

**REVIEW OF THE TWENTY-FIFTH ACTUARIAL REPORT
ON THE CANADA PENSION PLAN**

**Conducted by the CPP Actuarial Review Panel
16 March 2011**

**Douglas Andrews, FCIA
Rob Brown, FCIA
Warren McGillivray, FSA**

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	1
SECTION 1 – INTRODUCTION	6
1.1 Terms of Reference.....	6
1.2 Procedures Followed	7
1.3 The Canada Pension Plan	8
1.4 Statutory Actuarial Requirements.....	9
1.5 Actuarial Report 23 (AR23)	9
1.6 Improvements Since Actuarial Report 23.....	10
1.7 Actuarial Report 25 (AR25)	10
1.8 Interpretation of Results	11
1.9 Outline of this Report	12
SECTION 2 – PROFESSIONAL EXPERIENCE.....	13
2.1 Background.....	13
2.2 Observations	14
2.2.1 Continuity of Staff.....	15
2.2.2 Guidance From Experts.....	15
2.3 Opinion on Professional Experience	15
SECTION 3 – PROFESSIONAL AND STATUTORY REQUIREMENTS.....	16
3.1 Background.....	16
3.2 Canadian Institute of Actuaries (CIA) Rules of Professional Conduct	17
3.3 Canadian Institute of Actuaries (CIA) General Standards of Practice	18
3.4 International Actuarial Association (IAA) Guidelines of Actuarial Practice for Social Security Programs.....	19
3.5 Canada Pension Plan Statute	19
3.6 Opinion on Professional and Statutory Requirements.....	19
SECTION 4 – DATA.....	20
4.1 Background.....	20
4.2 Observations	22
4.3 Opinion on Data.....	23
4.4 Recommendations.....	23
SECTION 5 – METHODOLOGY.....	24
5.1 Background.....	24
5.2 Macro-simulation Model	24
5.3 Form of Output	26
5.4 Actuarial Cost Analysis	26
5.4.1 Pay-As-You-Go Method	26
5.4.2 Minimum Contribution Rate.....	27

5.4.3	Actuarial Balance Sheet	28
5.4.4	Current Service Cost	28
5.4.5	Internal Rates of Return	29
5.4.6	Reconciliations	29
5.4.7	Sensitivity Tests	29
5.4.8	Individual Sensitivity Tests	30
5.5	Opinion on Methodology	31
5.6	Recommendations	31
SECTION 6 – ASSUMPTIONS		32
6.1	Background	32
6.2	Demographic Assumptions and Opinions Thereon	33
6.2.1	Fertility	33
6.2.2	Mortality	35
6.2.3	Migration	37
6.2.4	Disability Incidence	38
6.2.5	Retirement Rates	38
6.3	Economic Assumptions and Opinions Thereon	40
6.3.1	Unemployment and Labour Force Participation Rates	40
6.3.2	Real Wage Differential	41
6.3.3	Price Increases	42
6.3.4	Real Rate of Return on Investments	43
6.4	Assumptions in the Aggregate and Opinion Thereon	46
6.5	Recommendations	47
SECTION 7 – COMMUNICATION OF RESULTS		48
7.1	Background	48
7.2	Observations	48
7.3	Opinion on Communication of Results	49
7.4	Recommendation	49
SECTION 8 – ACTUARIAL REPORT 24 (AR24): THE IMPACT OF BILL C-51		50
8.1	Background	50
8.2	Main Findings of AR24	51
8.3	Opinion on AR24	52
8.4	Recommendations	52
SECTION 9 – OTHER ISSUES AND RECOMMENDATIONS THEREON		54
9.1	CPP Expenses	54
9.2	External Guidance in Selecting Assumptions	55
9.3	Recommendations	56
SIGNATURES		57

ACRONYMS USED IN THIS REPORT

AR23	Twenty-Third Actuarial Report on the CPP
AR24	Twenty-Fourth Actuarial Report on the CPP
AR25	Twenty-Fifth Actuarial Report on the CPP
CPP	Canada Pension Plan
CPPIB	Canada Pension Plan Investment Board
CRA	Canada Revenue Agency
HRSDC	Human Resources and Skills Development Canada
OCA	Office of the Chief Actuary
OSFI	Office of the Superintendent of Financial Institutions
QPP	Québec Pension Plan
OASDI	Old Age, Survivors and Disability Insurance (the U.S. Social Security program)

This report was prepared by a review panel of three independent actuaries Doug Andrews and Rob Brown, Fellows of the Canadian Institute of Actuaries and Warren McGillivray, Fellow of the Society of Actuaries.

EXECUTIVE SUMMARY

Terms of Reference

The panel conducted its review of the 25th Actuarial Report on the Canada Pension Plan (AR25) in accordance with the following terms of reference:

“The Canadian peer reviewers will review the work of the Chief Actuary in completing the 25th Actuarial Report on the Canada Pension Plan as at 31 December 2009 (25th Report) and, following the review, provide a report to the Chief Actuary and the United Kingdom Government Actuary’s Department (GAD). GAD will then provide its opinion of the peer review to the Chief Actuary.

The review report should contain opinions on the following questions:

1. Is the professional experience of the Chief Actuary and his staff who worked on the report adequate for carrying out the work required?
2. Has the work been completed in compliance with the relevant professional standards of practice and statutory requirements?
3. Did the Chief Actuary have access to the information required to perform the valuation, and were relevant tests and analysis on the data completed as might be expected?
4. Were the actuarial methods and assumptions used in completing the report reasonable?
5. Does the 25th Report fairly communicate the results of the work performed by the Chief Actuary and his staff?

6. Does the 24th Report supplementing the 23rd CPP Report in respect of Bill C-51 use appropriate assumptions and fairly communicate the changes from the estimates contained in the 23rd CPP Report?

In providing opinions on the questions listed above, the Canadian peer reviewers will also provide such recommendations as the peer reviewers deem appropriate with respect to future actuarial reports on the Canada Pension Plan prepared by the Office of the Chief Actuary.”

Actuarial Report 25 (AR25)

AR25 was prepared as at 31 December 2009. It presents a best-estimate projection of pay-as-you-go contribution rates for the Plan, rising from 8.65% of contributory earnings in 2010 to 11.22% in 2060, then hovering thereafter.

It also presents a minimum contribution rate to be paid from 2013 to 2022 of 9.86% of contributory earnings and 9.85% for years 2023 and thereafter. This consists of a best-estimate steady-state contribution rate of 9.84% to finance the Plan and a second component required to fully fund the expanded eligibility for disability benefits for long-term contributors following the 2008 amendments to the Plan contained in Bill C-36. The full funding rate is 0.02% for years 2013 to 2022 and 0.01% for years 2023 and thereafter.

Using this minimum contribution rate, AR25 projects ratios of assets-to-expenditures rising from 3.94 in 2010 to 4.70 by 2022, and to be the same fifty years later in 2072. Under a continuation of the current 9.9% contribution rate, AR25 projects ratios rising steadily from 3.94 in 2010 to 5.18 in 2050 and then dropping very slowly to 5.03 in 2085.

AR25 also presents the results of several sensitivity tests that show how different the results would be if particular assumptions, either individually or in combination, were varied.

All of the results are estimates. All but the sensitivity tests represent the Chief Actuary’s “best” estimates, with no deliberate margins of conservatism or other deliberate bias.

It is essential to recognize that these results are not predictions. They simply present what the outcome will be if all of the actuarial assumptions were realized. But those assumptions are about demographic and economic parameters for the next 75 years that are not amenable to accurate prediction. Readers of AR25 should look at the sensitivity tests to understand the range of possible actual outcomes.

Opinions

With respect to the six questions listed in the terms of reference it is our opinion that:

1. the professional experience of the Chief Actuary and the staff who worked on AR25 was adequate for carrying out the work required,
2. the work on AR25 complies with all relevant professional standards of practice and statutory requirements,
3. the Chief Actuary had access to the data he required to perform the valuation, and he completed such relevant tests and analysis on the data as might be expected,
4. the actuarial methods employed in AR25 are reasonable and the assumptions used in completing AR25 are, in the aggregate, reasonable, but towards the low-cost side of the reasonable range,
5. AR25 fairly communicates the results of the work performed by the Chief Actuary and his staff, and
6. AR24, supplementing AR23 in respect of Bill C-51, used appropriate assumptions and fairly communicates the changes from the estimates contained in AR23.

Recommendations

We compliment the Chief Actuary and the staff of his Office who prepared AR25 on their competence, commitment and professionalism. They were unfailingly helpful in clarifying issues raised by the review panel and in providing additional information. In the spirit of seeking to help the Chief Actuary and his staff to continue improving their work, our report includes the following recommendations:

Recommendation 1: We recommend that the Chief Actuary continue his program of seminars with presentations from appropriate experts and continue to broaden the range of presenters and the range of viewpoints.

Recommendation 2: We recommend that the OCA continue to work with its data providers to address items on the OCA's list of data enhancement priorities.

Recommendation 3: We recommend that the Chief Actuary continue to report the expected progression of the minimum contribution rate over time assuming that the best-estimate assumptions are realized. This would help to allay CPP stakeholders' concerns about the sustainability of the current contribution rate.

Recommendation 4: We recommend that an actuarial balance sheet on an open group basis only appear in the actuarial report, and that details and analysis of alternative actuarial balance sheets be dealt with in an OCA Actuarial Study (e.g., in a revision of Actuarial Study No. 8).

Recommendation 5: We recommend that the Table displaying Internal Rates of Return by Cohort be prefaced by a comment to the effect that the CPP should not be considered as an investment program.

Recommendation 6: We recommend that the Chief Actuary continue to apply the stochastic element of the projections, but that he be cognizant of the limitations inherent in stochastic modelling.

Recommendation 7: We recommend that the Chief Actuary maintain his programs of research and consultation with experts, with the goal of continual improvements in the process of setting best-estimate assumptions.

Recommendation 8: We recommend that the OCA do a research report on migration as it is a very important variable which is subject to significant volatility. The research should include an investigation as to whether there is a relationship between migration and fertility from the perspective of setting actuarial assumptions.

Recommendation 9: Because of its strong impact on the financial operations of the Plan, we suggest that for the economic assumptions, particular attention be given to further research on the size and sustainability of the equity risk premium.

Recommendation 10: We recommend that the Chief Actuary and his counterparts at the CPPIB put in place procedures that will result in truly effective two-way communication between the OCA and the CPPIB.

Recommendation 11: We recommend that the Chief Actuary continue to explore ways to address the needs of both the broad audience and more technical readers of his reports. In particular, the public should be made aware that all information made available to the review panel is available to others upon request.

Recommendation 12: We recommend that subsection 115(2) of the Canada Pension Plan statute be amended to remove the requirement that the actuary use “the same actuarial assumptions and basis as were used in that report” (i.e., the most recent report). Rather, the wording should require that the actuary justify non-compliance with this general requirement.

Recommendation 13: We recommend that in future actuarial reports supplementing triennial actuarial reports, the Chief Actuary provide a Reconciliation of Changes in the Minimum Contribution Rate from the preceding triennial actuarial report to the supplementary report similar in format to that found in Table 19 in AR25.

Recommendation 14: We recommend that the actuarial report include an analysis of CPP administrative expenses, and in view of their importance and recent increases, treat the CPPIB operating expenses separately from the expenses incurred by other departments and agencies. The CPPIB operating expenses should be expressed in terms of assets. Other expenses should be expressed in terms of contribution income (or contributory earnings) as well as in terms of total earnings.

Recommendation 15: We recommend that the Chief Actuary continue to consult widely with officials from other government departments and with other experts, but that the process and timing of the report remain as it is today.

SECTION 1 – INTRODUCTION

This report presents the results of an in-depth review we conducted into the Twenty-Fifth Actuarial Report on the Canada Pension Plan (AR25) and the detailed actuarial examination on which it was based. This is the fifth such review that has been conducted.

Rather than “re-inventing the wheel”, in this report we have borrowed extensively from the descriptive and explanatory portions of the previous review reports. The observations, conclusions and recommendations, however, are our own.

1.1 Terms of Reference

In accordance with our terms of reference, our review focused on the actuarial work done on the Plan. We were not asked to, and did not, review the merits of the current design, administration or investment arrangements of the Plan. Our review of those aspects was confined to how they interact with, and are reflected in, the actuarial review.

The terms of reference for our review were as follows:

“...the panel will review the work of the Chief Actuary in completing the 25th Actuarial Report on the Canada Pension Plan as at 31 December 2009 (AR25) and, following the review, provide a report to the Chief Actuary and the United Kingdom Government Actuary’s Department (GAD). The GAD will then provide its opinion of the peer review to the Chief Actuary.

The review report should contain opinions on the following questions:

1. Is the professional experience of the Chief Actuary and his staff who worked on the report adequate for carrying out the work required?
2. Has the work been completed in compliance with the relevant professional standards of practice and statutory requirements?
3. Did the Chief Actuary have access to the information required to perform the valuation, and were relevant tests and analysis on the data completed as might be expected?
4. Were the actuarial methods and assumptions used in completing the report reasonable?
5. Does the 25th Report fairly communicate the results of the work performed by the Chief Actuary and his staff?

6. Does the 24th Report supplementing the 23rd CPP Report in respect of Bill C-51 use appropriate assumptions and fairly communicate the changes from the estimates contained in the 23rd CPP Report?

In providing opinions on the questions listed above, the Canadian peer reviewers will also provide such recommendations as the peer reviewers deem appropriate with respect to future actuarial reports on the Canada Pension Plan prepared by the Office of the Chief Actuary.”

1.2 Procedures Followed

Our review was conducted as a close collaboration of the three panel members. The review work took place over the months from October 2010 through March 2011.

We received copies of some of the working papers in October 2010, in advance of the report. We received the report on 15 November 2010, the day it was tabled in Parliament. We received access to all other needed working papers on a timely basis after the report was tabled.

We interviewed the Chief Actuary and senior members of the Office of the Chief Actuary (OCA), a Division of the Office of the Superintendent of Financial Institutions (OSFI), for one and one-half days. We met with officials of the Department of Finance Canada, Human Resources and Skills Development Canada, the Demography Section of Statistics Canada and the Canada Pension Plan Investment Board (CPPIB). All of these officials responded promptly and fully to each request we made for information.

We also reviewed the papers presented at the International Conference of Social Security Actuaries and Statisticians, Ottawa, 16-18 September 2009, a QPP seminar held 27 November 2009, the Chief Actuary’s presentation on the CPP actuarial valuation projection model at the Society of Actuaries 2010 Annual Meeting and other technical materials.

We made use of the historical documents that are maintained on the website of the Office of the Chief Actuary, which we found to be useful.

We held several meetings in person and by teleconference, and corresponded extensively by e-mail.

After reviewing all of the information, and after much discussion among ourselves, we were able to reach agreement on all of the opinions and recommendations presented in this report.

The Canada Pension Plan is a complex Plan that provides benefits on a variety of bases (part earnings-related and part flat-rate) on the occurrence of three different events (retirement, disability and death) and with different qualification criteria for each event. The actuarial computer model used to produce the results in AR25 is extremely complex. It projects the intertwining of the Plan provisions and current population statistics with projections of future demographic and economic experience.

In our work, we have tended to concentrate on what we consider to be the most important issues – in particular, the data used, the major methodology issues, and nine key actuarial assumptions. As described in Section 4 (Data) of this report, we reviewed the sources of the data, and the processes used by the Chief Actuary to test and analyze the data, but our mandate did not include a detailed audit of the data. Similarly, we reviewed the procedures used by the Chief Actuary to test the actuarial computer model, but our mandate did not include a verification of the accuracy of the model.

1.3 The Canada Pension Plan

The Canada Pension Plan (CPP) is a social insurance program that provides monthly income benefits and some lump sum benefits upon retirement, death and disability of participants. Virtually all working Canadians outside Québec contribute to the Plan.

Before 1997, contribution rates were set at a level that created relatively little advance funding of benefits and the funds not used for immediate benefit payments and expenses were loaned to the provinces at federal government borrowing rates of interest. The Plan was amended in 1997 to:

- require an increased measure of advance funding,
- add a sunset clause regarding the investment of CPP assets in provincial revolving 20-year bonds,
- require that the funds not used for immediate benefit payments and expenses or for investment in those provincial bonds be invested in a diversified portfolio of investments, and
- establish an Investment Board to manage these investments.

In recent years, there have been several amendments, the most recent being Bill C-51, which introduced a number of important changes. The impact of Bill C-51 will be presented in more detail in Section 8 wherein we review AR 24 which was tabled in the House of Commons on 19 October 2009.

1.4 Statutory Actuarial Requirements

Section 115 of the Canada Pension Plan Statute requires that an actuarial review be conducted once every three years and that it report:

- projected pay-as-you-go contribution rates (i.e., each year's contribution rate is just sufficient to cover that year's benefit payments and expenses), and
- a contribution rate, calculated by combining
 1. a contribution rate, calculated in a prescribed manner in respect of steady-state funding excluding changes that require full funding, and
 2. a contribution rate, calculated in a prescribed manner in respect of full funding for benefit improvements.

Section 113.1 of the Canada Pension Plan Statute requires a financial review of the Canada Pension Plan every three years by the federal Minister of Finance and ministers of the included provinces. This review is to take into account the most recent report of the Chief Actuary under Section 115 and two financing objectives – full funding for benefit improvements and steady-state funding for all other benefits. Section 115 states that projections must extend for at least 75 years into the future.

The federal government repealed the Calculation of Default Contribution Rates Regulation and introduced a new Regulation on the Calculation of Contribution Rates Regulations, 2007 which became effective on 3 March 2008. This Regulation described two funding objectives:

1. The steady-state funding objective by prescribing a contribution rate calculated as the lowest constant rate for which the projected ratio of Plan assets-to-expenditures 10 years after the end of the review period matches the corresponding projected ratio 60 years after the end of the review period.
2. The incremental full funding objective that added the requirement for full funding of post-1997 benefit improvements.

1.5 Actuarial Report 23 (AR23)

AR23 was prepared as at December 31, 2006. It presents a best-estimate projection of pay-as-you-go contribution rates for the Plan rising from 8.35% in 2007 to 11.49% in 2060, then hovering thereafter.

It also presents a minimum contribution rate to be paid in 2010 and later of 9.82% (rounded to the nearest 0.01%) of contributory earnings. This consists of a best-estimate steady-state contribution rate of 9.80% to finance the Plan without Bill C-36 and a contribution rate of 0.02% to fully fund the benefit improvements introduced by Bill C-36. Using this minimum contribution rate, AR23 projects ratios of assets-to-expenditures rising from 4.31 in 2007 to 5.48 in 2022, then staying fairly level until 2056 before dropping gradually to 5.17 in 2081. The projected ratios in the key years 2019 and 2069 are 5.41 and 5.37 respectively. Under a continuation of the current 9.9% contribution rate, AR23 projects ratios rising steadily from 4.31 in 2007 to 5.59 in 2022 and then rising more slowly to 6.45 in 2080.

1.6 Improvements Since Actuarial Report 23

The actuarial review panel for AR23 made 12 recommendations arising from its review, plus numerous other observations or suggestions for improvement which the Chief Actuary has taken into account. In preparing AR25, the Chief Actuary has made numerous improvements in the work and reporting, and many of these improvements are a direct response to the recommendations, observations and suggestions of the prior actuarial review panel. Where the recommendations of that panel have not been fully adopted, the Chief Actuary has provided a discussion of the partial progress made and/or has explained and supported any discrepancies.

However, our terms of reference do not call for, nor did we make, a detailed evaluation of the appropriateness of the response of the Chief Actuary to the findings of the prior actuarial review panel.

1.7 Actuarial Report 25 (AR25)

AR25 was prepared as at 31 December 2009. It presents a best-estimate projection of pay-as-you-go contribution rates for the Plan rising from 8.65% in 2010 to 11.22% in 2060, then hovering thereafter.

It also presents a minimum contribution rate to be paid of 9.86% (rounded to the nearest 0.01%) of contributory earnings for years 2013 to 2022 and 9.85% for years 2023 and thereafter. This consists of a best-estimate steady-state contribution rate of 9.84% to finance the Plan without Bill C-36 and a contribution rate of 0.02% for years 2010 to 2022 and 0.01% for years 2023 and thereafter to fully fund the benefit improvements introduced by Bill C-36.

Using this minimum contribution rate, AR25 projects ratios of assets-to-expenditures rising from 3.94 in 2010 to 4.95 in 2047, then dropping gradually to 4.25 in 2087. The projected ratios in the key years 2022 and 2072 are 4.70 and 4.69 respectively. Under a continuation of the current

9.9% contribution rate, AR25 projects ratios rising steadily from 3.94 in 2010 to 5.18 in 2050 and hovering thereafter.

AR25 includes a reconciliation of the changes to the minimum contribution rate between AR23 and AR25. The factors that increased the minimum contribution rate were:

- the poor economic experience in the period 2007 to 2009,
- changes in methods,
- changes in economic assumptions, and
- changes in investment assumptions.

On the other hand, the minimum contribution rate was reduced as a result of:

- amendments to the Plan (Bill C-51), and
- changes in certain demographic assumptions.

The impact of each of the above factors was relatively small. The positive impacts were nearly offset by the negative, so the minimum contribution rate in AR23 was increased by only 0.04% – from 9.82% to 9.86% in 2010 to 2022 and to 9.85% in 2023 and thereafter in AR25.

1.8 Interpretation of Results

AR25 presents:

- the projected pay-as-you-go contribution rates and asset-to-expenditure ratios by year to 2040 and then every fifth year through to 2085,
- the minimum contribution rate by year to 2027, and then every fifth year through to 2087,
- a number of sensitivity tests, which illustrate the results that would be obtained under various changes in actuarial assumptions,
- actuarial balance sheets showing estimates of the unfunded liability under closed and open group approaches,
- the current service cost (the value of future benefits earned in a year by contributors during the year), and
- a calculation of the internal rate of return of each cohort of participants (the projected rate of return each cohort can expect to achieve on its combined employee and employer contributions).

The minimum contribution rate is the most significant of these results. The federal Minister of Finance and ministers of the included provinces are to take it into account in their triennial financial review of the CPP. If the minimum contribution rate is higher than the legislated rate, and the federal and provincial governments do not take action, the insufficient rates provisions in Section 113.1 of the Canada Pension Plan Statute will apply to increase the legislated rate to the minimum contribution rate over a period of years. The other results are also useful because they provide information as to the long-term pattern of costs under the Plan and the unpredictability and variability of the costs if the assumptions were not realized. They also allow comparisons to be made with other countries' public pension plans.

All of the results are estimates. All but the sensitivity tests represent the Chief Actuary's "best" estimates, with no deliberate margins of conservatism or other deliberate bias.

It is essential to recognize that these results are not predictions. They simply present what the outcome will be if all of the assumptions were realized. The parameters involved (e.g., fertility rates, net migration rates, mortality rates, disability incidence rates, rates of labour force participation, retirement rates, rates of price increase, real rates of wage increase, real rates of return on investments, each from 2010 for 75 years) are not amenable to accurate prediction.

The estimates in AR25 and in previous reports are essential outputs to provide guidance in financing the Plan and in performing other planning and management tasks. Yet, no matter how carefully they are prepared, they are still only estimates. Thus, it is important that readers of the actuarial reports look at the sensitivity tests to understand the range of possible actual outcomes.

1.9 Outline of this Report

Sections 2, 3 and 4 of this report address the first three questions in our terms of reference regarding Professional Experience, Professional Standards of Practice and Data.

Section 5 (Methodology) and Section 6 (Assumptions) address question 4 in the terms of reference.

Section 7 addresses question 5 in the terms of reference.

Section 8 addresses question 6 in the terms of reference

Section 9 provides further important commentary.

The Executive Summary provides an overview of our findings.

SECTION 2 – PROFESSIONAL EXPERIENCE

In this Section we address the following question:

“Is the professional experience of the Chief Actuary and his staff who worked on the report adequate for carrying out the work required?”

2.1 Background

The Chief Actuary submitted AR25 to the Minister of Finance on 3 November 2010, and it was tabled in Parliament on 15 November 2010. The Chief Actuary is Jean-Claude Ménard, a Fellow of the Society of Actuaries (1985) and of the Canadian Institute of Actuaries (1985). He accepted the position of Chief Actuary for the federal government on 15 August 1999, following 18 years (the last four as Chief Actuary) with the Régie des rentes, the agency of the Québec government responsible for the Québec Pension Plan. Mr. Ménard was responsible for preparing the actuarial reports on the Québec Pension Plan from 1990 to 1999. Few actuaries can match his 29 years of experience in social insurance actuarial work, especially with respect to the Canadian context.

The professionals who worked most closely with Mr. Ménard on AR25, and co-signed the report with him, are Michel Montambeault and Michel Millette, both Senior Actuaries in the Office of the Chief Actuary, a Division of OSFI.

Mr. Montambeault is a Fellow of the Society of Actuaries (1992) and of the Canadian Institute of Actuaries (1992). He is also Senior Actuary (Old Age Security Program) in the Office of the Chief Actuary. He spends his time on Canada Pension Plan and Old Age Security Program affairs. He has worked on actuarial reviews of the Canada Pension Plan and the Old Age Security Program in the Office of the Chief Actuary for the last 21 years.

Mr. Millette is a Fellow of the Society of Actuaries (1986) and of the Canadian Institute of Actuaries (1986). He joined OSFI in May 2000, following 12 years of experience working on social insurance programs with Mr. Ménard at the Régie des rentes du Québec. He is also Senior Actuary (Canada Student Loans) in the Office of the Chief Actuary. He spends 50% of his time on Canada Pension Plan affairs and is responsible for the liaison with the staff of the Canada Pension Plan Investment Board.

The other professional staff who worked on AR25 are:

Name	Actuarial Designation	Years of Experience	
		In Actuarial Work	In Social Security
Assia Billig	PhD, FSA, FCIA	14 years	3 years
Yu Cheng	ASA	13 years	11 years
Mathieu Désy	FSA, FCIA	4 years	1 year
Patrick Dontigny	ASA	15 years	15 years
Alain Guimond	ASA	30 years	15 years
Sari Harrel	FSA, FCIA	11 years	8 years
François Lemire	FSA, FCIA	21 years	1 year
Danita Pattemore	FSA, FCIA	10 years	7 years
Jonathan Petrin	ASA	3 years	3 years
Louis-Marie Pommainville	FSA, FCIA	31 years	11 years
Annie St.-Jacques	ASA	10 years	8 years

The three senior actuaries reviewed the work of the staff and co-signed the report.

2.2 Observations

There are very few actuaries working in Canada with experience in valuing and costing social insurance programs like the CPP and the QPP. The data sources, macro-economic modelling and range of assumptions involved in actuarial valuations of social programs are more complex than for employer-sponsored plans. Therefore, occupational pension plan experience is useful but not as useful as previous experience with social programs like the CPP and the QPP. Messrs. Ménard, Montambeault and Millette have considerable experience and understanding of the issues involved in valuing the Canada Pension Plan.

The staff of the Office of the Chief Actuary is of sufficient size to spend adequate amounts of time on CPP matters, such as improving methodologies and data sources, performing inter-valuation studies, improving documentation and liaising with other government departments and other social security actuaries, all of which contribute to the quality of the work and of the report.

We are satisfied that Mr. Ménard and the staff who assisted him in preparing AR25 have the relevant experience and are qualified to carry out the actuarial valuation.

2.2.1 Continuity of Staff

For each actuarial review of the CPP, it is desirable to have the work performed by a group of professionals who have considerable experience with the process. We are pleased to observe that staff levels are being maintained and that there appears to be a program of staff recruiting and succession planning in place. There is a mix of more experienced and newer personnel on the staff of the OCA, and staffing continuity has been excellent.

2.2.2 Guidance From Experts

Because of the wide range and complexity of the assumptions and methodologies involved in actuarial reviews of the CPP, it is desirable for the Chief Actuary to seek out the advice and guidance of experts, including actuaries, demographers and economists, in order to help ensure that a wide range of analysis and opinion is considered and to improve the credibility of the actuarial reviews.

To this end, the Office of the Chief Actuary hosted the 16th International Conference of Social Security Actuaries and Statisticians in Ottawa, 16-18 September 2009. Representatives of the OCA also attended a seminar hosted by the Régie des rentes du Québec on 27 November 2009. Participation at these events helped the OCA to formulate best-estimate assumptions and methodologies for AR25.

After the tabling of each of the last four triennial actuarial reports on the CPP (AR17, AR18, AR21 and AR23), OSFI engaged a panel of three independent actuaries to conduct a post-release review of the actuarial reports, similar to the review described in this report. The actuarial review panel reports for AR17, AR18, AR21 and AR23 and this report have included a number of recommendations for improvements in, or revised approaches to, the processes, sources of data, methodologies and assumptions utilized in preparing actuarial reports on the CPP. This process provides a level of assurance to the public and also helps the Chief Actuary in gathering a range of views regarding the complex methodologies and assumptions involved.

2.3 Opinion on Professional Experience

In our opinion, the professional experience of the Chief Actuary and his staff who worked on AR25 meets the high standard required for this work.

SECTION 3 – PROFESSIONAL AND STATUTORY REQUIREMENTS

In this Section, we address the following question:

“Has the work been completed in compliance with the relevant professional standards of practice and statutory requirements?”

3.1 Background

To address this question, we have considered each of the following:

- *Canadian Institute of Actuaries Rules of Professional Conduct*: The Chief Actuary and his co-signatories are Fellows of the Canadian Institute of Actuaries (CIA), the professional body governing the conduct and work of actuaries in Canada. The CIA promulgates “the professional rules and ethical standards with which a member must comply and thereby serve the public interest”. The *Rules of Professional Conduct* are the Institute’s highest level of guidance to its members. Failure to adhere to the rules results in disciplinary proceedings.
- *CIA Standards of Practice*: These standards govern the work performed by actuaries in Canada. There are general standards governing all areas of practice and practice-specific standards governing work in specific areas, namely: life insurance, property and casualty insurance, occupational pensions, workers’ compensation and actuarial evidence. There are no practice-specific Standards of Practice governing work on social security programs, so only the general Standards of Practice are relevant to this review.
- *International Actuarial Association Guidelines of Actuarial Practice for Social Security Programs*: The International Actuarial Association (IAA) is a worldwide association of professional actuarial organizations. The IAA promulgates guidelines of actuarial practice. These practice guidelines are not binding on actuaries in a particular country except to the extent that their national actuarial organization makes them so or the terms of the actuary’s engagement require their application. The CIA has not made the *IAA Guidelines of Actuarial Practice for Social Security Programs* (*IAA Guidelines*) binding on its membership. However, since the *IAA Guidelines* provide guidance specific to social security programs, and since the Chief Actuary has voluntarily applied the *IAA Guidelines* to his work on AR25, we have considered the *IAA Guidelines* in this review.

- *Canada Pension Plan*: This statute provides the terms of reference of the Chief Actuary when preparing an actuarial report in relation to the CPP. Section 113.1 identifies the actuarial information required by the Minister of Finance and ministers of the Crown of the participating provinces when recommending changes to CPP benefits or contribution rates, or both. Section 115 stipulates the timing, contents and certain other aspects of the Chief Actuary's triennial report.

In the Subsections below, we consider each of these in turn.

3.2 Canadian Institute of Actuaries (CIA) Rules of Professional Conduct

The following *Rules of Professional Conduct* of the CIA are relevant to this review:

- *Rule 1*: A member shall act honestly, with integrity and competence, and in a manner to fulfil the profession's responsibility to the public and to uphold the reputation of the actuarial profession.
- *Rule 2*: A member shall perform professional services only when the member is qualified to do so and meets applicable qualification standards.
- *Rule 3*: A member shall ensure that professional services performed by or under the direction of the member meet applicable standards of practice.

We are satisfied that the Chief Actuary and his staff have met the requirements of the CIA *Rules of Professional Conduct*.

Further to *Rule 2*, Section 2 of this report expands on our assessment of the professional experience of the staff of the Office of the Chief Actuary. Under the auspices of *Rule 2*, the CIA has also promulgated Continuing Professional Development (CPD) requirements that are applicable to practising actuaries. These requirements oblige an actuary to obtain at least 100 hours of CPD over a two year period, and the CPD activities should be relevant to the actuary's area of practice. The actuary must devote required minimum amounts of CPD time to technical skills and professionalism. At least 24 hours of CPD time must be obtained biennially by participating in "structured" activities such as participating in professional meetings or seminars. We have reviewed the CPD records of the Chief Actuary and his two co-signatories to AR25, as well as the professional staff of the OCA who are Fellows of the Canadian Institute of Actuaries, and confirmed that they all meet the CIA's CPD qualification requirements as of February 2011.

Further to *Rule 3*, the next two Subsections expand on our assessment of the Chief Actuary's compliance with the *CIA General Standards of Practice* and *IAA Guidelines of Actuarial Practice for Social Security Programs*.

3.3 Canadian Institute of Actuaries (CIA) General Standards of Practice

The *General Standards* of the CIA are extensive and detailed. The topics covered include numerous matters relevant to AR25 such as:

- materiality,
- knowledge of the circumstances of the case,
- approximations,
- subsequent events,
- data sufficiency and reliability,
- control procedures,
- reasonableness of results,
- documentation,
- actuary's use of another person's work,
- selection of assumptions,
- provision for adverse deviations,
- comparison of current and prior assumptions, and
- reporting.

The CIA standard on assumptions requires that the assumptions, individually and in the aggregate, should be appropriate. We have concluded that the assumptions adopted for AR25 are within the reasonable range, both individually and in the aggregate, and are therefore appropriate.

The CIA standard on provision for adverse deviations (such a provision is sometimes referred to as a margin for conservatism) states that the actuary "should not include a provision for adverse deviations if the related work requires an unbiased calculation." Section 113.1 of the Canada Pension Plan Statute requires that the Chief Actuary determine the lowest constant contribution rate that, if maintained over the foreseeable future, results in specified projected asset-to-expenditure ratios that are constant. The Chief Actuary interprets this requirement as necessitating an unbiased calculation, and we agree.

Accordingly, the Chief Actuary uses assumptions that represent his "best-estimate" for each relevant variable. The consequence is that the overall valuation results, other than the sensitivity

tests, are likewise the Chief Actuary’s “best-estimates” and do not include any provision for adverse deviations.

In our view, the work on AR25 complies with the relevant portions of the *CIA General Standards of Practice*.

3.4 International Actuarial Association (IAA) Guidelines of Actuarial Practice for Social Security Programs

The *Guidelines of Actuarial Practice for Social Security Programs* of the IAA are international in scope. They cover the following topics:

- scientific rigour,
- objectivity,
- quality of reports – transparency, explicitness, simplicity and consistency, and
- contents of reports.

The *IAA Guidelines* specifically call for the use of unbiased or “best-estimate” assumptions, so the Chief Actuary’s work is also in harmony with this guidance.

The *Guidelines* with respect to the contents of reports are particularly extensive. Nearly one hundred different disclosures are recommended, ranging over areas such as data, assumptions, methodology, results, analysis, conclusions and professional attestations. AR25 provides the relevant recommended disclosures, and the work of the Chief Actuary and his staff therefore complies with the requirements of the *IAA Guidelines*.

3.5 Canada Pension Plan Statute

The *Canada Pension Plan* stipulates the frequency, approximate timing and certain contents of the Chief Actuary’s triennial reports to the Minister of Finance and ministers of the Crown of the participating provinces. In AR25, the Chief Actuary and his staff have complied with all of these statutory requirements.

3.6 Opinion on Professional and Statutory Requirements

In our opinion, the work on AR25 complies with all relevant professional standards of practice and statutory requirements.

SECTION 4 – DATA

In this Section we address the following question:

“Did the Chief Actuary have access to the information required to perform the valuation, and were relevant tests and analysis on the data completed as might be expected?”

4.1 Background

Appropriate data are required for “current status” data inputs into the computer model, for “validation” (back-testing) of the model, and to develop appropriate actuarial assumptions for future years. Examples of such data are:

Purpose	Examples of Data	Source
current and past status data	<ul style="list-style-type: none"> • population by age and sex • earnings of contributors • contributions • benefits paid • assets • labour force 	<ul style="list-style-type: none"> • 2006 census, Statistics Canada estimates • HRSDC • CRA, HRSDC • HRSDC, PWGSC • CPPIB, HRSDC • Statistics Canada
validation data	<ul style="list-style-type: none"> • CPP financial transactions • benefit statistics • earnings statistics 	<ul style="list-style-type: none"> • CPPIB, HRSDC, CRA • HRSDC • HRSDC, CRA

Purpose	Examples of Data	Source
data for assumptions	<ul style="list-style-type: none"> • current mortality rates • future mortality improvement rates • fertility rates • migration rates • disability statistics • labour force participation • asset mix policy • economic indices • investment policy and performance • various topics 	<ul style="list-style-type: none"> • Statistics Canada Life Tables and historical deaths, Canadian Human Mortality Database (CHMD) • Statistics Canada, Social Security Administration <i>Trustees Report</i> (U.S.), Government Actuary's Department (U.K.) • Statistics Canada • Statistics Canada • HRSDC • Finance, Statistics Canada, OCA seminars, economic forecasts • CPPIB, large public and private pension plans • Statistics Canada, Canadian Institute of Actuaries, HRSDC, Bank of Canada, others • CPPIB • OCA seminars

The status and validation data, and the historical data used to develop assumptions, appear to be factual and up to date.

The data on benefits and earnings received from HRSDC are tested in detail for internal consistency and reasonableness. The data from other sources are reviewed for internal consistency and consistency with past data. Where applicable, the data for the intervaluation period are compared with the projections of the same items from the prior valuation. Any irregularities are checked out with the data source and any data errors are corrected.

The Chief Actuary has advised us that he had access to sufficient data to complete his work, and in AR25 has provided his opinion that “the data on which this report is based are sufficient and reliable”.

4.2 Observations

We have the following observations:

- The Chief Actuary appears to have had access to the data he required.
- The data are extensive and appear to be reasonably complete and available on a timely basis.
- The data are tested for reasonableness by the OCA and any deficiencies are resolved before the data are used.
- The Record of Earnings (ROE) file of all workers who ever made a contribution to the CPP appears to be sufficiently complete (except for recent transactions) and accurate, including dates of birth, although there is some concern about the inability to verify survivorship with respect to those residing outside of Canada.
- The Canada Pension Plan Investment Board (CPPIB) has a reference portfolio that is its baseline policy for asset allocations. The Chief Actuary made an assumption as to asset allocation targets based on the reference portfolio and on his judgement with respect to possible future changes in it. When the CPPIB decides to deviate from the reference portfolio it conducts a risk-budgeting analysis to determine that the deviation is justified on an expected risk-adjusted basis.
- Since 1991, the Bank of Canada and the Minister of Finance have jointly established inflation-control targets. These targets have been agreed on for five years at a time. The current target (target range: 1% to 3%; mid-point and monetary policy target: 2%) expires on 31 December 2011. There is currently no government policy in place regarding inflation-control targets after 2011 that the Chief Actuary can take into consideration when establishing his assumption regarding future inflation rates beyond 2011. However, the Chief Actuary has assumed that the 2% target will be renewed up to 2016. In the view of a number of experts with whom we spoke, future inflation targets are likely to be similar to the current target and will likely continue to be managed successfully.
- The CPP and QPP seminars have provided much useful information and improved in relevance over time (e.g., shift to longer-term focus). These seminars should engage presenters who are known to hold divergent views, or specifically encourage presenters to summarize the range of plausible viewpoints while still providing support for their own conclusions.
- The OCA maintains contacts with other Departments and Agencies such as the CPPIB, HRSDC, CRA, Statistics Canada and Finance Canada, and with external agencies such as the Régie des rentes du Québec, the Conference Board, the CD

Howe Institute, and the University of Toronto's Policy and Economic Analysis Program. All of this provides helpful input.

- OCA has identified its priorities for data enhancement that could lead to improved analysis.

4.3 Opinion on Data

In our opinion, the Chief Actuary had access to the data he required to perform the valuation, and he completed such relevant tests and analysis on the data as might be expected.

4.4 Recommendations

Recommendation 1: We recommend that the Chief Actuary continue his program of seminars with presentations from appropriate experts and continue to broaden the range of presenters and the range of viewpoints.

Recommendation 2: We recommend that the OCA continue to work with its data providers to address items on the OCA's list of data enhancement priorities.

SECTION 5 – METHODOLOGY

In this Section, we address the following question:

“Were the actuarial methods used in completing the report reasonable?”

5.1 Background

The results presented in AR25 are based on a macro-simulation model of the Plan’s operations, which projects the elements of income and outgo and the accumulation of the fund year by year up to the year 2087. Those projections are used to determine projected pay-as-you-go contribution rates and the minimum contribution rate based on the financing objectives set out in Section 113.1 of the Canada Pension Plan statute.

5.2 Macro-simulation Model

The macro-simulation model starts with current and past statistics on the population (numbers of people distributed by age and sex) and earnings (distributed by age, sex and broad earnings levels) of residents of Canada outside of Québec. The model projects each of the following, in turn, for each calendar year during the projection period:

- the number and characteristics (e.g., age, sex, earnings) of the population of Canada less Québec,
- the number and characteristics of eligible CPP contributors and beneficiaries,
- the amount of CPP contributions made and benefits received by eligible CPP contributors and beneficiaries,
- the investment income,
- the expenses, and
- the assets accumulating in the CPP fund.

Thus, the model combines the projections of the contribution income and benefit outgo with the projections of investment income and expenses to arrive at total projected asset amounts.

The model projects anticipated experience in future years based on demographic and economic assumptions related to the CPP as a whole. These assumptions include demographic parameters such as fertility, migration and mortality, and economic parameters such as labour force participation rates, price inflation, wage escalation and investment returns.

The Record of Earnings (ROE), the data file for each individual who has ever made a contribution to the CPP, is not used for the valuation itself. Certain assumptions and adjustments are set based on a review of the ROE file, and certain back-testing is done against the ROE file. However, the benefit and contribution projections themselves are built on population forecasts. Thus, the fundamental valuation concept differs from that used for actuarial valuations of occupational pension plans. Further, actuarial valuations of occupational pension plans effectively assume a closed population. The CPP valuation, on the other hand, has a constantly changing population, which may cause the steady state rate to change over time. However, the minimum contribution rate will not have large fluctuations unless significant shifts occur in key assumptions and/or actual experience differs sharply and persistently from those assumptions.

The model is calibrated using a back-testing procedure. Model output for years prior to the valuation date is compared against historical values. Discrepancies are investigated and resolved. Resolution may include the development of adjustment factors to better calibrate the model to historical experience. These experience adjustment factors are generally modest, but they serve the important function of “truing up” the projected results to past observed values, so that minor inadequacies in virtually any assumption do not unduly distort the overall results.

The model relies principally on a deterministic, rather than a stochastic, approach. That is, for each year in the projection period, each run of the model produces:

- a (deterministic) single set of projected results rather than
- a (stochastic) probability distribution of possible results derived from projections of the expected results and of the underlying volatility of one or more of the parameters of the model (this allows estimates of probability to be assigned to ranges of outcomes, thereby increasing the information available).

The results of the stochastic analysis appear in the individual sensitivity tests, which are described in Subsection 5.4.8.

Moreover, once an assumption reaches its ultimate value, each subsequent year’s projected results are based on that assumption. There is no provision in the model for assumptions to deviate from the ultimate value. As a consequence, the model gives the impression of continuing growth, without reversals. It is likely the future experience will be more varied than that reflected by the projections.

5.3 Form of Output

The model produces the following outputs which are discussed in Section 5.4:

- projected demographic and financial results, including the pay-as-you-go contribution rates, the asset-to-expenditure ratios based on the current statutory contribution rate, and other income and expenditure details for each year up to 2040 and thereafter every fifth year up to 2085,
- the minimum and steady state contribution rates by year to 2027, and thereafter every fifth year up to 2087,
- actuarial balance sheets showing estimates of the unfunded liability under closed and open group approaches,
- the current service cost (the value of future benefits earned in a year by contributors during the year),
- internal rates of return for various year-of-birth cohorts of Plan members, each of which is the rate of return the report estimates will be realized by that cohort when comparing its projected benefits to its total (employee and employer) contributions to the Plan,
- reconciliations of AR25 results with the results in AR23, and
- sensitivity tests showing the results of applying alternative assumptions.

5.4 Actuarial Cost Analysis

The actuarial cost analyses used in AR25 are described in this Section.

5.4.1 Pay-As-You-Go Method

When the CPP was initially established, it was financed by the “pay-as-you-go” method with a small reserve. Although that financing method was replaced in 1997, the projected pay-as-you-go costs provide useful information about the future financial status of the Plan. Paragraphs 115(1.1)(a) and (b) of the Canada Pension Plan require the Chief Actuary to present “pay-as-you-go” projections year by year for the first 30 years and thereafter every five years up to at least 75 years after the valuation date. In AR25, the projection extends to the year 2087.

5.4.2 Minimum Contribution Rate

The methods used to compute the minimum contribution rate involve a combination of “steady-state funding” and “full funding”. Thus, the “minimum contribution rate” is computed as the sum of:

1. the contribution rate determined by the steady-state method for all benefits other than benefit improvements resulting from changes to the Canada Pension Plan statute that occurred after 1997, and
2. the contribution rate determined by the full funding method for benefit improvements due to post-1997 changes to the Canada Pension Plan statute.

The steady-state method produces a contribution rate that is the lowest constant rate that, if maintained over the foreseeable future, results in projected asset-to-expenditure ratios that are generally constant. The asset-to-expenditure ratio for any year is the ratio of the projected assets at the end of the year to the projected expenditures in the following year. In practice, the steady-state rate is computed as the lowest level contribution rate, starting three years after the review date, that produces the same projected asset-to-expenditure ratios in the 10th and the 60th years following the review period. In AR25, the asset-to-expenditure ratios for 2022 and 2072 are used for this purpose.

Paragraph 113.1(4)(d) of the Canada Pension Plan statute requires that post-1997 benefit improvements be separately identified and funded on a “full funding” basis. That is, the contribution rate must be increased permanently to reflect benefit improvements that are deemed to be earned in the future, and there must also be a temporary increase in the contribution rate to liquidate any unfunded liability resulting from the benefit improvement. The temporary increase is to apply for a number of years that is consistent with common actuarial practice.

For the permanent full funding contribution rate, the Chief Actuary uses the ratio of the increase in future liabilities due to the improvement to the present value of future contributory earnings. For the temporary full funding contribution rate, the Chief Actuary amortizes the increase in past liabilities due to the improvement as a level percentage of contributory earnings over 15 years.

Over time, the accumulation of successive improvements could significantly complicate the process. If the full funding requirement is interpreted rigidly, each future actuarial report would have to include a recalculation of the cost of each post-1997 benefit improvement, taking account of experience to date. That would require the maintenance of historical information about the parts of each benefit payment attributable to each benefit improvement, and a notional

allocation of assets to each improvement for an extended period. It would be desirable to reduce or eliminate this complexity, without violating the spirit of the full funding requirement. For example, this might be accomplished by basing the full funding contributions only on the original projections for each benefit improvement (i.e., not tracking and recalibrating the full funding cost of each benefit improvement at every successive valuation date). Alternatively, the Chief Actuary might recalibrate the full funding contributions for one or two subsequent valuations. If these full funding contributions are confirmed for a suitably lengthy period, there is no need to continue tracking them thereafter.

5.4.3 Actuarial Balance Sheet

(Appendix A.II)

An actuarial balance sheet compares current Plan assets to actuarial liabilities for members and beneficiaries of the plan under the present Plan provisions. A closed group actuarial balance sheet considers future benefits to current beneficiaries and accrued benefit rights of current members. In an open group actuarial balance sheet, it is assumed that the Plan is ongoing into the future, and the balance sheet also takes into account future contributions of current and future members and benefits of future members. Benefits and contributions are discounted at the assumed rate of return.

In accordance with a recommendation of the AR23 peer review, the presentation of actuarial balance sheets has been substantially changed. Closed and open group balance sheets are presented. Under the open group approach, the unfunded liability at 31 December 2009 is 0.3% of the actuarial liability.

We concur with the statement in AR25 “The Plan is intended to be long-term and enduring in nature, a fact that is reinforced by the federal, provincial and territorial governments’ stewardship through the established strong governance and accountability framework of the Plan. Thus, an open group valuation that emphasizes the long-term nature of the Plan could be deemed to be the most appropriate.”

5.4.4 Current Service Cost

(Appendix A.III)

The value of future benefits earned in a year for contributors in the year is approximately 6.3% of contributory earnings over the period 2010 to 2012.

5.4.5 Internal Rates of Return

(Appendix A.V)

The statement “The real internal rate of return of about 2.3% for these cohorts provides a competitive return in a low interest rate environment” gives the impression that the CPP is an investment vehicle which can be compared to alternative investments. In our opinion, this invites challenges to the design and compulsory contributions of the CPP. The statement is also misleading since it is based on an assumption that the plan assets will earn an ultimate real annual rate of return of 4.0%. Were it our unilateral decision, we would exclude Table 34 (Internal Rates of Return by Cohort) because we view the CPP as a transfer scheme not an investment vehicle. We understand, however, that leaving it out could lead to questions as to why it was omitted.

5.4.6 Reconciliations

Detailed reconciliations are conducted of the current results against the results in AR23. These identify the principal causes of the changes in results from AR23 to AR25, and measure the impact of each on the results. The detailed reconciliations also serve as a check on the results of AR25.

5.4.7 Sensitivity Tests

In addition to the results based on best-estimate assumptions selected by the Chief Actuary, a number of sensitivity tests are produced. These show the results using alternative assumptions and thereby give information on the possible range of future actual results.

Seven sensitivity tests in AR 25 examine one parameter at a time and an eighth test examines two parameters simultaneously. The tests illustrate the effect of changes, both lower-cost and higher-cost, in each of nine key parameters. These tests are discussed in detail in Subsection 5.4.8.

Another set consists of two “combined” sensitivity tests: the “Younger Population Scenario” and the “Older Population Scenario”. The first is based on generally more optimistic and the second on generally more pessimistic demographic assumptions than the best-estimate assumptions. Both of these scenarios were presented to test possible combinations of key demographic assumptions (considering the interrelationship of the various parameters) that provide a reasonable range of possible future outcomes.

A third set of sensitivity tests shows the impact of one possible form of stock market volatility on the growing CPP asset base, and in turn on the steady-state contribution rate. This is accomplished by showing the effect on three different asset portfolios of abnormally high or low stock market returns in 2012 followed by a resumption of best-estimate returns. A range of nominal equity returns for 2012 was developed based on a one in 10 year event and a one in 50 year event. This was used to determine the impact on the minimum contribution rate. This type of analysis will inevitably show lower minimum contribution rates for higher equity allocations, but they do not give the reader any sense of the differing risk related to the alternative asset allocations. This is because the years of poor assumed equity returns are more than offset by the assumed resumption of best-estimate returns in all other years.

Finally, AR25 includes a sensitivity test of an economic slowdown followed by a partial economic recovery.

5.4.8 Individual Sensitivity Tests

The individual sensitivity tests examine the effect of changes, both lower-cost and higher-cost, in each of nine key assumptions (fertility, mortality, migration, unemployment/labour force participation, price increases, real wage differential, real rates of return and disability incidence). Except for the unemployment/labour force participation rates, stochastic considerations were used to provide estimates of low-cost and high-cost scenarios within an 80% probability range for each underlying variable. That is, stochastic scenarios are generated within an 80% confidence interval for each variable. The resulting high-cost and low-cost values for each assumption were then used as inputs into the model to project revised (a) minimum contribution rates, (b) pay-as-you-go rates, and (c) asset-to-expenditure ratios if there were no change in the current 9.9% rate.

In addition to the information provided regarding the variability of the tested assumptions over the full 75 year projection period, information has also been provided regarding their variability over a 10 year projection period. This information indicates the potential variability of an assumption depending on the time period and how the minimum contribution rate could be impacted. For example, the variability in the real rate of return indicates how the minimum contribution rate could be impacted by the order in which investment returns are actually realized, even if they are equal to the average return projected over the 75 year period.

The approach to the individual sensitivity tests used in AR25 is the same one that was used in AR23. Each report shows how much variation should be expected, with equal plausibility, in each direction and for each parameter. However, the approach used in AR25 represents an

improvement, since the variation shown is limited to a more reasonable 80% probability range compared to a wider 95% range used in AR23.

We believe that individual sensitivity tests are a valuable tool, if used prudently. They give the reader information that may be used to estimate the financial impact of a change in a particular best-estimate assumption. However, the reader should be cautious in interpreting the information provided about the likely variations in the parameters.

5.5 Opinion on Methodology

In our opinion, the actuarial methods employed in AR25 are reasonable.

5.6 Recommendations

Recommendation 3: We recommend that the Chief Actuary continue to report the expected progression of the minimum contribution rate over time assuming that the best-estimate assumptions are realized. This would help to allay CPP stakeholders' concerns about the sustainability of the current contribution rate.

Recommendation 4: We recommend that an actuarial balance sheet on an open group basis only appear in the actuarial report, and that details and analysis of alternative actuarial balance sheets be dealt with in an OCA Actuarial Study (e.g., in a revision of Actuarial Study No. 8).

Recommendation 5: We recommend that the table displaying Internal Rates of Return by Cohort be prefaced by a comment to the effect that the CPP should not be considered as an investment program.

Recommendation 6: We recommend that the Chief Actuary continue to apply the stochastic element of the projections, but that he be cognizant of the limitations inherent in stochastic modelling.

SECTION 6 – ASSUMPTIONS

In this Section, we address the following question:

“Were the assumptions used in completing the report reasonable?”

6.1 Background

The actuarial review that is required to be made every three years under Section 115 of the Canada Pension Plan requires that the Chief Actuary look back in time, to review the operations of the program, and also look forward, to make an estimate of its future operations. For the forward-looking part of the process, the Chief Actuary builds a model that incorporates the details of the benefit, contribution and investment elements of the CPP and reflects the expected behaviour of the factors that determine the year-by-year development of the benefit costs and the contribution and investment income. The model for a plan as complex as the CPP is necessarily complex itself. The assumptions incorporated into the model for a particular actuarial review reflect the Chief Actuary’s judgement, based on his interpretation of past experience and the available evidence about the likely course of future experience.

The nature of the actuarial process is to make projections (not predictions) about the future based on the evidence available and then to revisit and review them periodically. Where appropriate, the actuary makes “mid-course corrections” in the assumptions as the emerging experience of the plan deviates from the previous assumptions and the expectations for likely future experience change. In assessing whether to change an assumption and if so, by how much, the actuary must weigh:

- long-term historical data,
- short-term historical data,
- recent amendments to the Canada Pension Plan,
- policy (e.g., CPPIB investment policy, HRSDC administration policies and government policies on inflation control and immigration levels),
- academic research, and
- other external sources of relevant information.

The assumptions are intended to apply over the long-term future, so the actuary will normally give substantial weight to long-term historical data. However, where the actuary judges that more recent data for a particular assumption indicate a shift or a trend that is likely to continue for the long-term future, the actuary will recognize that shift or trend in the assumption.

For many of the assumptions used in the model, the Chief Actuary has adopted a method that actuaries describe as “select and ultimate”. Under this approach, the particular assumption gradually changes over a period of years (the “select period”) from one that initially is very close to actual recent experience to one that reflects the actuary’s best-estimate of the long-term future (the “ultimate” assumption). The length of the select period can be different for different assumptions. The choice is based on the actuary’s judgement and depends partly on the nature of the parameter involved and partly on how significantly the ultimate assumption differs from recent experience.

The results of the actuarial process at any given time do not yield a “right” answer but should lie somewhere within a range that can be regarded as “reasonable”. Previous actuarial reports on the CPP have focused on several key assumptions. All assumptions used in those reports can be described as “best-estimate”, i.e., the assumptions were, in the judgement of the Chief Actuary, such that adverse or favourable deviations of actual future experience from each of those assumptions are about equally likely. AR25 follows this same approach.

The major actuarial assumptions in AR25 can be conveniently divided into two groups:

- “demographic” assumptions that deal with changes in the covered population (e.g., fertility, mortality and migration rates) and events (e.g., death, disability and retirement) that trigger the starting or stopping of CPP benefit payments or contributions, and
- “economic” assumptions that deal with such issues as employment, wages, prices and returns on investment.

6.2 Demographic Assumptions and Opinions Thereon

6.2.1 Fertility

Fertility rates varying by age and year are applied to the female population to project the number of births each year. The Chief Actuary assumes that in the future fertility rates decrease up to age 30 and increase from age 30 to 45. The fertility trends are based on historic cohort fertility rates by age of mother, not calendar year fertility rates. As for some other assumptions, the approach used in AR25 (and in past actuarial reports on the CPP) is to develop one fertility assumption for Canada and a separate one for Québec. The assumption is used to develop separate population projections for Canada and for Québec. From these, the projected population of Canada less

Québec is derived. In AR 25 it is assumed that the total fertility rates of Canada and Québec will converge.

In background material to AR25, it was noted that “Several periods of historical data had been tested for projection in AR23, and it was found that using 30 years of historical data for that report produced results that were the most consistent with recent trends at the time.” This could be interpreted by a reader similar to the phrase: “we chose 30 years of historical data because that gave us the results we wanted”. We think a more statistical defence should be presented.

The total fertility rate is a convenient way of summarizing a set of age-specific fertility rates. It indicates the average number of children that would be born to a woman in her lifetime based on those age-specific rates in that calendar year. The assumed total fertility rate for Canada in AR25 decreases slightly from the 2007 level of 1.66 to an ultimate level of 1.65 in 2015. The AR25 assumed ultimate total fertility rate is slightly higher than that in AR23 (1.60), and the year in which the ultimate rate is reached in AR25 is later than that assumed in AR23 (2015 versus 2010).

The long-term fertility assumption depends on several factors that are difficult to predict. Fertility rates at all child-bearing ages declined sharply in Canada in the 1960s and early 1970s as the result of social, economic and medical factors, including improved contraception methods. Since the mid-1970s, fertility rates at ages under 30 have continued to trend downward, while the rates at higher ages have increased, so the average age of motherhood has increased. In the future, fertility rates could decline to the lower levels experienced in several other developed countries (e.g., Germany at 1.3), or increase in the direction of the higher rates recently experienced in the U.S. (2.1). The assumed ultimate rate of 1.65 in AR25 is lower than the Statistics Canada medium assumption of 1.7. The United Nations assumed rates of 1.77 in 2025 and 1.85 in 2045.

The sensitivity tests for the fertility assumption are a low-cost ultimate total fertility rate for Canada of 1.90 and a high-cost ultimate rate of 1.40. The test results may be summarized as follows:

Ultimate Total Fertility Rate from 2015	Minimum Contribution Rate	Pay-As-You-Go Rates		
		2025	2050	2084
Lower-cost (1.90)	9.54	10.42	10.37	10.19
Best-estimate (1.65)	9.85	10.43	10.94	11.37
Higher-cost (1.40)	10.16	10.43	11.58	12.87

The preceding table illustrates that changes in fertility can have a relatively large effect on the cost of the Plan. However, the individual sensitivity test results should be interpreted with caution. Readers should form their own opinion about the plausibility of the low-cost and high-cost assumptions. Moreover, they should assume that changes in parameters are not likely to occur in isolation. For example, a radical change in fertility rates would likely be accompanied by other changes that would mitigate their impact (e.g., changes in average ages at retirement, levels of immigration or labour force participation rates).

Opinion on Fertility

In our opinion, the AR25 fertility assumption is reasonable.

6.2.2 Mortality

The mortality rates, q_x by age, sex, province and calendar years 1921 to 2006 were obtained from the Canadian Human Mortality Database (CHMD) which is part of a broader database with mortality data from 37 countries. The starting point for the CHMD is mortality data from Statistics Canada. The mortality values and life expectancy values produced by the CHMD and Statistics Canada are extremely similar. The CHMD data were extended to age 120. Direct data were also obtained from Statistics Canada, Institut de la statistique du Québec, and from the U.S. and U.K.

Future mortality rates are then projected by using estimates of mortality improvement rates. The best-estimate ultimate rates of mortality improvement were established based on trends in Canadian experience over the last 30 years by age and sex. For the first five years of the projection (2007-2011), mortality improvement rates are assumed to correspond to the experience over the last 15 years (1991-2006) and vary by age and sex. These improvement rates are then graded down linearly to the ultimate values by 2031. For 2031 and beyond, the improvement rates for both sexes are set to 0.8% for ages 0-74, 0.7% for ages 75-84, 0.5% for ages 85-89, 0.4% for ages 90-94 and 0.3% for higher ages.

This methodology is very similar to that used in AR23.

The gap between male and female life expectancy is modeled to narrow, though at a slower pace after 2031.

It is implicit in these assumptions that there will be no shocks affecting future life expectancies, either positively (e.g., a major advance in the treatment of heart disease or cancer) or negatively

(e.g., an outbreak of a serious infectious disease). Also implicit in the assumptions is that, regardless of future improvements in mortality rates, male life expectancy at a given age will not exceed female life expectancy at the same age.

The AR25 ultimate improvement rates are higher than those assumed in AR23 at ages up to 74, the same at ages 75-84 but lower after age 85. Compared to the rates used in the U.S. Social Security (OASDI) *2009 Trustees Report*, the AR25 ultimate improvement rates for males are lower than the U.S. rates for both sexes and at all ages except 65-74 where they are equal.

The sensitivity tests for the mortality assumption were implemented by adjusting the rates of mortality improvement to obtain life expectancy ranges that are expected to occur with 80% probability. Based on the best-estimate assumptions, the average life expectancy at age 65 in 2050 would be 22.6 years for males and 24.6 years for females. The low-cost assumption is that those average life expectancies would be 19.2 years for males and 20.2 years for females. The high-cost assumption is that those average life expectancies would be 25.2 years for males and 27.9 years for females. The test results may be summarized as follows:

Life Expectancy in 2050	Minimum Contribution Rate	Pay-As-You-Go Rates		
		2025	2050	2084
Lower-cost (M 19.2, F 20.2)	9.27	10.24	10.15	9.98
Best-estimate (M 22.6, F 24.6)	9.85	10.43	10.94	11.37
Higher-cost (M 25.2, F 27.9)	10.25	10.59	11.49	12.21

Opinion on Mortality

In our opinion, the AR25 mortality assumption is in the reasonable range. The Chief Actuary has assumed very significant mortality improvements until 2031. However, we believe that the ultimate mortality assumptions produce results toward the optimistic end of the reasonable cost range. That is, future mortality improvement rates are at the low end of the reasonable spectrum. We would note that in the last four actuarial reports life expectancy at age 65 projected as of 2025 in each report was higher than that in the previous report. That is an indication that the OCA historically has been pessimistic as to the ability of mortality rates to improve. We also note that, in general, the ultimate improvement rates for mortality in AR25 are lower than those effectively used by Statistics Canada, the U.S. OASDI and U.K. projections. However, they are very much in line with the UP94 Scale AA mortality table adopted by the CIA for the commuted values of pensions.

Were the mortality improvement rates higher, the table above shows that the contribution rate would be higher.

6.2.3 Migration

The rate of net annual immigration to Canada since 1972 has varied from a low of 0.22% of the population to a high of 0.76%; the variations in the earlier years of the 20th century were even more extreme. This illustrates the extent to which migration varies from year to year in response to demographic, economic, social and political changes. Over 2007 to 2009, the average net migration rate for Canada was 0.62% of the population.

The AR25 assumption for net annual migration to Canada starts at 0.62% and then decreases uniformly from 2010 to 0.53% in 2014, remaining at 0.53% until 2018 and increasing uniformly to 0.58% in 2023 and thereafter. The net migration rates of 0.53% and 0.58% were the average over the last 30 years and over the last 15 years respectively. The Chief Actuary assumes a modest increase in net migration rates from 2018 to 2023 as a response to expected future labour shortages. The ultimate net migration assumption used in AR23 was 0.54% from 2020.

Statistics Canada considers migration to be a major driver of population growth. The assumed ultimate net migration rate in AR25 is lower than the medium projection rate used by Statistics Canada in its projections (which run only to 2036).

The sensitivity tests for the net migration are again based on an 80% confidence interval. The assumptions are an ultimate low-cost annual net migration rate for Canada of 0.61% and a high-cost rate of 0.54%. The test results may be summarized as follows:

Ultimate Average Annual Net Migration Rate from 2023	Minimum Contribution Rate	Pay-As-You-Go Rates		
		2025	2050	2084
Lower-cost (0.61%)	9.76	10.32	10.81	11.25
Best-estimate (0.58%)	9.85	10.43	10.94	11.37
Higher-cost (0.54%)	9.91	10.45	11.09	11.54

Opinion on Migration

In our opinion, the rationale regarding the development of the AR25 net migration assumptions is reasonable but the assumed value itself is at the very low end of the reasonable range.

6.2.4 Disability Incidence

The assumption about the incidence of disability takes the form of rates that vary by age and sex. These can be summarized as an aggregate rate based on the current population distribution. The 2008 experience indicates aggregate rates of 3.0 new disabilities per thousand eligible male workers and 3.3 new disabilities per thousand eligible female workers. The AR25 assumption is that disability incidence will increase to produce aggregate rates for years 2015 and later of 3.3 for males and 3.6 for females. The adjusted ultimate rates in AR23 were 3.5 for males and 3.8 for females for years 2011 and beyond.

The use of historical data as the basis for assumptions about the future must always be done carefully. In this case, very little weight can be given to experience data for the years before 1995, when there were major changes in the administration of the disability provisions that led to a significant decline in disability incidence rates. The Chief Actuary must also take into account the effect of changes in the law, such as Bill C-36, which relaxed the minimum qualifying period, effective 1 January 2008, for those with 25 or more years of contributions.

The sensitivity tests for this assumption are an ultimate (2015 and beyond) low-cost rate per thousand eligible workers of 2.4 for males and 2.8 for females, and an ultimate high-cost rate of 4.0 for males and 4.5 for females. The test results may be summarized as follows:

Ultimate Disability Incidence Rate from 2015	Minimum Contribution Rate	Pay-As-You-Go Rates		
		2025	2050	2084
Lower-cost (M 2.4, F 2.8)	9.66	10.25	10.72	11.17
Best-estimate (M 3.3, F 3.6)	9.85	10.43	10.94	11.37
Higher-cost (M 4.0, F 4.5)	10.03	10.61	11.15	11.57

Opinion on Disability Incidence

In our opinion, the AR25 disability incidence assumption is reasonable.

6.2.5 Retirement Rates

The contributions to the Plan and benefits paid from the Plan are affected by the ages at which individuals retire. Prior to the implementation of Bill C-51, contributions to the Plan by individuals, and by employers on their behalf, stopped when the individual started to collect a retirement pension, and neither contributions nor benefit accruals were resumed even if the individual returned to employment. The amount of an individual's retirement pension depends

in part on the age at which it starts. The normal retirement age is 65. Prior to the implementation of Bill C-51, pensions were reduced by 0.5% for each month by which the pension start age is below 65, or increased by 0.5% for each month by which the pension start age is after age 65.

Bill C-51 changed both of these conditions. Bill C-51, Part 2, amends the CPP effective 1 January 2012, by removing the need, for those under age 65, to cease working for the month before and the month of benefit commencement. Those who choose to work while receiving the retirement benefit must participate in the CPP by making continuing contributions (matched by their employer) until age 65 and receive commensurate benefit increases. Between ages 65 and 70, pensioners who are working can opt to contribute to the CPP and, if so, their employers must contribute.

Further, the early and late retirement pension adjustment factors will gradually be changed to factors which do not involve a subsidy. From 2016, the pre-65 Downward Monthly Adjustment Factor will be 0.6% and the Post-65 Upward Monthly Adjustment Factor will be 0.7%.

A full review of AR24, which was an actuarial valuation of the CPP taking into account the provisions of Bill C-51, is found in Section 8.

Returning to AR25, the retirement rate represents the ratio of the number of individuals who elect to start receiving their retirement pension at a particular age to the total number of individuals who are eligible for a retirement pension at that age. Separate retirement rates are assumed for each year, each sex, and each age from 60 to 70 inclusive.

AR25 reflects the expected impact of Bill C-51. As early retirement reduction factors will be increased from 0.5% to 0.6% over the period between 2011 and 2016, it was assumed that more people reaching age 60 during the phase-in period would retire immediately to take advantage of the subsidy while it remains and the removal of the work cessation test. By 2016, however, the new reduction factors will be in place and early retirement rates are assumed to drop. The retirement rate at age 60 for males is assumed to increase from 38.0% in 2010 to 42.0% in 2012 and then fall to 38.0% in 2016 and later. The rate at age 60 for females is assumed to increase from 41.5% in 2010 to 45.0% in 2012 and then fall to 41.0% in 2016 and later. These rates are lower than the rates assumed in AR23. The change in assumption was made to reflect the impact of Bill C-51.

Some observers suggest that, because of improvements in health and life expectancy together with the prospect of labour shortages associated with the retirement of the baby boomers, there

could be a tendency for individuals to retire at older ages in the future. Others suggest that these considerations must be balanced against entrenched social expectations of early retirement.

There is no sensitivity test for the retirement rate assumption. With the new actuarially fair early- and late-retirement adjustment factors, this omission seems logical.

Opinion on Retirement Rates

In our opinion, the AR25 retirement rates assumption is reasonable but at the low-cost end of the reasonable range. That is, we would assume later retirement ages than those modelled in AR25. From Table 19 of AR24, we infer that assuming later retirement ages would result in a higher minimum contribution rate.

6.3 Economic Assumptions and Opinions Thereon

6.3.1 Unemployment and Labour Force Participation Rates

The development of projected numbers and profiles of contributors begins with the development of calendar year labour force participation rates by age-sex group and the application of these rates to the projections of the total population in each of those groups. The participation rates are “cohort-based” to reflect expected changes in participation as a result of longer periods in education and training, the trend of postponing childbearing to later ages, better wages and more plentiful job opportunities as the demand for labour increases, and a move toward later retirement.

The resulting labour force projections are then used in combination with projections of assumed net jobs created to give projections of employed and unemployed workers. Assumptions were affected by the economic downturn in 2008 and 2009. The assumptions for net job creation are established so that the assumed rate of unemployment, 8.4% in 2010, decreases to a constant 6.1% from 2022 onwards for Canada.

There are two sensitivity tests for this assumption, both expressed as changes in the post-2030 assumptions for Canada as a whole. A probabilistic range was not used for these assumptions as the retirement of the baby boom seems like a unique event. Instead, the low-cost ultimate assumed unemployment rate is 4.1% together with an ultimate aggregate labour force participation rate for ages 15 to 69 of 80% (a 5 percentage point upshift) while the high-cost ultimate assumed unemployment rate is 8.1% together with an ultimate aggregate labour force participation rate of 72% (a 3 percentage point downshift). The ultimate unemployment rates are applicable from 2022. The aggregate labour force participation rates are for 2030.

Unemployment (U) and Participation Rates (PR) for Canada	Minimum Contribution Rate	Pay-As-You-Go Rates		
		2025	2050	2084
Lower-cost (U 4.1%, PR 80%)	9.55	9.92	10.57	11.50
Best-estimate (U 6.1%, PR 75%)	9.85	10.43	10.94	11.37
Higher-cost (U 8.1%, PR 72%)	10.11	10.90	11.23	11.28

Opinion on Unemployment and Participation Rates

In our opinion, the AR25 assumption as to the rates of unemployment and labour force participation are reasonable.

6.3.2 Real Wage Differential

Both contributions and initial benefits under the CPP are affected by wage increases. Subsequent benefit increases are affected by inflation. The wage increase assumption is separated into two parts: the inflation assumption (discussed in Subsection 6.3.3 below) and the real wage differential assumption (the portion of wages above inflation) which is discussed here.

In AR25, the wage increase assumption is applied to both average annual earnings (AAE, used to project contributory earnings) and to average weekly earnings (AWE, an index used to adjust the Year's Maximum Pensionable Earnings).

The real increase in AAE is assumed to increase at the same rate as the real increase in AWE. An ultimate real wage differential of 1.3% has been assumed in years 2019 and thereafter for the best-estimate projections. Rates move from their 2009 values to 1.3% gradually over the period 2010 to 2019.

The OCA also considered real wage differential forecasts from three expert agencies: the Conference Board of Canada, University of Toronto Policy and Economic Analysis Program and Towers Watson's Economic Expectations Survey, 2010. These agencies forecast real wage differentials from 0.9% to 1.7% with an average forecast of 1.2% ultimate. However, the University of Toronto forecast is significantly higher than the other two in most years which raises the average forecast; hence, the average forecast is more than 0.2% higher than the higher of either of the other two forecasts in all years from 2015. The OCA assumption is the same as the ultimate assumption in AR23.

The consensus of expert opinion is that real wages have stagnated in recent decades. Some experts suggest that deepening capital investment in combination with tightening labour markets may result in a return to higher levels of real wages.

The sensitivity tests for the ultimate real wage differential assumption with respect to 2019 and later are a low-cost scenario of 1.9% versus a high-cost scenario of 0.7%. The results of these tests are shown below:

Ultimate Real Wage Differentials from 2019	Minimum Contribution Rate	Pay-As-You-Go Rates		
		2025	2050	2084
Lower-cost (1.9%)	9.34	9.86	9.95	10.34
Best-estimate (1.3%)	9.85	10.43	10.94	11.37
Higher-cost (0.7%)	10.33	10.93	12.04	12.58

Opinion on Real Wage Differential

In our opinion, the real wage differential assumption in AR25 is reasonable but toward the high end of the range. The table above shows that if a lower rate were used the contribution rate would be higher.

6.3.3 Price Increases

The rate of price inflation is a necessary assumption for an actuarial review of the CPP. CPP contributions, benefit payments and investment returns are all affected by inflation. However, the extent and timing of these effects are not uniform. The net result is that an increase in the inflation assumption results in a decrease in the pay-as-you-go rates and steady-state contribution rate, and vice versa.

The price increase assumption in AR25 is 2.0% in 2010 through 2016 which is consistent with recent inflation. From 2017 to 2019, the CPI assumption is that prices will increase uniformly from 2.0% to 2.3% in 2019 and beyond. This reflects an expectation that the Bank of Canada will maintain and achieve its inflation control target during the initial period, but that in the long run there will be challenges such as rising energy prices and labour market shortages.

The sensitivity tests for this assumption are a high-cost scenario with an ultimate price increase rate of 1.7% and a low-cost scenario with an ultimate rate of 2.9%. This is again based on an 80% confidence interval. The results of these tests may be summarized as follows:

Price Increases from 2016	Minimum Contribution Rate	Pay-As-You-Go Rates		
		2025	2050	2084
Lower-cost (2.9%)	9.74	10.35	10.76	11.24
Best-estimate (2.3%)	9.85	10.43	10.94	11.37
Higher-cost (1.7%)	9.99	10.56	11.14	11.53

Inflation in Canada was extremely volatile during the 20th century, with long runs of both very high and very low inflation. The present system of Bank of Canada five-year inflation targets has been in effect since 1991. Since this framework was introduced it has been remarkably successful at keeping the inflation rate in Canada generally within a range of +/-1% around the policy target. Our inquiries lead us to believe that this framework will continue for a long time and that there is no reason to expect an upward revision to the current target of 2%. Indeed, the experts with whom we consulted suggested that any change is more likely to be a decrease than an increase, and that the recent monetary policy history is so consistent as to suggest that it will persist.

Our review of the opinions of some economists and financial forecasters found a concentration of views of long term inflation rates around 2%. Thus, we see the decrease in the long-term assumption from 2.5% in AR23 to 2.3% in AR25 as a cautious move in the right direction.

Opinion on Price Increases

In our opinion, the price increase assumption used in AR25 is within, but slightly on the high side of, the reasonable range. The results shown in the table above indicate that, if a lower assumption had been used, the minimum contribution rate would have been higher.

6.3.4 Real Rate of Return on Investments

If the CPP were totally unfunded (i.e. if the contributions each year were just enough to cover that year's benefit payments and expenses), then the CPP contribution rate would be equal to the pay-as-you-go rate and no assumption for the rate of investment return would be required. However, under the steady-state contribution rate approach to financing the Plan, a sizeable fund will accumulate (eventually reaching more than five years' benefit payments, according to AR25) and the rate of investment return becomes a material factor in determining the contribution rate for the Plan. The CPP assets totalled \$127 billion at the end of 2009 and are projected to grow over the coming decades.

As with assumed increases in employment earnings and benefit payments, part of the assumed nominal rate of investment return is attributable to general price inflation. Here we focus on the real rate of investment return (i.e., net of the rate of inflation).

The best-estimate real rate of return assumption in AR25, before deducting administrative expenses but net of investment expenses, is (0.2)% in 2010, rebounding to 3.2% in 2011 and then settling in to an ultimate assumption of 4.0% in 2017 and later. The ultimate rate reflects a “building block approach” whereby:

- From 2015, long-term Government of Canada bonds are assumed to return 2.80% per year in real terms (higher than current yields, but lower than long-term real returns).
- From 2015, Canadian and foreign equities are assumed to return 2.00% per year higher than long Canada bonds (emerging market equities 3.00% higher). This results in a lower than historical equity risk premium and an ultimate total real equity return of 4.80% for Canadian and foreign equities and 5.80% for emerging market equities.
- Real estate and infrastructure investments (inflation-sensitive assets) are assumed to provide a return calculated as 50% of the return on marketable bonds and 50% of the return on Canadian equities.
- The actual CPP portfolio earns additional risk premiums by making fixed income investments in other than Government of Canada bonds (an ultimate additional 0.45% earned on provincial bonds and 0.90% earned on corporate bonds which is consistent with the spreads available over the last two decades given the maturities and credit quality in which the CPPIB is expected to invest). It also holds non-marketable provincial bonds that are assumed to provide an ultimate real yield of 3.35% for 2015 and thereafter.

The asset mix of the CPPIB as at 31 December 2009 was 56% equities, 33% fixed income securities and 11% in real estate and infrastructure. The CPPIB does not adopt long-term asset mix targets. The Chief Actuary postulated an assumed ultimate allocation of assets as 42% equities, 40% fixed income securities and 18% real estate and infrastructure from 2035 reflecting his expectation that the future maturation of the CPP fund would lead to this increased fixed income commitment to achieve more stable cash flows.

Other assumptions include a projection that the equity risk premium will be lower than historically, and that rollovers of non-marketable provincial bonds currently held in the CPP fund will evolve in line with historical experience and be eventually eliminated altogether by 2044.

The sensitivity tests for this assumption are to increase or decrease the rate of return on all of the CPP assets to reflect an 80% confidence interval. This gives a range from 3.2% to 4.8% with 80% probability. The results of these tests are summarized below and show the sensitivity of the minimum contribution rate to this assumption (pay-as-you-go rates are not shown since they are unaffected by the assumed real rates of return on CPP assets):

Real Rate of Return	Minimum Contribution Rate
Lower-cost (4.8%)	9.45
Best-estimate (4.0%)	9.85
Higher-cost (3.2%)	10.25

From the Canadian Institute of Actuaries *Report on Canadian Economic Statistics 1924-2009*, real rates of return on Canadian equities have been approximately 6.7% over the last 85 years. Over the same period, the real return on long Canada bonds has been approximately 3.0% per year and the Canadian equity risk premium relative to returns on long Canada bonds has been about 3.7%. There is considerable variation in these results depending on the period chosen and the ending date. There is also considerable debate, however, about the sustainability of these returns, particularly given the changes in the investment environment that have occurred during the last century (changes in laws and regulations, globalization, incipient climate change, shifts in the relative returns to labour and capital and so on).

The real rate of return assumptions adopted by the Chief Actuary are within the reasonable range but his assumed equity risk premium is lower than the historical average for both Canadian and international markets, and lower than the risk premium postulated by many experts. However, it should be noted that there is a wide range of expert opinion on this issue and much debate about both the relevance of the past and the prospects for the future. We suggest that the Chief Actuary undertake further research and consultation concerning the size and sustainability of the equity risk premium. Such analysis should not be confined to the Canadian marketplace, since the CPP fund will be increasingly invested in non-Canadian assets. Also, the analysis should not be confined to a review of the past, since the future may differ substantially.

Also, the assumed ultimate asset mix is a little more heavily weighted to fixed income investments than what we would expect. We strongly urge the CPPIB and the OCA to jointly estimate the range of the ultimate portfolio mix in order to provide a sound basis for the OCA to make projections.

Until the CPPIB and Chief Actuary agree on a stochastic analysis that leads to a clear direction for change in the CPPIB “reference portfolio”, we believe that the anticipated shift to fixed income investments is uncertain.

Finally, the assumptions do not include any specific additional allowance for the CPPIB outperforming the assumed returns for their reference portfolio. We understand that CPPIB staff compensation includes a significant reward for such outperformance, which may lead to higher real rates of return.

In this regard, it is important to understand that the 4.0% rate of return used in AR25 is not a target for the CPPIB to attain. It is what the Chief Actuary estimates the returns will ultimately be given assumptions as to asset mix and rates of return for several classes of assets. The mandate of the CPPIB is to earn a maximum rate of return within its stated risk tolerance levels regardless of what the Chief Actuary assumes ultimate real rates of return will be.

Opinion on Real Rate of Return

In our opinion, the 4.0% assumption for the ultimate annual real rate of investment return on assets is within, but towards the high side of, the reasonable range. The results shown in the table above indicate that, if a lower assumption had been used, the minimum contribution rate would have been higher.

6.4 Assumptions in the Aggregate and Opinion Thereon

The Chief Actuary’s actuarial assumptions are best-estimates, based on his review of past experience and his judgement about the likely course of future experience. For most assumptions there is considerable room for actuarial judgement and the range of values that could be considered reasonable can be quite wide. In our review of the major actuarial assumptions, we concluded that each of them is within the reasonable range.

With respect to long-term assumptions, we found that three of the nine major assumptions (fertility, disability incidence and unemployment and labour force participation) are near the centre of the reasonable range. We believe that the migration assumption is at the low end of the range which results in higher cost. Based on the expert opinions that we reviewed, the Chief Actuary’s long-term assumptions about mortality, retirement rates, real wage increases, price increases and real rate of return on investments are towards the lower cost side of the reasonable range.

Based on these results, it is our opinion that the assumptions used by the Chief Actuary tend towards the low-cost side of the reasonable range. But the results also show that the range of results that may be produced by reasonable assumptions is not narrow. There is a high degree of uncertainty inherent in the parameters about which assumptions must be made, so it is possible to have more than one set of projected pay-as-you-go costs and minimum contribution rates, all based on reasonable assumptions, that differ by several tenths of one percent of contributory earnings.

Opinion on the Assumptions in the Aggregate

In our opinion, the assumptions used in completing AR25 are, in the aggregate, reasonable, but towards the low-cost side of the reasonable range.

6.5 Recommendations

Recommendation 7: We recommend that the Chief Actuary maintain his programs of research and consultation with experts, with the goal of continual improvements in the process of setting best-estimate assumptions.

Recommendation 8: We recommend that the OCA prepare a research report on migration as it is a very important variable which is subject to significant volatility. The research should include an investigation as to whether there is a relationship between migration and fertility from the perspective of setting actuarial assumptions.

Recommendation 9: Because of its strong impact on the financial operations of the Plan, we suggest that for the economic assumptions, particular attention be given to further research on the size and sustainability of the equity risk premium.

Recommendation 10: We recommend that the Chief Actuary and his counterparts at the CPPIB put in place procedures that will result in truly effective two-way communication between the OCA and the CPPIB.

SECTION 7 – COMMUNICATION OF RESULTS

In this Section, we address the following question:

“Does the 25th Report fairly communicate the results of the work performed by the Chief Actuary and his staff?”

7.1 Background

AR25, as tabled in the House of Commons on 15 November 2010, is a bound soft-cover book, separately published in English (139 pages) and French (145 pages). It consists of the following sections:

	Number of Pages (English version)
Complete index, listing all the sections, tables and charts	4
I. Executive Summary	4
II. Methodology	2
III. Best-Estimate Assumptions	9
IV. Results	20
V. Reconciliation with Previous Report	2
VI. Uncertainty of Results	20
VII. Conclusion	1
VIII. Actuarial Opinion	1
Appendix A – Financing the Canada Pension Plan	7
Appendix B – Summary of Plan Provisions	8
Appendix C – Detailed Reconciliations with Previous Report	4
Appendix D – Assumptions and Methods	52
Appendix E – Acknowledgements	1

AR25 is also available from the OSFI website at
http://www.osfi-bsif.gc.ca/app/DocRepository/1/eng/oca/reports/PPP/cpp25_e.pdf.

7.2 Observations

AR25 is a very informative document. It includes a great deal of detail, a comprehensive Executive Summary and many useful tables and charts. The overall conclusions are clearly set out.

The review panel for AR21 suggested a radical change in presentation, whereby the Chief Actuary would produce a two-volume report. One volume would be intended for a broad audience, and would contain only the high level results of the actuarial review. The other volume would address the needs of a more technical audience of actuaries, economists, demographers, policy analysts, etc., and would provide more extensive details of the Plan provisions, data, methodology and assumptions.

The Chief Actuary recognizes the dual nature of the audience, but has not implemented the two-volume suggestion for valid practical reasons. However, he has changed the layout of the report to include the high level results in its main body, while placing the more technical information in appendices. Thus, the form of the report continues to be a compromise, containing more detail than is needed by the broad audience, and less than may be desired by technical readers.

We understand that all data and analysis given to the review panel in special binders is also available to others upon request. We believe that the total information in AR25 and the accompanying binders is more than enough for the reader to get a full comprehension of the analysis.

We believe that the changes made since AR23 enhance readers' understanding of the uncertainty inherent in the Chief Actuary's best-estimate of the future contribution rates. We especially appreciate the "confidence interval" approach for determining the range of each variable for the high-cost and low-cost projections.

7.3 Opinion on Communication of Results

In our opinion, AR25 fairly communicates the results of the work performed by the Chief Actuary and his staff.

7.4 Recommendation

Recommendation 11: We recommend that the Chief Actuary continue to explore ways to address the needs of both the broad audience and more technical readers of his reports. In particular, the public should be made aware that all information made available to the review panel is available to others upon request.

SECTION 8 – ACTUARIAL REPORT 24 (AR24): THE IMPACT OF BILL C-51

In this Section, we address the following question:

“Does the 24th Report supplementing the 23rd CPP Report in respect of Bill C-51 use appropriate assumptions and fairly communicate the changes from the estimates contained in the 23rd CPP Report?”

8.1 Background

The Canada Pension Plan was subject to a series of amendments since the 23rd CPP Actuarial Report pursuant to adoption of Part 2 of Bill C-51 - *Economic Recovery Act (Stimulus)*.

Bill C-51 amends the *Canada Pension Plan* as follows:

- To remove the Work Cessation Test as of 1 January 2012, for those who opt for their retirement benefit prior to age 65.
- To increase the General Drop-Out Provision from 15 percent to 16 percent in 2012 and 17 percent in 2014.
- Starting 1 January 2012, individuals under age 65 who receive a retirement benefit and work, as well as their employers, will be required to make CPP contributions that will increase their retirement benefit. For individuals aged 65 to 69, contributing after starting their retirement benefit will be voluntary, and employers of those opting to participate in the Plan will be required to contribute. As under the current Plan, contributions are not permitted once age 70 is reached.
- To change the pension adjustment factors in order to gradually restore the factors to their actuarially fair values.
- For early take-up (before age 65, earliest at age 60) of the retirement pension, the downward pension adjustment factor is increased from 0.5% to 0.6% for each month between the start of the pension and age 65. This reduction is permanent and will be implemented gradually over the five year period 2012 to 2016.
- For late take-up (after age 65) of the retirement pension, the upward adjustment factor is increased from 0.5% to 0.7% for each month between age 65 and the start of the pension (latest age 70). This increase is permanent and will be implemented over the three year period 2011 to 2013.
- To require the Chief Actuary to report on the fair level of the pension adjustment factors in at least every third actuarial report (and more frequently, if required) starting in 2016.

There were some other technical changes to the Canada Pension Plan that had no material financial implications for the Plan.

Under subsection 115(2) of the Canada Pension Plan Act:

“...the Chief Actuary shall, whenever any Bill is introduced in or presented to the House of Commons to amend this Act in a manner that would in the opinion of the Chief Actuary materially affect any of the estimates contained in the most recent report under this section made by the Chief Actuary, prepare, using the same actuarial assumptions and basis as were used in that report, a report setting forth the extent to which such Bill would, if enacted by Parliament, materially affect any of the estimates contained in that report.”

That is the purpose of AR24 (with AR23 being “the most recent report”).

Thus, AR24 should have used the same actuarial assumptions as AR23. Appendix A of AR24 shows the financial status of the CPP using the same actuarial assumptions and bases throughout as in AR23. In addition, and in accordance with standard actuarial practice, some modifications were made to some of the short-term economic assumptions to reflect the financial crisis of 2008 and 2009. These results were used to establish the best-estimate of the minimum contribution rate.

The Review panel believes that this approach was justified.

8.2 Main Findings of AR24

The main findings of AR24 were:

- The minimum contribution rate of the amended Plan (as under modified short-term economic assumptions) is 9.84% for years 2010 and thereafter.
- After implementation of the amendments, the projected number of CPP contributors will rise and so too will projected contributions.
- Projected annual expenditures will fall.
- Projected assets will rise as will the asset to expenditure ratio.

Because of the uncertainty about future possible changes in retirement benefit uptake behaviour that would result from the amendments, two sensitivity tests were performed. In one, the benefit uptake rate at age 60 was increased by 20 percentage points resulting in a contribution rate that decreases from 9.84% to 9.77%. If, instead, the retirement benefit uptake rate at age 65 were to

increase by 20 percentage points, the minimum contribution rate would increase to 9.91%. The review panel noted the wide range of the results of the sensitivity tests in spite of the actuarial equivalence of the adjustment factors.

Because the present value of the projected net cash flows (contributions less expenditures) under the amended Plan is greater than under the plan evaluated by AR23, the full funding provision of paragraph 113.1(4)(d) does not apply.

Thus, AR24 confirms that with the amendments of Part 2 of Bill C-51, a contribution rate of 9.90% for years 2010 and thereafter is sufficient to financially sustain the Plan over the next 75 years.

The AR 23 Review panel recommended: “that the Chief Actuary take steps to ensure that he has the latitude to prepare appropriate reports for the purpose of section 115(2) on changes in the Canada Pension Plan Statute that would affect the projected costs and contribution rate, without undue constraints on the choice of actuarial assumptions. We further recommend that the terms of reference of future actuarial review panels be extended to include consultation with the Chief Actuary concerning appropriate assumptions for use in material interim actuarial reports under section 115(2)”.

We believe that the limited scope of interim reports is such that independent peer reviews of these reports are not necessary. We believe this in particular because full Actuarial Reports are done every three years and these are subjected to independent peer review.

8.3 Opinion on AR24

In our opinion, the 24th Actuarial Report supplementing the 23rd Actuarial Report in respect of Bill C-51 used appropriate assumptions and fairly communicated the changes from the estimates contained in the 23rd Actuarial Report.

8.4 Recommendations

Recommendation 12: We recommend that subsection 115(2) of the Canada Pension Plan statute be amended to remove the requirement that the actuary use “the same actuarial assumptions and basis as were used in that report” (i.e., the most recent report). Rather, the wording should require that the actuary justify non-compliance with this general requirement.

Recommendation 13: We recommend that in future actuarial reports supplementing triennial actuarial reports, the Chief Actuary provide a Reconciliation of Changes in the Minimum Contribution Rate from the preceding triennial actuarial report to the supplementary report similar in format to that found in Table 19 in AR25.

SECTION 9 – OTHER ISSUES AND RECOMMENDATIONS THEREON

In this Section, we address two other issues that we considered in our review, namely:

- CPP expenses, and
- external guidance in selecting assumptions.

9.1 CPP Expenses

AR25 includes a useful new Table 88 which shows the projection of administrative expenses and relates total administrative expenses as percentages of total expenditures, of assets and of total earnings. Administrative expenditures include expenses incurred by Human Resources and Skills Development Canada, Canada Revenue Agency, Public Works and Government Services Canada, the Office of the Superintendent of Financial Institutions, the RCMP, the Department of Finance and the CPP Investment Board.

Relating administrative expenses to total earnings enables comparison over periods with different contribution rates and Year's Basic Exemptions. The contribution income of the CPP depends on contributory earnings, not total earnings. Relating administrative expenses to CPP contribution income shows that the expense ratio has risen from 1.6% in 2006, to 1.7% in 2007 and 2008 and to 2.0% in 2009. This may be compared to the much larger OASDI program in the United States which over the period 2005 to 2009 had administrative expenditures of 0.9% of contribution income. (*2010 Trustees Report* Table III.A6) From AR25 Tables 11 and 88, the assumed total administrative expenses are 2.2% of contribution income from 2010 to 2020, reducing to 2.0% in 2050.

The increase in CPP administrative expense ratios can be explained in part by the treatment of CPPIB expenses. Since 2006, CPPIB operating expenses (personnel costs, professional services, operational business services, custodial fees, premises, amortization of premises and equipment, etc.) have been included in CPP administrative expenses. CPPIB external investment management fees and transaction costs are accounted for separately. In the interest of clarity, it would be desirable to consolidate the presentation of all CPPIB investment expenses.

From Table 5 of *The CPP & OAS Stats Book 2010*, until fiscal year 2004 there were no CPP administrative expenses on account of the CPPIB. The evolution of CPP administrative expenses attributable to the CPPIB is shown in the following table. In 2009/10, the CPPIB operating expenses were \$236 million.

CPP Operating Expenses (\$ millions)				
Fiscal Year ending 31 March	2006	2007	2008	2009
HRSDC, CRA/RCMP, PWGSC, OSFI/Finance	408	460	445	505
CPPIB operating expenses	54	114	154	189
Total	462	574	599	694

The fiscal year CPP administrative expenses attributable to the CPPIB have risen from 12% or less of total CPP expenses from 2004 to 2006 to 20% in 2007, 26% in 2008 and 27% in 2009. We find these trends to be of concern and believe that they are worthy of further study. We note that the expenses identified as OSFI/Finance Canada represent only \$2 million of the total.

The CPP administrative expenses attributable to the CPPIB are more closely related to CPP assets under CPPIB management than to total earnings. According to CPPIB Annual Reports, CPPIB fiscal year operating expense ratios to invested assets were 0.07% in 2004 and 2005, 0.071% in 2006, 0.112% in 2007, 0.137% in 2008, 0.161% in 2009 and 0.198% in 2010.

9.2 External Guidance in Selecting Assumptions

AR25 is a vitally important document. Its audience is not only the federal and provincial governments, who are responsible for the governance and administration of the CPP, but also the millions of present and former contributors who rely on the CPP for their financial security. The assumptions used in the report should be, and be seen as, the best available unbiased estimates of future events.

The Chief Actuary has developed rigorous processes for the selection of assumptions. All decisions on assumptions are made in consultation with his internal staff, including two other actuaries who co-sign the report. He draws upon the expertise of officials from other government departments and agencies who participate with him in interdisciplinary seminars, and he devotes a considerable amount of time to keeping abreast of experts' views on demographic and economic matters. He also reflects the comments and advice contained in the report of the actuarial review panel that reviewed the previous actuarial report. However, after the Chief Actuary has chosen the assumptions, they are not subject to external review or challenge until after the report is tabled in Parliament.

The AR23 review panel suggested that there would be merit in establishing a more formal process for obtaining external input before the actuarial assumptions are selected (such as through an Advisory Panel), or to have the review panel review the assumptions before the report is released.

The AR23 review panel acknowledged that their recommendation could delay the preparation of the Chief Actuary's report. On the other hand, it would reduce the time required for the post-release review. Since no action is taken on the Chief Actuary's report until that review has been completed, the practical effect of any delay should be minimized.

The review panel for AR23 recommended "the Chief Actuary explore ways to get formal feedback on his proposed assumptions from external experts prior to completion of the actuarial review, rather than after the report has been tabled in Parliament".

This has not been done by the Chief Actuary and we are supportive of his decision. We believe that the resulting delay in the production of the report does not justify the marginal improvements in the report that might result.

9.3 Recommendations

Recommendation 14: We recommend that the actuarial report include an analysis of CPP administrative expenses, and in view of their importance and recent increases, treat the CPPIB operating expenses separately from the expenses incurred by other departments and agencies. The CPPIB operating expenses should be expressed in terms of assets. Other expenses should be expressed in terms of contribution income (or contributory earnings) as well as in terms of total earnings.

Recommendation 15: We recommend that the Chief Actuary continue to consult widely with officials from other government departments and with other experts, but that the process and timing of the report remain as it is today.

This report is respectfully submitted on 16 March 2011 by,

SIGNATURES

Rob Brown, FCIA

Douglas Andrews, FCIA

Warren McGillivray, FSA

