirement pension commences prior to the age of 65, or upward by a factor of 0.7% for each month (or 8.4% for each year) that the retirement pension commences after age 65, subject to a maximum adjustment over five years.

In accordance with the CPP legislation, in the first actuarial report prepared after 2015 and in every third report that follows, the Chief Actuary is required to specify the AAFs as calculated according to a methodology deemed appropriate by him/her. The Chief Actuary may also specify the AAFs more frequently if he/she considers it necessary. CPP27 was the first such report for which it was required to specify the AAFs. The factors calculated for and specified in CPP27 are 0.6% per month and 0.7% per month for pre-65 and post-65 pension take-up, respectively, rounded to the nearest 0.1%. These factors are the same as the current legislated AAFs.

The purpose of this study is to describe the methodology used to calculate the AAFs specified in CPP27 and to provide the unrounded estimates of the factors. The underlying principle of the methodology used in this study is to determine the AAFs that result in the SSCR remaining the same whether all the Plan's contributors start their retirement benefit at age 60, 65 or 68, assuming that collective pension take-up at any age is associated with changes in the labour market environment. The actuarial adjustments that are determined to achieve this objective are deemed to be appropriate for the Plan. Three plausible alternative sets of pension take-up scenarios for ages 60, 65, and 68 are considered to provide a reasonable range of appropriate AAFs.

This study found that the AAFs for pre-65 retirement pension take-up determined using the given methodology are in the range of 0.56% to 0.61% per month. The AAFs determined for post-65

pension take-up are in the range of 0.70% to 0.71%. Sensitivity analysis showed that the AAFs (in respect of Alternative II) determined under different key demographic, economic, and investment assumptions remain reasonably close to their Alternative II and legislated values.

The AAFs for each alternative round to the legislated monthly AAFs of 0.6% and 0.7% per month for pre-65 and post-65 pension take-up, respectively. The legislated monthly AAFs are thus determined to be appropriate.



## II. Introduction

On 1 January 1987, flexible retirement age provisions introduced to the *Canada Pension Plan* became effective making it possible for contributors to begin receipt of a retirement pension as early as age 60. Prior to 1987, retirement pensions were payable no earlier than at age 65.<sup>1</sup> With the flexible retirement provisions, a basic monthly pension taken before or after age 65 became subject to an actuarial adjustment.

Subsections 46(3) and 46(3.1) of the *Canada Pension Plan* state that the amount of a retirement pension that becomes payable after 31 December 1986 will be adjusted if it commences in a month other than the month in which the contributor reaches 65 years of age. The basic monthly amount is adjusted by a factor fixed by the Minister of Employment and Social Development on the advice of the Chief Actuary of the Office of the Superintendent of Financial Institutions. The factor reflects the time interval between the month in which the retirement pension commences and the month in which the contributor reached, or would reach, 65 years of age, where the time interval is deemed to never exceed five years.

Prior to January 1, 2011, the amount of the retirement pension payable for life was adjusted downward by an actuarial adjustment factor (AAF) of 0.5% per month if retirement benefit take-up occurred early (before age 65, but no earlier than age 60) or was adjusted upward by the same factor if retirement benefit take-up occurred late (after age 65, but no later than a deemed age of 70). Thus, the pension paid to a contributor who elected to start their pension at age 60 before January 1, 2011 was equal to 70% of the accrued pension that was otherwise payable. Likewise, the pension paid to a contributor who elected to start their pension on or after age 70 before January 1, 2011 was equal to 130% of the pension otherwise payable.

In accordance with the *Economic Recovery Act (stimulus)* of 2009, the AAFs were increased in order to restore them to their appropriate values. The new factors were phased in over the period 2011 to 2016 as laid out in sections 78.3 and 78.4 of the *Canada Pension Plan Regulations*. The AAFs were increased according to the following schedule:

**Table 1    Legislated Actuarial Adjustment Factors – after 31 December 2010**

<b>Effective Date</b>	<b>Pre-65 Downward Monthly AAF</b>	<b>Post-65 Upward Monthly AAF</b>
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%

As of January 2016, the adjustment factors are 0.6% per month for early pension take-up and 0.7% per month for late pension take-up. As before, the adjustments apply up to five years before or after age 65. As such, the maximum downward adjustment for early pension take-up is now 36% for take-up at age 60, and the maximum upward adjustment for late pension take-up is

42% for take-up at age 70 or later (compared to the prior maximum adjustment of 30% for early or late retirement).

Along with the change in the factors, the CPP legislation was also amended in 2009 to provide for regular reviews of the factors. 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.”

The “first report prepared after 2015” stated in the legislation refers to the 27<sup>th</sup> *Actuarial Report on the Canada Pension Plan as at 31 December 2015* (CPP27). The calculated factors are specified in that report as follows:

“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.”

The purpose of this study is to describe the methodology used to calculate these factors and to provide the unrounded estimates of the factors.<sup>4</sup>

The following two definitions will be used throughout the study:

**Actuarial Adjustment Factor (AAF):**

This term refers to the monthly factor that would be used to calculate the actuarial adjustment at the particular retirement benefit take-up age. This factor would be multiplied by the number of months between the age of benefit take-up and exact age 65. An example is the legislated factor of 0.6% per month for early benefit take-up (before age 65).

**Actuarial Adjustment:**

This term refers to the adjustment that would be applied to the basic retirement pension at the particular take-up age, using the applicable AAF. An example would be an actuarial adjustment of 64% applied to the basic pension at age 60 (corresponding to the cumulative reduction of 36% from the legislated early retirement AAF of 0.6% per month over 60 months).

In addition, the words “benefit” or “pension” with or without the qualifier “retirement” are used interchangeably in this study and refer to the CPP retirement pension. The word “retire” used in the study means to start receiving the CPP pension.

### III. Methodology

The AAFs in this study are determined using a methodology that is similar to the “steady-state contribution rate methodology” described in the *Canada Pension Plan Actuarial Adjustment Factors Study: Actuarial Study No. 2* by the Office of the Chief Actuary published in March 2003 (“Prior Study”). The methodology used in this current study does not involve the calculation of present values of contributions or benefits. Further, the methodology recognizes all of the Plan’s current benefit provisions as well as the financing elements introduced by the 1997 reforms to the Plan.<sup>5</sup> Alternative methods, such as individual and collective methods, are not discussed in this study. For a discussion of the reasons why these methodologies were not adopted to determine the AAFs for the CPP, readers are referred to the Prior Study.

The underlying principle of the methodology used in this study is to determine the AAFs that result in the steady-state contribution rate (SSCR) of the Plan remaining the same whether all the Plan’s contributors start their retirement benefit at age 60, 65, or 68, where it is assumed that the changes in retirement behaviour associated with collective pension take-up at any of these ages would follow from certain changes in the labour market environment, as described below.

The SSCR is the minimum rate that both builds a reserve of assets and stabilizes the ratio of assets to expenditures over time. The SSCR is defined in the *Calculation of Contribution Rates Regulations, 2007* as the lowest level contribution rate applicable after a triennial review period<sup>6</sup> that results in the asset to expenditure ratio (A/E ratio) being the same in the 10<sup>th</sup> and 60<sup>th</sup> years following the end of the review period. For CPP27, the end of the corresponding review period is 2018, and therefore the SSCR applies for the year 2019 and thereafter, and the relevant A/E ratio target years used to determine the SSCR are 2028 and 2078.

The SSCR is distinct from the incremental rate used to fully fund any future new benefits or benefit improvements. The sum of the steady-state and incremental rates is the minimum contribution rate of the Plan. In the case where the incremental rate is zero, the steady-state and minimum contribution rates are then equal. Under CPP27, the incremental rate is deemed to be zero, and the minimum contribution rate equals the SSCR of 9.79% for the year 2019 and thereafter.

For early (pre-65) pension take-up, the AAF was derived from the actuarial adjustment determined at age 60 with linear interpolation applied between ages 60 and 65. Although the actuarial adjustments for ages below 65 follow an exponentially increasing trend (with the highest adjustment corresponding to that at age 60), the pre-65 AAF was derived from the age 60 adjustment since most early pension take-up occurs at that age.

For late (post-65) pension take-up, the AAF was derived from the actuarial adjustment determined at age 68 (instead of age 70) with linear interpolation applied between ages 65 and 68. Although the actuarial adjustments for ages after 65 also follow an exponentially increasing trend, less than 2% of CPP contributors ask for their benefit after age 68 as observed from statistics on pension take-up. Therefore, age 68 was considered an appropriate age to determine the post-65 AAFs for all ages between 65 and 70.

The “steady-state contribution rate methodology” used in the Prior Study was updated for the purpose of this current study as follows:

At the time of the Prior Study in 2003, CPP retirement beneficiaries who continued to work (referred to as “working beneficiaries”<sup>7</sup>) did not pay contributions and did not continue to build their CPP pension. The “working beneficiaries provision” along with other changes to the CPP provisions, including the removal of the Work Cessation Test, and increases to the General Drop-Out percentage and AAFs (see below), had not yet been introduced. As such, at the time of the Prior Study, CPP contributions after age 60 came only from those who had not yet taken their retirement pension, and the link between CPP contributors after age 60 and the labour force was weaker than it is today. As well, changes in retirement behaviour were not as strongly associated with changes in the labour market environment for ages 60 and older. These weaker associations were reflected in the Prior Study through:

- the assumption of “full loss of contributions” (i.e. it was assumed that the Plan would lose all contributions from Plan participants at or above the age at which all participants were assumed to start their pension), and
- the use for all scenarios of the labour force participation rates, job creation rate and unemployment rate assumptions of the underlying CPP actuarial report (the 18<sup>th</sup> *Actuarial Report on the Canada Pension Plan as at 31 December 2000*).

As per the 2009 *Economic Recovery Act (stimulus)*, a “working beneficiaries provision” was introduced to the CPP legislation. Specifically, 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 CPP. 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 required to also contribute. In any case, these post-retirement contributions generate post-retirement benefits which increase the pension. Contributions to the CPP are not permitted after reaching age 70. Other Plan provisions were also changed by the *Economic Recovery Act (stimulus)*. Specifically, the Work Cessation Test, which required a contributor to stop working or materially reduce their earnings to initially receive a pension, was removed, the General Drop-Out percentage of low earnings from the retirement pension calculation was increased from 15% to 17%, and the legislated AAFs were increased over the period 2011 to 2016 (described in section II).

The introduction of the working beneficiaries provision changed the relationship between CPP contributors after age 60, CPP retirement beneficiaries, and the labour force. The basis of the “full loss of contributions” used in the Prior Study is no longer applicable, since if it is assumed that all CPP contributors take their retirement benefit at age 60, then the Plan will continue to receive contributions from working beneficiaries. The methodology of the current study was therefore adjusted to reflect the working beneficiaries provision.

Further, for the current study, it is assumed that the take-up of the retirement benefit by all CPP contributors at particular ages is aligned with plausible labour market environments. In particular, the scenario with collective retirement benefit take-up at age 65 is assumed to occur in

a stronger labour market environment associated with higher labour force participation rates than the best-estimate labour force assumptions of CPP27. Under the scenario with collective pension take-up at age 60, the opposite is assumed, i.e. a weaker labour market environment associated with lower labour force participation rates compared to the best-estimate assumptions of CPP27. This approach of using different assumptions for benefit take-up at ages 60 and 65 is similar to the approach used for the sensitivity analysis tests of the labour market assumptions in CPP27. For the scenario with collective pension take-up at age 68, an even stronger labour market than under the age 65 scenario is assumed. Since the interaction between future labour force environments and retirement behaviour is highly uncertain, three sets of plausible environments at ages 60, 65 and 68 are considered. These sets are referred to as Alternatives I, II, and III.

For each Alternative, starting from 2017, the actuarial adjustments for the retirement benefit take-up ages of 60 and 68 are determined using an iterative process that yields the same SSCR as for the “benchmark scenario” where all individuals take their pension at age 65. The resulting AAFs for pre-65 and post-65 pension take-up are determined by linear interpolation between ages 60 and 65, and ages 65 and 68, respectively.

The AAFs calculated by the given methodology are deemed to be appropriate for the Plan since the methodology recognizes all the benefits and financing provisions of the Plan as well as aligns retirement benefit take-up behaviour with the labour market environment. This methodology provides a range of unrounded estimates of the AAFs from which simple, rounded factors may be obtained and used for pensions taken before or after age 65.

It is important to note that the AAFs determined under the given methodology are specifically the result of the given pension take-up age, the assumed labour market environment, and the benchmark SSCR for each alternative. However, the AAFs so determined for each alternative do not ensure that the corresponding SSCR will remain the same independent of the actual or assumed retirement rates (i.e. the percentages of contributors who elect to retire at different ages). That is, as individuals start their CPP pension at different ages, rather than collectively at a single age, the application of the calculated AAFs may result in the SSCR varying from its benchmark value under each alternative. As such, the SSCRs determined under this study should not be compared with the SSCR of 9.79% determined under the best-estimate assumptions of CPP27. In addition, it should be noted that the AAFs may not be actuarially neutral for individual Plan participants or cohorts of participants, i.e. groups of individuals with the same year of birth. Nonetheless, the methodology used to determine the AAFs in the study, based on three plausible alternatives, is deemed to be appropriate to assess the appropriateness of the legislated AAFs.

## IV. Assumptions

The results of this study are based on the best-estimate assumptions of CPP27 modified as described below in order to develop plausible labour market environments associated with the take-up of the CPP retirement benefit by all contributors at selected ages. The specific assumptions that are modified are those relating to the labour force participation rates, unemployment rate, and average earnings of individuals aged 50 and above.

Three plausible alternative sets are considered, where each set consists of assumed labour market environments associated with collective pension take-up ages of 60, 65 and 68. For each alternative, collective pension take-up at age 65 is referred to as the alternative's "benchmark scenario". For collective pension take-up at ages 65 and 68, the three alternatives define progressively stronger labour market environments compared to CPP27 by gradually increasing the labour force participation rates for older ages at first and then younger ages as well, and by eventually lowering the unemployment rate. For collective pension take-up at age 60, the labour force participation rates of the year 2015 are used in combination with progressively higher unemployment rates to reflect progressively weaker labour market environments. In this way, the three alternatives are meant to provide a range of plausible environments and thus a range of appropriate AAFs.

All other best-estimate assumptions of CPP27 are used without modification. A summary of the best-estimate assumptions of CPP27 is provided in Appendix A.

### A. Alternative I

Under Alternative I, for the scenarios of collective pension take-up at ages 65 and 68, the labour force participation rates are increased for ages over 60. For the scenario of collective pension take-up at age 60, the projected labour market environment is defined by using labour force participation rates held constant at their 2015 levels and the unemployment rate assumption of CPP27. Such environment is weaker than one assumed under CPP27.

#### 1. Age 65 Take-Up (Benchmark) Scenario: all CPP contributors opt for their retirement pension at age 65

It is assumed that, starting in 2016, all contributors ask for their retirement benefit at age 65. As a result, there are no working beneficiaries prior to age 65.

It is assumed that such a scenario takes place in a stronger labour market environment relative to the best-estimate assumptions of CPP27. Under this scenario, the following modifications are made to the best-estimate assumptions of CPP27:

- the labour force participation rates of those aged 60 to 64 are assumed to increase to the level of those aged 55 to 59 projected under CPP27.
- the unemployment rate for Canada is assumed to be the same as under CPP27.
- the assumed average employment earnings for those aged 60 to 64 are assumed to increase to the level of those aged 59 projected under CPP27.

- it is assumed that working beneficiaries aged 65 and older choose not to contribute to the CPP.

As shown in Table 2, the labour force participation rates for ages 60 to 64 are projected to be, in absolute terms for both sexes, about 20% higher compared to CPP27. The average employment earnings for this age group are projected to be about 11% higher for males and about 14% higher for females than under CPP27.

**Table 2 Labour Force Participation Rates and Average Employment Earnings for Ages 60 to 64: Alternative I Benchmark Scenario vs. CPP27**

	Labour force Participation Rates (Canada) (%)				Average Employment Earnings (Canada less Québec) (\$)			
	Alternative I Benchmark Scenario		CPP27		Alternative I Benchmark Scenario		CPP27	
	Males	Females	Males	Females	Males	Females	Males	Females
<b>2016</b>	79.9	68.9	60.4	48.4	47,608	35,545	47,080	34,783
<b>2020</b>	80.8	70.3	61.1	50.0	59,405	45,913	52,703	39,695
<b>2025</b>	82.0	72.0	62.0	52.0	67,849	54,103	60,982	47,481
<b>2050</b>	84.0	75.0	64.0	54.0	142,105	122,296	127,962	107,602
<b>2075</b>	84.0	75.0	64.0	54.0	300,464	266,318	269,142	233,061

**2. Age 60 Take-Up Scenario: all CPP contributors opt for their retirement pension at age 60**

It is assumed that, starting in 2016, all contributors ask for their retirement benefit at age 60.

This scenario is assumed to occur in a weaker labour market environment relative to the best-estimate assumptions of CPP27. Under this scenario, the following modifications are made to the best-estimate assumptions of CPP27:

- the projected labour force participation rates for all age groups are assumed to be lower in this scenario since they remain at their 2015 levels.
- the unemployment rate for Canada is assumed to be the same as under the best-estimate assumption of CPP27. All contributors between the ages of 60 and 65 are assumed to be working beneficiaries.
- the assumed average employment earnings for the age group 60 to 64 are set equal to the assumed average employment earnings of working beneficiaries under CPP27, and, as a result, are lower compared to the average earnings of the age group under CPP27.
- similar to the benchmark scenario, it is assumed that working beneficiaries after age 65 choose not to contribute to the CPP.

Table 3 compares the projected labour force participation rates and average employment earnings for ages 60 to 64 with the projections of CPP27. Over the long term, the labour force participation rates for ages 60 to 64 are projected to be, in absolute terms, about 4% and 6% lower for males and females, respectively compared to CPP27, and the average employment

earnings are projected to fall to about 75% of the CPP27 average employment earnings for both sexes.

**Table 3 Labour Force Participation Rates and Average Employment Earnings for Ages 60 to 64: Alternative I Age 60 Take-Up Scenario vs. CPP27**

	Labour force Participation Rates (Canada) (%)				Average Employment Earnings (Canada less Québec) (\$)			
	Alternative I Age 60 Take-Up Scenario		CPP27		Alternative I Age 60 Take-Up Scenario		CPP27	
	Males	Females	Males	Females	Males	Females	Males	Females
<b>2016</b>	60.2	48.0	60.4	48.4	47,021	34,701	47,080	34,783
<b>2020</b>	60.2	48.0	61.1	50.0	40,637	29,444	52,703	39,695
<b>2025</b>	60.2	48.0	62.0	52.0	46,016	34,362	60,982	47,481
<b>2050</b>	60.2	48.0	64.0	54.0	97,253	78,392	127,962	107,602
<b>2075</b>	60.2	48.0	64.0	54.0	205,090	170,185	269,142	233,061

**3. Age 68 Take-Up Scenario: all CPP contributors opt for their retirement pension at age 68**

It is assumed that, starting in 2016, all contributors ask for their retirement benefit at age 68. In particular, this means that there are no working beneficiaries prior to age 68.

It is assumed that such a scenario would occur in an even stronger labour market environment than under the benchmark scenario. The following modifications are made to the best-estimate assumptions of CPP27:

- in addition to increasing the labour force participation rates of those aged 60 to 64 in the same way as done for the benchmark scenario, the labour force participation rates of those aged 65 to 69 are assumed to increase to the level of those aged 60 to 64 projected under CPP27.
- the unemployment rate for Canada is assumed to be the same as under CPP27.
- in addition to increasing the average employment earnings for the age group 60 to 64 as done for the benchmark scenario, the average employment earnings for the age group 65 to 69 are assumed to be equal to the earnings of those aged 64 projected under CPP27.
- it is assumed that working beneficiaries aged 68 to 70 choose not to contribute to the CPP.

As shown in



Table 4, the labour force participation rates for those aged 65 to 69 are projected to be, in absolute terms for both sexes, about 30% higher compared to CPP27. The average employment earnings for this age group are projected to be about 30% higher for males and about 40% higher for females than under CPP27.

**Table 4 Labour Force Participation Rates and Average Employment Earnings for Ages 65 to 69: Alternative I Age 68 Take-Up Scenario vs. CPP27**

	Labour Force Participation Rates (Canada) (%)				Average Employment Earnings (Canada less Québec) (\$)			
	Alternative I Age 68 Take-Up Scenario		CPP27		Alternative I Age 68 Take-Up Scenario		CPP27	
	Males	Females	Males	Females	Males	Females	Males	Females
<b>2016</b>	60.4	48.4	32.2	20.4	46,378	34,128	37,292	25,457
<b>2020</b>	61.1	50.0	33.0	21.1	53,417	39,974	42,347	29,661
<b>2025</b>	62.0	52.0	34.0	22.0	65,081	50,200	50,494	36,255
<b>2050</b>	64.0	54.0	35.0	23.0	135,217	114,398	104,256	82,447
<b>2075</b>	64.0	54.0	35.0	23.0	285,004	250,112	216,226	177,274

## B. Alternative II

Under Alternative II, for the scenarios of collective pension take-up at ages 65 and 68, the labour force participation rates are increased for ages over 55. For the scenario of collective pension take-up at age 60, the labour market environment is projected to be similar to the one in 2015.

### 1. Age 65 Take-Up (Benchmark) Scenario: all CPP contributors opt for their retirement pension at age 65

As under Alternative I, it is assumed under Alternative II that, starting in 2016, all contributors ask for their retirement benefit at age 65. In particular, this means that there are no working beneficiaries prior to age 65.

It is also assumed under Alternative II that such a scenario takes place in an even stronger labour market than under Alternative I which results in a significantly different environment relative to the best-estimate assumptions of CPP27. Under this scenario, the following modifications are made to the best-estimate assumptions of CPP27:

- the labour force participation rates of those aged 55 to 64 are assumed to increase to the level of those aged 50 to 54 projected under CPP27.
- the unemployment rate for Canada is assumed to be the same as under CPP27.
- the assumed average employment earnings for the age group 55 to 64 are assumed to increase to the level of those aged 49 projected under CPP27.
- it is assumed that working beneficiaries aged 65 and older choose not to contribute to the CPP.

As shown in Table 5, the labour force participation rates for ages 55 to 64 are projected to be, in absolute terms for both sexes, about 20% higher compared to CPP27, and the average employment earnings for this age group are projected for both sexes to be about 15% higher than the average employment earnings under CPP27. This increase in average employment earnings consists of a 7% increase in average earnings for the age group 55 to 59 and a 25% increase in average earnings for the age group 60 to 64.

**Table 5 Labour Force Participation Rates and Average Employment Earnings for Ages 55 to 64: Alternative II Benchmark Scenario vs. CPP27**

	Labour force Participation Rates (Canada) (%)				Average Employment Earnings (Canada less Québec) (\$)			
	Alternative II Benchmark Scenario		CPP27		Alternative II Benchmark Scenario		CPP27	
	Males	Females	Males	Females	Males	Females	Males	Females
<b>2016</b>	88.2	81.8	70.9	59.3	57,585	44,347	52,650	39,903
<b>2020</b>	89.0	82.3	71.3	60.4	66,234	51,965	57,896	44,909
<b>2025</b>	90.0	83.0	71.5	61.5	76,014	60,878	66,189	52,625
<b>2050</b>	91.0	85.0	74.4	64.8	158,842	137,050	139,542	119,525
<b>2075</b>	91.0	85.0	74.4	64.8	336,798	298,592	294,929	259,642

**2. Age 60 Take-Up Scenario: all CPP contributors opt for their retirement pension at age 60**

As under Alternative I, it is assumed under Alternative II for this scenario that, starting in 2016, all contributors ask for their retirement benefit at age 60.

This scenario is assumed to occur in a weaker labour market environment relative to Alternative I and the best-estimate assumptions of CPP27. Under this scenario, the following modifications are made to the best-estimate assumptions of CPP27:

- The projected labour force participation rates for all age groups are assumed to be lower in this scenario as they remain at their 2015 levels.
- the unemployment rate (Canada) is expected to remain constant at 7.2% (which is higher than the CPP27 assumption of 7.1% in 2016, followed by a decrease to an ultimate rate of 6.2% for years 2025 and thereafter, which was used for the Age 60 Take-Up Scenario under Alternative I).
- all contributors between the ages of 60 and 65 are assumed to be working beneficiaries.
- the assumed average employment earnings for the age group 60 to 64 are set equal to the assumed average employment earnings of working beneficiaries under CPP27, and, as a result, are lower compared to the average earnings of the age group under CPP27.
- similar to the benchmark scenario, it is assumed that working beneficiaries after age 65 choose not to contribute to the CPP.

The labour force participation rates and average employment earnings are assumed to be the same as for the Age 60 Take-Up Scenario under Alternative I (see Table 3).

### 3. Age 68 Take-Up Scenario: all CPP contributors opt for their retirement pension at age 68

As under Alternative I, it is assumed under Alternative II that, starting in 2016, all contributors ask for their retirement benefit at age 68. In particular, this means that there are no working beneficiaries prior to age 68.

It is assumed that such a scenario would occur in an even stronger labour market environment than under the benchmark scenario. The following modifications are made to the best-estimate assumptions of CPP27:

- in addition to increasing the labour force participation rates of those aged 55 to 64 in the same way as done for the benchmark scenario, the labour force participation rates of those aged 65 to 69 are assumed to increase to the level of those aged 60 to 64 projected under CPP27.
- the unemployment rate for Canada is assumed to be the same as under CPP27.
- in addition to increasing the average employment earnings for the age group 55 to 64 as done for the benchmark scenario, the average employment earnings for the age group 65 to 69 are assumed to be equal to the earnings of those aged 64 projected under CPP27.
- it is assumed that working beneficiaries aged 68 to 70 choose not to contribute to the CPP.

The projected labour force participation rates and average employment earnings for those aged 65 to 69 are shown in Table 6. The labour force participation rates for those aged 65 to 69 under this scenario are projected to be substantially higher compared to CPP27. The average employment earnings are projected to be similar<sup>8</sup> to those under the Age 68 Take-Up Scenario of Alternative I.

**Table 6 Labour Force Participation Rates and Average Employment Earnings for Ages 65 to 69: Alternative II Age 68 Take-Up Scenario vs. CPP27**

	Labour force Participation Rates (Canada) (%)				Average Employment Earnings (Canada less Québec) (\$)			
	Alternative II Age 68 Take-Up Scenario		CPP27		Alternative II Age 68 Take-Up Scenario		CPP27	
	Males	Females	Males	Females	Males	Females	Males	Females
<b>2016</b>	88.2	81.8	32.2	20.4	45,217	34,727	37,292	25,457
<b>2020</b>	89.0	82.3	33.0	21.1	52,701	40,452	42,347	29,661
<b>2025</b>	90.0	83.0	34.0	22.0	64,121	49,943	50,494	36,255
<b>2050</b>	91.0	85.0	35.0	23.0	133,579	112,954	104,256	82,447
<b>2075</b>	91.0	85.0	35.0	23.0	281,856	247,201	216,226	177,274

### C. Alternative III

Alternative III uses the assumptions of the low-cost labour market sensitivity test of CPP27 for the age 65 take-up scenario and the assumptions of the high-cost labour market sensitivity of CPP27 for the age 60 take-up scenario, as shown in Table 7. For these scenarios, both the assumed labour force participation rates for all age groups are modified and the assumed unemployment rate is decreased as the labour force participation rates increase, and vice versa. For the age 68 take-up scenario, an even stronger labour market is assumed than under the benchmark scenario.

With respect to employment earnings, the following modifications are made to the best-estimate assumptions of CPP27:

- for the age 60 take-up scenario, the average employment earnings for the age group 60 to 69 are assumed to be equal to the average employment earnings of working beneficiaries in that age group projected under CPP27.
- For the age 68 take-up scenario, the average employment earnings for those aged 65 to 69 are assumed to equal the average employment earnings of those aged 64 projected under CPP27.

With respect to working beneficiaries, similar to Alternatives I and II, it is assumed that

- for the age 60 take-up scenario, all contributors between the ages of 60 and 65 are assumed to be working beneficiaries.
- for the age 65 and age 68 take-up scenarios, there are no working beneficiaries below age 65.
- under all scenarios, working beneficiaries aged 68 to 70 choose not to contribute to the CPP.

As such, the age 65 and 68 take-up scenarios represent stronger labour market environments relative to those under Alternatives I and II, while the age 60 take-up scenario represents a weaker labour market environment compared to the other two alternatives. A more detailed description of these low- and high-cost labour market environments is presented in Appendix B of CPP27.

**Table 7 Labour Force Participation Rates and Unemployment Rates: Alternative III Scenarios and CPP27 Low- and High-Cost Labour Market Sensitivity Tests Assumptions**

Canada	CPP27 Low-Cost / Age 65 Take-Up Scenario	CPP27 High-Cost / Age 60 Take-Up Scenario	Age 68 Take-Up Scenario
Participation rate (aged 15-69)	83% (2035)	74% (2035)	85% (2035)
Unemployment rate	4.2%	8.2%	4.2%

### D. Summary of Alternative Assumptions

Table 8 provides a summary of the assumptions used for the three considered alternatives in terms of the modifications made to the best-estimate assumptions of CPP27.

**Table 8 Summary of Alternative Assumptions in terms of CPP27 Best-Estimate Assumptions**

<b>Take-Up Scenario</b>	<b>Labour Force Participation rates and Unemployment rate</b>	<b>Average Employment Earnings</b>	<b>Labour Market Environment in Comparison to CPP27</b>
<b>Alternative I</b>			
<b>Age 65 (Benchmark)</b>	Ages below 60: CPP27 Ages 60-64: Ages 55-59 under CPP27 Ages 65-69: CPP27 Unemployment rate: CPP27	Ages below 60: CPP27 Ages 60-64: Age 59 under CPP27 Ages 65-69: CPP27	Somewhat Stronger
<b>Age 60</b>	All ages: Kept at 2015 level Unemployment rate: CPP27	Ages below 60: CPP27 Ages 60-69: Earnings of working beneficiaries aged 60-69 under CPP27	Weaker
<b>Age 68</b>	Ages below 60: CPP27 Ages 60-64: Ages 55-59 under CPP27 Ages 65-69: Ages 60-64 under CPP27 Unemployment rate: CPP27	Ages below 60: CPP27 Ages 60-64: Age 59 under CPP27 Ages 65-69: Age 64 under CPP27	Somewhat Stronger
<b>Alternative II</b>			
<b>Age 65 (Benchmark)</b>	Ages below 55: CPP27 Ages 55-64: Ages 50-54 under CPP27 Ages 65-69: CPP27 Unemployment rate: CPP27	Ages below 55: CPP27 Ages 55-64: Age 49 under CPP27 Ages 65-69: CPP27	Stronger
<b>Age 60</b>	All ages: Kept at 2015 level Unemployment rate at 7.2% (2016+)	Ages below 60: CPP27 Ages 60-69: Earnings of working beneficiaries aged 60-69 under CPP27	Weaker than Alternative I
<b>Age 68</b>	Ages below 55: CPP27 Ages 55-69: Ages 50-54 under CPP27 Unemployment rate: CPP27	Ages below 55: CPP27 Ages 55-64: Age 49 under CPP27 Ages 65-69: Age 64 under CPP27	Stronger
<b>Alternative III</b>			
<b>Age 65 (Benchmark)</b>	Low-cost labour market sensitivity test under CPP27 (higher labour force participation rates and lower unemployment rate)	CPP27	Much Stronger
<b>Age 60</b>	High-cost labour market sensitivity test under CPP27 (lower labour force participation rates and higher unemployment rate)	Ages below 60: CPP27 Ages 60-69: Earnings of working beneficiaries aged 60-69 under CPP27	Much Weaker
<b>Age 68</b>	Ages below 65: Low-cost labour market sensitivity test under CPP27 (higher labour force participation rates and lower unemployment rate) Ages 65-69: Ages 60-64 under CPP27	Ages below 65: CPP27 Ages 65-69: Age 64 under CPP27	Much Stronger

## V. Results

The actuarial adjustments and AAFs discussed in the remainder of this study apply to the year 2017 and thereafter.

### A. Alternative I: Pre- and Post-65 AAFs

The SSCR under the Alternative I benchmark scenario (collective pension take-up at age 65) is 9.97% for the year 2019 and thereafter.<sup>9</sup> No actuarial adjustment or AAF is determined for this scenario, since all contributors are assumed to start their pension at age 65.

The actuarial adjustment at age 60, which is determined through an iterative process that yields the Alternative I benchmark SSCR of 9.97% for the age 60 take-up scenario, is 66.4% compared to the legislated actuarial adjustment of 64% at age 60. A linear interpolation between ages 60 and 65 produces a downward AAF of 0.56% for each month between age 65 and the age of early (pre-65) pension take-up.<sup>10</sup> This monthly factor rounds to the legislated AAF of 0.6% for early pension take-up.

The actuarial adjustment at age 68, which is determined through an iterative process that yields the Alternative I benchmark SSCR of 9.97% for the age 68 take-up scenario, is 125.6% compared to the legislated actuarial adjustment of 125.2% at age 68. A linear interpolation between ages 65 and 68 produces an upward AAF of 0.71% for each month between ages 65 and 68. The monthly AAF for post-65 take-up is determined from the age 68 take-up scenario since less than 2% of CPP participants ask for their retirement benefit after age 68. The post-65 AAF under Alternative I is thus determined to be 0.71%.<sup>11</sup> This monthly factor rounds to the legislated AAF of 0.7% for late pension take-up.

### B. Alternative II: Pre- and Post-65 AAFs

The SSCR under the Alternative II benchmark scenario (collective pension take-up at age 65) is 9.88% for the year 2019 and thereafter. No actuarial adjustment or AAF is determined for this scenario, since all contributors are assumed to start their pension at age 65.

The actuarial adjustment at age 60, which is determined through an iterative process that yields the Alternative II benchmark SSCR of 9.88% for the age 60 take-up scenario, is 65.2% compared to the legislated actuarial adjustment of 64% at age 60. A linear interpolation between ages 60 and 65 produces a downward AAF of 0.58% for each month between age 65 and the age of early (pre-65) pension take-up. This monthly factor rounds to the legislated AAF of 0.6% for early pension take-up.

The actuarial adjustment at age 68, which is determined through an iterative process that yields the Alternative II benchmark SSCR of 9.88% for the age 68 take-up scenario, is 125.2%, the same as the legislated actuarial adjustment. A linear interpolation between ages 65 and 68 produces an upward AAF of 0.70% for each month between ages 65 and 68. Since the monthly AAF for post-65 take-up is determined from the age 68 take-up scenario, the post-65 AAF under

Alternative II is thus determined to be 0.70%, the same as the legislated AAF for late pension take-up.

### C. Alternative III: Pre- and Post-65 AAFs

The SSCR under the Alternative III benchmark scenario (collective pension take-up at age 65) is 9.77% for the year 2019 and thereafter. No actuarial adjustment or AAF is determined for this scenario, since all contributors are assumed to start their pension at age 65.

The actuarial adjustment at age 60, which is determined through an iterative process that yields the Alternative III benchmark SSCR of 9.77% for the age 60 take-up scenario, is 63.4% compared to the legislated actuarial adjustment of 64% at age 60. A linear interpolation between ages 60 and 65 produces a downward AAF of 0.61% for each month between age 65 and the age of early (pre-65) pension take-up. This monthly factor rounds to the legislated AAF of 0.6% for early pension take-up.

The actuarial adjustment at age 68, which is determined through an iterative process that yields the Alternative III benchmark SSCR of 9.77% for the age 68 take-up scenario, is 125.2%, the same as the legislated actuarial adjustment. A linear interpolation between ages 65 and 68 produces an upward AAF of 0.70% for each month between ages 65 and 68. Since the monthly AAF for post-65 take-up is determined from the age 68 take-up scenario, the post-65 AAF under Alternative III is thus determined to be 0.70%, the same as the legislated AAF for late pension take-up.

### D. Comparison with Legislated Adjustments

Table 9 presents a summary of the monthly AAFs under the three considered Alternatives in comparison with the legislated AAFs. For each alternative, the pre- and post-65 AAFs rounded to the nearest 0.1% are equal to the legislated factors.

**Table 9 Summary of AAFs under Alternatives I, II and III**

<b>Alternative</b>	<b>Pre-65 Monthly AAF (%)</b>	<b>Post-65 Monthly AAF (%)</b>
<i>Legislated</i>	0.60	0.70
<b>Alternative I</b>	0.56	0.71
<b>Alternative II</b>	0.58	0.70
<b>Alternative III</b>	0.61	0.70

Table 10 compares the legislated actuarial adjustments with the actuarial adjustments determined under three considered alternatives. It can be seen that the largest difference between the legislated and alternative adjustments occurs at age 60, which results from the alternative early pension adjustments and AAFs being determined based on that age.



**Table 10 Comparison of Best-Estimate and Legislated Actuarial Adjustments**

Age	Actuarial Adjustments and Difference with Legislated Adjustments (%)						
	Legislated Pre-/Post-65 AAFs: 0.60% / 0.70%	Alternative I Pre-/Post-65 AAFs: 0.56% / 0.71%		Alternative II Pre-/Post-65 AAFs: 0.58% / 0.70%		Alternative III Pre-/Post-65 AAFs: 0.61% / 0.70%	
		Adjustment	Difference	Adjustment	Difference	Adjustment	Difference
60	64.0	66.4	2.4	65.2	1.2	63.4	(0.6)
61	71.2	73.1	1.9	72.2	1.0	70.7	(0.5)
62	78.4	79.8	1.4	79.1	0.7	78.0	(0.4)
63	85.6	86.6	1.0	86.1	0.5	85.4	(0.2)
64	92.8	93.3	0.5	93.0	0.2	92.7	(0.1)
65	100.0	100.0	0.0	100.0	0.0	100.0	0.0
66	108.4	108.5	0.1	108.4	0.0	108.4	0.0
67	116.8	117.0	0.2	116.8	0.0	116.8	0.0
68	125.2	125.6	0.4	125.2	0.0	125.2	0.0
69	133.6	134.1	0.5	133.6	0.0	133.6	0.0
70	142.0	142.6	0.6	142.0	0.0	142.0	0.0

### E. Conclusion

The AAFs in this study were determined using a methodology that was deemed to be appropriate. Under that methodology, the AAFs were calculated under three alternatives, each considered to be plausible. The AAFs determined for each alternative round to the current legislated AAFs of 0.6% per month for pre-65 retirement pension take-up and 0.7% per month for post-65 retirement pension take-up. As such, the current legislated AAFs are determined to be appropriate.

## VI. Sensitivity Analysis

### A. Introduction

An examination of the AAFs involves the projection of the cash flows of the CPP over a long period of time. Further, the choice of the assumed labour market environments associated with changes in retirement behaviour of CPP participants calls for a degree of judgment. Both the length of the projection period and the number of assumptions required ensure that the “true” actuarial adjustment factors will not precisely correspond to the results obtained in this study. For this reason, sensitivity analysis has been performed to determine the AAFs that would result under alternative assumptions. Since the three alternatives considered already present a range of results for the AAFs, the sensitivity analysis was performed for the middle alternative (Alternative II).

### B. Sensitivity of AAFs to Key Demographic, Economic, and Investment Assumptions

The sensitivity of the AAFs determined in this study to key demographic, economic, and investment assumptions was examined regarding specifically mortality improvement rates, the real wage increase, and the real rate of return on the Plan’s assets. In respect of other key assumptions, the AAFs are not materially sensitive to changes in such demographic assumptions as the total fertility rate and net migration rate, or to changes in the price increases (inflation) assumption.

The individual sensitivity tests are based on the low- and high-cost assumptions used for the sensitivity tests in CPP27, summarized below in Table 11, which also shows the best-estimate assumptions of CPP27 for comparison. All other assumptions regarding Alternative II, as described in Section V-B, apply to the sensitivity tests in this subsection.

**Table 11 Individual Sensitivity Test Assumptions**

Canada	CPP27 Low-Cost		CPP27 Best-Estimate		CPP27 High-Cost	
Mortality:						
Canadian life expectancy at age 65 in 2050 with future improvements	Males	20.9	Males	23.3	Males	25.8
	Females	23.2	Females	25.6	Females	27.9
Real wage increase		1.8%		1.1%		0.4%
75-year average real rate of return		5.6%		3.9%		2.2%

Table 12 summarizes the monthly AAFs determined under these sensitivity tests using the Alternative II pension take-up age scenarios. As indicated, changes in mortality improvement rates, real wage increase, and real rate of return result in a certain degree of volatility in the AAFs. However, the AAFs remain reasonably close to the values determined under Alternative II and the legislated values. This is particularly the case for the pre-65 AAFs. As most individuals take their CPP pension on or before age 65, the early retirement factors are expected to have the largest impact on the retirement behaviour of CPP participants and thus on the financial state of the Plan.

**Table 12 Monthly AAFs – Individual Sensitivity Tests under Alternative II**

Age	Legislated	Alternative II	Mortality Rates		Real Wage Increase		Real Rate of Return on Investments	
			High Cost	Low Cost	High Cost	Low Cost	High Cost	Low Cost
Pre-65	0.60%	0.58%	0.56%	0.60%	0.61%	0.54%	0.49%	0.66%
Post-65	0.70%	0.70%	0.66%	0.75%	0.81%	0.60%	0.54%	0.87%

## VII. Conclusion

The actuarial adjustments made to the CPP retirement benefits are necessary to take account of both the length of time that contributions are made to the Plan and the length of time over which benefits are received. In the case of early benefit take-up, there will generally be fewer years of contributions made and more years of benefits received, compared to late pension take-up where the opposite will generally hold. Currently, the amount of the CPP retirement pension is adjusted downward by a factor of 0.6% for each month (or 7.2% for each year) that the retirement pension commences prior to the age of 65, or upward by a factor of 0.7% for each month (or 8.4% for each year) that the retirement pension commences after age 65. The maximum pension reduction is 36% at age 60 and the maximum pension increase is 42% at age 70 or older.

In accordance with the CPP legislation, in the first actuarial report prepared after 2015 and in every third report that follows, the Chief Actuary is required to specify the AAFs as calculated according to a methodology deemed appropriate by him/her. The Chief Actuary may also specify the AAFs more frequently if he/she considers it necessary. CPP27 was the first such report for which it was required to specify the AAFs. The factors calculated for and specified in CPP27 are 0.6% per month and 0.7% per month for early (pre-65) and late (post-65) pension take-up, respectively, rounded to the nearest 0.1%. These factors are the same as the current legislated AAFs.

The purpose of this study is to describe the methodology used to calculate the AAFs specified in CPP27 and to provide the unrounded estimates of the factors. The underlying principle of the methodology used in this study is to determine the AAFs that result in the SSCR remaining the same whether all the Plan's contributors start their retirement benefit at age 60, 65 or 68, assuming that collective pension take-up at any age is associated with changes in the labour market environment. The actuarial adjustments that are determined to achieve this objective are deemed to be appropriate for the Plan. Three plausible alternative sets of pension take-up scenarios for ages 60, 65, and 68 are considered to provide a reasonable range of appropriate AAFs.

This study found that the AAFs for pre-65 retirement pension take-up determined using the given methodology are 0.56%, 0.58%, and 0.61% per month under Alternatives I, II, and III, respectively. The AAFs determined for post-65 pension take-up are 0.71%, 0.70%, and 0.70% under Alternatives I, II, and III, respectively. Sensitivity analysis showed that the AAFs (in respect of Alternative II) determined under different key demographic, economic, and investment assumptions remain reasonably close to their Alternative II and legislated values.

The AAFs for each alternative round to the legislated monthly AAFs of 0.6% and 0.7% per month for pre-65 and post-65 pension take-up, respectively. The legislated monthly AAFs are thus determined to be appropriate.

## VIII. Appendices

### A. Best-Estimate Assumptions of the CPP27

**Table 13 Summary of Best-Estimate Assumptions of the CPP27**

<b>Canada</b>	<b>27<sup>th</sup> CPP Actuarial Report as at 31 December 2015</b>	
Total fertility rate	1.65 (2019+)	
Mortality	Canadian Human Mortality Database (CHMD 2011) with assumed future improvements	
Canadian life expectancy	Males	Females
at birth in 2016	86.7 years	89.7 years
at age 65 in 2016	21.3 years	23.7 years
Net migration rate	0.62% of population (2016+)	
Participation rate (age group 15-69)	77.5% (2035)	
Employment rate (age group 15-69)	72.6% (2035)	
Unemployment rate	6.2% (2025+)	
Rate of increase in prices	2.0% (2017+)	
Real wage increase	1.1% (2025+)	
Real rate of return	3.9% 75-year average	
Retirement rates for cohort at age 60	Males	34% (2016+)
	Females	38% (2016+)
CPP disability incidence rates (per 1,000 eligible)	Males	3.10 (2020+)
	Females	3.65 (2020+)

### B. Endnotes

<sup>1</sup> The minimum age to receive a CPP pension was initially 68 in 1967. The minimum age to receive a pension was then lowered each subsequent year until reaching 65 in 1970. Full pensions were first paid after a ten-year accrual period from 1967 to 1976. The minimum retirement age of the CPP remained at 65 from 1970 until 1986.

<sup>2</sup> The steady-state contribution rate of the CPP is the minimum rate that both builds a reserve of assets and stabilizes the ratio of assets to expenditures over time. The steady-state contribution rate is distinct from the incremental rate that fully funds any future new benefits or benefit improvements. The sum of the steady-state and incremental rates is the minimum contribution rate of the Plan. As the incremental rate was deemed to be zero in CPP27, the minimum contribution rate equals the steady-state contribution rate of 9.79% in that report.

<sup>3</sup> The actuarial adjustment at a given age refers to the adjustment that would be applied to a retirement benefit started at the given age based on applying the monthly AAF between that age and age 65.

<sup>4</sup> On 15 December 2016, Bill C-26, An Act to amend the Canada Pension Plan, the Canada Pension Plan Investment Board Act and the Income Tax Act, received Royal Assent. Part 1 of Bill C-26 amends the Canada Pension Plan to enhance the CPP by increasing the level of benefits and level of earnings on which contributions are made, and introducing additional contribution rates. This “additional CPP” pertains to additional benefits and contributions over and above the current “base CPP”. The valuation of

the impact of Part 1 of Bill C-26 on the CPP is provided in the 28<sup>th</sup> Actuarial Report supplementing the Actuarial Report on the Canada Pension Plan as at 31 December 2015. As the purpose of this study is to describe the methodology used to calculate the AAFs as presented in CPP27, the analysis performed conducted for this study pertains to the base CPP.

<sup>5</sup> Major reforms were made to the CPP in 1997, which included a change in the financing approach of the Plan from pay-as-you-go to partial and incremental full funding through the steady-state and incremental contribution rates.

<sup>6</sup> The CPP is subject to triennial financial reviews by the Federal and Provincial Ministers of Finance in accordance with section 113.1 of the *Canada Pension Plan*.

<sup>7</sup> The term “working beneficiaries” refers to CPP pensioners who continue to work while receiving their pension. Effective 1 January 2012, working beneficiaries younger than 65 are required, along with their employers, to contribute to the CPP in exchange for a post-retirement benefit that increases their pension. Working beneficiaries aged 65 to 69 have the option to contribute to the Plan, and for those who choose to do so, their employers must also contribute. Contributions to the CPP are not permitted after reaching age 70.

<sup>8</sup> The minor differences in projected earnings are due to the projection algorithm.

<sup>9</sup> The SSCR is determined for all years following the first three years after an actuarial valuation date of the Plan (the triennial review period), with the legislated rate (9.9%) applied for the first three years. As CPP27 had a valuation date of 31 December 2015, the SSCR determined for this study applies for the year 2019 and thereafter, and the legislated rate applies for years 2016 to 2018.

<sup>10</sup> The Alternative I actuarial adjustment at age 60 of 66.4% is equivalent to a reduction applied to the pension at age 60 of  $1 - 0.664 = 0.336$  or 33.6%. Linearly interpolating this reduction over five years or 60 months gives the AAF, that is:  $0.336 / (5 * 12) = 0.0056$  or 0.56% per month. Similar calculations are used to determine the pre-65 AAFs for Alternatives II and III.

<sup>11</sup> The Alternative I actuarial adjustment at age 68 of 125.6% is equivalent to an increase applied to the pension at age 68 of  $1.256 - 1 = 0.256$  or 25.6%. Linearly interpolating this increase over three years or 36 months gives the best-estimate AAF, that is:  $0.256 / (3 * 12) = .0071$  (approximately) or 0.71% per month. Similar calculations are used to determine the post-65 AAFs for Alternatives II and III.

## C. Bibliography

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