

Review of the Eighteenth Actuarial Report on the Canada Pension Plan

**Conducted by the CPP Actuarial Review Panel
March 11, 2002**

**M. David R. Brown, FCIA
Robert C. Dowsett, FCIA
James G. Paterson, FCIA**

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
Section 1. INTRODUCTION	10
1.1 Terms of Reference.....	10
1.2 Procedures Followed	11
1.3 The Canada Pension Plan	12
1.4 Statutory Actuarial Requirements	12
1.5 Actuarial Report 17 (AR17).....	13
1.6 Actuarial Report 18 (AR18).....	13
1.7 Complexity.....	14
1.8 Interpretation of Results	14
1.9 Outline of this Report.....	16
Section 2. PROFESSIONAL EXPERIENCE	17
2.1 Background	17
2.2 Observations	18
2.2.1 Continuity of Staff.....	18
2.2.2 Guidance From Experts.....	19
2.3 Opinion on Professional Experience.....	19
Section 3. PROFESSIONAL STANDARDS OF PRACTICE	20
3.1 Background	20
3.2 Rules of Professional Conduct.....	21
3.3 Existing CIA Standard of Practice For the Valuation of Pension Plans.....	21
3.4 Draft CIA Consolidated Standards of Practice, General Standards (CSOP-General Standards)	22
3.5 Draft CIA Consolidated Standards of Practice, Practice-Specific Standards for Pension Plans (CSOP-Pension Standards)	22
3.6 U.S. Actuarial Standard of Practice No. 32.....	23
3.7 International Actuarial Association Guidelines of Practice-Social Security Programs.....	23
3.8 Opinion on Professional Standards.....	24
Section 4. DATA	25
4.1 Background	25
4.2 Observations	26
4.3 Opinion on Data	27
4.4 Recommendations.....	27
Section 5. METHODOLOGY	28
5.1 Background	28
5.1.1 Macro-simulation Model.....	28

5.1.2	Deterministic Approach and Stochastic Research	28
5.1.3	Sensitivity Tests	29
5.1.4	Actuarial Cost Methods	30
5.1.5	Asset Valuation	31
5.1.6	Back-testing of Results	31
5.1.7	Reconciliations	32
5.1.8	Form of Output	32
5.2	Observations	32
5.2.1	Stochastic Processes	32
5.2.2	Sensitivity Testing	33
5.2.3	Actuarial Cost Methods	34
5.2.4	Back-testing of Results	35
5.3	Opinion on Methodology	35
5.4	Recommendations	35
Section 6.	ASSUMPTIONS	37
6.1	Background	37
6.2	Demographic Assumptions	38
6.2.1	Fertility	38
6.2.2	Migration	40
6.2.3	Mortality	41
6.2.4	Disability Incidence	42
6.2.5	Retirement Rates	43
6.3	Economic Assumptions	44
6.3.1	Employment and Participation Rates	44
6.3.2	Real Wages	46
6.3.3	Price Increases	47
6.3.4	Real Rate of Return on Investments	48
6.4	Reasonableness of the Assumptions in the Aggregate	50
Section 7.	COMMUNICATION OF RESULTS	52
7.1	Background	52
7.2	Observations	53
7.3	Opinion on Communication of Results	54
7.4	Recommendations	54
Section 8.	RESPONSES TO RECOMMENDATIONS OF PREVIOUS PANEL	55
8.1	Background	55
8.2	Responses to Previous Panel Recommendations	55
8.3	Opinion on Responses to Previous Recommendations	60
8.4	Recommendations	60
SIGNATURES		61

ACRONYMS USED IN THIS REPORT

AR17	SEVENTEENTH ACTUARIAL REPORT ON THE CPP
AR18	EIGHTEENTH ACTUARIAL REPORT ON THE CPP
AWE	AVERAGE WEEKLY EARNINGS
CIA	CANADIAN INSTITUTE OF ACTUARIES
CPP	CANADA PENSION PLAN
CPPIB	CANADA PENSION PLAN INVESTMENT BOARD
OAS	OLD AGE SECURITY
OCA	OFFICE OF THE CHIEF ACTUARY
OSFI	OFFICE OF THE SUPERINTENDENT OF FINANCIAL INSTITUTIONS
QPP	QUEBEC PENSION PLAN

This report was prepared by a review panel of three independent actuaries, M. David R. Brown of Eckler Partners Limited in Toronto, Robert C. Dowsett of Robert Dowsett Consulting in Toronto, and James G. Paterson of Paterson Pension Management Inc. in Vancouver, all Fellows of the Canadian Institute of Actuaries and of the Society of Actuaries.

EXECUTIVE SUMMARY

1. INTRODUCTION

Terms of Reference:

The Panel conducted its review in accordance with the following terms of reference:

“The panel will review the work of the Chief Actuary in completing the Eighteenth Actuarial Report on the Canada Pension Plan and provide a report to the Superintendent of Financial Institutions expressing its opinion on the following questions:

1. Is the professional experience of the Chief Actuary and the 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?
3. Has the Chief Actuary had access to the information he required and completed such tests and analysis on the data as might be expected?
4. Were the methods and assumptions used in completing this report reasonable?
5. Does the Eighteenth Actuarial Report fairly communicate the results of the work performed by the Chief Actuary and his staff?

6. Has the Chief Actuary adequately addressed the recommendations made by the panel which reviewed the work of the Acting Chief Actuary in completing the Seventeenth Actuarial Report on the Canada Pension Plan?

and make such recommendations as the panel feels appropriate in relation to these questions.”

Actuarial Report 18 (AR18)

AR18 was prepared as at December 31, 2000. It presents a best-estimate projection of pay-as-you-go contribution rates for the Plan, rising from 8.14% of contributory earnings in 2001 to 11.01% in 2030 and then rising slowly to 11.45% in 2075.

It also presents a steady-state contribution rate to be paid in 2003 and later of 9.8% of contributory earnings. Using this steady-state contribution rate, it projects ratios of assets to expenditures rising from 2.20 in 2001 to 4.90 in 2018, then hovering around 5.0 from 2018 to 2030, then dropping steadily to 4.17 in 2075. Under a continuation of the current 9.9% contribution rate from 2003 on, AR18 projects ratios rising from 2.20 in 2001 to 5.20 in 2020 and hovering around 5.25 from 2020 to 2040, then rising steadily to 5.99 in 2075.

AR18 also presents the results of several sensitivity tests which show how different the results would be if particular assumptions were varied up or down.

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 are not predictions. They are not necessarily “accurate” to one decimal place or even to one percent of contributory earnings. They simply present what the results would be if all the assumptions were to come true in the future. The parameters involved (e.g., rates of fertility, net migration, mortality, price increases, real wage gains, real rates of return on investments – all from 2001 to 2075) are not open to accurate prediction.

2. PROFESSIONAL EXPERIENCE

Question: *“Is the professional experience of the Chief Actuary and the staff who worked on the 18th Actuarial Report adequate for carrying out the work required?”*

Observation: The professional staff has more than doubled since the tabling of AR17. The staff members have considerable experience in valuation of social insurance plans.

Opinion: In our opinion, the professional experience of the Chief Actuary and the staff who worked on AR18 was adequate for carrying out the work required.

3. PROFESSIONAL STANDARDS OF PRACTICE

Question: *“Has the work [on AR18] been completed in compliance with the relevant professional standards of practice?”*

Observation: We reviewed the work involved in preparing AR18 in relation to relevant Canadian, US and international professional actuarial standards of practice.

Opinion: In our opinion, the work on AR18 was completed in compliance with the relevant professional standards.

4. DATA

Question: *“Has the Chief Actuary had access to the information he required and completed such tests and analysis on the data as might be expected?”*

Observations: The data requirements for AR18 were extensive. The Chief Actuary has expanded the sources of information for the valuation and arranged improvements in specific data inputs. One desirable data input is missing; long-term asset mix targets have not yet been established by the CPP Investment Board. It is expected that they will be established in 2002 or 2003.

Opinion: In our opinion,

- The Chief Actuary had access to the data he required;

- The Chief Actuary completed such tests and analysis on the data as might be expected;
- The data used are, with one exception, adequate and appropriate for the purpose of the review; the one exception is the lack of information on the long-term asset mix targets of the CPPIB.

Recommendation 1: We recommend that the Chief Actuary closely monitor the methodology used by Statistics Canada in developing statistics on emigrants and returning emigrants.

Recommendation 2: We recommend that the Chief Actuary continue his program of seminars with presentations from appropriate experts, and strive to broaden the range of presenters and to better focus their contributions on matters of most relevance to the preparation of actuarial reports on the CPP.

5. METHODOLOGY

Question: *“Were the methods used in completing [AR18] reasonable?”*

Observations: The Chief Actuary uses a macro-simulation mathematical model of the Plan’s past and future operations and of future economic and demographic experience to develop deterministic (a single set of) “best estimate” projections of income and outgo and other key outputs and to conduct sensitivity tests. Results are produced on four actuarial cost methods, as well as estimates of internal rates of return. The model is back-tested and the results of AR18 are reconciled to those of AR17.

Opinion: In our opinion, under the current CPP legislation, all of the methodology elements employed in AR18 are appropriate and reasonable for the purposes of the Plan and have been properly applied.

Recommendation 3: We recommend that the Chief Actuary continue to keep up the tradition of continual improvements to the methodology by such actions as:

- Continuing research on both the technical and feasibility aspects of applying stochastic processes to the actuarial review of the CPP,

- Developing and articulating objective criteria for selection of the current, or “plausible”, sensitivity tests and for any future additional sensitivity tests, and
- Reviewing what length of experience data should be considered when developing projected distributions of parameters.

Recommendation 4: We recommend that the Chief Actuary include in future reports

- the normal actuarial cost under the accrued benefit actuarial cost method,
- revised descriptions of the Actuarial Balance figures, and
- additional sensitivity tests of the “two standard deviation” or “stress testing” variety (i.e., in addition to the current “plausible” individual and combined sensitivity tests).

6. ASSUMPTIONS

Question: *“Were the assumptions used in completing [AR18] reasonable?”*

Observations: The model requires the input of dozens of assumptions about future economic and demographic experience and future costs of operation of the plan. A great deal of research and analysis goes into the selection of these assumptions. We reviewed all of these but concentrated on the ten most important ones. The assumptions are utilized on a “select and ultimate” basis, starting in 2001 with an assumption that is close to recent experience, and then modifying this assumption during the years of the “select period” to reach the level of the “ultimate” assumption which reflects the best-estimate view of the long-term future. The ultimate assumptions for these ten parameters are summarized as follows:

Parameter	Ultimate Assumption	First "Ultimate" Year
Fertility rates	1.64 per woman (in her lifetime)	2007
Mortality rates	continually improving (using complex projections)	
Net migration rates	0.52% of population	2020
Disability incidence rates	Males 3.25, females 2.75 per 1,000 eligible	2005
Retirement rates	Rates varying by age between ages 60 and 70	2030
Unemployment rate	6.5%	2015
Labour force participation rate	Ages 15-69: 72%	2030
Real wage differential	1.1%	2015
Rate of price increases	3.0%	2015
Real rates of return on new investments	Account (operating balance): 2.00% Fund (loans to provinces): 3.50% CPPIB (balance of plan assets): 4.25%	2000 2015 2030

In our review of the major actuarial assumptions, we found that each of them was in the reasonable range. We found that all but three assumptions were near the centre of the reasonable range. In our view

- the real wage increase assumption is at the higher-cost end of the reasonable range;
- the price increase assumption is at the lower-cost end of the reasonable range;
- the real rate of return assumption is at the higher-cost end of the reasonable range.

The total effect, in our view, is a set of assumptions well within the reasonable range, but a little on the conservative, or higher-cost side of the best-estimate assumptions that we would have selected.

Opinion: In our opinion, the assumptions used in completing AR18 in the aggregate are within the reasonable range, while a little on the conservative side of the best-estimate assumptions that we would have selected.

7. COMMUNICATION OF RESULTS

Question: *“Does the 18th Actuarial Report fairly communicate the results of the work performed by the Chief Actuary and his staff?”*

Observations: AR18 is a lengthy but well-organized document that explains the methodology and assumptions and presents the results in a readable and straightforward manner. It is considerably shorter than AR17; the English version is 126 pages, the French version is 132 pages, each including a three page Executive Summary.

Opinion: In our opinion, AR18 fairly communicates the results of the work performed by the Chief Actuary and his staff.

Recommendation 5: We recommend that in future Actuarial Reports information on sensitivity testing be included in the Executive Summary.

8. RESPONSES TO RECOMMENDATIONS OF PREVIOUS PANEL

Question: *“Has the Chief Actuary adequately addressed the recommendations made by the panel which reviewed the work of the Acting Chief Actuary in completing the Seventeenth Actuarial Report on the Canada Pension Plan?”*

Observation: In response to the recommendations made by the panel reviewing AR17, good progress has been made on strengthening of the staff of the OCA, on methodologies, assumption setting, documentation and report presentation, but two recommendations deserve further consideration, and two would benefit from further work.

Opinion: In our opinion, the Chief Actuary and his staff have responded well to the thirteen recommendations listed in the report of our review on AR17. Two of those recommendations have not been implemented: Recommendation 1 (separate OCA from OSFI) and Recommendation 3 (form an Advisory Panel). We believe that these deserve further consideration. Two other recommendations - Recommendation 6 (broaden data

sources) and Recommendation 7 (methodology improvements) - have seen progress but would benefit from further work and the allocation of additional resources.

The overall result, in our opinion, is that good progress has been made on methodologies, assumption setting, documentation and report presentation in AR18, compared to AR17.

Recommendation 6: We recommend that further consideration be given to two recommendations made by the previous panel: their Recommendations 1 (separate OCA from OSFI) and 3 (form an Advisory Panel).

Recommendation 7: We recommend that further work and additional resources be allocated to enhance the responses to two recommendations made by the previous panel: their Recommendations 6 (broaden data sources) and 7 (methodology improvements).

9. SUMMARY OPINION

Following an in-depth review of the Eighteenth Actuarial Report on the Canada Pension Plan, we have set out our opinions in the various sections of this report in response to the questions asked in our terms of reference. These opinions are summarized below.

In our opinion, the professional experience of the Chief Actuary and the staff who worked on the Eighteenth Actuarial Report is adequate for carrying out the work required, the work was completed in compliance with the relevant standards of practice, and the Chief Actuary had access to the required information. He and his staff conducted such tests and analyses on the data as might be expected. The methods used were reasonable.

Also, in our opinion, the Eighteenth Actuarial Report fairly communicates the results of the work performed by the Chief Actuary and his staff.

Regarding the assumptions used, we found that all but three assumptions were near the centre of the reasonable range, while two were at the higher-cost end and one was at the lower-cost end of their reasonable ranges. The total effect, in our opinion, is a set of assumptions well within the reasonable range, while a little on the conservative side of the best-estimate assumptions that we would have selected.

In our opinion, the Chief Actuary and his staff responded well to the thirteen recommendations made in our review of the Seventeenth Report on the CPP, although two recommendations were not followed and deserve further consideration, and two others would benefit from further work.

We believe that the Eighteenth Actuarial Report on the CPP was competently prepared and presents a reasonable set of results.

Section 1. INTRODUCTION

This report presents the results of an in-depth review we conducted into the Eighteenth Actuarial Report on the Canada Pension Plan (AR18) and the detailed actuarial examination on which it was based. This is the second such review we have conducted.

1.1 TERMS OF REFERENCE

In accordance with our terms of reference, our review focussed on the actuarial work done on the Plan. We were not asked to, and did not, review the design, administration or investment arrangements of the Plan.

The terms of reference for our review were the same as for our review of AR17, with one addition (item 6, below). The terms of reference were as follows:

“The panel will review the work of the Chief Actuary in completing the Eighteenth Actuarial Report on the Canada Pension Plan and provide a report to the Superintendent of Financial Institutions expressing its opinion on the following questions:

1. Is the professional experience of the Chief Actuary and the 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?
3. Has the Chief Actuary had access to the information he required and completed such tests and analysis on the data as might be expected?
4. Were the methods and assumptions used in completing this report reasonable?
5. Does the Eighteenth Actuarial Report fairly communicate the results of the work performed by the Chief Actuary and his staff?

6. Has the Chief Actuary adequately addressed the recommendations made by the panel, which reviewed the work of the Acting Chief Actuary in completing the Seventeenth Actuarial Report on the Canada Pension Plan?

and make such recommendations as the panel feels appropriate in relation to these questions.”

1.2 PROCEDURES FOLLOWED

Our review was conducted as a close collaboration of the three panel members. Over the months from November 2001 through February 2002, we held one three-day meeting in person and had several teleconference meetings. We exchanged dozens of fax and e-mail messages and drafts of report sections.

We received copies of some of the working papers in November 2001, in advance of the report. We received the report on December 10, 2001, the day it was tabled in Parliament.

We interviewed the Chief Actuary and senior members of the Social Insurance Programs Section 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 spoke to officials of the Economic Studies and Policy Analysis Division of the Department of Finance (Canada) and officials of the Demography Section of Statistics Canada. We met with two senior officers of the Canada Pension Plan Investment Board (CPPIB), the President and CEO and the Vice President, Research and Risk Management. We reviewed portions of the 2001 Report of the Trustees for the U.S. Social Security Program. We also reviewed the papers presented to the two seminars conducted in 2000 by the OCA, and other technical materials.

The OCA responded promptly and fully to each request we made for information.

After reviewing all of the information, and after much discussion among ourselves, we found, as we did in our review of the Seventeenth Actuarial Report on the Canada Pension Plan (AR17), that we were able to reach agreement on all of the opinions and recommendations presented in this report.

1.3 THE CANADA PENSION PLAN

The Canada Pension Plan (CPP) is a social insurance program which 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 which 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 by Bill C-2 to require an increased measure of advanced funding, to add a sunset clause regarding the investment of CPP assets in provincial revolving 20-year bonds, to 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 to establish an Investment Board to control that portfolio.

1.4 STATUTORY ACTUARIAL REQUIREMENTS

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

- projected pay-as-you-go (paygo) contributions rates (i.e., each year's contribution rate is just sufficient to cover that year's benefit payments and expenses);
- a contribution rate, calculated in prescribed manner (the "default contribution rate").

Section 113.1 of the CPP Statute requires a financial review of the CPP 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 "the financing objective of having a contribution rate that is no lower than the rate that, beginning with the year 2003, is the lowest constant rate that can be maintained over the foreseeable future." Section 115 states that projections must extend for at least 75 years into the future.

The federal government adopted the Calculation of Default Contribution Rates Regulation by order-in-council on December 10, 1998. This Regulation has been confirmed by the required two-thirds of the provinces containing two-thirds of the population of Canada. This Regulation, as adopted by the federal government, calls for a default contribution rate calculated as that constant rate for which the projected ratio of Plan assets to Plan

expenditures 10 years after the end of the review period matches the corresponding projected ratio 60 years after the end of the review period.

1.5 ACTUARIAL REPORT 17 (AR17)

The last full actuarial review of the CPP was conducted as at December 31, 1997 and is reported in AR17.

AR17 presented a best-estimate projection of paygo contribution rates for the Plan as amended rising from 8.21% in 1998 to 11.21% in 2035 and then staying in the 10.9% – 11.3% range through to 2100.

It also presented a best-estimate steady-state contribution rate to be paid in 2003 and later of 9.8% of contributory earnings. Using this steady-state contribution rate, it projected ratios of assets to expenditures peaking at 4.95 in 2021, then dropping to 4.50 by 2042, and then dropping gradually to 3.54 in 2100. Under a continuation of the current 9.9% contribution rate from 2003 on, it projected ratios hovering around 5.0 from 2015 to 2050, then rising steadily to 6.61 in 2100.

Several sensitivity tests were presented in AR17 which show how different the results would be under alternative actuarial assumptions.

1.6 ACTUARIAL REPORT 18 (AR18)

AR18 was prepared as at December 31, 2000. It presents a best-estimate projection of paygo contribution rates for the Plan rising steadily from 8.14% in 2001 to 11.01% in 2030 and then rising slowly to 11.45% in 2075.

It also presents a best-estimate steady-state contribution rate to be paid in 2003 and later of 9.8% of contributory earnings. Using this steady-state contribution rate, it projects ratios of assets to expenditures rising from 2.20 in 2001 to 4.90 in 2018, then hovering around 5.0 from 2018 to 2030, then dropping steadily to 4.17 in 2075; the projected ratios in the key years 2013 and 2063 are 4.47 and 4.52. Under a continuation of the current 9.9% contribution rate from 2003 on, AR18 projects ratios rising from 2.20 in 2001 to 5.20 in 2020 and hovering around 5.25 from 2020 to 2035, then rising steadily to 5.99 in 2075.

A reconciliation of the changes to the steady-state contribution rate, moving from AR17 to AR18, is set out in AR18. The steady-state rate was impacted, sometimes positively and sometimes negatively, by inter-valuation actuarial gains and losses due to plan experience, changes in actuarial assumptions, a plan amendment (Bill C-23, which extended benefits to qualifying same-sex couples), improvements in methodology and a three-year change in the steady-state pairing of years. Each such impact was relatively small. In aggregate, the positive impacts offset the negative ones, resulting in no change in the rounded steady-state contribution rate from AR17 to AR18.

AR18 presents an expanded array of sensitivity tests.

1.7 COMPLEXITY

The CPP is a complex plan which 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. It will be obvious from a reading of the body of our report that the actuarial computer model used to produce the results in AR17 is an extremely complex model. 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 ten key actuarial assumptions.

1.8 INTERPRETATION OF RESULTS

AR18 presents:

- the projected paygo contribution rates year by year to 2030 and then every fifth year through to 2075;
- the steady-state contribution rate;
- a number of sensitivity tests (which illustrate the results which would be obtained under various changes in actuarial assumptions);

- an estimate of the unfunded liability of the CPP obtained using the accrued benefit actuarial cost method (which is commonly used with occupational pension plans);
- estimates of reductions to the 9.9% contribution rate for various periods under the so-called “actuarial balance” method (under which, in each case, the fund is exhausted at the end of the period);
- 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 steady-state contribution rate is the only one of these results that may translate into actual contributions to the CPP. Under the Regulation dealing with Calculation of Default Contribution Rates, the steady-state contribution rate will become the default contribution rate if it is higher than 9.9%. The other results are also useful because they provide information as to the long-term pattern of costs under the Plan, the unpredictability and variability of the costs, how these costs compare with the costs of occupational pension plans, at what combinations of time periods and contribution rates the fund would become exhausted, and the value-for-money each cohort of participants may receive.

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 are not necessarily accurate to one decimal place or even to one percent of contributory earnings. They simply present what the outcome will be if all of the assumptions were to come true in the future. The parameters involved (e.g., fertility rates, net migration rates, mortality rates, disability incidence rates, rates of work force participation, retirement rates, rates of price increase, real rates of wage increase, real rates of return on investments, each from 2001 through to 2075) are not open to accurate prediction.

The estimates in AR18 and in previous reports are essential outputs to provide guidance in funding 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 get a feel for 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.

Sections 7 and 8 address questions 5 and 6 in the terms of reference.

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 the staff who worked on the 18th Actuarial Report adequate for carrying out the work required?”

2.1 BACKGROUND

AR18 was submitted to the Minister of Finance on November 21, 2001 by the Chief Actuary, Jean-Claude Ménard; it was tabled in Parliament on December 10, 2001. Mr. Ménard is 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 August 15, 1999, following 18 years (the last four as its Chief Actuary) with the Régie des rentes, the agency of the Québec government responsible for the Québec Pension Plan (QPP). Mr. Ménard was responsible for preparing the Actuarial Reviews of the QPP from 1990 to 1999. His 20 years of experience in social insurance actuarial work is more such experience than that recorded by most actuaries working in Canada.

The professional who worked most closely with Mr. Ménard on AR18 is Michel Montambeault, Senior Actuary (Social Insurance) in the Social Insurance Programs Section of the OCA, a Division of OSFI. Mr. Montambeault is a Fellow of the Society of Actuaries (1992) and of the Canadian Institute of Actuaries (1992). He has worked on actuarial reviews of the CPP and other programs in the Social Insurance Programs Section of OSFI for the last 12 years, including the last nine years as team leader. Both Mr. Ménard and Mr. Montambeault signed the Actuarial Opinion section of AR18.

The third senior actuary who worked on AR18 is Michel Millette, a Fellow of the Society of Actuaries (1986) and of the Canadian Institute of Actuaries (1986). Mr. Millette joined OSFI in May 2000, following 12 years of experience working on social insurance programs with Mr. Ménard at the Régie des rentes for the Québec government. He is Senior Actuary (Canada Student Loans) in the Social Insurance Programs Section at OSFI, spending 50% of his time on CPP affairs and is responsible for the liaison with the staff of the Canada Pension Plan Investment Board.

In addition, there are 4 other full-time professionals with actuarial training who worked on AR18. Louis-Marie Pommainville, a Fellow of the Society of Actuaries (1989) and of the Canadian Institute of Actuaries (1990), with 22 years of actuarial experience, has worked for the last 2 years with the Social Insurance Programs Section of OSFI. Alain Guimond, an Associate of the Society of Actuaries, has 6 years' experience in the Section; Patrick Dontigny is an actuarial student with 6 years' experience in the Section; and Yu Cheng is an actuarial student with 2 years' experience in the Section.

A limited pre-release peer review of the final AR18 document was carried out by Lou Cornelis, Senior Actuary, Public Sector Insurance and Pension Programs Section of OCA.

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 evaluating social programs are more complex than for employer-sponsored plans and thus employer 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 evaluating the CPP, more than most other actuaries working in Canada.

The staff of the Social Insurance Programs Section of OSFI has more than doubled since the tabling of AR17, in December 1998. While there has been the addition to the OCA of some responsibilities for the Canada Student Loans Program, the staff increase has enabled the OCA to spend considerable time on CPP matters, improving methodologies, data sources, inter-valuation studies, documentation and liaison with other government departments, all of which help the quality of the work and of the report.

We are satisfied that Mr. Ménard and the staff who assisted him in preparing AR18 have relevant experience and are qualified to carry out the assignment.

2.2.1 Continuity of Staff

Clearly, for each actuarial review of the CPP, it is desirable to have the setting of assumptions and the review of data sources and methodologies made by a group of professionals who have had considerable previous experience with the process. The more professionals with previous experience the better, all other things being equal. We are

pleased to observe that there appears to be a program of staff recruiting and succession planning in place, and that there is now available a mix of more experienced and newer personnel on the staff of the OCA.

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 to 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 two Inter-Disciplinary Seminars, on March 17, 2000 and on November 10, 2000 entitled “Demographic and Economic Perspectives of Canada, Years 2000-2050”. Each of these seminars was addressed by four invited guest speakers who spoke to audiences of 80 and 100 invited participants from across the country and from various provincial and federal organizations. The speakers were respected actuaries, economists and demographers and a sociologist; they gave learned presentations regarding demographic and economic projections, labour force growth, investment returns, and modeling techniques. These inputs and the discussion of them were quite valuable to the OCA in helping to crystallize best-estimate assumptions and methodologies for the development of AR18.

After the tabling of AR17 in December 1998, OSFI engaged three independent actuaries to conduct a post-release review of AR17, similar to the review described in this report. The Actuarial Review Panel Report for AR17 included 13 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 also helps the Chief Actuary in the gathering of a wide 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 the staff who worked on AR18 was adequate for carrying out the work required.

Section 3. PROFESSIONAL STANDARDS OF PRACTICE

In this Section, we address the following question:

“Has the work [on AR18] been completed in compliance with the relevant professional standards of practice?”

3.1 BACKGROUND

The relevant rules of professional conduct and standards of practice for actuarial work in Canada are those that have been adopted by the Canadian Institute of Actuaries (CIA). The Institute has adopted formal “Rules of Professional Conduct” and “Standards of Practice”. We will deal with these separately below. In the future, if the International Actuarial Association adopts Standards of Practice similar to a recently issued preliminary exposure draft, those Standards also would have to be considered.

The CIA Rules of Professional Conduct “identify the professional rules and ethical standards with which a member must comply and thereby serve the public interest”. These are referred to below.

The CIA Standards of Practice cover the major areas of professional work by Canadian actuaries, in particular, life insurance, property and casualty insurance, occupational pensions, workers’ compensation, self-insured employee benefit plans and the presentation of expert evidence in the courts. However, other than general standards that apply to all actuarial work, there is, so far, no CIA standard of practice specifically governing actuarial work for social insurance programs such as the CPP. The Standard of Practice for the Valuation of Pension Plans was adopted in 1994: we will comment on it below.

The CIA has undertaken a project to restructure and consolidate its standards of practice in the form of “general” standards that apply in all areas of actuarial practice and “practice-specific” standards like those already in place. Exposure Draft versions of these “Consolidated Standards of Practice, General Standards” (CSOP-General Standards) and “Consolidated Standards of Practice, Practice-Specific Standards for Pension Plans” (CSOP-Pension Standards) were released in May of 2001 and it is expected that these Standards may be adopted by the CIA before July 1, 2002. We will comment below on the relevance of these to actuarial reviews of the CPP.

In the USA, the Actuarial Standards Board has adopted Standard of Practice No. 32 on Social Insurance. On the global scene, the International Actuarial Association (IAA) has published a Preliminary Exposure Draft (for comments) of Guidelines of Practice for actuarial work provided with respect to Social Security Programs. We will comment on both of these below.

3.2 RULES OF PROFESSIONAL CONDUCT

In the report on our review of AR17, we reviewed in some detail the various CIA Rules of Professional Conduct and concluded that the Acting Chief Actuary and his staff had met the requirements of the applicable Rules in completing the work on AR17. The Rules remain substantially unchanged, and again, we are able to conclude that, in a similar manner, the Chief Actuary and his staff, in completing the work on AR18, have met the requirements of the applicable Rules of Professional Conduct.

3.3 EXISTING CIA STANDARD OF PRACTICE FOR THE VALUATION OF PENSION PLANS

This Standard (“the Pension Standard”) was adopted in 1994. The wording will be replaced in part by the wording in the draft CSOP-General Standards and, in part, by the draft CSOP-Pension Standards, but that will not affect its substance. Section 1.01 of the existing Pension Standard explicitly excludes from the scope of the Pension Standard “social security programs, such as the Canada Pension Plan, the Québec Pension Plan and the Old Age Security Act.” However, some portions of the Pension Standard, particularly “Part 2 – Data” and “Part 4 – Actuarial Assumptions” are relevant to the actuarial work on the CPP. The Pension Standard also prescribes various statements and opinions that the actuary’s report should contain.

We note that no CIA standard of practice currently exists giving guidance on actuarial methodology for social insurance plans like the CPP.

In our view, the work on AR18 complied with the relevant portions of the Pension Standard.

3.4 DRAFT CIA CONSOLIDATED STANDARDS OF PRACTICE, GENERAL STANDARDS (CSOP-GENERAL STANDARDS)

The Exposure Draft for CSOP-General Standards runs to 93 pages, including extensive examples and footnote commentary. The topics covered include matters relevant to AR18 such as:

- Materiality
- Approximations
- Subsequent Events
- Data-Sufficiency and Reliability
- Reasonableness of Results
- Documentation
- Selection of Assumptions
- Comparison of Assumptions to Prior Assumptions

In the section on Assumptions there is a requirement that the assumptions in the aggregate should be appropriate. As will be seen from our conclusions in Section 6 (Assumptions), even though we may differ from the Chief Actuary on a few of the best-estimate assumptions, we have concluded that the assumptions adopted for AR18 are, in the aggregate, well within the reasonable range. This is a question we are required in our mandate to answer. We have also concluded that the assumptions are “appropriate”, as required by the existing Pension Standard and by the draft CSOP General Standards.

In our view the work on AR18 complies with the relevant portions of the proposed CIA CSOP General Standards.

3.5 DRAFT CIA CONSOLIDATED STANDARDS OF PRACTICE, PRACTICE-SPECIFIC STANDARDS FOR PENSION PLANS (CSOP-PENSION STANDARDS)

The Exposure Draft for CSOP Pension Standards runs to some 20 pages. In it, Section 3100-Scope indicates that these Standards do not apply to the actuary’s work on “Social security programs like the Canada Pension Plan, the Québec Pension Plan and the pension provided by the federal Old Age Security Act”.

However, some portions of the CSOP Pension Standards, particularly Sections 3200-Methods, 3300-Assumptions and 3600-Reporting, are relevant to the actuarial work on the

CPP. In Section 3200-Methods there is a requirement that the methods used “are appropriate for the purpose and circumstances of the work”.

As will be seen from our conclusions in Section 5 (Methodology), we have concluded that the methods employed in AR18 are reasonable. This is a question we are required in our mandate to answer. We have also concluded that the methods are “appropriate”, as required by the existing Pension Standard and by the draft CSOP-Pension Standards.

3.6 U.S. ACTUARIAL STANDARD OF PRACTICE NO. 32

This Standard was adopted by the U.S. Actuarial Standards Board in January 1998. Normally, we would pay no attention in this report to a U.S. Standard but, since it is specifically addressed to a practice area for which there is no Canadian counterpart standard, we thought it would be useful to review it and comment on it in this report, as we did in the report on our review of AR17.

The sections of Standard No. 32 cover subjects such as:

- Recommended Practices
- Taking Account of All Relevant Features
- Actuarial Assumptions
- Sensitivity Testing
- Communications and Disclosures

We concluded that the actuarial work on AR18 complied with all sections of Standard of Practice No. 32.

3.7 INTERNATIONAL ACTUARIAL ASSOCIATION GUIDELINES OF PRACTICE-SOCIAL SECURITY PROGRAMS

On June 5, 2001, IAA published a Preliminary Exposure Draft for Comments on Guidelines of Practice for actuarial work provided with respect to Social Security Programs. While these guidelines are not as yet promulgated, that is expected to happen late in 2002, after which they will have the status of non-binding guidelines for Canadian actuaries.

Included in the Guidelines are sections on:

- Scientific Rigour
- Objectivity
- Transparency, Explicitness, Simplicity and Consistency in Report
- Matters to be Included in Actuarial Reports
- Data
- Assumptions
- Methodology
- Presentation of Results
- Cash Flow Financial Projections
- Sensitivity Analysis
- Reconciliation to Previous Evaluation
- Conclusions
- Attestations.

In our opinion, the actuarial work on AR18 complied with all elements of the draft IAA Guidelines of Practice for actuarial work provided with respect to Social Security Programs.

3.8 OPINION ON PROFESSIONAL STANDARDS

In our opinion, the work on AR18 was completed in compliance with the relevant professional standards.

Section 4. DATA

In this Section we address the following question:

“Has the Chief Actuary had access to the information he required and completed such tests and analyses on the data as might be expected?”

4.1 BACKGROUND

The extensive data requirements for AR17 were described in section 4.1 of the report on our review of AR17.

For AR18, a number of improvements in data have been implemented, notably including:

- statistics on earnings from Human Resources Development Canada are now provided quarterly, and broken down by age;
- data on contributions and refunds from the Canada Customs and Revenue Agency are now more up-to-date and provided more frequently than before;
- a new database has been created for CPP assets based on monthly information reports for the Fund, bond rollovers; the CPPIB provides quarterly financial reports on the assets under their management;
- the methods used by Statistics Canada to estimate the number of emigrants and returning emigrants have been improved;
- the sources of data for use in developing assumptions have been expanded through the establishment of a program of one-day seminars at which experts in such fields as demography, economics and actuarial science provide information and opinions to the Chief Actuary and others involved in the operation of the CPP.

4.2 OBSERVATIONS

We have the following observations:

- At the time AR18 was prepared, the CPPIB had not established long-term asset mix targets for the portion of the CPP assets managed by them. The Chief Actuary therefore made an assumption as to those targets in the absence of actual targets. We understand that the CPPIB is developing long-term asset mix targets, that they will be available for the next triennial actuarial review, and that the Chief Actuary intends to apply them in determining the long-term assumed rate of investment return for that review;
- Except for the long-term asset mix targets, the Chief Actuary has had access to the data he required;
- The data are extensive and are 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 data on emigrants and returning emigrants provided by Statistics Canada are much improved from that used for AR17, but are still based on estimates and not on “head counts”; nonetheless, we believe they are acceptable for use in developing the net immigration assumption;
- The seminars have provided much useful information and are a very positive development; there is room, however, to broaden the range of presenters and for presenters to better focus their contributions on matters of most relevance to the preparation of actuarial reports on the CPP;
- The OCA has increased its contacts with other Departments and Agencies such as Human Resources Development Canada, the Canada Customs and Revenue Agency, Statistics Canada and Finance Canada and this has provided helpful results.

4.3 OPINION ON DATA

In our opinion,

- The Chief Actuary had access to the data he required;
- The Chief Actuary completed such tests and analyses on the data as might be expected;
- The data used are, with one exception, adequate and appropriate for the purpose of the review - the one exception is the lack of information on the long-term asset mix targets of the CPPIB.

4.4 RECOMMENDATIONS

Recommendation 1: We recommend that the Chief Actuary closely monitor the methodology used by Statistics Canada in developing statistics on emigrants and returning emigrants.

Recommendation 2: We recommend that the Chief Actuary continue his program of seminars with presentations from appropriate experts, and strive to broaden the range of presenters and to better focus their contributions on matters of most relevance to the preparation of actuarial reports on the CPP.

Section 5. METHODOLOGY

In this Section, we address the following question:

“Were the methods used in completing [AR18] reasonable?”

5.1 BACKGROUND

The results presented in AR18 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 2075.

5.1.1 Macro-simulation Model

The macro-simulation model was described in Section 5.1.1 of the report on our review of AR17. Since then a number of refinements have been made to the model. The most important of these were:

- A new module for asset projections which treats separately the Account (the operating balance), the Fund (current holdings of federal and provincial bonds and future “rollovers” of those bonds) and the assets managed by the CPPIB, and
- A new approach to project labour force participation rates and numbers of contributors, using explicit assumptions for the job creation rate and labour force participation rates, and producing as a by-product a projection of the resulting unemployment rate and CPP retirement rates. This new approach is described in more detail in Section 6.3.1.

5.1.2 Deterministic Approach and Stochastic Research

The model continues to use a *deterministic*, rather than a *stochastic* approach. That is, each run of the model produces

- a (deterministic) single set of projected results for each year up to 2075

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).

Since the tabling of AR17, the Chief Actuary has

- had a presentation of one stochastic application made at an OCA seminar, and
- formed a departmental task force to conduct a preliminary feasibility study on the use of stochastic processes.

The task force conducted a survey of three stochastic models and, based on this survey and on meetings with the operators of those models, prepared estimates of the hardware, human resources, time frames, and budgets required to incorporate each of those stochastic models in the CPP macro-simulation model.

The Chief Actuary plans to study this issue further over the next year or two. Specifically, he plans to employ a consultant with experience in stochastic modeling to assist with this issue later this year.

5.1.3 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 some information on the possible range of future actual results.

Two sets of sensitivity tests are presented in AR18. The first set consists of two “combined” sensitivity tests (the “Low-Dependency Scenario” and the “High-Dependency Scenario” tests), one based on generally more optimistic and the other on generally more pessimistic assumptions than the best-estimate assumptions. Both of these tests were based on plausible *combinations* of the key assumptions (considering the interrelationship of the various parameters), in each case starting from a change in the demographic outlook. These differed from the low-cost and high-cost “combined” sensitivity tests in AR17; in each of those two tests, all of the single variable sensitivity test changes were simply combined, with no attempt to consider the interrelationship of the parameters. Those low-cost and high-cost “combined” scenarios in AR17 were somewhat implausible, since not all of the favourable

deviations or all of the adverse deviations in the parameters are likely to occur at the same time and to persist indefinitely.

The second set of sensitivity tests in AR18 is presented in a technical appendix rather than in the body of the report. These tests (11 in all) examine:

- One parameter at a time - the effect of a change, both upward and downward, in each of 10 parameters (up from 8 parameters in AR17 by the addition of specific tests on retirement rates and labour force participation rates), and
- In combination - the effect of (generally negative) combined changes in several assumptions over the 10 years following the valuation date to reflect a longer and more severe current economic slowdown (there was no counterpart in AR17).

5.1.4 Actuarial Cost Methods

As in AR17, the main results in AR18 are presented on two actuarial cost methods: the traditional “pay-as-you-go”, or “paygo”, method and the so-called “steady-state” method.

Additional results are presented on the accrued benefit actuarial cost method and the so-called “actuarial balance” method. The latter is a new item not found in AR17.

The paygo method projects CPP income and expenditures into the future. In AR18, the projection extends to the year 2075. In AR17 it extended to 2100. Section 115(1.1)(a) and (b) of the CPP Statute requires the Chief Actuary to present “paygo” projections year by year for the first 30 years and thereafter every 5 years up to at least 75 years after the valuation date.

The “steady-state” method is based on a comparison of assets-to-expenditures ratios 10 and 60 years following the review period (i.e., starting three years after the valuation date, therefore comparing ratios in the years 2013 and 2063 for AR18). This is the “default” contribution rate calculated “in prescribed manner” required by Section 115(1.1)(c) of the CPP Statute.

The accrued benefit actuarial cost method is the method used by typical funded defined benefit pension plans. It produces a comparison of current plan assets to accrued liabilities for the members and beneficiaries currently covered by the plan and a calculation of the normal actuarial cost of the plan (the cost of benefits currently accruing). In AR17, the

unfunded liability at December 31, 1997 and the normal actuarial cost for 1998 were shown. In AR18, the unfunded liability at December 31, 2000 is shown, together with a projection of funded ratios for years up to 2050 (a new item); normal actuarial cost, however, is not shown.

The Actuarial Balance method calculates, for each of several periods:

- the difference between (a) the sum of the beginning assets and the discounted present value of contributions for the period and (b) the discounted present value of the expenditures for the same period,

divided by

- the discounted present value of the contributory earnings for all years in the period.

The resulting figure, referred to in each case as the “Actuarial Balance”, is actually the estimated amount of reduction in the contribution rates (i.e., reduction below 9.9% in 2003 and later) that could be made if it were decided to fund the Plan over the period measured on a basis that left a zero fund at the end of the period. The Actuarial Balance figures are developed using a variation of the Actuarial Balance method used in actuarial projections of the U.S. Social Security Program and presented in the OASDI Trustees Reports.

AR18 includes this sentence: “A positive actuarial balance indicates that the estimated income (assets and contributions) is more than sufficient to meet estimated CPP expenditures for the period as a whole; a negative actuarial balance indicates the opposite.”

5.1.5 Asset Valuation

In AR18, the valuation of the assets of the CPP is handled as follows. The Account and Fund components are valued at cost and the CPPIB component is valued at market.

5.1.6 Back-testing of Results

The back-testing procedure is described in Section 5.1.5 of the report on our review of AR17. Similar procedures were followed for AR18.

5.1.7 Reconciliations

Detailed reconciliations are conducted of the current results on the paygo, steady-state and accrued benefit methods against the results in AR17. These identify the principal causes of the changes in results from AR17 to AR18, and measure the impact of each on the results. The detailed reconciliations also serve as a check on the results of AR18.

5.1.8 Form of Output

The model produces five principal forms of output. These are:

- projected financial results showing the paygo contribution rate, the assets/expenditures ratio based on current statutory contribution rates, and other income and expenditure details for each of the first 30 years after the review date and thereafter every 5 years up to 2075;
- the steady-state contribution rate;
- a comparison of current plan assets to accrued liabilities based on the accrued benefit actuarial cost method;
- projected “actuarial balance” contribution rates over various periods; and
- the 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.

5.2 OBSERVATIONS

5.2.1 Stochastic Processes

Since AR17 some progress has been made on both the technical aspects and the feasibility issues of adopting stochastic processes for the actuarial reviews of the CPP, but further research seems appropriate.

Preliminary indications are that the development and implementation of suitable stochastic processes may entail start-up costs of more than \$1,000,000 and ongoing maintenance costs of more than \$300,000 per year. Thus careful further definition of the expected benefits and limitations of the approach, refinement of the estimated costs, and refinement of the technical specifications for the stochastic processes appear to be warranted before a decision is made to implement or not to implement stochastic processes.

5.2.2 Sensitivity Testing

The new Low-Dependency and High-Dependency Scenario “combined” sensitivity tests represent an advance over the two “combined” sensitivity tests in AR17.

The two new “individual” sensitivity tests (sensitivity tests of the retirement rates and the labour force participation rates) and the new prolonged economic downturn tests are useful.

We note that several of the sensitivity tests are not “symmetric” (the low-side change in the assumption is not the same distance from the best estimate as the high-side change). There is nothing wrong with that *per se* (in fact it may be inconsistent with the approach we suggest in the next paragraph) but the reader of AR18 should be aware of that when assessing the results of the sensitivity tests.

As in the report on our review of AR17, we continue to think it would be helpful to develop objective criteria for how far from the best-estimate assumption each sensitivity test assumption should fall. In probability terms, should each be set so as to represent an approximation to, for example, one standard deviation away from the best-estimate assumption or two standard deviations away? For some parameters there may not be sufficient relevant data to measure the standard deviation; in those cases, an estimate based on judgment would be required. We think a consistent approach along these lines would be helpful. We acknowledge that it will only be possible to develop precise distributions of results when the stochastic processes referred to above are available to the OCA.

Parenthetically, we note that by “one standard deviation away”, we mean that about two-thirds of the actual results in the future are expected to fall within this range. By “two standard deviations”, we mean that about 95% of future actual results are expected to fall within this range. These are the results one would expect if each of the parameters were, in statistical terms, normally distributed around the best estimate. In this sense, we find that the current and most of the past sensitivity tests have fallen in the range of one standard deviation or less. We think these are very useful.

We think it may be useful to policymakers and the public also to perform and report some sensitivity tests of the “two standard deviation” variety to show the impact on the plan of less probable but still possible future experience. In particular, “two standard deviation” high-cost sensitivity tests could be looked upon by policymakers as a sort of “stress test” of the plan. Four examples of “two standard deviation” high-cost sensitivity tests are an ultimate fertility rate of 1.3, an ultimate net immigration rate of 0.20%, an ultimate life expectancy for age zero of, say, 100 years and an ultimate real-wage differential of zero.

5.2.3 Actuarial Cost Methods

With respect to the accrued benefit actuarial cost method, we feel the graph showing projected funded ratios up to the year 2050 is valuable new information. On the other hand, we feel that the normal actuarial cost on the accrued benefit actuarial cost method is useful and regret its absence from AR18.

Regarding the new Actuarial Balance figures, we believe they are marginally useful, but not well described. They might better be described as the portion of the level contribution rate (9.9% in 2003 and later) which is required to sustain the Plan beyond the period of measurement using the same level contribution rate. The notion of exhausting the fund at the end of the measurement period is contrary to the strategy used to develop the steady-state contribution rate; thus the comment that “A positive actuarial balance indicates that income (assets and contributions) is more than sufficient to meet estimated CPP expenditures for the period as a whole” is somewhat misleading, as this ignores the requirement of a fund at the end of the measurement period.

The information provided by the Actuarial Balance figures is meaningful if the Actuarial Balance is negative (as it was in the last two reports on the U.S. Social Security OASI program) but if an inspection of projected asset balances shows them to be uniformly positive and if the Asset/Expenditure ratio is stable or increasing in the later years of the projection period, then we believe reporting the Actuarial Balance adds very little that is useful, except in the context of international comparisons.

5.2.4 Back-testing of Results

The back-testing continues to be a powerful and useful procedure. It “validates” the model, identifies necessary adjustments to be made to the inputs and projections, and detects anomalies in the operation of the plan such as under-utilization of a particular benefit.

As in AR17, the resulting adjustments are generally based on the experience of the most recent 10 years or less. We think there would be merit in conducting tests and analysis to determine whether the adjustments should be based on longer periods.

5.3 OPINION ON METHODOLOGY

In our opinion, under the current CPP legislation, all of the methodology elements employed in AR18 are appropriate and reasonable for the purposes of the Plan and have been properly applied.

5.4 RECOMMENDATIONS

Recommendation 3: We recommend that the Chief Actuary continue to keep up the tradition of continual improvements to the methodology by such actions as:

- Continuing research on both the technical and feasibility aspects of applying stochastic processes to the actuarial review of the CPP,
- Developing and articulating objective criteria for selection of the current, or “plausible”, sensitivity tests and for any future additional sensitivity tests, and
- Reviewing what length of experience data should be considered when developing projected distributions of parameters.

Recommendation 4: We recommend that the Chief Actuary include in future reports

- the normal actuarial cost under the accrued benefit actuarial cost method,
- revised descriptions of the Actuarial Balance figures, and
- additional sensitivity tests of the “two standard deviation” or “stress testing” variety (i.e., in addition to the current “plausible” individual and combined sensitivity tests).

Section 6. ASSUMPTIONS

In this Section, we address the following question:

“Were the assumptions used in completing [AR18] reasonable?”

6.1 BACKGROUND

The actuarial review that is required to be made every three years under section 115 of the CPP Act 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 itself complex. The assumptions incorporated into the model for a particular actuarial review reflect the Chief Actuary’s judgment, 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 estimates (not predictions) about the future based on the evidence available and then to revisit and review them every one or two or three years and where appropriate, to make “mid-course corrections” in the assumptions as the emerging experience of the Plan deviates from the previous assumptions and the available information on likely future experience changes. In assessing whether to change an assumption and if so, by how much, the actuary must weigh

- long-term historical data;
- shorter-term historical data;
- very recent experience data;
- 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 but where the actuary judges that more recent data for a particular assumption indicate a trend that is likely to continue for the long-term future, the actuary will recognize that trend in adjusting the assumption.

For many of the assumptions used in the model, the Chief Actuary has adopted an approach 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 judgment 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 reviews of the Canada Pension Plan have been based on key assumptions that were explicitly described as “best-estimate”, i.e. the assumptions were, in the judgement of the Chief Actuary, such that adverse or favorable deviations of actual future experience from each of those assumptions are about equally likely. AR18 follows this same approach.

The major actuarial assumptions in AR18 can be conveniently divided into two groups:

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

6.2 DEMOGRAPHIC ASSUMPTIONS

6.2.1 Fertility

The total fertility rate summarizes a set of age-specific fertility rates and indicates the average number of children that would be born to a woman in her lifetime based on those age-specific rates. Like some other assumptions, the approach used in AR18 (and in past Actuarial Reports on the CPP) is to develop one assumption for Canada and a separate one for Québec. The assumptions are used to develop separate population projections for Canada and for Québec. From these the projected population of Canada-less-Québec is derived.

The fertility assumptions in AR18 are lower than those used in AR17 and the select period is shorter. For Canada, AR18 assumes an ultimate rate of 1.64 in 2007 and later, compared to the previous assumption of 1.70 in 2016 and later.

The effect of this change on the steady-state contribution rate is an increase of 0.027% of contributory earnings. The effect on the paygo rates, as compared to the paygo rates that would have resulted from using the same assumption as in AR17, is to increase the paygo rates in the later years: by 0.12% in 2050 and 0.37% in 2075.

The assumed rates reflect the significant decline in fertility rates over the last 50 years. They also anticipate a small rise in rates from current levels because of current trends in women having a first child at a later age than previously. They are higher than the medium projections of Statistics Canada (which run only to 2026) and lower than the projections for Canada (to 2050) performed by the United Nations. Officials of the Demography Division of Statistics Canada feel the assumed rates in AR18 are reasonable.

The sensitivity tests for the fertility assumption were a low-cost ultimate rate of 1.9 for Canada and a high-cost ultimate rate of 1.4. This spread of 0.5 is the same as the spread used by Statistics Canada between their “high” and “low” fertility projections to 2026. The tests showed a significant variation in the long-term paygo rates (a decrease of 1.26% or an increase of 1.41% of contributory payroll in 2075) and moderate variation in the steady-state contribution rate (a rounded low-cost decrease of 0.3% and a rounded high-cost increase of 0.2% of contributory earnings).

The long-term fertility assumption depends on social, medical and economic factors that are difficult to predict. Following a sharp decline in the 1960's and early 1970's resulting from the development of birth control pills and other social and economic changes, fertility rates in Canada have been relatively stable for the last 25 years. Nonetheless, they could in future decline to the lower levels experienced in Québec and some European countries or could increase in the direction of a “full replacement” rate.

Opinion on Fertility

On balance, we believe that the AR18 best-estimate fertility assumptions can properly be described as “reasonable”.

6.2.2 Migration

The AR18 assumption is net annual immigration to Canada of 0.47% of population in 2000 changing in various steps to 0.52% in 2020 and later, with net migration from Québec to other provinces of 16,200 in 2000 changing in various steps to 7,500 per year for 2015 and thereafter. The assumption is considerably lower than the assumption in AR17, which was 0.60% of population for years 2005 and later, with net migration from Québec to the other provinces of 10,000 per year.

The effect of the change in this assumption is significant. It increases the steady-state rate by 0.190% of contributory earnings and the long-term (2075) paygo rate by 0.41% of such earnings. The changes in both the steady-state rate and the paygo rates were larger than for any other single change in the assumptions.

AR18 cites the expected future labour shortage as one reason for assuming an increase in net immigration rates from the 2000 level of 0.47% of population.

The sensitivity tests for the migration assumption were a low-cost ultimate net immigration rate of 0.65% and a high-cost rate of 0.35%. The resulting paygo rates for 2075 deviated from the best-estimate results by a low-cost decrease of 0.48% and a high-cost increase of 0.68%. The effect on the (rounded) steady-state rate was a low-cost decrease of 0.2% and a high-cost increase of 0.3%.

The Chief Actuary based his conclusions on a review of data prepared by Statistics Canada. The data on emigrants and on returning Canadians are derived indirectly from survey data, income tax data and data on child tax benefits, and are therefore only estimates. The methodology for developing these figures has improved substantially in the last few years and the figures are more reliable than in the past, but we note that the data are still estimates and not “head counts”. Officials of the Demography Division of Statistics Canada feel the assumed rates of net migration used in AR18 are reasonable.

We note that net immigration rates are highly volatile. In the last 50 years, they have ranged from a low of 0.07% of population (1962) to a high of 1.2% (1952 and 1957).

Opinion on Immigration

In our opinion, an assumed annual net immigration rate of 0.47% of population rising to 0.52% in 2020 is a reasonable best-estimate assumption for the annual rate of net immigration.

6.2.3 Mortality

The mortality assumption for AR18 starts from the 1990-92 Life Tables for Canada and Quebec, prepared by Statistics Canada. These mortality rates were projected to 1996 using the actual improvements in mortality experienced in the years 1991-1996. The rates of assumed improvement in 1997 to 2020 are interpolated between the average annual rates experienced in Canada in 1987-1996 and the rates of improvement that were assumed in 2021 and later. These rates were derived from assumed improvement rates adopted for the 2000 trustees report on the U.S. Social Security OASDI program, modified to reflect historical differences between mortality in Canada and the U.S. The differences in mortality are assumed to decline gradually and this is reflected in assumed rates of improvement in Canada after 2020 that are lower than the U.S. Social Security assumed rates. At ages 55 and older, the AR18 assumed rates of improvement for males are 0.60% to age 79 and then 0.55%. For females, the assumed rates of improvement are 0.50% for ages 55 and older. In the U.S. Social Security report, the comparable assumed rates of improvement hover around 0.73% for males and hover around 0.65% for females.

The mortality assumption for AR17 was based on the same Canada Life Tables and an earlier U.S. Social Security study of rates of reduction in mortality. The AR18 assumption gives lower mortality rates for males and higher rates for females than those assumed in AR17, which results in a narrowing of the gap between male and female life expectancies. The effect of the change in the mortality assumption was negligible: an increase in the paygo rate for 2075 of 0.07% of contributory earnings and in the steady-state rate of 0.002% of earnings.

The sensitivity tests were a high-cost scenario of ultimate mortality reductions of 200% of the best-estimate rates of reduction and a low-cost scenario of no mortality reductions after 2020. The high-cost paygo rate in 2075 is higher than on the best-estimate basis by 0.86% of contributory earnings and the corresponding low-cost rate is lower than on the best-estimate basis by 0.87% of contributory earnings. The effect on the steady-state rate is an increase of 0.2% for the high-cost scenario and a decrease of 0.2% for the low-cost.

For comparative purposes, we obtained from Statistics Canada their Life Tables for 2026 that were developed in connection with their projections of future population. We calculated the implicit rates of assumed mortality improvement going from the abridged life table for 1996 to that for 2026, and compared them with the average improvement rates assumed in AR18 over the years 2001 to 2025. The Statistics Canada improvement rates were noticeably higher than the AR18 rates for males aged 30 to 54 and ages above 80 but otherwise, the two sets of rates were close to each other.

In our opinion, the approach to this assumption that was adopted by the OCA is well thought out and reasonable. We prefer it to the Statistics Canada approach which is based on projecting improvements in life expectancy (a derived quantity) rather than in the underlying mortality rates.

Opinion on Mortality

In our opinion, the AR18 mortality assumptions are reasonable.

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 AR18 assumptions for years 2005 and later can be expressed as aggregate rates of 3.25 new disabilities per thousand eligible male workers with a corresponding female rate of 2.75 per thousand or a combined rate of 3.0 per thousand. These rates are lower than the aggregate rates used in AR17 which were 4.0 for males and 3.0 for females and a combined rate of 3.5 per thousand.

The rates used in AR18 are midway between the rates assumed in AR17 and the recent experience of 1997-99. The change in assumed rates reflects

- the more stringent administrative rules that were adopted in 1995
- the significant change in the qualification requirements that were introduced as a result of the passage in 1997 of Bill C-2.
- the narrowing of the gap in incidence rates between males and females.

The effect of the change in the disability incidence assumption from the assumption used in AR17 is identified in AR18 as a reduction in the paygo rates—short term (0.14% in 2025), medium term (0.10% in 2050) and long term (0.07% in 2075). The reduction in the steady-state contribution rate is 0.12% of contributory earnings.

The sensitivity tests of the disability incidence assumption are high-cost aggregate ultimate assumed rates of 4.25 per thousand for males and 3.75 for females and low-cost rates of 2.25 per thousand for males and 1.75 for females. The paygo rate goes down by 0.34% in 2025, 0.33% in 2050 and 0.31% in 2075 under the low-cost scenario versus the same amount of increase in those years under the high-cost scenario. For the steady-state rate, the low-cost decrease is 0.3% of contributory earnings and the high-cost increase is 0.3%.

We believe that the downward change in this assumption was warranted by the 1997-99 experience but note that there is only a relatively short three years of experience since the changes in administrative practice and plan provisions. We think the choice of rates midway between the rates assumed in AR17 and those experienced in 1997-99 was appropriate.

Opinion on Disability Incidence

In our opinion, the AR18 disability incidence assumptions are reasonable.

6.2.5 Retirement Rates

The assumption about retirement rates is considered in AR18 both as a demographic assumption (in that it affects the commencement of benefits) and as an economic assumption (in that it affects employment levels and hence contributions).

In AR18, age-specific retirement rates for males and females for 2001 are based on recent experience in 1996-2000 for ages 60 to 69 years; for example, at age 60 for males 34% and for females 41%. These rates are assumed to decrease gradually to reach levels of 31% and 38% respectively for males and females aged 60 years in 2030, with compensating increases in the rates at age 65. This reflects the assumption in AR18 that labour force participation rates for people aged 60 to 64 will increase from 2001 to 2020 by 16%. For ages 61 to 70 other retirement rates are used based on recent experience, appropriately modified each year up to 2030, to fit with the reducing age 60 rates. The resulting retirement rates are taken as best-estimate projections.

The rationale for these best-estimate assumed retirement rates seems to us to be logical and reasonable, and appropriately harmonized with the new approach to projecting numbers of employed workers.

There is no simple way to reconcile the effects of the change in the retirement rates assumption from AR17 to AR18 because of the new approach taken in AR18 to developing projections of employed workers (using labour force participation rates, job creation rates and unemployment rates). The reconciliation for the retirement rate changes is included partly within the effect of the changes in assumptions for unemployment and labour force participation and partly within the effect of the changes in “other” assumptions.

There was a sensitivity test for the retirement rate assumption. The low-cost set of retirement rates assumes that, from 2006 onward, everyone would retire at age 65 (rather than earlier). This reduces the steady-state contribution rate by 0.4%, and the paygo rates by 0.50% in 2025, 0.12% in 2050 and 0.02% in 2075. The high-cost sensitivity set of retirement rates assumes that, from 2006 onward, everyone retires at age 60. This increases the steady-state contribution rate by 0.3% and the paygo rates by 0.52% in 2025, 0.30% in 2050 and 0.24% in 2075.

Opinion on Retirement Rates

In our opinion, the AR18 assumptions as to the rates of retirement are reasonable.

6.3 ECONOMIC ASSUMPTIONS

6.3.1 Employment and Participation Rates

The development for AR18 of projected numbers and profiles of contributors has been considerably modified from the approach used in AR17. Previously, the model included a set of age-sex-specific factors that were applied to projected working-age populations to give projected numbers with earnings and the level of those earnings. The factors were developed from a review of historical data and extrapolation of some observed trends in those data. For AR17, this approach was combined with the use of a cohort-based model that recognized different lifetime employment patterns for different year-of-birth groups.

For AR18 the approach was to begin with the development of calendar-year labour force participation rates by age-sex group and apply these rates to the projections of the total

population in each of those groups. The participation rates are “cohort-based” so as to reflect expected changes in participation as a result of longer periods in education and training, the trend of postponing child-bearing to later ages and a move toward later retirement. The resulting labour force projections were then used in combination with projections of assumed net jobs created to give projections of employed workers. Since this process, without adjustment, would project zero unemployment by about 2020, the projections were adjusted to provide a minimum or “natural” unemployment rate of about 7% up to 2010, and then decreasing to 6.5% in 2015 and thereafter. The resulting projections were taken as the best-estimate projections.

Some elements of this approach were used in AR17. Its fuller adoption for AR18 results, in our view, in a more coherent and rational model and one more aligned with customary economic analysis. The parameters adopted for the rates of net job creation and unemployment are well within the consensus range of expert opinion.

The effect of these changes in approach and assumptions for unemployment and labour force participation from those used in AR17 was to decrease the steady-state contribution rate by .061% of contributory earnings and the paygo rates by 0.11% in 2025, 0.23% in 2050 and 0.14% in 2075.

There were two sensitivity tests for this assumption. One was the use of a low-cost ultimate assumed unemployment rate of 4.5% and a high-cost rate of 8.5%. The results showed relatively little sensitivity to this assumption, with the variation in the rounded steady-state contribution rate of 0.1% of contributory earnings in either direction and variations in the paygo rate diminishing from about 0.18% in 2025 to about 0.02% in 2075.

The second sensitivity test was with respect to the labour force participation rate. The best-estimate assumption is an aggregate rate for ages 15-69 of 73% in 2000 decreasing to 72% in 2010, then increasing (mostly under age 55) in 2010-2020 and at ages 55 and older in 2020-2030. These changes reflect the probable effects on the labour market of the retirement of the baby-boom generation. The low-cost sensitivity test has male rates reaching their highest level in 2030 and female rates increasing to equal male rates, with an aggregate rate of 81% in 2030. This reduces the steady-state contribution rate by 0.4% and the paygo rates by 0.56% in 2025, 0.65% in 2050 and 0.24% in 2075. The high-cost scenario is based on assumed labour force participation rates which are constant rates after 1999, with an aggregate (15-69) rate of 68%. This increases the steady-state rate by 0.3% and the paygo rates by 0.48% in 2025 declining to 0.13% in 2075. The sensitivity of the steady-state contribution rate and the

paygo rates in the first 25 years to variation in the participation assumption is among the highest of the assumptions for which sensitivity was tested.

The rationale for the best-estimate assumed unemployment and participation rates seems to us both plausible and reasonable.

Opinion on Unemployment and Participation Rates

In our opinion, the AR18 assumptions as to the rates of unemployment and labour force participation are reasonable.

6.3.2 Real Wages

Both contributions and benefits under the CPP are affected by wage increases. Since benefits are indexed to inflation, the actuarial model requires an explicit inflation assumption, which is discussed below. The wage increase assumption is separated into two parts: the inflation assumption and the real wage increase assumption.

For AR18, the real wage increase assumption in the short term takes into account the difference in recent years between the real rate of increase in average annual earnings and the real rate of increase in Average Weekly Earnings (AWE), an index that is used to adjust the Year's Maximum Pensionable Earnings in the CPP. The assumed real rate of increase in the AWE is assumed to be -1.0% in 2001 and 0.2% in 2002, gradually increasing to 1.1% in 2015 and later. The real rate of increase in average annual earnings is assumed to be 0.0% for 2002, then outpacing the AWE increases for 2003-2007 and thereafter increasing at the same rate as the AWE.

In AR17, the real wage increase assumption was 0.6% in 1998 grading up to 1.0% in 2003 and later. The AR18 assumption is, therefore, lower until 2010 and higher thereafter. The total effect of the change in the assumption on the steady-state contribution rate is zero.

The sensitivity tests for the real wage assumption were a low-cost scenario of an ultimate rate of 1.6% in 2015 and later and a high-cost scenario of an ultimate rate of 0.6% in 2004 and later. The results of the tests indicate a high degree of sensitivity to this assumption. The decrease in cost for the low-cost scenario is 0.3% in the steady-state contribution rate and 0.50% in the 2025 paygo rate, 0.87% in 2050 and 0.91% in 2075. The cost increases for the high-cost scenario are 0.4% in the steady-state rate and 0.64% in the 2025 paygo rate, 1.00% in 2050 and 1.05% in 2075.

Expert opinion among economists appears to be divided on the long-term outlook for real wage increases. Historical data from the CIA Report on Economic Statistics shows an average annual rate of real wage increase over the last 76 years (1924-2000) to be 1.46% but over the last 25 years (1976-2000) only 0.10%. Credible expert evidence we obtained suggested that 1.1% was too low to be a “best-estimate” rate, and that a rate of 1.6% would be a better long term estimate for the future of both productivity gains and real wage gains.

In our opinion, the increase in the long-term assumption from 1.0% to 1.1% (the first change in that assumption in at least 10 years) is a cautious move in the right direction. We note that the assumption adopted in the recent actuarial report on the Québec Pension Plan is 1.2% in 2010 and later and that the assumption used in the most recent valuations of large public sector pension plans in Ontario ranged from 1.00% to 2.00%. We believe that the range of reasonable assumed annual rates of real wage increases appears to be from 1.0% to about 2.0%.

Opinion on Real Wages

In our opinion, the real wage increase assumption in AR18 is within, but at the lower end of, the reasonable range.

6.3.3 Price Increases

The rate of price inflation is a necessary assumption for an actuarial review of the CPP. Nominal rates of increase in earnings and benefit payments are both affected by inflation but, because the impact of inflation on employment earnings occurs earlier in time than the impact on benefits, the effects on paygo rates and on the steady-state contribution rate of a change in the inflation assumption do not cancel out. An increase in the inflation assumption results in a decrease in the paygo rates and steady-state contribution rates and vice versa.

The inflation assumption in AR18 is 2.8% in 2001 and 2.0% in 2002-2005, increasing to 3% in 2015 and later. In AR17, the assumption was 1% in 1998 increasing to 3% in 2003 and later. The effect of the change in the assumption was to increase the steady-state contribution rate by 0.108% of contributory earnings and to increase the paygo rates by 0.08% in 2025 and by 0.01% in 2050.

The sensitivity tests for this assumption were a high-cost scenario with an ultimate inflation rate of 2% and a low-cost scenario with an ultimate rate of 4%. The high-cost paygo rates were 0.27% to 0.35% higher than the best-estimate rates and the low-cost paygo rates were 0.24% to 0.29% lower than the best-estimate rates. The rounded steady-state contribution rates were higher and lower by 0.2%, respectively, of contributory earnings.

Historic levels of inflation in Canada have averaged 3.10% per year over the last 76 years (1924-2000), 4.10% per year over the last 50 years (1951-2000) and 4.77% over the last 25 years. In the last 50 years, the rate of inflation has been less than 3.0% in 22 of those years. In the last 25 years, it has been less than 3.0% in only eight years, 1992 through 1999. The assumption used for the 2000 report on the QPP was 2.8% in 2001 and 2% in 2002 to 2006, increasing to 2.7% in 2013 and thereafter.

On reviewing economic literature and considering the evidence we obtained in our interviews with the Chief Actuary and with other government officials, we find that there are differing views not only between individual economists but also between labour economists and financial economists on this parameter. The range of views on the long-term rate of inflation tends to fall in the range of 2% to 3% per annum.

Given both the long term (76-year) average and the prolonged recent decline in Canada's inflation rate, we believe it was appropriate for the Chief Actuary to adopt a lower short-term (2003-2014) inflation rate in AR18 than the rate used in AR17. The ultimate real price increase assumption used in AR18 is near the higher end of the reasonable range

Opinion on Price Increases

The price increase assumption used in AR18 was, in our opinion, within, but at the higher end of the reasonable range.

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 costs would be equal to the paygo rates 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 (equal to five to six years' benefit payments, according to AR18) and the rate of investment return becomes a material factor in the cost of the plan. 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.

The best-estimate real rate of return assumptions, net of direct investment expenses, in AR18 are, for new funds, 4.25% per year for money invested by the CPPIB (which excludes the Operating Balance and the CPP Fund), 2.0% for the Operating Balance and 3.50% for rollover investments in the CPP Fund. The result is an ultimate weighted average for the total assets after 2033 (when the CPP Fund – the 20 year revolving loans to the provinces – has expired) of about 4.15%. The Operating Balance is equal to three months of benefit payments and is generally invested in very short-term securities. The AR17 ultimate assumptions for the real rates of return were 4% for the CPPIB assets and 1.5% for the Operating Balance, for a composite rate of about 3.88%. The changes in these assumptions reduced the steady-state contribution rate by .087% of contributory earnings.

The sensitivity tests for this assumption were to increase or decrease the rate of return on all of the CPP assets (including the 20-year loans to the provinces) by 1%. The result would be to decrease or increase the steady-state contribution rate by 0.4% of contributory earnings. This assumption has no effect on the paygo rates, so there is no sensitivity effect on them of increasing or decreasing the assumed rate of return.

In arriving at the assumed long-term rate of return for the CPPIB assets, the Chief Actuary noted that the investment policy to date for these assets has been to invest them entirely in equities because total CPP assets are still predominantly invested in 20-year loans to the provinces. The provinces have the option to roll over for one further 20-year period any loans that were outstanding on January 1, 1998. Based on experience to date, it was assumed that the rate of future rollovers will be 70%. The amount of CPPIB assets is projected to overtake the amount of outstanding loans to the provinces by the end of 2003, and by 2010 the CPPIB assets will exceed \$100 billion and will account for 80% of all CPP assets.

So far, the CPPIB has not adopted any long-term asset mix policy because they haven't needed one yet. The CEO of the CPPIB advised us that they are aware of the need for such a policy and intend to formulate one over the next 18 to 24 months. In the absence of any existing policy, the Chief Actuary derived his long-term real rate of return assumption on the basis of an assumed ultimate asset mix of 50% fixed income (bonds plus the Operating Balance) and 50% in equities (25% Canadian and 25% U.S. and overseas) with assumed real

rates of return for CPPIB funds after 2001 of 3.80% for bonds, 4.50% for Canadian equities and 5.00% for U.S. and overseas equities.

In our opinion, the long-term real rate of return assumption adopted by the Chief Actuary is within the reasonable range but below what we would consider a “best-estimate” assumption. The “equity risk premium” embodied in the Chief Actuary’s assumptions is well below the historical figures. He has assumed that Canadian equities will return only 1.5% more than the (3%) assumed real rate of return on risk-free long Canada bonds and that the excess return on foreign equities will be 2.00%. According to the CIA Report on Canadian Economic Statistics, the 50-year (1951-2000) average real rate of return on Canadian common stocks is 6.56% versus 2.56% for Canada Long Bonds, an “equity risk premium” of 4.00%. The comparable average “equity risk premium” for U.S. Common Stocks in Canadian dollars is substantially higher, at 6.57%.

The 2000 report on the QPP used an assumed real rate of return of 4.7%.

We believe that a reasonable range for the real rate of return assumption for a CPPIB portfolio with a 50-50 asset mix is 4.25% to 5.25%.

Opinion on Real Rate of Return

In our opinion, the 4.15% assumption for the ultimate annual real rate of investment return on assets (which include both the Account and the CPPIB Assets) is within, but at the low end of the reasonable range. We would, however, select a best-estimate assumption perhaps 50 to 75 basis points higher.

6.4 REASONABLENESS OF THE ASSUMPTIONS IN THE AGGREGATE

In our review of the major actuarial assumptions, we found that each of them was in the reasonable range. We found that all but three assumptions were near the centre of the reasonable range. In our view

- the real wage increase assumption is at the higher-cost end of the reasonable range;
- the price increase assumption is at the lower-cost end of the reasonable range;
- the real rate of return assumption is at the higher-cost end of the reasonable range.

The total effect, in our view, is a set of assumptions well within the reasonable range, but a little on the conservative, or higher-cost side of the best-estimate assumptions that we would have selected.

Opinion on the Assumptions in the Aggregate

In our opinion, the assumptions used in completing AR18 in the aggregate are within the reasonable range, while a little on the conservative side of the best-estimate assumptions we would have selected.

Section 7. COMMUNICATION OF RESULTS

In this Section we address the following question:

“Does the 18th Actuarial Report fairly communicate the results of the work performed by the Chief Actuary and his staff?”

7.1 BACKGROUND

AR18, as tabled in the House of Commons on December 10, 2001, is a bound soft-cover book, separately published in English (126 pages) and French (132 pages). It consists of the following sections:

	Number of Pages In English
Complete index, listing all the sections, tables and graphs	3
I. Executive Summary	3
II. Methodology	1
III. Best-Estimate Assumptions	12
IV. Results	18
V. Sensitivity Analysis	5
VI. Conclusion	1
VII. Actuarial Opinion	1
Appendix A – Summary of Plan Main Provisions of CPP	6
Appendix B – Descriptions of Assumptions and Methods, subdivided into	
I. Introduction	1
II. Demographic Assumptions	10
III. Economic Assumptions	11
IV. Contributions	4
V. Benefit Expenditures	19
VI. Assets	3
Appendix C – Sensitivity Tests	9

Appendix D – Financing the CPP	8
Appendix E – Reconciliation with Previous Report	5
Appendix F – Financial Projections	1
Appendix G – Acknowledgements	1

AR18 is also available from the OSFI Web site www.osfi-bsif.gc.ca in PDF format in 4 forms, as follows (In brackets are shown the KB numbers in English and French):

- | | |
|-----------------------------|--------------------|
| ➤ Complete Report | E-446KB, F-461KB |
| ➤ Executive Summary | E-14.5KB, F-17.4KB |
| ➤ Report without Appendices | E-192KB, F-198KB |
| ➤ Appendices | E-258KB, F-267KB |

7.2 OBSERVATIONS

AR18 is a well-organized and readable document. It includes many useful tables and graphs. The overall conclusions are clearly set out.

The document is much more manageable than AR17; English and French versions are published separately, each around 130 pages and including an Executive Summary, compared to 400 pages for the combined English and French versions of AR17, with no Executive Summary.

The inclusion of a three page Executive Summary is a valuable change from AR17, although it would be better if, as had been recommended, the Executive Summary were to include reference to the sensitivity tests involving the High-Dependency Scenario and Low-Dependency Scenario results as well as the Best-Estimate results.

There are a few relatively minor deficiencies we have noted in the English version of the report. They are errors of detail and matters of presentation or description that could be improved. We have brought them to the attention of the Chief Actuary.

7.3 OPINION ON COMMUNICATION OF RESULTS

In our opinion, AR18 fairly communicates the results of the work performed by the Chief Actuary and his staff.

7.4 RECOMMENDATIONS

Recommendation 5: We recommend that in future Actuarial Reports information on sensitivity testing be included in the Executive Summary.

Section 8. RESPONSES TO RECOMMENDATIONS OF PREVIOUS PANEL

In this Section we address the following question:

“Has the Chief Actuary adequately addressed the recommendations made by the panel which reviewed the work of the Acting Chief Actuary in completing the Seventeenth Actuarial Report on the Canada Pension Plan?”

8.1 BACKGROUND

The three-member panel of actuaries who prepared this report also completed a similar report reviewing the Seventeenth Actuarial Report on the CPP. That Actuarial Review Panel Report, dated March 31, 1999, was submitted to the Superintendent of Financial Institutions in Ottawa. It included thirteen recommendations for possible changes in approaches regarding the data and methodologies to be used, the preparation of actuarial reports and the organization and staffing involved in future actuarial reviews of the CPP.

8.2 RESPONSES TO PREVIOUS PANEL RECOMMENDATIONS

Below we have reproduced the thirteen recommendations and set out under each recommendation our detailed answers to the question above.

AR17 Panel Recommendation 1: *We recommend that the Department of Finance and OSFI seriously consider establishing the Chief Actuary’s Department, separate from OSFI and reporting directly to the Minister of Finance or to the Minister of State for Finance. The work of the Social Insurance Programs Section-Valuation Unit and the valuation responsibilities for pension plans for the public service, the military, RCMP, MPs and federal judges could also be transferred to the new Chief Actuary’s Department.*

Comment: No action has been taken in direct response to this recommendation, and, in point of fact, the recommendation was not one that the Chief Actuary could act upon himself. However, three organizational changes have been made or are under consideration in the OCA:

- Since April, 2000 services provided by the OCA to third parties are subject to fees,
- the Chief Actuary is proposing to move from a budget appropriation basis to a full cost recovery basis for the entire OCA budget, and
- the staff of the Social Insurance Programs Section of the OCA has been more than doubled since 1999.

These organizational changes and the improved relationships with other government departments lead us to feel that the OCA is more highly regarded in the government hierarchy than it was three years ago, and that the independence of the Chief Actuary and the ability of the OCA to marshal the necessary resources to properly fulfil its mandate appear to be stronger than they were in 1998. These factors mitigate against the urgency of creating a Chief Actuary's Department reporting directly to an appropriate Minister. We also recognize that such a Department would be small, as Departments go, and would entail some overhead administrative costs beyond those incurred as a part of a larger organization (OSFI).

In spite of the above comments we are still of the opinion that a separate Chief Actuary's Department would be the best arrangement. We think it would assure the greatest independence and the most direct reporting arrangement. We note that the benefit payments under the CPP and OAS programs are projected to be over 5.5% of Gross National Product in 2030, and we think this justifies the higher profile and greater independence of a separate Department, despite the marginal cost increase.

AR17 Panel Recommendation 2: *We recommend that adequate staff and financial resources be made available to the Chief Actuary's Department to allow for more extensive "inter-valuation" studies of emerging experience and continuing development of improved forecasting and modelling techniques for projecting future contributions and expenditures.*

Comment: This has been done. See our comments in Section 2.2 of this report.

AR17 Panel Recommendation 3: *We recommend that consideration be given to establishing an Advisory Panel, to advise the Chief Actuary with regard to the assumptions to be used in actuarial reviews of the CPP; the Advisory Panel would be made up of senior and experienced professionals, such as actuaries, economists and demographers.*

Comment: For AR18, instead of implementing a formal Advisory Panel, the OCA organized two Inter-Disciplinary Seminars to learn about experts' views of the economic and demographic future of Canada. There are, we believe potential advantages to having an Advisory Panel in addition to holding these periodic seminars.

By its nature, an Advisory Panel would entail more interaction of the experts among themselves and a very concentrated focus on the methodologies and specific assumptions and time frames inherent in an actuarial review of the CPP than is usually possible in a series of seminars with expert presenters. This would increase the comprehensiveness and coherence of the advice provided to the Chief Actuary.

The potential downside is that such advice may be hard to ignore; the Chief Actuary may, in practice, have less independence in selecting the methods and assumptions for the actuarial reports than he does now.

We think this recommendation continues to deserve a thorough review.

AR17 Panel Recommendation 4: *We recommend that Revenue Canada be requested to provide the Chief Actuary with details of CPP contributions and the earnings of CPP contributors promptly (i.e., within, say, three months) after the end of each calendar year.*

Comment: As noted in Section 4.1 of this Report, OCA now receives each quarter statistics on earnings from Human Resources Development Canada, and data on contributions and refunds are provided from the Canada Customs and Revenue Agency more frequently than before. The situation now appears to be satisfactory.

AR17 Panel Recommendation 5: *We recommend that Statistics Canada be asked to investigate what steps can be taken to improve the data on emigrants and returning emigrants.*

Comment: This has been done. See comments in Section 4.2 of this Report.

AR17 Panel Recommendation 6: *We recommend that, in future, additional sources of data, inside and outside of Canada and inside and outside of government, be*

reviewed to broaden, where appropriate, the data and considerations used to develop actuarial assumptions.

Comment: For AR18, the OCA organized two Inter-Disciplinary Seminars to learn about experts' views of the economic and demographic future of Canada and other relevant topics. This approach to seeking the guidance from experts appears to be working well and, we believe, will be even more effective as the OCA gains experience in organizing these seminars.

The OCA also increased its contacts with other government departments and agencies.

These steps are appropriate, and we believe have proven valuable. They should be continued and, where appropriate, expanded in future years.

AR17 Panel Recommendation 7: *We recommend that the Chief Actuary continue in future to improve the methodology. Examples of possible improvements are:*

- *application of stochastic processes to aspects of the valuation,*
- *development of objective criteria for selection of sensitivity tests,*
- *improvements in methodology for "validation adjustments".*

Comment: Many steps have been taken to improve the methodologies used in the actuarial review process since the completion of AR17. However we would still recommend further effort and resources be expended to harness stochastic processes and to refine the sensitivity tests. See comments in Sections 5.2.1 and 5.2.2 of this Report.

AR17 Panel Recommendation 8: *We recommend that Human Resources Development Canada be asked to investigate further the causes of apparent underutilization of widower's benefits, death benefits and children's benefits and develop a long term policy as to what actions it may take in this regard. The Chief Actuary could then take this policy into consideration, in addition to past experience, in future actuarial reviews.*

Comment: This has been done.

AR17 Panel Recommendation 9: *We recommend that the Chief Actuary continue to produce high-cost and low-cost "combined" sensitivity tests in addition to the one-*

parameter-at-a-time sensitivity tests. These high-cost and low-cost estimates should each represent a plausible combination of assumptions and lead to a meaningful estimate.

Comment: This has been done.

AR17 Panel Recommendation 10: *We recommend that the calculation of the steady-state contribution rate should continue to be based on the Chief Actuary’s best-estimate derived independently from the high-cost and low-cost estimates.*

Comment: This continues to be done.

AR17 Panel Recommendation 11: *We recommend that, for future actuarial reviews of the CPP, a rigorous and complete peer review process be adopted, with appropriate time allowed for expert and objective analysis of data, assumptions and methodologies as well as report preparation.*

Comment: The response to Recommendation 11 has been multi-faceted and appropriate. Two Fellows of the Canadian Institute of Actuaries have been heavily involved in the preparation of AR18 and both have expressed comprehensive and positive opinions regarding the report. That, in our opinion, constitutes a very suitable form of rigorous “pre-release” peer review. Also, the actual writing of AR18 was again subjected to “pre-release” partial peer review by another qualified actuary from OCA who was not otherwise involved in the preparation of AR18. In addition, the “post-release” review by the panel of independent actuaries was continued for AR18; this process provides an external review and valuable objective input for improvements in the future.

AR17 Panel Recommendation 12: *We recommend the inclusion of an Executive Summary in future Actuarial Reports, showing the main results and including information on sensitivity testing*

Comment: A good Executive Summary was included in AR18. We have only one relatively small criticism: that the Executive Summary does not show any information on sensitivity testing. It would have been a more meaningful Summary had it included information on sensitivity testing as recommended.

AR17 Panel Recommendation 13: *We recommend that the full report be published separately in French and English, each in three volumes. One volume would contain the Executive Summary, a second would contain the major findings (i.e. Sections I to VI and Appendix D in AR17) and the third would contain the technical material (found in Appendices A, B and C).*

Comment: The response to Recommendation 13 was appropriate. There are separate volumes in English and French. Each is much shorter than the 400 pages of AR17.

8.3 OPINION ON RESPONSES TO PREVIOUS RECOMMENDATIONS

In our opinion, the Chief Actuary and his staff have responded well to the thirteen recommendations listed in the report of our review on AR17. Two of those recommendations have not been implemented: Recommendation 1 (separate OCA from OSFI) and Recommendation 3 (form an Advisory Panel). We believe that these deserve further consideration. Two other recommendations - Recommendation 6 (broaden data sources) and Recommendation 7 (methodology improvements) - have seen progress but would benefit from further work and the allocation of additional resources.

The overall result, in our opinion, is that good progress has been made on methodologies, assumption setting, documentation and report presentation in AR18, compared to AR17.

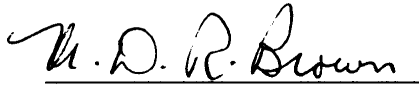
8.4 RECOMMENDATIONS


Recommendation 6: We recommend that further consideration be given to two recommendations made by the previous panel: their Recommendations 1 (separate OCA from OSFI) and 3 (form an Advisory Panel).


Recommendation 7: We recommend that further work and additional resources be allocated to enhance the responses to two recommendations made by the previous panel: their Recommendations 6 (broaden data sources) and 7 (methodology improvements).

Signatures

This report is respectfully submitted by,


M. David R. Brown,
FSA, FCIA


Robert C. Dowsett,
FSA, FCIA, MAAA


James G. Paterson,
FSA, FCIA

March 11, 2002.