Office of the Superintendent
of Financial Institutions

Bureau du surintendant
des institutions financières

CANADA PENSION PLAN

Fifteenth

Actuarial Report

as at 31 December 1993

Canada

Office of the Superintendent
of Financial Institutions Canada

255 Albert Street
Ottawa, Canada
K1A 0H2

Bureau du surintendant
des institutions financières Canada

255, rue Albert
Ottawa, Canada
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13 February 1995

The Honourable Paul Martin, P.C., M.P.
Minister of Finance
House of Commons
Ottawa, Ontario
K1A 0G5

Dear Minister:

Pursuant to subsection 115(3) of the *Canada Pension Plan Act*, which provides that a periodic report shall be prepared every five years for purposes of the contribution rates review by the Minister of Finance Canada and the Ministers of the Crown from the included provinces, I am pleased to transmit my actuarial report, as at 31 December 1993, on the Canada Pension Plan.

Yours sincerely,

Bernard Dussault
Chief Actuary

Canada

CANADA PENSION PLAN

FIFTEENTH STATUTORY ACTUARIAL REPORT AS AT 31 DECEMBER 1993

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CANADA PENSION PLAN
FIFTEENTH STATUTORY ACTUARIAL REPORT
AS AT 31 DECEMBER 1993

I- Introduction

This is the Fifteenth Statutory Actuarial Report since the inception of the Canada Pension Plan (CPP) in 1966. It has been prepared in compliance with subsection 115(3) of the *Canada Pension Plan Act* which provides that a report shall be prepared every five years for purposes of the contribution rates review by the Minister of Finance Canada and the Ministers of the Crown from the included provinces. The previous quinquennial report is the Eleventh Actuarial Report, as at 31 December 1988, which had been tabled in the House of Commons on 22 January 1990.

This fifteenth report also complies with subsection 115(1) which provides that a periodic report shall be prepared at least every three years. The previous triennial report is the Fourteenth Actuarial Report, as at 31 December 1991, which was tabled in the House of Commons on 28 April 1993.

No amendments having a significant impact on the CPP actuarial projections have been made since the preparation of the previous (fourteenth) report.

II- Key Assumptions

The main financial projections of this report rest on an extensive set of economic and demographic assumptions that are described in Appendix B. The subset of key ultimate assumptions, briefly described below, has not changed from the previous (fourteenth) report. The year indicated in brackets corresponds to the ultimate year, i.e., the first year for which the assumed value is deemed constant until the end of the projection period (1994-2100).

Rate of increase in earnings:	4.5% (2000)
Rate of increase in prices:	3.5% (2000)
Nominal annual rate of interest:	6.0% (2000)
Mortality:	1985-87 Canada Life Tables adjusted for future improvements in life expectancy (2100)
Net annual immigration to Canada (percentage of population):	0.4% (1991)
Total fertility rate:	Canada: 1.85 (2000) Québec: 1.80 (2000)

III- Results of the Actuarial Examination

1. Main Findings

The chart below shows, along with their corresponding Account/expenditure ratio, the contribution rates, taken from the detailed main projection Tables 1A and 1B of this report, projected under the two scenarios prescribed in connection with the ministerial quinquennial reviews of CPP contribution rates.

- Scenario A contemplates the application, until its expiration in 2016, of the existing 25-year Schedule of contribution rates and, thereafter, of the rates resulting from the application of the *15-year formula* (see paragraph 11 of Appendix A).

- Scenario B contemplates the application, only until 1996, of the existing 25-year Schedule of contribution rates and, thereafter, of the rates resulting from the application of the *15-year formula* (see paragraph 11 of Appendix A).

	Scenario A (15-year formula in 2017)		Scenario B (15-year formula in 1997)	
Year	Contribution rate	Accnt/Exp. ratio	Contribution rate	Accnt/Exp. ratio
1993	5.00	2.71	5.00	2.71
1994	5.20	2.50	5.20	2.50
1995	5.40	2.32	5.40	2.32
1996	5.60	2.14	5.60	2.14
1997	5.85	1.97	5.99	1.99
1998	6.10	1.81	6.38	1.86
1999	6.35	1.66	6.77	1.76
2000	6.60	1.52	7.16	1.69
2005	7.85	0.93	8.87	1.56
2010	8.90	0.45	10.28	1.63
2012	9.30	0.26	10.80	1.69
2015	9.90	(0.02)	11.55	1.76
2016	10.10	(0.11)	11.80	1.79
2020	12.62	(0.18)	12.60	1.85
2025	14.61	0.16	13.40	1.83
2030	15.43	0.58	13.91	1.77
2050	14.37	1.96	14.07	1.96
2075	14.03	2.11	14.09	2.08
2100	14.44	2.04	14.44	2.03

The preceding chart indicates that:

- The application to 2016, as under scenario A, of the contribution rates included in the current 25-year Schedule (1992 to 2016) is projected to result in the Account/Expenditure ratio gradually falling from 2.71 at the end of 1993 to 0.26 at the end of 2012. The CPP Account would be exhausted by the end of 2015. This compares with an Account/expenditure ratio of 1.65 at the end of 2016 from the previous (fourteenth) report.

- In accordance with the *15-year formula* provided for in the CPP legislation, the constant annual increase applicable for 5 years starting in 1997 (scenario B), to the 1996 rate, is 0.39%, as compared to 0.25% under the existing 25-year schedule of contribution rates.

- The contribution rates of 11.80% and 14.07% projected under scenario B for 2016 and 2050, respectively, exceed those of the previous report by 1.70% and 0.96% of contributory earnings.

These differences from the previous (fourteenth) report are very significant. The 1993 year-end Account was accordingly overestimated by $805 million. This results from two main factors: lower contributions and higher expenditures for 1993. Indeed, although the previous report quite accurately projected contributions and expenditures for 1992 (both were underestimated by about 0.3%), for 1993 it overestimated contributions by $427 million and underestimated actual expenditures by $378 million. This is due mainly to the greater than expected effect of the recession of the early 1990s on employment earnings for 1993 (and hence contributions) and to higher than expected disability benefits.

The proportion of new CPP disability cases increased from 1992 to 1993 at a very high and unforeseen rate as shown in section 2(b)(viii) of appendix B. At the same time, the proportion of CPP disability recipients coming off benefits has been declining steadily since 1988, and the average duration of disability benefits has consequently been gradually increasing.

Higher projected expenditures in the long term, as compared to the previous report, stem primarily from the assumption that the higher incidence of disability (i.e., number of new cases as a proportion of the eligible population) experienced in recent years will be a permanent feature of the CPP.

In summary, the financial projections shown in this report indicate that the existing 25-year Schedule of contribution rates requires some revision to prevent the Account from becoming exhausted by the end of 2015.

2. Comparison with Previous Report

One way of understanding the differences between this report's projections and those of the previous report is by looking at the effect of three major factors (changes in methodology, experience and assumptions) on the pay-as-you-go rate (the ratio of the year's expenditure to the year's contributory earnings). This approach is useful because the CPP contribution rate generally corresponds to the pay-as-you-go rate except for the small margin resulting from the prescribed maintenance of an account equal to about two years of expenditures.

RECONCILIATION OF PAY-AS-YOU-GO RATES

	1994 %	1995 %	2000 %	2025 %	2050 %	2100 %
Fourteenth Report rates:	7.36	7.40	7.66	12.40	12.97	13.95
I- Improvements in valuation methodology (1)	-0.17	-0.14	-0.12	-0.29	-0.25	-0.26
II- Experience update (2)						
A- Demographic (3)	-0.17	-0.20	-0.25	-0.09	-0.01	-0.16
B- Economic (4)	0.18	0.20	0.03	0.01	0.04	0.02
C- Benefits in pay (5)	0.32	0.27	0.09	-0.04	-0.05	-0.04
Sub-Total II	0.33	0.26	-0.13	-0.12	-0.02	-0.18
III- Changes in assumptions						
A- Demographic						
i) fertility	0.00	0.00	0.00	0.00	0.00	0.00
ii) migration	0.01	0.00	0.00	-0.05	-0.10	-0.16
iii) miscellaneous (6)	0.11	0.31	0.89	1.52	1.50	1.40
Sub-Total A	0.12	0.31	0.89	1.47	1.40	1.24
B- Economic	0.04	-0.03	-0.05	0.03	0.01	0.01
Sub-Total III	0.16	0.28	0.84	1.50	1.41	1.25
Total I + II + III	0.32	0.40	0.59	1.09	1.14	0.81
Fifteenth Report rates:	7.68	7.80	8.25	13.49	14.11	14.76

(1) See Appendix B.
(2) Replacement of previously projected values by actual values.
(3) Updating previous projections in accordance with the 1991 census.
(4) Effect of the early 1990s recession on proportions of earners and average employment earnings.
(5) Effect of the early 1990s recession on disability benefits.
(6) Increase in assumed disability incidence rates.

3. Main Tables of Financial Projections

This section contains three main tables of financial projections developed on the basis of the set of main assumptions:

Main table 1A:	Account projection using the contribution rates of the existing 25-year (1992 to 2016) schedule until 2016 and those resulting from the *15-year formula* after 2016 (see Appendix A, paragraph 11).
Main table 1B:	Account projection using the contribution rates of the existing 25-year (1992 to 2016) schedule only until 1996 and those resulting from the *15-year formula* after 1996 (see Appendix A, paragraph 11).
Main table 2:	Projection of expenditures, by type, in millions of dollars.
Main table 3:	Projection of expenditures, by type, as a percentage of contributory earnings, i.e., the pay-as-you-go rates.

MAIN TABLE 1A
ACCOUNT PROJECTION
(millions of dollars)

The contribution rate for 1993 was 5.0%. Contribution rates for subsequent years were determined as follows:
1. From 1994 to 2016: the existing 25-year schedule.
2. After 2016, contribution rates were generated by the *15-year formula*.

YEAR	PAY-AS-YOU-GO RATE	CONTRIBUTION RATE	CHANGE IN CONT. RATE	CONTRIB. EARNINGS	CONTRIBUTIONS	EXPENDITURES	CASH FLOW	INVESTMENT EARNINGS	CHANGE IN ACCOUNT	YEAR-END ACCOUNT	ACCOUNT/EXPENDITURES RATIO
	%	%	%	$	$	$	$	$	$	$	
1994	7.68	5.20	0.20	200287	10415	15380	-4965	4436	-529	41191	2.50
1995	7.80	5.40	0.20	210931	11390	16456	-5066	4394	-672	40519	2.32
1996	7.85	5.60	0.20	222695	12471	17489	-5018	4308	-710	39808	2.14
1997	8.00	5.85	0.25	232684	13612	18616	-5004	4208	-796	39013	1.97
1998	8.11	6.10	0.25	244403	14909	19811	-4902	4097	-806	38207	1.81
1999	8.18	6.35	0.25	258034	16385	21109	-4724	3971	-753	37454	1.66
2000	8.25	6.60	0.25	273016	18019	22530	-4511	3818	-693	36760	1.52
2001	8.36	6.85	0.25	288716	19777	24130	-4353	3645	-708	36052	1.39
2002	8.50	7.10	0.25	304197	21598	25861	-4263	3394	-869	35183	1.27
2003	8.63	7.35	0.25	321060	23598	27714	-4116	3087	-1029	34154	1.15
2004	8.77	7.60	0.25	338899	25756	29712	-3956	2893	-1063	33091	1.04
2005	8.92	7.85	0.25	357209	28041	31858	-3817	2640	-1177	31914	0.93
2006	9.11	8.10	0.25	375130	30386	34160	-3774	2441	-1333	30581	0.83
2007	9.27	8.30	0.20	395583	32833	36675	-3842	2255	-1587	28994	0.74
2008	9.46	8.50	0.20	416767	35425	39420	-3995	2095	-1899	27095	0.64
2009	9.67	8.70	0.20	438125	38117	42378	-4261	1920	-2341	24754	0.54
2010	9.89	8.90	0.20	460647	40998	45541	-4543	1722	-2822	21932	0.45
2011	10.08	9.10	0.20	485129	44147	48905	-4758	1516	-3243	18689	0.36
2012	10.30	9.30	0.20	509286	47364	52479	-5115	1304	-3811	14878	0.26
2013	10.54	9.50	0.20	534463	50774	56351	-5577	1053	-4524	10353	0.17
2014	10.80	9.70	0.20	559852	54306	60475	-6169	755	-5415	4939	0.08
2015	11.03	9.90	0.20	587991	58211	64855	-6644	403	-6240	-1302	-0.02
2016	11.26	10.10	0.20	617250	62342	69504	-7162	1	-7161	-8463	-0.11
2017	11.52	10.73	0.63	646235	69341	74447	-5106	-413	-5519	-13982	-0.18
2018	11.78	11.36	0.63	676820	76887	79709	-2822	-723	-3546	-17528	-0.21
2019	12.03	11.99	0.63	708976	85006	85287	-281	-909	-1190	-18718	-0.21
2020	12.29	12.62	0.63	742176	93663	91198	2465	-948	1516	-17201	-0.18
2021	12.53	13.25	0.63	777513	103020	97454	5566	-817	4750	-12452	-0.12
2022	12.80	13.59	0.34	812803	110460	104014	6446	-529	5917	-6535	-0.06
2023	13.04	13.93	0.34	850384	118458	110921	7537	-166	7371	836	0.01
2024	13.28	14.27	0.34	889437	126923	118144	8779	286	9065	9901	0.08
2025	13.49	14.61	0.34	931098	136033	125641	10392	848	11241	21142	0.16
2030	14.22	15.43	0.12	1173082	181007	166766	14241	5285	19526	102800	0.58
2035	14.42	15.51	-0.01	1490477	231173	214914	16259	12211	28470	226720	1.00
2040	14.31	15.18	-0.08	1902838	288851	272377	16474	21957	38431	398757	1.40
2045	14.16	14.74	-0.09	2427750	357850	343770	14080	34729	48810	622135	1.73
2050	14.11	14.37	-0.07	3083488	443097	435048	8049	50483	58532	895607	1.96
2055	14.15	14.14	-0.04	3906080	552320	552860	-540	69049	68508	1217319	2.10
2060	14.23	13.98	-0.03	4945100	691325	703705	-12380	90518	78138	1588658	2.15
2065	14.28	13.91	-0.01	6269119	872034	895490	-23456	115159	91703	2017446	2.15
2070	14.32	13.94	0.01	7958022	1109348	1139293	-29945	144936	114992	2541031	2.13
2075	14.37	14.03	0.02	10096983	1416607	1451202	-34595	182971	148376	3212364	2.11
2100	14.76	14.44	0.01	32969880	4760851	4866777	-105927	592506	486579	10428743	2.04

MAIN TABLE 1B
ACCOUNT PROJECTION
(millions of dollars)

The contribution rate for 1993 was 5.0%. Contribution rates for subsequent years were determined as follows:
1. From 1994 to 1996: the existing 25-year schedule.
2. After 1996, contribution rates were generated by the *15-year formula*.

YEAR	PAY-AS-YOU-GO RATE	CONTRIBUTION RATE	CHANGE IN CONT. RATE	CONTRIB. EARNINGS	CONTRIBUTIONS	EXPENDITURES	CASH FLOW	INVESTMENT EARNINGS	CHANGE IN ACCOUNT	YEAR-END ACCOUNT	ACCOUNT/EXPENDITURES RATIO
	%	%	%	$	$	$	$	$	$	$	
1994	7.68	5.20	0.20	200287	10415	15380	-4965	4436	-529	41191	2.50
1995	7.80	5.40	0.20	210931	11390	16456	-5066	4394	-672	40519	2.32
1996	7.85	5.60	0.20	222695	12471	17489	-5018	4308	-710	39808	2.14
1997	8.00	5.99	0.39	232684	13938	18616	-4678	4216	-462	39346	1.99
1998	8.11	6.38	0.39	244403	15593	19811	-4218	4138	-80	39266	1.86
1999	8.18	6.77	0.39	258034	17469	21109	-3640	4072	432	39698	1.76
2000	8.25	7.16	0.39	273016	19548	22530	-2982	4005	1023	40720	1.69
2001	8.36	7.55	0.39	288716	21798	24130	-2332	3945	1613	42333	1.64
2002	8.50	7.88	0.33	304197	23971	25861	-1890	3843	1952	44286	1.60
2003	8.63	8.21	0.33	321060	26359	27714	-1355	3715	2360	46646	1.57
2004	8.77	8.54	0.33	338899	28942	29712	-770	3735	2965	49611	1.56
2005	8.92	8.87	0.33	357209	31684	31858	-174	3737	3563	53174	1.56
2006	9.11	9.20	0.33	375130	34512	34160	352	3836	4188	57362	1.56
2007	9.27	9.47	0.27	395583	37462	36675	787	3979	4766	62128	1.58
2008	9.46	9.74	0.27	416767	40593	39420	1173	4181	5354	67483	1.59
2009	9.67	10.01	0.27	438125	43856	42378	1478	4415	5893	73376	1.61
2010	9.89	10.28	0.27	460647	47355	45541	1814	4695	6508	79884	1.63
2011	10.08	10.55	0.27	485129	51181	48905	2276	4977	7253	87137	1.66
2012	10.30	10.80	0.25	509286	55003	52479	2524	5332	7856	94993	1.69
2013	10.54	11.05	0.25	534463	59058	56351	2707	5754	8461	103454	1.71
2014	10.80	11.30	0.25	559852	63263	60475	2788	6266	9055	112509	1.73
2015	11.03	11.55	0.25	587991	67913	64855	3058	6812	9870	122379	1.76
2016	11.26	11.80	0.25	617250	72836	69504	3332	7407	10739	133118	1.79
2017	11.52	12.00	0.20	646235	77548	74447	3101	8032	11133	144251	1.81
2018	11.78	12.20	0.20	676820	82572	79709	2863	8678	11541	155792	1.83
2019	12.03	12.40	0.20	708976	87913	85287	2626	9348	11974	167766	1.84
2020	12.29	12.60	0.20	742176	93514	91198	2316	10045	12361	180127	1.85
2021	12.53	12.80	0.20	777513	99522	97454	2068	10779	12846	192974	1.86
2022	12.80	12.95	0.15	812803	105258	104014	1244	11531	12775	205748	1.85
2023	13.04	13.10	0.15	850384	111400	110921	479	12279	12758	218506	1.85
2024	13.28	13.25	0.15	889437	117850	118144	-294	13024	12730	231237	1.84
2025	13.49	13.40	0.15	931098	124767	125641	-874	13771	12897	244133	1.83
2030	14.22	13.91	0.09	1173082	163176	166766	-3590	17630	14040	311129	1.77
2035	14.42	14.16	0.04	1490477	211052	214914	-3862	22180	18318	392162	1.74
2040	14.31	14.20	0.00	1902838	270203	272377	-2174	28526	26352	506174	1.77
2045	14.16	14.16	-0.01	2427750	343769	343770	-1	37729	37728	670770	1.86
2050	14.11	14.07	-0.02	3083488	433847	435048	-1201	50414	49213	894347	1.96
2055	14.15	14.01	-0.01	3906080	547242	552860	-5618	66421	60803	1174544	2.02
2060	14.23	14.00	0.00	4945100	692314	703705	-11391	86062	74671	1518393	2.06
2065	14.28	14.00	0.00	6269119	877677	895490	-17813	110302	92488	1943505	2.07
2070	14.32	14.04	0.01	7958022	1117306	1139293	-21987	140775	118789	2480810	2.07
2075	14.37	14.09	0.01	10096983	1422665	1451202	-28537	179993	151456	3171357	2.08
2100	14.76	14.44	0.01	32969880	4760851	4866777	-105927	589653	483727	10385643	2.03

MAIN TABLE 2
PROJECTION OF TOTAL EXPENDITURES
(millions of dollars)

		Disability				Survivor						
Year	Retirement	Flat-Rate	Earnings-Related	DCC Children	Sub-Total	Flat-Rate	Earnings-Related	Sub-Total	Orphans	Death	Expenses	Grand Total
1994	9780	1259	1345	260	2864	323	1787	2110	199	226	200	15380
1995	10326	1418	1524	295	3237	338	1904	2241	204	237	211	16456
1996	10888	1562	1691	329	3582	341	1997	2337	209	250	223	17489
1997	11525	1711	1864	362	3937	345	2096	2441	217	263	233	18616
1998	12204	1862	2037	392	4291	352	2214	2566	227	279	244	19811
1999	12952	2018	2217	421	4656	362	2347	2708	238	297	258	21109
2000	13793	2179	2400	449	5028	374	2495	2869	251	317	273	22530
2001	14752	2354	2601	479	5434	389	2661	3050	266	340	289	24130
2002	15788	2545	2820	510	5874	405	2844	3249	280	365	304	25861
2003	16903	2747	3056	542	6345	422	3035	3457	295	392	321	27714
2004	18120	2963	3310	574	6848	440	3235	3676	309	421	339	29712
2005	19439	3193	3584	607	7384	459	3444	3903	323	451	357	31858
2006	20876	3434	3874	640	7949	478	3661	4139	337	484	375	34160
2007	22482	3687	4183	672	8543	497	3888	4386	349	519	396	36675
2008	24290	3946	4503	703	9152	518	4126	4644	360	557	417	39420
2009	26273	4215	4838	733	9785	538	4375	4913	371	598	438	42378
2010	28414	4497	5191	764	10451	560	4634	5194	381	641	461	45541
2011	30731	4776	5551	795	11122	583	4905	5489	391	687	485	48905
2012	33300	5024	5885	826	11734	607	5192	5799	401	735	509	52479
2013	36130	5281	6228	857	12366	629	5494	6124	410	787	534	56351
2014	39150	5555	6595	889	13039	654	5811	6465	419	843	560	60475
2015	42370	5840	6983	921	13743	678	6145	6823	428	902	588	64855
2016	45810	6134	7386	953	14472	704	6498	7202	437	965	617	69504
2017	49498	6434	7803	986	15223	731	6871	7602	446	1032	646	74447
2018	53474	6732	8222	1020	15973	758	7267	8025	456	1104	677	79709
2019	57749	7021	8636	1054	16711	785	7688	8472	466	1180	709	85287
2020	62334	7303	9047	1089	17439	812	8134	8946	476	1261	742	91198
2021	67224	7585	9460	1125	18169	839	8609	9448	487	1348	778	97454
2022	72427	7842	9849	1162	18853	867	9115	9981	499	1441	813	104014
2023	77955	8084	10228	1202	19514	894	9655	10549	512	1540	850	110921
2024	83761	8320	10607	1244	20170	922	10232	11153	526	1645	889	118144
2025	89816	8538	10974	1288	20800	949	10847	11796	541	1757	931	125641
2030	122711	9617	12974	1553	24145	1086	14591	15677	631	2429	1173	166766
2035	159071	11366	16192	1898	29456	1242	19597	20839	749	3309	1490	214914
2040	200905	13786	20748	2313	36847	1442	25986	27427	891	4403	1903	272377
2045	252120	17072	27114	2798	46985	1703	33772	35475	1060	5703	2428	343770
2050	319287	20883	34953	3369	59205	2033	42964	44997	1259	7217	3083	435048
2055	408491	25246	44485	4059	73791	2426	53751	56177	1496	8999	3906	552860
2060	525315	30138	55826	4911	90875	2881	66717	69598	1778	11194	4945	703705
2065	674265	36179	70399	5954	112533	3412	82879	86291	2114	14018	6269	895490
2070	862951	43819	89532	7209	140559	4048	103545	107593	2513	17719	7958	1139293
2075	1104085	53362	114498	8702	176561	4819	130116	134935	2986	22537	10097	1451202
2100	3793977	136609	373545	22373	532528	11425	415573	426999	7063	73240	32970	4866777

MAIN TABLE 3
PROJECTION OF TOTAL EXPENDITURES
(as a percentage of contributory earnings, i.e., pay-as-you-go rate)

		Disability				Survivor						
Year	Retirement	Flat-Rate	Earnings-Related	DCC Children	Sub-Total	Flat-Rate	Earnings-Related	Sub-Total	Orphans	Death	Expenses	Total Pay-As-You-Go Rate
1994	4.88	0.63	0.67	0.13	1.43	0.16	0.89	1.05	0.10	0.11	0.10	7.68
1995	4.90	0.67	0.72	0.14	1.53	0.16	0.90	1.06	0.10	0.11	0.10	7.80
1996	4.89	0.70	0.76	0.15	1.61	0.15	0.90	1.05	0.09	0.11	0.10	7.85
1997	4.95	0.74	0.80	0.16	1.69	0.15	0.90	1.05	0.09	0.11	0.10	8.00
1998	4.99	0.76	0.83	0.16	1.76	0.14	0.91	1.05	0.09	0.11	0.10	8.11
1999	5.02	0.78	0.86	0.16	1.80	0.14	0.91	1.05	0.09	0.11	0.10	8.18
2000	5.05	0.80	0.88	0.16	1.84	0.14	0.91	1.05	0.09	0.12	0.10	8.25
2001	5.11	0.82	0.90	0.17	1.88	0.13	0.92	1.06	0.09	0.12	0.10	8.36
2002	5.19	0.84	0.93	0.17	1.93	0.13	0.93	1.07	0.09	0.12	0.10	8.50
2003	5.26	0.86	0.95	0.17	1.98	0.13	0.95	1.08	0.09	0.12	0.10	8.63
2004	5.35	0.87	0.98	0.17	2.02	0.13	0.95	1.08	0.09	0.12	0.10	8.77
2005	5.44	0.89	1.00	0.17	2.07	0.13	0.96	1.09	0.09	0.13	0.10	8.92
2006	5.56	0.92	1.03	0.17	2.12	0.13	0.98	1.10	0.09	0.13	0.10	9.11
2007	5.68	0.93	1.06	0.17	2.16	0.13	0.98	1.11	0.09	0.13	0.10	9.27
2008	5.83	0.95	1.08	0.17	2.20	0.12	0.99	1.11	0.09	0.13	0.10	9.46
2009	6.00	0.96	1.10	0.17	2.23	0.12	1.00	1.12	0.08	0.14	0.10	9.67
2010	6.17	0.98	1.13	0.17	2.27	0.12	1.01	1.13	0.08	0.14	0.10	9.89
2011	6.33	0.98	1.14	0.16	2.29	0.12	1.01	1.13	0.08	0.14	0.10	10.08
2012	6.54	0.99	1.16	0.16	2.30	0.12	1.02	1.14	0.08	0.14	0.10	10.30
2013	6.76	0.99	1.17	0.16	2.31	0.12	1.03	1.15	0.08	0.15	0.10	10.54
2014	6.99	0.99	1.18	0.16	2.33	0.12	1.04	1.15	0.07	0.15	0.10	10.80
2015	7.21	0.99	1.19	0.16	2.34	0.12	1.05	1.16	0.07	0.15	0.10	11.03
2016	7.42	0.99	1.20	0.15	2.34	0.11	1.05	1.17	0.07	0.16	0.10	11.26
2017	7.66	1.00	1.21	0.15	2.36	0.11	1.06	1.18	0.07	0.16	0.10	11.52
2018	7.90	0.99	1.21	0.15	2.36	0.11	1.07	1.19	0.07	0.16	0.10	11.78
2019	8.15	0.99	1.22	0.15	2.36	0.11	1.08	1.20	0.07	0.17	0.10	12.03
2020	8.40	0.98	1.22	0.15	2.35	0.11	1.10	1.21	0.06	0.17	0.10	12.29
2021	8.65	0.98	1.22	0.14	2.34	0.11	1.11	1.22	0.06	0.17	0.10	12.53
2022	8.91	0.96	1.21	0.14	2.32	0.11	1.12	1.23	0.06	0.18	0.10	12.80
2023	9.17	0.95	1.20	0.14	2.29	0.11	1.14	1.24	0.06	0.18	0.10	13.04
2024	9.42	0.94	1.19	0.14	2.27	0.10	1.15	1.25	0.06	0.18	0.10	13.28
2025	9.65	0.92	1.18	0.14	2.23	0.10	1.16	1.27	0.06	0.19	0.10	13.49
2030	10.46	0.82	1.11	0.13	2.06	0.09	1.24	1.34	0.05	0.21	0.10	14.22
2035	10.67	0.76	1.09	0.13	1.98	0.08	1.31	1.40	0.05	0.22	0.10	14.42
2040	10.56	0.72	1.09	0.12	1.94	0.08	1.37	1.44	0.05	0.23	0.10	14.31
2045	10.38	0.70	1.12	0.12	1.94	0.07	1.39	1.46	0.04	0.23	0.10	14.16
2050	10.35	0.68	1.13	0.11	1.92	0.07	1.39	1.46	0.04	0.23	0.10	14.11
2055	10.46	0.65	1.14	0.10	1.89	0.06	1.38	1.44	0.04	0.23	0.10	14.15
2060	10.62	0.61	1.13	0.10	1.84	0.06	1.35	1.41	0.04	0.23	0.10	14.23
2065	10.76	0.58	1.12	0.09	1.80	0.05	1.32	1.38	0.03	0.22	0.10	14.28
2070	10.84	0.55	1.13	0.09	1.77	0.05	1.30	1.35	0.03	0.22	0.10	14.32
2075	10.93	0.53	1.13	0.09	1.75	0.05	1.29	1.34	0.03	0.22	0.10	14.37
2100	11.51	0.41	1.13	0.07	1.62	0.03	1.26	1.30	0.02	0.22	0.10	14.76

4. Sensitivity of Projections to Assumptions

Eight tables of auxiliary Account projections have been prepared to provide an indication of the degree to which the results of this report depend on each of its key assumptions. The differences between the results shown in main table 1B and in those of one or more given auxiliary Account projections tables can also serve as the basis for deriving a reasonable approximation of the projected effect of larger or smaller changes in the value specified by one or more of the key assumptions. However, one must bear in mind that any such calculation does not take into account either the extent to which the effect of changing a given assumption may not be strictly linear, or the interaction effect that may come into play when more than one assumption is changed.

Each of the eight auxiliary Account projections below was developed using until 1996 the contribution rates of the existing 25-year schedule, and, thereafter, the rates generated by the *15-year formula* (see Appendix A, section 11). Each auxiliary Account projection is based on a set of assumptions that differs in the following respects from the set underlying main table 1B:

Auxiliary table 1:	0.1 arithmetic increase in the total ultimate **fertility** rate, i.e., 1.95 for Canada and 1.90 for Québec instead of 1.85 and 1.80, respectively).
Auxiliary table 2:	10% geometric increase in the **net immigration** to Canada (124,300 or 0.4408% of the Canada population, instead of 113,000 or 0.4007% of the Canada population).
Auxiliary table 3:	**improvements in life expectancy:** 10% geometric decrease in each of the annual mortality reduction factors assumed for 1987 and subsequent years (i.e., a reduction factor of 0.8 would be decreased to 0.72).
Auxiliary table 4:	0.25% arithmetic increase in the ultimate annual rate of increase in **earnings** (i.e., 4.75% instead of 4.5%).
Auxiliary table 5:	0.25% arithmetic decrease in the ultimate annual rate of increase in **prices** (i.e., 3.25% instead of 3.5%).
Auxiliary table 6:	1% arithmetic increase in the nominal annual rate of **interest** on new loans (annual Fund increase) to provinces (i.e., 7% instead of 6%).
Auxiliary table 7:	0.5 arithmetic decrease in the ultimate **disability incidence** rate (5.0 per 1,000 instead of 5.5)
Auxiliary table 8:	1% constant (each year starting in 1993 for both sexes at all ages) geometric decrease in **proportions of earners**.

AUXILIARY TABLE 1 (fertility rate: +0.1)
ACCOUNT PROJECTION
(millions of dollars)

Future contribution rates were determined as follows:
1. From 1994 to 1996: the existing 25-year schedule.
2. After 1996, contribution rates were generated by the *15-year formula*.

YEAR	PAY-AS-YOU-GO RATE	CONTRIBUTION RATE	CHANGE IN CONT. RATE	CONTRIB. EARNINGS	CONTRIBUTIONS	EXPENDITURES	CASH FLOW	INVESTMENT EARNINGS	CHANGE IN ACCOUNT	YEAR-END ACCOUNT	ACCOUNT/EXPENDITURES RATIO
	%	%	%	$	$	$	$	$	$	$	
1994	7.68	5.20	0.20	200287	10415	15380	-4965	4436	-529	41191	2.50
1995	7.80	5.40	0.20	210931	11390	16456	-5066	4394	-672	40519	2.32
1996	7.85	5.60	0.20	222696	12471	17489	-5018	4308	-710	39808	2.14
1997	8.00	5.99	0.39	232686	13938	18616	-4678	4216	-462	39346	1.99
1998	8.11	6.38	0.39	244407	15593	19812	-4219	4138	-81	39265	1.86
1999	8.18	6.77	0.39	258039	17469	21111	-3642	4072	430	39695	1.76
2000	8.25	7.16	0.39	273025	19549	22532	-2983	4004	1021	40716	1.69
2001	8.36	7.55	0.39	288729	21799	24133	-2334	3945	1611	42327	1.64
2002	8.50	7.88	0.33	304216	23972	25865	-1893	3842	1950	44277	1.60
2003	8.63	8.21	0.33	321086	26361	27720	-1359	3714	2356	46632	1.57
2004	8.77	8.54	0.33	338935	28945	29720	-775	3734	2959	49591	1.56
2005	8.92	8.87	0.33	357256	31689	31868	-179	3735	3556	53147	1.56
2006	9.11	9.20	0.33	375191	34518	34173	345	3835	4179	57327	1.56
2007	9.27	9.47	0.27	395660	37469	36691	778	3977	4755	62081	1.57
2008	9.46	9.74	0.27	416863	40602	39440	1162	4178	5341	67422	1.59
2009	9.68	10.01	0.27	438242	43868	42403	1465	4411	5876	73298	1.61
2010	9.89	10.28	0.27	460789	47369	45572	1797	4689	6487	79784	1.63
2011	10.08	10.55	0.27	485318	51201	48941	2260	4971	7231	87015	1.66
2012	10.31	10.79	0.24	509567	54982	52522	2460	5323	7783	94798	1.68
2013	10.54	11.03	0.24	534891	58998	56402	2596	5740	8337	103135	1.70
2014	10.80	11.27	0.24	560496	63168	60533	2635	6244	8879	112014	1.73
2015	11.02	11.51	0.24	588937	67787	64920	2867	6779	9645	121659	1.75
2016	11.25	11.75	0.24	618600	72686	69578	3108	7359	10467	132126	1.77
2017	11.50	11.95	0.20	648102	77448	74529	2919	7968	10887	143013	1.79
2018	11.75	12.15	0.20	679338	82540	79799	2741	8599	11340	154353	1.81
2019	11.99	12.35	0.20	712276	87966	85385	2581	9259	11840	166192	1.82
2020	12.23	12.55	0.20	746374	93670	91305	2365	9950	12315	178507	1.83
2021	12.47	12.75	0.20	782738	99799	97570	2229	10682	12912	191419	1.84
2022	12.71	12.89	0.14	819167	105591	104140	1451	11439	12890	204309	1.84
2023	12.94	13.03	0.14	858021	111800	111059	741	12195	12936	217245	1.84
2024	13.17	13.17	0.14	898473	118329	118294	35	12953	12987	230232	1.83
2025	13.36	13.31	0.14	941668	125336	125805	-469	13716	13247	243479	1.82
2030	14.00	13.73	0.07	1193522	163871	167038	-3167	17713	14546	312882	1.78
2035	14.12	13.88	0.02	1525883	211793	215387	-3594	22417	18823	396485	1.75
2040	13.93	13.82	-0.02	1961051	271017	273218	-2201	28895	26695	512612	1.79
2045	13.70	13.68	-0.03	2520853	344853	345258	-405	38160	37755	678036	1.87
2050	13.55	13.53	-0.03	3229025	436887	437682	-795	50923	50128	903583	1.97
2055	13.51	13.42	-0.02	4127144	553863	557651	-3788	67462	63673	1194108	2.04
2060	13.55	13.36	-0.01	5267594	703751	713549	-9798	88126	78328	1555770	2.07
2065	13.61	13.35	0.00	6725583	897865	915151	-17286	113412	96126	1998715	2.08
2070	13.65	13.39	0.01	8598300	1151312	1173611	-22299	144943	122645	2554444	2.07
2075	13.70	13.44	0.01	10993326	1477503	1505941	-28438	185454	157016	3268630	2.06
2100	14.05	13.79	0.01	37328096	5147544	5244341	-96797	638657	541860	11259847	2.04

AUXILIARY TABLE 2 (net immigration: +10%)
ACCOUNT PROJECTION
(millions of dollars)

Future contribution rates were determined as follows:
1. From 1994 to 1996: the existing 25-year schedule.
2. After 1996, contribution rates were generated by the *15-year formula*.

YEAR	PAY-AS-YOU-GO RATE	CONTRIBUTION RATE	CHANGE IN CONT. RATE	CONTRIB. EARNINGS	CONTRIBUTIONS	EXPENDITURES	CASH FLOW	INVESTMENT EARNINGS	CHANGE IN ACCOUNT	YEAR-END ACCOUNT	ACCOUNT/EXPENDITURES RATIO
	%	%	%	$	$	$	$	$	$	$	
1994	7.67	5.20	0.20	200496	10426	15382	-4956	4436	-520	41200	2.50
1995	7.79	5.40	0.20	211261	11408	16460	-5052	4395	-657	40543	2.32
1996	7.84	5.60	0.20	223163	12497	17495	-4998	4310	-688	39855	2.14
1997	7.98	5.98	0.38	233297	13951	18625	-4674	4220	-454	39402	1.99
1998	8.09	6.36	0.38	245178	15593	19824	-4231	4142	-88	39313	1.86
1999	8.16	6.74	0.38	258991	17456	21125	-3669	4076	407	39720	1.76
2000	8.22	7.12	0.38	274178	19521	22551	-3030	4006	977	40697	1.68
2001	8.33	7.50	0.38	290094	21757	24156	-2399	3943	1545	42241	1.63
2002	8.47	7.82	0.32	305808	23914	25893	-1979	3837	1858	44099	1.59
2003	8.59	8.14	0.32	322929	26286	27753	-1467	3703	2236	46335	1.56
2004	8.73	8.46	0.32	341053	28853	29759	-906	3715	2809	49144	1.54
2005	8.87	8.78	0.32	359672	31579	31915	-336	3706	3370	52514	1.53
2006	9.06	9.10	0.32	377923	34391	34227	164	3794	3958	56472	1.54
2007	9.22	9.38	0.28	398749	37403	36755	648	3923	4571	61043	1.54
2008	9.40	9.66	0.28	420336	40604	39513	1091	4114	5206	66248	1.56
2009	9.61	9.94	0.28	442125	43947	42487	1460	4340	5800	72049	1.58
2010	9.82	10.22	0.28	465115	47535	45668	1867	4615	6482	78531	1.60
2011	10.01	10.50	0.28	490120	51463	49052	2411	4898	7308	85839	1.63
2012	10.23	10.74	0.24	514832	55293	52648	2645	5255	7900	93739	1.66
2013	10.46	10.98	0.24	540610	59359	56546	2813	5680	8493	102233	1.68
2014	10.71	11.22	0.24	566639	63577	60699	2878	6194	9072	111304	1.71
2015	10.93	11.46	0.24	595491	68243	65111	3132	6741	9873	121177	1.74
2016	11.16	11.70	0.24	625520	73186	69797	3389	7335	10723	131901	1.76
2017	11.41	11.90	0.20	655318	77983	74781	3202	7959	11160	143061	1.79
2018	11.66	12.10	0.20	686784	83101	80088	3013	8606	11619	154680	1.80
2019	11.91	12.30	0.20	719894	88547	85717	2830	9282	12112	166792	1.82
2020	12.16	12.50	0.20	754116	94265	91686	2579	9989	12568	179360	1.83
2021	12.40	12.70	0.20	790565	100402	98006	2396	10736	13132	192492	1.84
2022	12.65	12.85	0.15	827020	106272	104637	1635	11507	13142	205634	1.84
2023	12.89	13.00	0.15	865862	112562	111623	939	12278	13217	218851	1.84
2024	13.12	13.15	0.15	906260	119173	118935	238	13053	13291	232142	1.83
2025	13.33	13.30	0.15	949372	126266	126529	-263	13835	13572	245714	1.83
2030	14.02	13.77	0.08	1200182	165265	168314	-3049	17934	14885	316856	1.78
2035	14.22	13.97	0.03	1529737	213704	217485	-3781	22714	18933	401595	1.76
2040	14.11	14.00	0.00	1958844	274238	276457	-2219	29229	27010	518533	1.79
2045	13.96	13.96	-0.01	2506751	349942	350016	-74	38650	38576	686982	1.87
2050	13.91	13.91	-0.01	3193814	444260	444353	-93	51743	51650	918624	1.97
2055	13.96	13.86	-0.01	4058911	562565	566439	-3874	68717	64843	1216249	2.04
2060	14.03	13.81	-0.01	5155055	711913	723238	-11325	89568	78244	1580206	2.08
2065	14.08	13.80	0.00	6555504	904660	923270	-18611	114820	96210	2022654	2.09
2070	14.12	13.84	0.01	8346647	1155176	1178365	-23189	146482	123293	2580811	2.09
2075	14.17	13.89	0.01	10622206	1475424	1505617	-30193	187142	156949	3296761	2.08
2100	14.55	14.28	0.02	35226792	5030386	5126074	-95688	620153	524465	10934132	2.03

AUXILIARY TABLE 3 (improvement in life expectancy: -10%)
ACCOUNT PROJECTION
(millions of dollars)

Future contribution rates were determined as follows:
1. From 1994 to 1996: the existing 25-year schedule.
2. After 1996, contribution rates were generated by the *15-year formula*.

YEAR	PAY-AS-YOU-GO RATE	CONTRIBUTION RATE	CHANGE IN CONT. RATE	CONTRIB. EARNINGS	CONTRIBUTIONS	EXPENDITURES	CASH FLOW	INVESTMENT EARNINGS	CHANGE IN ACCOUNT	YEAR-END ACCOUNT	ACCOUNT/EXPENDITURES RATIO
	%	%	%	$	$	$	$	$	$	$	
1994	7.68	5.20	0.20	200273	10414	15376	-4962	4436	-526	41194	2.50
1995	7.80	5.40	0.20	210907	11389	16450	-5061	4394	-667	40527	2.32
1996	7.85	5.60	0.20	222661	12469	17480	-5011	4309	-702	39825	2.14
1997	8.00	5.99	0.39	232638	13935	18604	-4669	4218	-451	39373	1.99
1998	8.10	6.38	0.39	244345	15589	19795	-4206	4141	-65	39308	1.86
1999	8.17	6.77	0.39	257960	17464	21088	-3624	4076	452	39760	1.77
2000	8.25	7.16	0.39	272925	19541	22504	-2963	4010	1047	40807	1.69
2001	8.35	7.55	0.39	288607	21790	24097	-2307	3952	1645	42452	1.64
2002	8.49	7.87	0.32	304069	23930	25820	-1890	3851	1961	44414	1.61
2003	8.62	8.19	0.32	320910	26283	27665	-1382	3724	2341	46755	1.58
2004	8.75	8.51	0.32	338726	28826	29653	-827	3742	2914	49669	1.56
2005	8.90	8.83	0.32	357010	31524	31788	-264	3740	3476	53145	1.56
2006	9.09	9.15	0.32	374905	34304	34078	226	3834	4059	57205	1.56
2007	9.25	9.43	0.28	395327	37279	36579	700	3969	4670	61874	1.57
2008	9.44	9.71	0.28	416479	40440	39309	1131	4166	5297	67172	1.59
2009	9.65	9.99	0.28	437803	43737	42249	1488	4397	5885	73057	1.61
2010	9.86	10.27	0.28	460288	47272	45394	1878	4678	6555	79612	1.63
2011	10.05	10.55	0.28	484729	51139	48737	2402	4964	7366	86978	1.66
2012	10.28	10.79	0.24	508844	54904	52288	2616	5325	7941	94920	1.69
2013	10.51	11.03	0.24	533976	58898	56135	2763	5752	8515	103435	1.72
2014	10.77	11.27	0.24	559318	63035	60231	2804	6267	9071	112506	1.74
2015	10.99	11.51	0.24	587406	67610	64581	3029	6813	9843	122349	1.77
2016	11.22	11.75	0.24	616610	72452	69198	3254	7406	10659	133008	1.79
2017	11.48	11.95	0.20	645539	77142	74106	3036	8026	11062	144069	1.82
2018	11.73	12.15	0.20	676062	82142	79329	2813	8667	11479	155549	1.83
2019	11.98	12.35	0.20	708154	87457	84864	2593	9333	11926	167475	1.85
2020	12.24	12.55	0.20	741285	93031	90730	2301	10028	12330	179805	1.85
2021	12.48	12.75	0.20	776549	99010	96936	2074	10761	12835	192640	1.86
2022	12.74	12.90	0.15	811764	104718	103440	1278	11512	12790	205430	1.86
2023	12.99	13.05	0.15	849263	110829	110288	541	12262	12803	218232	1.86
2024	13.22	13.20	0.15	888232	117247	117446	-199	13011	12811	231044	1.85
2025	13.43	13.35	0.15	929802	124129	124873	-744	13763	13019	244062	1.84
2030	14.14	13.82	0.08	1171229	161864	165556	-3692	17649	13956	311326	1.78
2035	14.32	14.06	0.04	1487813	209187	213076	-3890	22164	18275	391787	1.75
2040	14.20	14.10	0.00	1898998	267759	269677	-1918	28538	26619	506443	1.79
2045	14.03	14.02	-0.02	2422230	339597	339923	-326	37788	37462	671400	1.89
2050	13.97	13.92	-0.02	3075651	428131	429720	-1589	50341	48752	892572	1.98
2055	14.01	13.86	-0.01	3895096	539860	545643	-5783	66227	60444	1170739	2.04
2060	14.08	13.81	-0.01	4929872	680815	694056	-13241	85580	72339	1508290	2.07
2065	14.13	13.80	0.00	6248123	862241	882643	-20402	108844	88442	1915787	2.07
2070	14.15	13.84	0.01	7929155	1097395	1122117	-24722	137907	113185	2428300	2.06
2075	14.20	13.89	0.01	10057430	1396977	1428097	-31120	175222	144102	3085631	2.06
2100	14.54	14.24	0.01	32790092	4669309	4768401	-99092	579127	480035	10203260	2.04

AUXILIARY TABLE 4 (earnings: +0.25%)
ACCOUNT PROJECTION
(millions of dollars)

Future contribution rates were determined as follows:
1. From 1994 to 1996: the existing 25-year schedule.
2. After 1996, contribution rates were generated by the *15-year formula*.

YEAR	PAY-AS-YOU-GO RATE	CONTRIBUTION RATE	CHANGE IN CONT. RATE	CONTRIB. EARNINGS	CONTRIBUTIONS	EXPENDITURES	CASH FLOW	INVESTMENT EARNINGS	CHANGE IN ACCOUNT	YEAR-END ACCOUNT	ACCOUNT/EXPENDITURES RATIO
	%	%	%	$	$	$	$	$	$	$	
1994	7.68	5.20	0.20	200287	10415	15380	-4965	4436	-529	41191	2.50
1995	7.80	5.40	0.20	210931	11390	16456	-5066	4394	-672	40519	2.32
1996	7.85	5.60	0.20	222695	12471	17489	-5018	4308	-710	39808	2.14
1997	8.00	5.98	0.38	232684	13915	18616	-4701	4215	-486	39322	1.98
1998	8.11	6.36	0.38	244403	15544	19811	-4267	4135	-132	39190	1.86
1999	8.18	6.74	0.38	258034	17391	21109	-3718	4065	347	39537	1.75
2000	8.24	7.12	0.38	273363	19463	22531	-3068	3992	924	40461	1.68
2001	8.34	7.50	0.38	289444	21708	24131	-2423	3926	1503	41965	1.62
2002	8.45	7.81	0.31	306239	23917	25865	-1948	3818	1870	43835	1.58
2003	8.56	8.12	0.31	324030	26311	27725	-1414	3685	2271	46106	1.55
2004	8.70	8.43	0.31	341672	28803	29733	-930	3698	2768	48873	1.53
2005	8.84	8.74	0.31	361015	31553	31897	-344	3687	3343	52216	1.53
2006	8.97	9.05	0.31	381698	34544	34225	319	3776	4094	56310	1.53
2007	9.14	9.32	0.27	402112	37477	36771	706	3912	4617	60928	1.54
2008	9.30	9.59	0.27	425464	40802	39561	1241	4107	5348	66276	1.56
2009	9.50	9.86	0.27	448134	44186	42573	1613	4342	5955	72231	1.58
2010	9.69	10.13	0.27	472518	47866	45804	2062	4627	6689	78920	1.60
2011	9.89	10.40	0.27	497695	51760	49245	2515	4920	7436	86355	1.63
2012	10.09	10.63	0.23	524349	55738	52916	2822	5287	8109	94464	1.66
2013	10.33	10.86	0.23	550858	59823	56903	2920	5723	8643	103108	1.69
2014	10.54	11.09	0.23	580194	64344	61164	3180	6249	9429	112536	1.71
2015	10.78	11.32	0.23	609368	68980	65698	3282	6815	10097	122633	1.74
2016	10.99	11.55	0.23	641517	74095	70525	3570	7423	10993	133626	1.77
2017	11.23	11.75	0.20	673985	79193	75670	3523	8066	11590	145216	1.79
2018	11.48	11.95	0.20	706890	84473	81159	3314	8740	12054	157270	1.81
2019	11.71	12.15	0.20	742761	90245	86997	3248	9444	12693	169963	1.82
2020	11.97	12.35	0.20	778510	96146	93201	2945	10186	13131	183094	1.83
2021	12.20	12.55	0.20	817811	102635	99784	2851	10968	13820	196914	1.85
2022	12.43	12.69	0.14	858193	108905	106708	2197	11782	13979	210893	1.85
2023	12.69	12.83	0.14	898735	115308	114016	1292	12600	13891	224784	1.85
2024	12.89	12.97	0.14	943696	122397	121683	714	13417	14131	238915	1.84
2025	13.11	13.11	0.14	989156	129678	129661	17	14245	14263	253178	1.84
2030	13.79	13.57	0.08	1260749	171084	173819	-2735	18577	15842	328483	1.79
2035	13.95	13.77	0.03	1621343	223259	226214	-2955	23748	20793	420524	1.77
2040	13.82	13.76	-0.01	2095464	288336	289620	-1284	30917	29633	549089	1.81
2045	13.66	13.71	-0.01	2704792	370827	369497	1330	41291	42621	734696	1.89
2050	13.60	13.62	-0.02	3477819	473679	473001	678	55719	56397	989474	1.99
2055	13.64	13.56	-0.01	4458372	604555	608256	-3701	74113	70412	1311921	2.05
2060	13.72	13.55	0.00	5712777	774081	783515	-9434	96954	87520	1712460	2.08
2065	13.77	13.55	0.00	7328066	992953	1008799	-15846	125494	109648	2213751	2.09
2070	13.79	13.55	0.00	9414313	1275639	1298327	-22688	161444	138757	2846334	2.08
2075	13.84	13.59	0.01	12087853	1642739	1672946	-30207	207081	176874	3650457	2.07
2100	14.20	13.99	0.01	41895688	5861207	5949540	-88334	723320	634987	12767747	2.04

AUXILIARY TABLE 5 (prices: -0.25%)
ACCOUNT PROJECTION
(millions of dollars)

Future contribution rates were determined as follows:
1. From 1994 to 1996: the existing 25-year schedule.
2. After 1996, contribution rates were generated by the *15-year formula*.

YEAR	PAY-AS-YOU-GO RATE	CONTRIBUTION RATE	CHANGE IN CONT. RATE	CONTRIB. EARNINGS	CONTRIBUTIONS	EXPENDITURES	CASH FLOW	INVESTMENT EARNINGS	CHANGE IN ACCOUNT	YEAR-END ACCOUNT	ACCOUNT/EXPENDITURES RATIO
	%	%	%	$	$	$	$	$	$	$	
1994	7.68	5.20	0.20	200287	10415	15380	-4965	4436	-529	41191	2.50
1995	7.80	5.40	0.20	210931	11390	16456	-5066	4394	-672	40519	2.32
1996	7.85	5.60	0.20	222695	12471	17489	-5018	4308	-710	39808	2.14
1997	8.00	5.98	0.38	232684	13915	18616	-4701	4215	-486	39322	1.98
1998	8.11	6.36	0.38	244403	15544	19811	-4267	4135	-132	39190	1.86
1999	8.18	6.74	0.38	258034	17391	21109	-3718	4065	347	39537	1.75
2000	8.25	7.12	0.38	273016	19439	22530	-3091	3991	900	40437	1.68
2001	8.34	7.50	0.38	288716	21654	24088	-2434	3924	1490	41927	1.63
2002	8.47	7.81	0.31	304197	23758	25760	-2002	3814	1812	43740	1.59
2003	8.58	8.12	0.31	321060	26070	27549	-1479	3678	2199	45939	1.56
2004	8.70	8.43	0.31	338899	28569	29479	-910	3688	2778	48717	1.54
2005	8.83	8.74	0.31	357209	31220	31553	-333	3678	3345	52063	1.54
2006	9.00	9.05	0.31	375130	33949	33778	171	3765	3936	55999	1.55
2007	9.15	9.32	0.27	395583	36868	36211	657	3893	4550	60549	1.56
2008	9.33	9.59	0.27	416767	39968	38868	1100	4083	5183	65732	1.58
2009	9.53	9.86	0.27	438125	43199	41732	1467	4308	5775	71507	1.60
2010	9.72	10.13	0.27	460647	46664	44795	1869	4582	6450	77957	1.62
2011	9.91	10.40	0.27	485129	50453	48053	2400	4862	7263	85220	1.65
2012	10.12	10.63	0.23	509286	54137	51515	2622	5217	7839	93059	1.68
2013	10.34	10.86	0.23	534463	58043	55270	2773	5638	8411	101470	1.71
2014	10.59	11.09	0.23	559852	62088	59267	2821	6147	8968	110438	1.74
2015	10.80	11.32	0.23	587991	66561	63512	3049	6688	9736	120174	1.77
2016	11.02	11.55	0.23	617250	71292	68018	3274	7274	10548	130723	1.80
2017	11.27	11.74	0.19	646235	75868	72808	3060	7888	10948	141670	1.82
2018	11.51	11.93	0.19	676820	80745	77908	2837	8523	11360	153030	1.84
2019	11.75	12.12	0.19	708976	85928	83314	2614	9183	11797	164827	1.85
2020	12.00	12.31	0.19	742176	91362	89045	2317	9871	12188	177015	1.86
2021	12.23	12.50	0.19	777513	97189	95109	2080	10595	12675	189691	1.87
2022	12.48	12.64	0.14	812803	102738	101467	1271	11337	12609	202299	1.87
2023	12.72	12.78	0.14	850384	108679	108162	517	12076	12593	214892	1.87
2024	12.95	12.92	0.14	889437	114915	115161	-246	12812	12566	227459	1.86
2025	13.15	13.06	0.14	931098	121601	122421	-820	13549	12730	240188	1.85
2030	13.82	13.52	0.08	1173082	158601	162162	-3561	17355	13794	306169	1.79
2035	13.99	13.72	0.03	1490477	204493	208516	-4023	21805	17783	385255	1.76
2040	13.86	13.75	0.00	1902838	261640	263761	-2121	27984	25864	496425	1.80
2045	13.69	13.67	-0.02	2427750	331873	332452	-579	36976	36397	656774	1.89
2050	13.64	13.57	-0.02	3083488	418429	420475	-2046	49140	47095	870972	1.97
2055	13.68	13.51	-0.01	3906080	527711	534257	-6546	64417	57872	1138248	2.03
2060	13.75	13.50	0.00	4945100	667589	679982	-12394	83046	70653	1464245	2.05
2065	13.80	13.50	0.00	6269119	846331	865070	-18739	105927	87188	1865494	2.06
2070	13.82	13.54	0.01	7958022	1077516	1100110	-22594	134637	112043	2372005	2.05
2075	13.87	13.59	0.01	10096983	1372180	1400686	-28506	171649	143143	3024185	2.06
2100	14.23	13.94	0.01	32969880	4596002	4692467	-96466	568000	471535	10008404	2.03

AUXILIARY TABLE 6 (interest rate: +1%)
ACCOUNT PROJECTION
(millions of dollars)

Future contribution rates were determined as follows:
1. From 1994 to 1996: the existing 25-year schedule.
2. After 1996, contribution rates were generated by the *15-year formula*.

YEAR	PAY-AS-YOU-GO RATE	CONTRIBUTION RATE	CHANGE IN CONT. RATE	CONTRIB. EARNINGS	CONTRIBUTIONS	EXPENDITURES	CASH FLOW	INVESTMENT EARNINGS	CHANGE IN ACCOUNT	YEAR-END ACCOUNT	ACCOUNT/EXPENDITURES RATIO
	%	%	%	$	$	$	$	$	$	$	
1994	7.68	5.20	0.20	200287	10415	15380	-4965	4436	-529	41191	2.50
1995	7.80	5.40	0.20	210931	11390	16456	-5066	4394	-672	40519	2.32
1996	7.85	5.60	0.20	222695	12471	17489	-5018	4308	-710	39808	2.14
1997	8.00	5.98	0.38	232684	13915	18616	-4701	4215	-486	39322	1.98
1998	8.11	6.36	0.38	244403	15544	19811	-4267	4135	-132	39190	1.86
1999	8.18	6.74	0.38	258034	17391	21109	-3718	4065	347	39537	1.75
2000	8.25	7.12	0.38	273016	19439	22530	-3091	4048	957	40494	1.68
2001	8.36	7.50	0.38	288716	21654	24130	-2476	4014	1538	42032	1.63
2002	8.50	7.82	0.32	304197	23788	25861	-2073	3946	1873	43905	1.58
2003	8.63	8.14	0.32	321060	26134	27714	-1580	3861	2281	46186	1.55
2004	8.77	8.46	0.32	338899	28671	29712	-1041	3923	2882	49068	1.54
2005	8.92	8.78	0.32	357209	31363	31858	-495	3975	3480	52547	1.54
2006	9.11	9.10	0.32	375130	34137	34160	-23	4127	4104	56651	1.54
2007	9.27	9.37	0.27	395583	37066	36675	391	4337	4729	61380	1.56
2008	9.46	9.64	0.27	416767	40176	39420	756	4611	5367	66747	1.58
2009	9.67	9.91	0.27	438125	43418	42378	1040	4924	5964	72711	1.60
2010	9.89	10.18	0.27	460647	46894	45541	1353	5289	6642	79353	1.62
2011	10.08	10.45	0.27	485129	50696	48905	1791	5674	7465	86818	1.65
2012	10.30	10.68	0.23	509286	54392	52479	1913	6137	8050	94868	1.68
2013	10.54	10.91	0.23	534463	58310	56351	1959	6668	8626	103494	1.71
2014	10.80	11.14	0.23	559852	62368	60475	1893	7279	9172	112666	1.74
2015	11.03	11.37	0.23	587991	66855	64855	2000	7925	9924	122590	1.76
2016	11.26	11.60	0.23	617250	71601	69504	2097	8623	10720	133310	1.79
2017	11.52	11.80	0.20	646235	76256	74447	1809	9361	11170	144479	1.81
2018	11.78	12.00	0.20	676820	81218	79709	1509	10131	11641	156120	1.83
2019	12.03	12.20	0.20	708976	86495	85287	1208	10939	12147	168266	1.85
2020	12.29	12.40	0.20	742176	92030	91198	832	11790	12622	180888	1.86
2021	12.53	12.60	0.20	777513	97967	97454	513	12668	13180	194068	1.87
2022	12.80	12.74	0.14	812803	103551	104014	-463	13571	13108	207176	1.87
2023	13.04	12.88	0.14	850384	109529	110921	-1392	14468	13077	220253	1.86
2024	13.28	13.02	0.14	889437	115805	118144	-2339	15362	13023	233276	1.86
2025	13.49	13.16	0.14	931098	122533	125641	-3109	16255	13147	246423	1.85
2030	14.22	13.66	0.09	1173082	160243	166766	-6523	20857	14334	314657	1.79
2035	14.42	13.91	0.04	1490477	207325	214914	-7589	26300	18711	397457	1.76
2040	14.31	13.95	0.00	1902838	265446	272377	-6931	33888	26957	513999	1.80
2045	14.16	13.87	-0.02	2427750	336729	343770	-7041	44811	37770	680516	1.89
2050	14.11	13.77	-0.02	3083488	424596	435048	-10452	59601	49149	903448	1.98
2055	14.15	13.71	-0.01	3906080	535524	552860	-17336	78331	60994	1184050	2.04
2060	14.23	13.70	0.00	4945100	677479	703705	-26226	101412	75186	1529803	2.07
2065	14.28	13.70	0.00	6269119	858869	895490	-36621	129995	93374	1958588	2.08
2070	14.32	13.70	0.00	7958022	1090249	1139293	-49044	165603	116559	2493332	2.09
2075	14.37	13.78	0.02	10096983	1391364	1451202	-59838	210632	150794	3173149	2.08
2100	14.76	14.14	0.01	32969880	4661941	4866777	-204836	692400	487564	10429115	2.04

AUXILIARY TABLE 7 (disability incidence rate: -0.5/1000)
ACCOUNT PROJECTION
(millions of dollars)

Future contribution rates were determined as follows:
1. From 1994 to 1996: the existing 25-year schedule.
2. After 1996, contribution rates were generated by the *15-year formula*.

YEAR	PAY-AS-YOU-GO RATE	CONTRIBUTION RATE	CHANGE IN CONT. RATE	CONTRIB. EARNINGS	CONTRIBUTIONS	EXPENDITURES	CASH FLOW	INVESTMENT EARNINGS	CHANGE IN ACCOUNT	YEAR-END ACCOUNT	ACCOUNT/EXPENDITURES RATIO
	%	%	%	$	$	$	$	$	$	$	
1994	7.68	5.20	0.20	200287	10415	15380	-4965	4436	-529	41191	2.50
1995	7.80	5.40	0.20	210931	11390	16456	-5066	4394	-672	40519	2.32
1996	7.85	5.60	0.20	222695	12471	17483	-5012	4308	-704	39814	2.14
1997	7.99	5.97	0.37	232684	13891	18593	-4702	4216	-486	39328	1.99
1998	8.09	6.34	0.37	244403	15495	19760	-4265	4136	-129	39199	1.87
1999	8.15	6.71	0.37	258034	17314	21017	-3703	4066	363	39562	1.77
2000	8.20	7.08	0.37	273016	19330	22384	-3054	3994	940	40502	1.69
2001	8.29	7.45	0.37	288716	21509	23923	-2414	3930	1516	42019	1.64
2002	8.41	7.76	0.31	304197	23606	25591	-1985	3822	1836	43855	1.60
2003	8.53	8.07	0.31	321060	25910	27380	-1470	3687	2216	46071	1.57
2004	8.65	8.38	0.31	338899	28400	29312	-912	3697	2785	48856	1.56
2005	8.79	8.69	0.31	357209	31041	31390	-349	3688	3339	52195	1.55
2006	8.96	9.00	0.31	375130	33762	33622	140	3773	3913	56108	1.56
2007	9.12	9.27	0.27	395583	36671	36066	605	3900	4504	60613	1.56
2008	9.29	9.54	0.27	416767	39760	38738	1022	4087	5108	65721	1.58
2009	9.50	9.81	0.27	438125	42980	41621	1359	4306	5665	71386	1.60
2010	9.71	10.08	0.27	460647	46433	44708	1725	4573	6298	77684	1.62
2011	9.89	10.35	0.27	485129	50211	47993	2218	4843	7061	84746	1.65
2012	10.11	10.60	0.25	509286	53984	51494	2490	5187	7677	92423	1.67
2013	10.35	10.85	0.25	534463	57989	55291	2698	5599	8297	100720	1.70
2014	10.60	11.10	0.25	559852	62144	59337	2807	6102	8908	109628	1.72
2015	10.82	11.35	0.25	587991	66737	63635	3102	6640	9742	119370	1.75
2016	11.05	11.60	0.25	617250	71601	68200	3401	7227	10628	129998	1.78
2017	11.31	11.80	0.20	646235	76256	73057	3199	7846	11045	141043	1.80
2018	11.56	12.00	0.20	676820	81218	78231	2987	8487	11474	152517	1.82
2019	11.81	12.20	0.20	708976	86495	83721	2774	9154	11928	164445	1.84
2020	12.07	12.40	0.20	742176	92030	89545	2485	9850	12335	176780	1.85
2021	12.31	12.60	0.20	777513	97967	95712	2255	10582	12837	189617	1.86
2022	12.57	12.75	0.15	812803	103632	102185	1447	11334	12782	202399	1.86
2023	12.82	12.90	0.15	850384	109700	109008	692	12083	12775	215173	1.85
2024	13.06	13.05	0.15	889437	116072	116147	-75	12830	12754	227928	1.84
2025	13.27	13.20	0.15	931098	122905	123560	-655	13578	12923	240851	1.84
2030	14.00	13.71	0.09	1173082	160830	164239	-3409	17443	14034	307894	1.78
2035	14.21	13.96	0.04	1490477	208071	211744	-3673	21995	18321	388935	1.75
2040	14.10	14.00	0.00	1902838	266397	268341	-1944	28348	26404	503061	1.79
2045	13.95	13.92	-0.02	2427750	337943	338570	-627	37484	36857	665839	1.88
2050	13.89	13.86	-0.01	3083488	427371	428425	-1054	49905	48852	885314	1.97
2055	13.94	13.81	-0.01	3906080	539430	544502	-5072	65898	60826	1165467	2.04
2060	14.02	13.76	-0.01	4945100	680446	693265	-12819	85339	72520	1504364	2.07
2065	14.08	13.75	0.00	6269119	862004	882417	-20413	108605	88191	1911605	2.06
2070	14.11	13.79	0.01	7958022	1097411	1122837	-25426	137483	112057	2420457	2.05
2075	14.17	13.88	0.02	10096983	1401461	1430426	-28965	174679	145714	3077814	2.05
2100	14.57	14.28	0.02	32969880	4708099	4802432	-94333	580069	485736	10224455	2.03

AUXILIARY TABLE 8 (proportions of earners: -1%)
ACCOUNT PROJECTION
(millions of dollars)

Future contribution rates were determined as follows:
1. From 1994 to 1996: the existing 25-year schedule.
2. After 1996, contribution rates were generated by the *15-year formula*.

YEAR	PAY-AS-YOU-GO RATE	CONTRIBUTION RATE	CHANGE IN CONT. RATE	CONTRIB. EARNINGS	CONTRIBUTIONS	EXPENDITURES	CASH FLOW	INVESTMENT EARNINGS	CHANGE IN ACCOUNT	YEAR-END ACCOUNT	ACCOUNT/EXPENDITURES RATIO
	%	%	%	$	$	$	$	$	$	$	
1994	7.75	5.20	0.20	198285	10311	15377	-5066	4433	-633	41087	2.50
1995	7.88	5.40	0.20	208821	11276	16453	-5177	4381	-796	40292	2.30
1996	7.93	5.60	0.20	220468	12346	17485	-5139	4284	-855	39437	2.12
1997	8.08	6.00	0.40	230357	13821	18611	-4790	4181	-608	38828	1.96
1998	8.19	6.40	0.40	241959	15485	19806	-4321	4092	-228	38600	1.83
1999	8.26	6.80	0.40	255453	17371	21101	-3730	4016	286	38885	1.73
2000	8.33	7.20	0.40	270286	19461	22520	-3059	3939	880	39765	1.65
2001	8.44	7.60	0.40	285829	21723	24116	-2393	3871	1478	41243	1.60
2002	8.58	7.93	0.33	301155	23882	25841	-1959	3760	1801	43044	1.55
2003	8.71	8.26	0.33	317849	26254	27689	-1435	3623	2189	45233	1.52
2004	8.85	8.59	0.33	335510	28820	29681	-861	3633	2772	48005	1.51
2005	9.00	8.92	0.33	353637	31544	31820	-276	3622	3347	51352	1.51
2006	9.19	9.25	0.33	371379	34353	34114	239	3709	3947	55299	1.51
2007	9.35	9.53	0.28	391627	37322	36620	702	3837	4539	59838	1.52
2008	9.54	9.81	0.28	412600	40476	39355	1121	4026	5147	64985	1.54
2009	9.75	10.09	0.28	433744	43765	42301	1464	4248	5711	70697	1.56
2010	9.97	10.37	0.28	456040	47291	45452	1839	4517	6357	77053	1.58
2011	10.16	10.65	0.28	480278	51150	48801	2349	4791	7140	84194	1.61
2012	10.38	10.90	0.25	504193	54957	52359	2598	5139	7737	91931	1.64
2013	10.62	11.15	0.25	529118	58997	56214	2783	5554	8337	100268	1.66
2014	10.88	11.40	0.25	554253	63185	60320	2865	6059	8924	109191	1.69
2015	11.11	11.65	0.25	582111	67816	64678	3138	6597	9735	118926	1.72
2016	11.34	11.90	0.25	611077	72718	69304	3414	7184	10598	129525	1.75
2017	11.60	12.10	0.20	639773	77413	74221	3192	7809	11001	140526	1.77
2018	11.86	12.30	0.20	670052	82416	79454	2962	8450	11412	151938	1.79
2019	12.11	12.50	0.20	701887	87736	85000	2736	9114	11850	163788	1.80
2020	12.37	12.70	0.20	734754	93314	90878	2436	9805	12241	176029	1.81
2021	12.61	12.90	0.20	769738	99296	97096	2200	10532	12732	188761	1.82
2022	12.88	13.05	0.15	804675	105010	103613	1397	11277	12674	201435	1.82
2023	13.12	13.20	0.15	841880	111128	110476	652	12019	12672	214107	1.82
2024	13.36	13.35	0.15	880543	117552	117652	-100	12760	12661	226767	1.81
2025	13.57	13.50	0.15	921787	124441	125096	-655	13503	12848	239615	1.80
2030	14.29	14.01	0.09	1161351	162705	165908	-3203	17371	14168	306862	1.75
2035	14.48	14.22	0.03	1475572	209826	213649	-3823	21937	18114	387909	1.73
2040	14.36	14.25	0.00	1883810	268443	270578	-2135	28191	26056	500305	1.77
2045	14.20	14.21	-0.01	2403473	341534	341288	246	37324	37569	663797	1.86
2050	14.14	14.12	-0.02	3052653	431035	431687	-652	49999	49347	887375	1.96
2055	14.18	14.06	-0.01	3867020	543703	548408	-4705	66109	61404	1169566	2.03
2060	14.25	14.01	-0.01	4895648	685880	697848	-11968	85819	73852	1513512	2.07
2065	14.31	14.00	0.00	6206429	868900	887912	-19012	109621	90609	1930502	2.07
2070	14.34	14.04	0.01	7878441	1106133	1129549	-23416	139421	116006	2455850	2.07
2075	14.39	14.09	0.01	9996012	1408438	1438716	-30278	177643	147365	3128749	2.07
2100	14.78	14.48	0.02	32640180	4726299	4824910	-98612	582983	484371	10273059	2.03

HISTORICAL RESULTS
(millions of dollars)

YEAR	PAYGO RATE	CONT. RATE	CHANGE CON.RAT.	CONTRIB. EARNINGS	CONTRI-BUTIONS	EXPEN-DITURES	CASH FLOW	INVEST. EARNINGS	CHANGE OP. BAL.	DEC. 31 OP. BAL.	CHANGE FUND	DEC. 31 FUND	20-YEAR MATURITIES	NEW LOANS AVAILABLE	CHANGE IN ACCOUNT	DEC. 31 ACCOUNT	ACCOUNT/ EXPENDIT.
	%	%	%	$	$	$	$	$	$	$	$	$	$	$	$	$	
1966	0.05	3.60	3.60	14744	531	8	523	2	61	61	463	463	0	463	525	525	52.47
1967	0.06	3.60	0.00	17316	623	10	613	37	-19	42	670	1134	0	670	651	1175	48.98
1968	0.13	3.60	0.00	19056	686	24	662	79	26	68	715	1848	0	715	741	1916	35.49
1969	0.26	3.60	0.00	20485	737	54	683	128	-2	66	813	2661	0	813	811	2727	28.12
1970	0.45	3.60	0.00	21475	773	97	676	193	7	73	863	3524	0	863	869	3596	23.98
1971	0.66	3.60	0.00	22663	816	150	666	261	5	78	921	4445	0	921	927	4523	21.23
1972	0.88	3.60	0.00	24148	869	213	656	334	21	98	970	5415	0	970	990	5513	19.69
1973	1.07	3.60	0.00	26072	939	280	659	407	19	118	1046	6461	0	1046	1065	6578	16.78
1974	1.17	3.60	0.00	33429	1203	392	811	497	65	182	1244	7704	0	1244	1308	7887	14.06
1975	1.42	3.60	0.00	39617	1426	561	865	607	86	269	1386	9091	0	1386	1472	9359	11.46
1976	1.80	3.60	0.00	45288	1630	817	813	747	19	288	1542	10632	0	1542	1561	10920	10.51
1977	2.05	3.60	0.00	50782	1828	1039	789	886	42	330	1633	12265	0	1633	1675	12596	9.71
1978	2.31	3.60	0.00	56176	2022	1297	725	1045	97	427	1673	13938	0	1673	1770	14365	9.03
1979	2.47	3.60	0.00	64374	2317	1591	726	1236	47	474	1915	15854	0	1915	1962	16328	8.29
1980	2.72	3.60	0.00	72325	2604	1970	634	1472	182	656	1923	17777	0	1923	2105	18433	7.64
1981	2.89	3.60	0.00	83566	3008	2412	596	1783	168	824	2211	19988	0	2211	2379	20812	7.04
1982	2.91	3.60	0.00	101810	3665	2958	707	2160	142	966	2725	22713	0	2725	2867	23679	6.58
1983	3.73	3.60	0.00	96507	3474	3597	-123	2492	90	1056	2280	24992	0	2280	2369	26049	6.22
1984	3.66	3.60	0.00	114386	4118	4185	-67	2830	264	1320	2499	27491	0	2499	2763	28811	5.97
1985	4.31	3.60	0.00	111993	4032	4827	-795	3114	206	1526	2113	29604	0	2113	2319	31130	5.66
1986	4.20	3.60	0.00	131131	4721	5502	-781	3394	134	1659	2479	32084	463	2943	2613	33743	4.73
1987	5.02	3.80	0.20	141927	5393	7130	-1737	3654	209	1868	1708	33792	670	2378	1917	35660	4.31
1988	5.41	4.00	0.20	152832	6113	8272	-2159	3886	225	2093	1502	35294	715	2217	1727	37387	3.98
1989	5.89	4.20	0.20	159373	6694	9391	-2697	4162	331	2424	1134	36428	813	1947	1465	38852	3.72
1990	5.82	4.40	0.20	179290	7889	10438	-2549	4387	329	2753	1508	37936	863	2371	1838	40689	3.53
1991	6.31	4.60	0.20	182518	8396	11518	-3122	4476	180	2933	1174	39110	921	2095	1353	42043	3.22
1992	7.06	4.80	0.20	185062	8883	13064	-4181	4486	-190	2743	495	39605	970	1464	305	42347	2.96
1993	7.79	5.00	0.20	183329	9166	14289	-5123	4495	119	2862	-747	38858	1046	299	-627	41720	2.71

IV- Actuarial Standards

In my opinion, for the purposes of this actuarial report,

- the data on which the valuation is based are sufficient and reliable for the purpose of the valuation;
- the assumptions which have been used are adequate and appropriate; and
- the valuation methodology employed is consistent with sound actuarial principles.

This report has been prepared and this opinion has been given in accordance with generally accepted actuarial principles and the Recommendations of the Canadian Institute of Actuaries.

Bernard Dussault, B.Sc, F.S.A., F.C.I.A.
Chief Actuary

Ottawa, Canada
13 February 1995

APPENDIX A

MAIN PROVISIONS OF THE CANADA PENSION PLAN

1. DEFINITION OF TERMS RELATING TO EARNINGS

Contributor

The Canada Pension Plan (CPP), which came into force on 1 January 1966, includes as contributors virtually all members of the labour force in Canada (both employees and self-employed persons) between the ages of 18 and 70 with employment earnings, other than persons in the province of Québec who are covered by the Québec Pension Plan (QPP). However, the Canada Pension Plan covers all members of the Canadian Forces and the Royal Canadian Mounted Police, including those residing in the province of Québec. The main exceptions are persons with earnings less than the Year's Basic Exemption (YBE, defined below), persons to whom a retirement or disability pension is payable pursuant to the *CPP Act* and members of certain religious groups.

Contributory Period

The contributory period corresponds to the number of months from attainment of age 18 or from January 1, 1966, if later, to the earliest of the month in which the contributor dies, the month preceding the one in which the retirement pension commences and the month preceding the one in which the contributor reaches 70 years of age, less the number of months during which the contributor received a CPP disability pension, or during which, after 1977, the contributor had at least one eligible child under 7 years of age, and had earnings less than 1/12 of the YBE.

Year's Maximum Pensionable Earnings (YMPE)

The YMPE for any calendar year corresponds to the limit above which that year's employment earnings are not subject to contributions and benefits. The YMPE for a particular calendar year is prorated in individual cases to allow for the portion of the year before age 18 or after age 70, or after death, retirement or disablement. The YMPE increases each year in accordance with the ratio of the average of the Industrial Aggregate (the measure of average wages and salaries by Statistics Canada) during the 12-month period ending 30 June of the preceding year over the average during the corresponding period one year earlier. If the amount calculated by formula is not a multiple of $100, the next lower multiple of $100 is used. However, the YMPE is not allowed to decrease from one year to the next. For 1995, the YMPE is $34,900.

Year's Basic Exemption (YBE)
The YBE for any calendar year corresponds to the lower limit below which that year's employment earnings are not subject to contributions. It is calculated as 10% of the YMPE and rounded, if necessary, to the next lower multiple of $100. The YBE is subject to adjustment, in individual cases, similar to the YMPE. For 1995, the YBE is $3,400.

Unadjusted Pensionable Earnings
Unadjusted pensionable earnings for any calendar month correspond to all employment earnings of a contributor in the calendar month up to 1/12 of the YMPE applicable to the corresponding calendar year, provided that required contributions have been made for that month. The unadjusted pensionable earnings are zero for any month during which contributions are not required or not made. Earnings in a month in excess of one twelfth of the YMPE are applied to the extent required to maximize the unadjusted pensionable earnings in other months in the same calendar year.

Contributory Earnings
Contributory earnings for any calendar year correspond to the portion of unadjusted pensionable earnings on which contributions are payable, i.e., employment earnings between the YBE and the YMPE for that year.

Pensionable Earnings
Pensionable earnings for a given month correspond to the product of the unadjusted pensionable earnings of that month and the ratio that the average of the YMPE for the year when a retirement pension or any earnings-related pension becomes payable under the *CPP Act*, and of the YMPE for the two preceding years, bears to the YMPE for the year to which the given month belongs. Hence, the application of this ratio escalates the earnings of a given month, in accordance with the current 3-year average YMPE, for purposes of averaging earnings over the contributory period elapsed at the time of emergence of a benefit.

2. RETIREMENT PENSION

A person aged 60 or over becomes eligible for a retirement pension, upon application, provided contributions (see section 11 below) have been made for at least one calendar year. After a retirement pension becomes payable or, in any event after age 70, a contributor may not contribute under the Plan. Thus, except for annual adjustments of the amount of pension in payment in accordance with changes in the Pension Index (see section 8 below), the amount of pension is fixed at the time the pension first becomes payable. The initial amount of retirement pension payable to a contributor is based on the whole history of pensionable earnings during the contributory period. The initial amount of monthly retirement pension is equal to 25% of the average of a number of the highest monthly pensionable earnings. This number is determined as follows:

For pensions commencing	Number of months used in computing the initial retirement pension
before 1976	120 less the number of months of disability;
after 1975	the number of months in the contributory period less (a) the number of months, after 1977, during which the contributor had at least one eligible child less than 7 years of age, and had earnings greater than one-twelfth of the YBE which, if dropped out, would increase his or her average pensionable earnings, provided the remaining number of months is not thereby reduced to less than 120 months minus the months of disability, less (b) the number of months, if any, between age 65 of the contributor and the commencement of the retirement pension, if later, provided the remaining number of months is not thereby reduced to less than 120 months minus the months of disability, less (c) 15% of the number of months remaining in the contributory period, provided the remaining number of months is not thereby reduced to less than 120 months.

A certain number of months associated with the lowest recorded monthly pensionable earnings are therefore excluded, in the calculation of benefits, by reason of pensions commencing after age 65 and of the disability, the child-rearing and the 15% drop-out provisions. The resulting amount of pension is subject to an actuarial adjustment that depends on the contributor's age at commencement of the retirement pension: the initial rate of pension is accordingly decreased or increased, depending on whether the pension begins before or after age 65, by 0.5% for each month between age 65 and the age when the pension commences. An applicant for a retirement pension payable before age 65 must have ceased to be wholly or substantially engaged in paid employment or self-employment. The maximum amount of retirement pensions commencing in 1995 is, before the actuarial adjustment, $713.19 per month.

3. DISABILITY PENSION

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

Under current conditions, *substantially gainful* corresponds to annual employment earnings exceeding the maximum CPP retirement pension, i.e., about $8,500, and *prolonged* corresponds to a medical condition not expected to improve whatsoever within the next 12 months.

A person who becomes disabled while under age 65 and not receiving a CPP retirement pension is eligible for a disability pension provided that contributions have been made, at time of disablement, for at least either 5 of the last 10 calendar years, or 2 of the last 3 calendar years, irrespective of whether any of these years is included wholly or partly in the contributory period.

Disability pensions commence with the fourth month following the month of disablement and are payable until age 65 (disability pensions are automatically replaced by retirement pensions at age 65) or until death or recovery from disability at an earlier age. If an application for a disability pension is filed more than 15 months following the date at which the pension would normally have commenced, eligibility to receive a disability pension is determined as described above irrespective of the filing delay. For cases so eligible, the initial amount of the pension is then determined as if disability had commenced 15 months before the filing date, and retroactive payments are made commencing with the eleventh month prior to the filing date.

The amount of pension payable is composed of a flat-rate portion depending only on the year in which the pension is payable and an earnings-related portion depending, when it commences, only on the pensionable earnings record of the contributor as of the onset of disability. The monthly flat-rate portion is $319.85 for 1995. The earnings-related portion is equal, when it commences, to 75% of a pension calculated in the manner described earlier for retirement pensions, except that no actuarial adjustment applies and that the number of months to be taken into account in determining the Average Pensionable Earnings is subject, in connection with the child-rearing drop-out period, to a minimum of 24 (instead of 120) less months of disability. The maximum initial monthly earnings-related portion is $534.89 for 1995.

4. SURVIVOR'S PENSION

(a) Eligibility

The surviving spouse of a contributor is eligible for a survivor pension if the following three conditions are met as at the date of the contributor's death:

i) if the surviving spouse was not legally married to the deceased contributor, they must have cohabited for not less than one year immediately before the death of the contributor;

ii) the deceased contributor must have made contributions during the lesser of 10 calendar years, or one-third of the number of years included wholly or partly in his or her contributory period, but not less than three years;

iii) the surviving spouse must have dependent children (as described at item (b) below), be disabled or be at least 35 years of age.

(b) Definition of surviving spouse with dependent children

A surviving spouse with dependent children means a widow or widower who wholly or substantially maintains a child of the deceased contributor where the child is

- under age 18, or
- aged 18 or over but under age 25 and attending school full-time, or
- aged 18 or over and disabled, having been disabled without interruption since attaining age 18 or the time of the contributor's death, whichever occurred later.

(c) Amount of survivor's pension

i) **Surviving spouses aged between 45 and 65 at date of contributor's death**

The amount of pension payable until the surviving spouse attains age 65 is composed of two portions: a flat-rate portion depending only on the year in which the survivor's pension is payable, and an earnings-related portion depending initially only on the contributor's record of pensionable earnings as at the date of his or her death. The monthly flat-rate portion is $124.79 for 1995. The initial earnings-related portion is equal to 37.5% of an earnings-related pension based on the deceased contributor's pensionable earnings record. The amount of the contributor's earnings-related pension is calculated in the manner described earlier for retirement pensions (see section 3 above) except that no actuarial adjustment applies and that the number of months to be taken into account in determining the Average Pensionable Earnings may not be reduced, in respect of the months of child-rearing, to less than 36 (instead of 120) minus the months of disability. The earnings-related portion is calculated as at the date of the deceased spouse's death or commencement of his or her retirement pension, whichever is earlier, except that in the latter case the calculated pension is adjusted in accordance with the increase in the Pension Index (see section 8 below) from the year in which the contributor's retirement pension became payable to the year of his or her death. The maximum initial monthly earnings-related portion in respect of surviving spouses under age 65 is $267.45 for 1995.

ii) Surviving spouses, aged less than 45 at date of contributor's death, without dependent children and not disabled

An eligible spouse without dependent children and not disabled who becomes widowed:

- while aged less than 35 years is not entitled to a survivor's pension;
- while between 35 and 45 years of age is entitled for an amount of pension, calculated as described in i) above, reduced by 1/120th of such amount for each month that the surviving spouse's age at onset of widowhood or widowerhood is less than 45.

iii) Surviving spouses aged less than 45 with dependent children at date of contributor's death

An eligible spouse who becomes widowed while aged less than 45 and with dependent children is entitled to a survivor's pension calculated as described in i) above. If a surviving spouse in receipt of a survivor's pension ceases to be a surviving spouse with dependent children before attaining age 45 and is not disabled at that time, the amount of the survivor's pension is discontinued or reduced in the manner described in ii) above in accordance with the surviving spouse's age at the time she or he ceased to be a surviving spouse with dependent children.

iv) Disabled surviving spouses aged less than 65

An eligible surviving spouse aged less than 65 years is entitled to a survivor's pension if she/he is either disabled at the date of death of the contributor or becomes disabled at a later date. The disabled surviving spouse's pension is payable from the month following the month in which the contributor dies or from the month following the month in which the surviving spouse becomes disabled, whichever is later. If the disabled surviving spouse recovers from disability before age 45, the amount of the survivor's pension is discontinued or reduced in the manner described in ii) above in accordance with the surviving spouse's age at the time of recovery. The initial amount of pension is calculated as described in i) above, except that, in the case where the surviving spouse becomes disabled subsequent to the death of the contributor, the pension so calculated is adjusted in accordance with changes in the Pension Index (see section 8 below) from the year in which the contributor died to the year in which disability occurs.

v) Surviving spouses aged 65 or over

At age 65, or upon widowhood or widowerhood at a later age, an eligible surviving spouse is entitled a pension equal to 60% of an earnings-related pension based on the pensionable earnings record of the deceased spouse. This earnings-related pension is calculated as described in i) above and is adjusted, where applicable, in accordance with changes in the Pension Index (see 8 below) from the year in which the contributor died to the year in which the surviving spouse attains age 65 or the year in which a retirement pension becomes payable to her/him while in receipt of a survivor's pension. The maximum initial monthly earnings-related portion in respect of survivors aged 65 and over is $427.91 for 1995.

5. DEATH BENEFIT

A lump-sum benefit is payable to the estate of a deceased contributor if the eligibility rules described in 4(a)i) above are met. The amount of the death benefit is equal to:

(a) in respect of a contributor to whom a retirement pension was payable at the time of death, one-half of the annual amount of pension payable in the year of death, adjusted to exclude any reduction that may have arisen by reason of commencement of pension within the 10-year phase-in period ending 31 December 1975 or any actuarial adjustment applicable by reason of commencement of a retirement pension after 1986 at an age other than 65; and

(b) in respect of any other contributor, one-half of the annual amount of an earnings-related pension calculated, exclusive of the actuarial adjustment, in the manner described for retirement pensions in section 2 above,

subject to the limitation that the amount of benefit cannot exceed 10% of the YMPE applicable in the year of the contributor's death. The maximum death benefit payable for deaths occurring in 1995 is $3,490.

6. CHILDREN'S BENEFITS

(a) Disabled contributor's child's (DCC) benefit

Each child of a contributor who is eligible for a CPP disability pension is entitled to a DCC benefit provided the child is under age 18, or is aged 18 or over but under 25 and is attending school full-time.

(b) Orphan's benefit

Each child of a deceased contributor is entitled an orphan's benefit if the eligibility rules described in 4(a)i) above are met and if the child is under age 18, or aged 18 or over but under age 25 and is attending school full-time.

(c) Amount of children's benefit

The amount of the monthly pension payable in respect of each eligible child is $161.27 for 1995. Two child's benefits are payable in respect of each child if both parents died while eligible for a survivor benefit or are entitled a CPP disability pension; furthermore, where applicable, a child may simultaneously receive a disabled contributor's child's benefit and an orphan's benefit.

7. COMBINED PENSIONS

Benefits payable to persons who become entitled to both a survivor pension and either a disability or a retirement pension are subject to a limit as follows:

(a) Survivor pension combined with a disability pension

i) the flat-rate portion of the combined pension is equal to the flat-rate portion of the disability pension;

ii) the earnings-related portion of the combined pension is equal to the sum of the earnings-related portions of the survivor and the disability annual pensions but cannot initially exceed the maximum retirement pension applicable for the year in which the later of the two pensions commences; in such case, the earnings-related portion of the survivor pension is reduced accordingly.

(b) Survivor pension combined with a retirement pension

i) the flat-rate portion of the combined pension is equal to the flat-rate portion of the survivor pension;

ii) the earnings-related portion of the combined pension is equal to the sum of the earnings-related portion of the survivor pension and of the survivor's actuarially adjusted retirement pension; however, the sum of the earnings-related portion of the survivor pension and of the survivor's retirement pension before application of the actuarial adjustment cannot initially exceed the maximum retirement pension applicable for the year in which the later of the two pensions commences; in such case, the earnings-related portion of the survivor pension is reduced accordingly but any actuarially reduced retirement pension (i.e., a retirement pension commencing under age 65) is increased by an amount equal to the product of the applicable actuarial reduction percentage and the absolute reduction in the earnings-related survivor pension computed as above.

8. INFLATION ADJUSTMENTS

All CPP benefits are, with the exception of the death benefit which is payable in a lump sum, payable in the form of monthly pensions. Once a CPP pension has commenced, its initial amount is adjusted thereafter in accordance with inflation. Pensions are accordingly multiplied on 1 January of each calendar year by the ratio of the Pension Index (described below) applicable for that calendar year to the Pension Index applicable for the year during which the pension commenced.

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

9. CREDIT-SPLITTING UPON MARITAL UNION BREAKDOWN

In the event of a divorce occurring after 1976 or of a separation or the breakdown of a marital common-law union after 1982, Unadjusted Pensionable Earnings may be split equally between the two spouses of a given couple in respect of their previous cohabitation period. In case of divorce, splitting is automatic provided the Minister receives the prescribed information; in case of separation for at least 12 consecutive months or until the death of one of the former spouses during this period, splitting is mandatory, upon valid application by one spouse, provided the former spouses did cohabit for at least twelve months. Splitting can be waived by agreement between the two parties where expressly provided for by the applicable provincial law.

10. SPLITTING OF RETIREMENT PENSIONS

If one of the spouses requests it, retirement pensions may be divided, in respect of the proportionate number of years during which the spouses cohabited, during the joint lifetime of the spouses. This applies provided both spouses are at least 60 years old and have ceased contributing. On the death of the first spouse, or in the event of divorce or separation, any pension splitting previously applied is reversed. In the case of separation, the assignment ceases the twelfth month after the spouses separated.

11. CONTRIBUTION RATES AND CONTRIBUTIONS

Contributions are required during the contributory period in respect of the contributory earnings of each contributor. From 1966 to 1986, the annual rate of contribution applicable to contributory earnings was 1.8% for employees (and a like amount for their employers) and 3.6% in respect of self-employed earnings. This combined employer-employee contribution rate of 3.6% was subject, in accordance with the 25-year Schedule adopted pursuant to *Bill C-116*, to an annual increase of 0.2% for 1987 to 1991 and is subject, in accordance with the 25-year Schedule adopted pursuant to *Bill C-39*, to an annual increase of 0.2% for 1992 to 1996, 0.25% for 1997 to 2006, and 0.20% for 2007 to 2016.

However, the rates beyond 1996 will depend on the conclusions of the quinquennial federal-provincial reviews by the Ministers of Finance. The next such review is scheduled to take place prior to 1997 and, if possible, to be completed early enough to permit the Minister of Finance to make appropriate recommendations before 1 January 1996. At the conclusion of each quinquennial federal-provincial review, the rates for the last 20 years in the 25-year Schedule must be confirmed or revised and the Schedule extended for the following five years. In addition to the 25-year Schedule, the *15-year formula* (described below) prescribed by regulation would come into operation in the absence of agreement or recommendation at subsequent quinquennial federal-provincial reviews.

The *15-year formula* is designed to extend the schedule for each successive five-year period by means of the smallest constant annual rate of change, expressed as a multiple of 0.01% of contributory earnings, such that if a change of that size were in effect for a total of 15 years, the Account (see section 12 below) at the end of 15 years would be at least equal to twice the expenditure in the following year (i.e., an Account/Expenditure ratio equal to 2).

12. ACCOUNT, OPERATING BALANCE AND INVESTMENT FUND

Income (contributions, and investment earnings from the Operating Balance and the Investment Fund described below) and expenditures (benefits and administrative expenses) are posted to the CPP Account in the Consolidated Revenue Fund.

At the end of each quarter, the excess of the balance to the credit of the Account over the Operating Balance (the estimated amount required in the ensuing three months to pay benefits and administrative expenses) constitutes an increase in the Investment Fund and is available for loans to the provinces in proportion to contributions made by the residents of the respective provinces. Any part of this excess not borrowed by the provinces is invested in federal securities.

The securities are non-negotiable obligations payable to the CPP Investment Fund. The term to maturity is 20 years, unless the Minister of Finance, on the recommendation of the Chief Actuary of the Office of the Superintendent of Financial Institutions, deems it appropriate to fix a lesser period to meet the projected payments. The interest applicable to the securities is payable semi-annually and is based on the average yield to maturity on all outstanding Government of Canada bonds maturing in 20 years or more.

13. AMENDMENTS

Any major amendment providing for changes in benefits or contributions cannot become effective until the first day of the third year following the year in which notice of intention to introduce such a measure was laid before Parliament. An amendment requires the consent of at least two-thirds of the provinces having in aggregate at least two-thirds of the population of Canada, excluding the Yukon and the Northwest Territories.

APPENDIX B

DATA, ASSUMPTIONS AND METHODOLOGY

TABLE OF CONTENTS

APPENDIX B

DATA, ASSUMPTIONS AND METHODOLOGY

Appendix B describes the data, the assumptions and the methodology used in making the CPP financial projections that appear in the main body of this report.

-I- POPULATION

1. Data

The following data were used in performing the demographic projections:

(a) Canadian quinquennial censuses

Catalogue No. 93-101 published by Statistics Canada is the main reference used regarding the data on Canadian censuses. The calculation of future average earnings and benefits requires population figures not only for the projection period (1994 to 2100), but also for 1966 to 1993. Data from each of the six quinquennial censuses of 1966 to 1991 are accordingly maintained not only for the projection of average earnings and benefits of all relevant cohorts of contributors and beneficiaries, but also for methodology validation purposes as described in section 3 below. The 1991 Census data, by age and sex, for Canada and Québec separately, serve as the starting point for the projection of the population and deaths until year 2100. The census data used for projection purposes consist primarily of the numbers of live persons by age (last birthday) and sex, the proportions of male to female births and the adjustments for undercount.

(b) Postcensal data

In between each Canada quinquennial census, Statistics Canada publishes annually various postcensal data. Data on actual past fertility rates and migration levels, taken from catalogues No. 82-003s14, 82-204 and 91-210, are used as a basis for determining the assumptions required for projecting the actual 1991 population by age and sex. Moreover, previously assumed fertility rates and migration values for the period 1987 to 1992 and 1993, respectively, were replaced by actual values in the projection process that, in a technical sense, starts in 1966.

(c) Life Tables, Canada and the Provinces, 1985-1987

These mortality tables, published by Statistics Canada (catalogue No. 82-003S), are used as a basis for the determination of the assumptions required for projecting the population into the future. The Life Tables for 1990-1992 were not yet available when this report was completed. The 1985-1987 Canada Life Tables for Canada, the corresponding tables for Québec, and the ultimate mortality tables consist of one-year probabilities of mortality for individual ages from 0 to 106.

(d) The November 1988, 1989, 1990 and 1991 Reports of the Subcommittee on Modelling, Canadian Institute of Actuaries' (CIA) Task Force on AIDS.
These studies are the main reference used to estimate the effect of AIDS on mortality rates.

(e) Actuarial Study No. 102
This study, conducted by the Social Security Administration in the U.S.A, shows the extent to which mortality rates could be expected to decrease annually until year 2100. These annual rates of decrease were determined by analysing the current trends in mortality decrease separately for each of 10 broad causes of death.

2. Demographic assumptions

In accordance with the practice first adopted for the Third CPP Statutory Actuarial Report as at 31 December 1973, the Main Tables of financial projections, as shown in the main body of this report, are based on a single set of realistic demographic assumptions. This section describes the assumptions most central to the demographic projections.

As in preceding reports, various auxiliary projections (see section III-4 of the main body of this report) provide an appreciation of the sensitivity of the financial projections to certain variations in key assumptions.

(a) Fertility

The fertility rate for a given age corresponds to the number of live births per female at the given age. The total fertility rate corresponds to the sum of all live births per female over the entire period of reproductive ages. For convenience, such rates are multiplied by 1,000 in the table below. The actual total fertility rates for 1992, i.e., 1.710 and 1.650 for Canada and Québec, respectively, are 6.6% and 4.8%, respectively, lower than those assumed for 1992 in the preceding actuarial report. The ultimate total fertility rates of 1.85 for Canada and 1.80 for Québec, used in the previous three actuarial reports, have been maintained. For 1993 to 1999, the assumed rates were calculated by linear interpolation between the actual 1992 values of 1.710 for Canada and 1.650 for Québec, and the assumed values of 1.85 for Canada and 1.80 for Québec for year 2000. The distribution of assumed ultimate total fertility rates for Canada and Québec into age-specific rates corresponds to their respective 1991 experience. In accordance with past experience, the assumed ratio of male to female births was maintained at 1.056.

Fertility rates are used not only for the demographic projections, but also for the valuation of the child rearing drop-out provision (II-2(b)vii) below), and for the projection of children's benefits (II-3(i)iv) below).

FERTILITY RATES

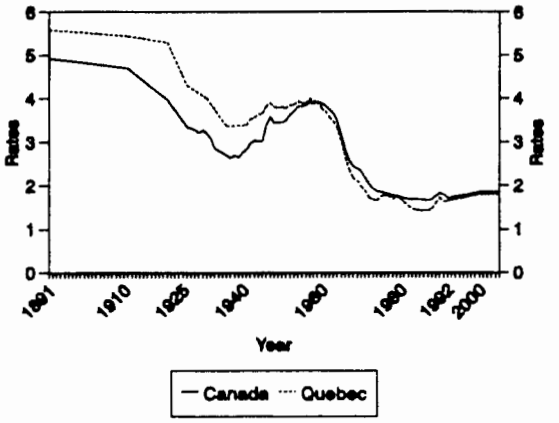
CANADA

Age Group	Calendar year					
	1970	1975	1980	1985	1990	2000+
15-19	42.8	35.3	27.6	23.7	26.6	28.1
20-24	143.3	112.7	100.1	85.3	85.5	85.0
25-29	147.2	131.2	129.4	125.3	132.2	132.1
30-34	81.8	64.4	69.3	74.6	88.1	90.5
35-39	39.0	21.6	19.4	21.8	28.8	30.0
40-44	11.3	4.8	3.1	3.0	3.9	4.1
45-49	0.9	0.4	0.2	0.1	0.1	0.2
Total	2,331.5	1,852.0	1,745.5	1,669.0	1,826.0	1,850.0

QUÉBEC

Age Group	Calendar year					
	1970	1975	1980	1985	1990	2000+
15-19	20.7	19.5	16.1	14.5	19.0	19.0
20-24	113.9	96.4	92.7	73.5	84.7	87.9
25-29	131.0	136.2	137.2	116.7	134.9	140.7
30-34	77.4	69.4	70.6	62.0	78.6	84.4
35-39	39.0	23.4	19.8	17.1	23.1	24.7
40-44	11.8	5.2	3.0	2.2	3.0	3.2
45-49	1.0	0.6	0.2	0.1	0.1	0.1
Total	1,974.0	1,753.5	1,698.0	1,430.5	1,717.0	1,800.0

TOTAL FERTILITY RATES



(b) Mortality (Canada Life Tables, mortality reductions, AIDS)

Life Tables for 1990-1992 were not yet available when this report was completed. However, an analysis of preliminary results of these Tables indicates that they correspond very closely in aggregate, i.e., 99% and 100% in terms of life expectancies at birth, for males and females, respectively, to the mortality rates projected for 1991 under the previous report from the 1985-1987 Tables. Therefore, mortality rates shown in Life Tables, Canada and the Provinces, 1985-1987 (see 1.c above), assumed to be applicable for 1986, were used as the starting point for mortality assumptions. However, these rates were adjusted (decreased) to account for the population undercount which was disregarded in the construction of the 1985-1987 Canada Life Tables.

To reflect anticipated sustained improvements in life expectancy, the 1986 mortality rates were projected to the year 2100 using the following annual rates of decrease:

i) For 1987 to 2010, the annual rates of decrease, varying by age, sex and calendar year, were determined by linear interpolation between:
   - the average reduction rates experienced in Canada between 1976 and 1986, and
   - the constant reduction rates, described in ii) below, in respect of the period running from 2011 to 2100.

ii) For 2011 and subsequent years, the annual rates of decrease, varying by age and sex only, not by calendar year, are those identified as *Alternative II (medium)* in Actuarial Study No. 102 (see section 1(e) above).

To account for AIDS, male mortality for both Canada and Québec was increased for the years 1989 to 2018 by the increments estimated by the Canadian Institute of Actuaries (see section 1(d) above). A constant level of new infections is assumed to hold from 1984 to 1988 and to decrease gradually from that level to 0 in 1999. Subsequent studies of the CIA's Task Force on AIDS for 1989 to 1991 have also been examined. These studies show average extra mortality lower than that of the 1988 study; however, recent trends indicate that AIDS-related extra mortality might return, after 1991, to levels previously assumed. For these reasons, the assumptions of the CPP eleventh actuarial report were maintained for this report. On the basis of the cumulative number of deaths attributable to AIDS (as reported by the Federal Centre for AIDS), female mortality was also increased, but by only 10 per cent of the above increments for males.

Life Expectancies (longevity expressed in number of years) resulting from the above mortality assumptions are shown below for Canada as a whole.

Year	At birth		At age 65		
	males	females	males	females	Calculation basis
1986	73.0	79.7	14.9	19.1	without improvements in life expectancy
1986	77.8	84.6	15.7	20.4	with improvements in life expectancy
2100	80.3	86.9	19.3	24.5	with improvements until 2150

The first table below sets out sample values of the ultimate mortality rates as well as sample values of mortality rates of the 1985-87 Canada Life Tables, all before AIDS adjustments. The second table shows sample values of the extra mortality assumed to apply in connection with AIDS.

MORTALITY RATES
(before AIDS adjustments)
(number of annual deaths per 1,000 persons)

	MALES			
	1985-87 Canada Life Tables		Rates Assumed for Year 2100	
Age	Québec	Canada	Québec	Canada
0	8.02	8.58	2.10	2.24
1	0.62	0.67	0.25	0.27
5	0.27	0.30	0.11	0.12
10	0.22	0.18	0.10	0.08
20	1.36	1.30	0.67	0.64
30	1.39	1.30	0.89	0.83
40	2.12	1.97	1.02	0.95
50	5.81	5.32	2.73	2.50
60	16.59	14.68	8.75	7.75
70	42.05	36.73	24.28	21.21
80	94.08	86.65	57.10	52.59
90	198.73	191.97	118.52	114.49
95	271.71	276.51	159.44	162.25
100	322.70	359.43	182.46	203.23
105	777.72	796.02	500.49	512.26

	FEMALES			
	1985-87 Canada Life Tables		Rates Assumed for Year 2100	
Age	Québec	Canada	Québec	Canada
0	6.22	6.78	1.48	1.61
1	0.58	0.62	0.22	0.24
5	0.26	0.22	0.09	0.07
10	0.16	0.14	0.06	0.05
20	0.37	0.42	0.18	0.20
30	0.54	0.51	0.28	0.26
40	1.09	1.12	0.52	0.53
50	3.21	3.12	1.73	1.68
60	7.67	7.51	4.32	4.23
70	19.49	18.67	10.68	10.23
80	55.09	51.73	28.96	27.19
90	150.37	144.15	75.74	72.61
95	235.05	230.03	119.72	117.16
100	322.27	322.72	163.29	163.52
105	784.40	785.62	454.20	454.91

EXTRA MORTALITY RATES IN RESPECT OF AIDS (*)
(number of annual deaths per 1,000 persons)

	Calendar year				
Age	1995	2000	2005	2010	2015
25	0.33	0.38	-	-	-
30	0.80	0.90	0.62	-	-
35	0.60	0.86	0.59	0.29	-
40	0.46	0.50	0.44	0.21	0.07
45	0.34	0.35	0.23	0.14	0.05
50	0.23	0.25	0.16	0.08	0.03
55	0.19	0.17	0.12	0.05	0.02
60	0.16	0.15	0.08	0.04	0.01

(*) 100% of these increases apply to male mortality rates; only 10% apply to female rates.

(c) Migration

Immigration and emigration are generally recognized to be volatile parameters of future population growth, since they are subject to a variety of demographic, economic, social and political factors; immigration, especially, is subject to government control. During the period from 1 June 1966 to 31 May 1993, for example, annual immigration to Canada varied from 82,939 to 257,465, and annual emigration out of Canada is estimated to have fluctuated between 37,314 and 111,500.

For purposes of this report it was decided to assume, for 1994, 163,000 immigrants to Canada and 50,000 emigrants leaving Canada. These figures correspond approximately to the 1983-1993 averages and were increased with time so as to maintain a constant ratio of net immigration to total current Canadian population of 0.4%.

For purposes of projecting the population of Québec, it was assumed as for the previous report, on the basis of the 1983-1988 averages, that 17% of the immigrants, and 14% of the emigrants assumed for Canada would be attributable to that province. Statistics Canada data for 1983 to 1993 indicate that 18.6% of immigrants and 13.3% of emigrants to be attributable to Québec on average. In addition it was assumed that Québec would experience net interprovincial emigration of about 10,000 in 1991, decreasing uniformly to zero by the year 2010, based on the trends observed over the 1979 to 1993 period.

The distributions of immigrants and emigrants by age group and sex used for the demographic projections correspond to Statistics Canada data averaged over mid-1988 to mid-1993.

DISTRIBUTIONS OF IMMIGRANTS AND EMIGRANTS
(mid-1988 to mid-1993 average)

	Age group	Immigrants		Emigrants	
		males (%)	females (%)	males (%)	females (%)
Canada	0- 4	3.711	3.517	2.979	2.660
	5- 9	4.179	3.848	3.891	3.879
	10-14	3.893	3.614	3.650	3.572
	15-19	3.954	3.850	3.424	3.185
	20-24	5.486	6.028	4.047	5.024
	25-29	7.745	7.445	7.340	7.969
	30-34	6.620	6.319	7.212	6.774
	35-39	4.608	4.358	6.052	5.291
	40-44	2.861	2.598	5.015	4.042
	45-49	1.628	1.621	2.573	2.172
	50-54	1.209	1.553	1.578	1.430
	55-59	1.191	1.552	1.071	0.929
	60-64	1.205	1.448	0.708	0.617
	65-69	0.819	1.016	0.619	0.792
	70+	0.882	1.233	0.604	0.894
	TOTAL	49.991	50.009	50.763	49.237
Québec	0- 4	4.052	3.681	2.865	2.478
	5- 9	4.619	4.251	3.801	3.864
	10-14	4.294	3.851	3.576	3.498
	15-19	4.308	3.944	3.300	3.002
	20-24	6.162	5.652	4.134	4.869
	25-29	8.257	6.890	7.438	8.169
	30-34	6.591	5.775	7.366	6.841
	35-39	4.600	4.032	6.085	5.392
	40-44	3.022	2.698	5.087	4.050
	45-49	1.988	1.698	2.617	2.189
	50-54	1.390	1.276	1.607	1.488
	55-59	1.044	1.066	1.091	0.951
	60-64	0.874	1.035	0.716	0.603
	65-69	0.592	0.708	0.632	0.776
	70+	0.641	1.003	0.634	0.880
	TOTAL	52.434	47.566	50.949	49.051

3. Methodology

The most recent Canada population census is as at 1 June 1991. The starting point for demographic projections purposes accordingly corresponds to mid-1991 and consists of numbers of males and females by age. However, population data for 1966 to 1990 are also required for the calculation of future benefits of the relevant cohorts of contributors and beneficiaries. For this latter purpose, use is made of historical data, developed by Statistics Canada. These historical data take into account the 1991 change in the definition of the census population which now includes both permanent and non-permanent residents of Canada.

The 1991 census data for Canada and Québec are available by individual ages up to 89, but the data for ages 90 and over are grouped. Hence, the latter data were dis-aggregated for individual ages 90 to 106 by surviving the population data at age 89, using the 1985-1987 Life Tables, up to age 106. A constant proportional adjustment was made to the population so survived for each age from 90 to 106 to match its total with the census aggregate value for this age group.

To compensate for the census undercount, adjustment factors developed by Statistics Canada were applied to the 1991 census population data. These factors vary by age, sex and area, i.e., Canada and Québec separately.

The population, by age and sex, was then projected from one year to the next by adding births and immigrants, subtracting deaths and emigrants, and adjusting for net migration between Québec and the rest of Canada. The annual numbers of births, deaths, immigrants and emigrants were developed by applying the fertility, mortality and migration assumptions to the mid-year population. The projections carry forward to 2112.

The populations covered by the CPP pertain to Canada excluding Québec, but include all members of the Canadian Forces and the Royal Canadian Mounted Police. The population and deaths projections used for purposes of the financial projections were obtained by simple subtraction of the projected figures for Québec from the projected figures for Canada. Consequently, the projected populations do not make explicit allowance for members of the Canadian Forces and Royal Canadian Mounted Police who reside in Québec or outside Canada. However, provision for this group was made implicitly through the development of the proportions of contributors described in section II-3(d) of this appendix.

4. Population Tables

The first two tables below show, for Canada excluding Québec, the 1991 starting population (1991 census adjusted for undercount) and the projected mid-year populations for 1995, 2000, 2025, 2050, 2075 and 2100. The populations shown are distributed by sex and broad age groups. The third table shows corresponding dependency ratios.

POPULATION (in thousands)
CANADA excluding QUÉBEC
BOTH SEXES

	Age Group	1991	1995	2000	2025	2050	2075	2100
	0- 4	1516	1561	1541	1662	1791	1933	2096
	5- 9	1497	1543	1602	1684	1805	1956	2124
	10-14	1430	1518	1585	1680	1819	1981	2155
	15-19	1474	1461	1555	1668	1838	2007	2180
TOTAL	0-19	5917	6083	6283	6694	7253	7877	8555
	20-24	1623	1546	1509	1712	1887	2051	2221
	25-29	1888	1686	1611	1801	1959	2112	2282
	30-34	1961	1990	1742	1883	2004	2153	2334
	35-39	1743	1946	2023	1863	1998	2164	2357
	40-44	1591	1713	1959	1808	1962	2155	2354
	45-49	1207	1526	1711	1706	1945	2142	2329
	50-54	988	1151	1513	1721	1941	2115	2285
	55-59	912	947	1131	1758	1921	2055	2217
	60-64	881	886	920	1928	1807	1953	2127
TOTAL	20-64	12794	13391	14119	16180	17424	18900	20506
	65-69	814	820	831	1751	1647	1806	2004
	70-74	630	722	736	1392	1420	1646	1842
	75-79	476	505	608	1061	1242	1446	1619
	80-84	292	349	385	630	1025	1177	1318
	85-89	149	179	228	356	811	826	959
	90+	75	91	119	272	674	779	1029
TOTAL	65+	2436	2666	2907	5462	6819	7680	8771
GRAND TOTAL		21147	22140	23309	28336	31496	34457	37832

POPULATION (thousands)
CANADA excluding QUÉBEC

Age Group	1991	1995	2000	2025	2050	2075	2100
				Males			
0- 4	770	799	790	853	920	993	1077
5- 9	766	784	819	864	926	1003	1089
10-14	732	776	804	861	931	1014	1103
15-19	755	747	793	853	939	1025	1114
0-19	3023	3106	3206	3431	3716	4035	4383
20-24	821	789	770	870	961	1045	1132
25-29	955	851	821	916	997	1076	1163
30-34	992	1007	880	959	1024	1100	1193
35-39	872	982	1023	946	1024	1108	1207
40-44	803	857	987	924	1005	1103	1205
45-49	611	769	854	871	992	1094	1191
50-54	499	581	759	874	988	1078	1166
55-59	459	475	567	879	972	1044	1127
60-64	434	441	457	956	903	986	1074
20-64	6446	6752	7118	8195	8866	9634	10458
65-69	376	392	405	850	814	897	997
70-74	278	319	339	648	681	792	892
75-79	199	209	252	471	564	664	750
80-84	111	132	144	257	423	500	570
85-89	49	59	75	127	295	311	374
90+	20	24	31	73	190	230	312
65+	1033	1135	1246	2426	2967	3394	3895
Total males	10502	10993	11570	14052	15549	17063	18736
				Females			
0- 4	746	762	751	809	871	940	1019
5- 9	731	759	783	820	879	953	1035
10-14	698	742	781	819	888	967	1052
15-19	719	714	762	815	899	982	1066
0-19	2894	2977	3077	3263	3537	3842	4172
20-24	802	757	739	842	926	1006	1089
25-29	933	835	790	885	962	1036	1119
30-34	969	983	862	924	980	1053	1141
35-39	871	964	1000	917	974	1056	1150
40-44	788	856	972	884	957	1052	1149
45-49	596	757	857	835	953	1048	1138
50-54	489	570	754	847	953	1037	1119
55-59	453	472	564	879	949	1011	1090
60-64	447	445	463	972	904	967	1053
20-64	6348	6639	7001	7985	8558	9266	10048
65-69	438	428	426	901	833	909	1007
70-74	352	403	397	744	739	854	950
75-79	277	296	356	590	678	782	869
80-84	181	217	241	373	602	677	748
85-89	100	120	153	229	516	515	585
90+	55	67	88	199	484	549	717
65+	1403	1531	1661	3036	3852	4286	4876
Total females	10645	11147	11739	14284	15947	17394	19096

DEPENDENCY RATIOS (%)
Canada excluding Québec

Year	Both Sexes		
	Children[1]	Seniors[2]	Total[3]
1991	46.3	19.0	65.3
2000	44.5	20.6	65.1
2025	41.4	33.8	75.1
2050	41.6	39.1	80.8
2075	41.7	40.6	82.3
2100	41.7	42.8	84.5

Year	Males		
	Children[1]	Seniors[2]	Total[3]
1991	46.9	16.0	62.9
2000	45.0	17.5	62.5
2025	41.9	29.6	71.5
2050	41.9	33.5	75.4
2075	41.9	35.2	77.1
2100	41.9	37.3	79.2

Year	Females		
	Children[1]	Seniors[2]	Total[3]
1991	45.6	22.1	67.7
2000	43.9	23.7	67.7
2025	40.9	38.0	78.9
2050	41.3	45.0	86.3
2075	41.5	46.3	87.7
2100	41.5	48.5	90.1

1 Population aged 19 years and under as a percentage of population aged 20 to 64 years.
2 Population aged 65 years and over as a percentage of population aged 20 to 64 years.
3 Population aged 19 years and under, plus population aged 65 years and over, as a percentage of population aged 20 to 64 years.

-II- EARNINGS AND BENEFITS

1. Data

(a) Demographic

Historical (1966-1991) and projected (1992-2150) populations and deaths, the output of section I above, are used for various computational purposes in the economic projections. For example,

- ratios of the actual number of earners to the population correspond to the proportions of earners;
- the relevant population times the benefit eligibility rate, and times the computed average benefit factor for each age-sex cohort, produces the amount of projected benefits;
- numbers of deaths by age, sex and year are used in computing death, survivor and orphan benefits.

(b) Economic indices

The Consumer Price Index (CPI) and the Average Industrial Aggregate Wages statistic (AIAW, the current measure of the average rate of weekly wages and salaries) are produced by Statistics Canada (catalogues 72-002 and 11-010, respectively). The observed (1966 to 1993) annual increases in the CPI and the AIAW replace, for methodology validation purposes, values assumed in previous actuarial reports; they are also used as a basis for the determination of corresponding assumptions for the future. Rates of interest, which come into play only in the Account projections, are discussed in section III below. For purposes of selecting related assumptions, use was also made of these CPI and AIAW indices averaged over the last 5, 10, 15, 25 and 50 years as determined by the Canadian Institute of Actuaries in its 1994 report on Canadian Economic Statistics. Actual past values of the YMPE, the YBE, the amount of the various monthly flat-rate benefits, and the distribution of retirement pensions, over six categories expressed as a percentage of the YMPE, constitute other economic indices used in the actuarial valuation process.

(c) Monthly Information Reports

Monthly Information Reports, flowing from the administration of the CPP by the Ministry of Human Resources Development Canada (HRDC), provide aggregate financial data (e.g., total contributions for the year, total benefits, administrative expenses) that serve as a basis for the CPP annual accounting report of the Comptroller General. Although these reports are basically prepared on a cash basis, their income (contributions and investment earnings) component is based, in respect of a given fiscal year, on projections made by the Finance Ministry about six months before the start of that fiscal year. These projections are used, in lieu of actual data, for both budgeting and accounting purposes because of the delay of about 12 months by Revenue Canada in allocating monthly pay deductions between Unemployment Insurance and CPP contributions.

For the methodology validation process, the total amounts of actual benefits obtained from the benefits statistics described in section (f) below, are linearly adjusted to correspond to the aggregate cash-basis results shown in the monthly information reports because they form the basis of the formal accounting reports on the CPP.

Aggregate data from Monthly Information Reports are also compiled over each calendar year after the preparation of an actuarial report and compared with corresponding aggregate projected values of that report for further methodology validation purposes until the next report comes due.

(d) Monthly Statistics

Statistics published monthly by HRDC are similar to benefits statistics (section (f) below), but are generally combined for some age-groups, and are less detailed (e.g., no information on terminations). Because the more detailed benefits statistics are not produced as frequently as monthly statistics, these monthly statistics are used for various preliminary valuation studies between valuation dates.

(e) Earnings statistics

Statistics on the average employment earnings, by sex and age-group, of all workers covered by the CPP are prepared annually and transmitted as machine readable files, via magnetic tapes, by officials of HRDC involved in the administration of the CPP. These data originate from Revenue Canada, which is responsible for the processing of CPP contributions through salary deductions. The complete employment earnings data pertaining to a given calendar year normally become available only in the second year (about mid-year) following that given year. This delay is partly due to the contribution adjustments resulting from tax returns filed after the given year, but mainly by the annual (as opposed to monthly) cycle of Revenue Canada's allocation of monthly pay deductions between Unemployment Insurance and CPP contributions.

In summary, these earnings statistics include the number of earners, average annual employment earnings of these earners and the distributions, over 78 earnings categories, of earners and of their average employment earnings by quinquennial age-groups and sex. For example, the distributions of earners and of their average employment earnings could indicate that 60% of earners (distribution of earners) for a particular age-sex cell earn less than 120% of average earnings for the cell and account for 40% of total earnings (distribution of average employment earnings) for the cell. By linear interpolation between the relevant points of the distributions, it is possible to determine, for a given percentage of average earnings in any age-sex cell, what percentage of earners earn less than that given percentage of average earnings, and what percentage of the total earnings for the cell is earned by such earners.

One might expect that earnings statistics would include few, if any, earners earning less than the Year's Basic Exemption (YBE), since, except in unusual circumstances, the CPP employee contributions are refundable in such cases and earnings are not counted for purposes of calculating pensionable earnings. However, each year's data reveal a large number of earners earning less than the YBE, a number as large or almost as large as one might expect if there were no YBE. The likely reason for this is that most contributors who earn less than the YBE during the course of a year have low annual earnings because they work for only a small fraction of the year, but during that fraction they have monthly earnings in excess of 1/12 of the YBE. Employer and employee contributions must be deducted at source for any month during which individual earnings exceed 1/12 of the YBE (unless the year's maximum has already been deducted). Although the employee contributions may be refundable if the employee earns less than the YBE during the year, the employer contributions

are not. Hence, most earners earning less than the YBE in any year would have employer contributions to their credit. They would therefore have records of their employment earnings for that year maintained on the CPP Record of Earnings, even though those earnings are not counted for pensionable earnings purposes. For this reason, it appeared reasonable to consider the cumulative distributions of earners and of their average earnings as being generally representative of cumulative distributions for all covered earners and of their average employment earnings.

Therefore, earnings statistics available for the most current year (1992) are used as the basis for projecting (by age, sex and calendar year) average employment, pensionable and contributory earnings, contributions, and benefits. For methodology validation purposes, they also prove to be a better basis for the comparison of projected to actual contributions because those from monthly information reports (item (c) above) are themselves projected rather than actual.

Officials responsible for earnings statistics in HRDC also report annually on the cumulative number of records of earnings as at 1 July of the year by individual age and sex. These numbers are intended to be used for the calculation and validation of the benefit eligibility rates (see section 3(g) below).

(f) Benefits Statistics

Benefits statistics correspond to extracts from individual records in the Master Benefit File administered by officials in HRDC. These include primarily, but not exclusively, for each past and existing beneficiary, separately for each type of benefit, the date (month and year) of emergence of the benefit, the beneficiary's age at emergence and sex, the initial monthly amount of the benefit, and, when applicable, the date of, and reason for, benefit termination.

Extracts as at 31 December 1993 from each individual record in the CPP Master Benefit file play an important role in the actuarial valuation process since they are used for three distinct reasons:

i) The number and amount of benefits by type, both emerging and in force, can be obtained by age, by sex and by calendar year. This information is used in a methodology validation algorithm integrated into the computer actuarial valuation system. The various values computed in this valuation system for years preceding 1994 are accordingly compared with actual values to validate the valuation methodology or to detect areas where it should be improved, and to ensure that benefits statistics are correctly interpreted. It must be pointed out that this validation process looks only at methodology, not assumptions; accordingly, in the methodology validation process, the assumptions made in previous reports are replaced by actual values. The results of the methodology validation process are favourable taking into account the adjustment of benefits statistics to match in aggregate the official CPP reports (see section (d) above) which are prepared on a cash basis, while actuarial valuation results data are computed on an accrual basis. However, the effect of this inconsistency is practically negligible as regards benefits because, in contrast to contributions, cash benefits are, as a general rule, nearly the same as accrued benefits due to the relatively fast

handling of most CPP claims. Some disability benefit cases do, however, constitute exceptions to this rule.

ii) The benefits, underlying these extracts, paid during 1993, are converted into benefits in pay as at the valuation date (31 December 1993) and used as the starting point for the projections. This is achieved by computing experience factors (i.e., ratios of actual to evaluated benefits for 1993) and by multiplying these experience factors by the evaluated benefits.

iii) Various secondary demographic and economic assumptions, required in projecting future benefits, are selected relying on past experience. These assumptions relate, for example, to the age at which contributors elect to start receiving the retirement pension, the proportions of contributors married at death, distribution of spouses by age, disability incidence (i.e., number of new cases as a proportion of the eligible population) and termination rates, and mortality rates of retirement and survivor pensions beneficiaries.

2. Assumptions (other than interest)

In accordance with the practice first adopted for the Third Statutory Actuarial Report as at 31 December 1973, the Main Tables of financial projections shown in the main body of this report are based on a single set of realistic economic and demographic assumptions. The economic assumptions described below relate to these Main Tables, but not to the Auxiliary Tables.

(a) Key assumptions

The key economic assumptions involved in the projection of earnings and benefits are the annual rates of increase in average employment earnings and in the CPI. Rates of interest, which come into play only in the Account projections, are discussed in section III below.

For the period 1994 to 1999, the assumptions were derived to fall smoothly between the 1993 experience and the ultimate (2000 and subsequent years) assumptions described below.

Since the financial projections of this report cover a long period, ultimate key economic assumptions were chosen on the basis of:

- The average long-term (about 50 years) past experience and the observed trends over the past short (about 15 years) and medium (about 25 years) terms.
- Judgmental opinion as to the outlook of the overall economy over the future long term.

It was accordingly decided to maintain the ultimate assumptions for the annual increase in prices and average employment earnings at 3.5% and 4.5%, respectively, as for the previous CPP actuarial report. This decision rests among other things on the fact that:

- The actual gap between the annual rates of increase in average employment earnings and prices, each measured using ratios of the relevant yearly average index over that of the previous year, has been equal on average in 1993 over the last 5, 10, 15 and 25 years, to 0.01%, –0.18%, 0.01% and 0.86%, respectively. The average gap over the last 50 years, measured as the ratio of the year-end relevant index to that of the previous year, is 1.52%. The assumed gap of 1% therefore corresponds closely to the actual recent 25-year average.
- It is generally believed that, in this post-industrialized era where the economy is more and more service-oriented, the productivity rate should not, in the long-term, be as high as during the industrialized era.

The table below shows the short-term and ultimate assumptions adopted for this report regarding the annual increases in earnings and prices.

ANNUAL RATE OF INCREASE IN PRICES AND AVERAGE EMPLOYMENT EARNINGS

YEAR	PRICES (%)	EARNINGS (%)	earnings-prices GAP (**) (%)
1985 (*)	3.9	3.5	(0.4)
1986 (*)	4.2	3.0	(1.2)
1987 (*)	4.4	3.8	(0.6)
1988 (*)	4.0	4.4	0.4
1989 (*)	5.0	5.2	0.2
1990 (*)	4.8	4.5	(0.3)
1991 (*)	5.6	4.6	(1.0)
1992 (*)	1.5	3.4	1.9
1993 (*)	1.8	1.7	(0.1)
1994 (*)	0.0	1.9	1.9
1995	1.0	2.0	1.0
1996	1.5	2.5	1.0
1997	2.0	3.0	1.0
1998	2.5	3.5	1.0
1999	3.0	4.0	1.0
2000 (ultimate)	3.5	4.5	1.0

(*) Rates for these years are actual experience rates (preliminary for 1994).
(**) Brackets mean that these rates are negative.

(b) Secondary (other than key) assumptions

The exhaustive list of secondary assumptions is quite extensive. The following 13 sections cover the majority of these assumptions. For example, a fourteenth secondary assumption, flowing implicitly from the valuation methodology, is described in section 3(a)i) below (i.e., earnings of contributors dying before retirement are assumed to be the same, on average each year until death, as those of all other contributors).

i) Proportions of earners

In respect of each past year (1966 to 1992), actual proportions of earners are computed, by age and sex, as the ratio of the number of earners (from earnings statistics) to the corresponding population (from demographic computations). In addition to being used for the computation of the past and future benefits of the relevant cohorts of contributors, these historical values constitute an important reference for the selection of assumed future proportions of earners.

These proportions for the future were accordingly determined taking partly into account the trends in their counterpart actual, adjusted (see 3.c below) values for 1966 to 1992. These trends reveal quite variable proportions for males, and significant year to year increases for females.

Male proportions of earners are assumed to reach by year 2000 the levels at which they were on average from 1975 to 1980, before the 1982-1984 and the early 1990s recessions. These assumed ultimate proportions rest upon a deemed average rate of unemployment comparable to that prevailing during that period, i.e., about 7.5%. Assumed proportions for 1993 to 1999 were obtained by interpolation between the latest experience figures (i.e., 1992) and the values assumed for 2000 and subsequent years.

Since 1985, proportions of females with earnings have increased much more rapidly than anticipated, and in 1990 had already, on average, reached the levels assumed in previous actuarial reports for 2050. It was accordingly decided to maintain the assumptions of the previous report from the ultimate year (varying by age for females) to 2100, and to determine values for intermediate years by linear interpolation from the actual 1992 values and those assumed for the applicable ultimate year.

Each set of male and female values for proportions of earners so resulting for 1993 to 2000 corresponds to annual increases of about 2% in the labour force.

Selected values of the adjusted past actual and future assumed proportions of earners is shown by age, sex and calendar year in section 3(c) below.

ii) Average employment earnings

In respect of a cohort of earners of a given age and sex, the average employment earnings for a given calendar year correspond to the ratio of the sum of individual employment earnings earned during the year to the number of earners in the cohort. On the other hand, the AIAW, compiled by Statistics Canada, corresponds to the weekly rate of pay, at a particular point in time, averaged over all industries.

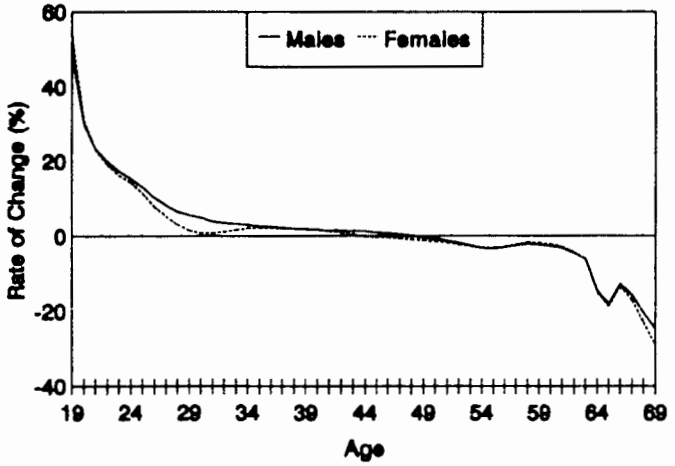
For a given age, average employment earnings are deemed to increase from one year to the next (but keeping the age constant) at the assumed rate of increase in the AIAW. Consistent with past experience, the annual seniority and promotional increases are accordingly implicitly assumed constant at the actual 1992 rates for every year of the projection period. The seniority and promotional increase for a given *age/year* cell is accordingly deemed equal to the ratio, minus one, of the average earnings for that *age/year* cell to the average earnings for the *preceding age/same year* cell. Therefore, projected average earnings for a given *age/year* cell are obtained simply by applying the annual increase in the AIAW assumed for this year to the average earnings for the *same age/previous year* cell.

$$EMPEAR_x^N = EMPEAR_{x-1}^{N-1} * (1+p_x^N) * (1+s^N) = EMPEAR_x^{N-1} * (1+s^N)$$

where N = calendar year
x = age attained during calendar year N
EMPEAR = average employment earnings
p_x^N = constant (by year) promotional and seniority rate of change in EMPEAR from age x-1 to age x
= $\{EMPEAR_x^{1992} / EMPEAR_{x-1}^{1992}\} - 1$
s^N = assumed constant (for any given age or sex) overall annual increase in EMPEAR from year N-1 to N

1992 RATE OF CHANGE IN EMPEAR

(Promotional and Seniority)



However, this assumed rate of increase in average employment earnings is subject to the following two adjustments:

- The preceding statement of the above assumption implies that the effect, on average employment earnings, of unemployment levels prevailing on average during the base year (1992) of earnings projections, will remain constant each year in the future. Whenever the actual level of average unemployment during the base year of earnings projections is not deemed representative of the expected average level of unemployment of 7.5% in the long term, projected average earnings are adjusted over the next 5 to 10 years consistent with this 7.5% unemployment level. The temporary reduction effect of the early 1990s recession on average employment earnings was removed by dividing male and female average employment earnings projected for 1995 and subsequent years by 0.945 (determined on the basis of past experience).

- The assumed annual rate of increase in the AIAW was not implemented uniformly by sex since it was further assumed that an annual geometrical narrowing of 1% in the gap between male and female average employment earnings would apply. Hence, rates of increase in average employment earnings were developed by age and by sex so as to produce:
  - an aggregate rate of increase equal to that assumed for the AIAW;
  - rates of increase for each age, both sexes combined, that would be the same for all ages; and
  - separate rates of increase for male and female average earnings for each age such that the ratio of female to male average earnings would move 1% of the way to unity each year.

iii) Distributions of earners and earnings over 78 earnings categories

The distributions of earners and earnings relative to average earnings (see section 1(c) above) have actually been quite stable since 1966, both by age and sex. It was therefore decided that for the future they would be assumed constantly equal to their actual adjusted five-year (1988-1992) average described and shown in section 3(c) below.

iv) Credit-splitting on marital union breakdown

The effect (not more than 0.02% of contributory earnings) of the equal apportionment, between spouses, of unadjusted pensionable earnings in event of marital union breakdown, is accounted for by adjusting appropriately the projected proportions of contributors and average (unadjusted) pensionable earnings of the respective spouses. These adjustments were achieved by assuming the following:

- On the basis of past medium-term average experience, the annual incidence rate of divorce is assumed at 1% for any age-sex-year cell. Divorce rates show increasing patterns, but these aspects were ignored because of their recency and of their negligible effect on financial projections.

- The proportions of married live contributors were derived, from the proportions of contributors married at death mentioned at item ix) below, by multiplying the latter by ratios of mortality rates of both married and non-married persons to mortality rates of married persons. These ratios, not available from CPP data, were taken from 1986 Canada Census data (catalogue 84-536E). The proportions of married live persons (as opposed to married CPP contributors) were derived taking into account the above procedure and the assumption described in the following paragraph.

- The proportions of contributors (see section 3(d) below) are deemed not to vary by marital status for males, and the corresponding proportions for single females are deemed the same as those for males having the same age. Assumed proportions for married females are then obtained as the weighted differences between overall female proportions of contributors and single female proportions of contributors assumed as above.

- The distribution of average employment earnings (see section 1(c) above) of the cohort of spouses (sorted by age in accordance with the distribution of surviving spouses, described in section xi) below) of a cohort of contributors of a given age is assumed to apply uniformly to each of the 78 earnings categories of the given cohort of contributors.

v) **Employment Mobility Rate**

In respect of a cohort of persons born in a given calendar year, the employment mobility rate corresponds to the proportion, assumed to never contribute to CPP, of those persons not contributing to CPP in respect of the calendar year associated with this cohort's highest annual proportion of contributors over its entire contributory period. For actuarial valuation purposes, the remainder of persons, i.e., those deemed to contribute for at least one year during the contributory period, is assumed to contribute randomly during the contributory period.

The employment mobility rate, which is required for the estimate of eligibility rates (see section 3(g) below), and of the effect of the drop-out provisions (see section 3(h) below), is assumed to be constantly equal to 50%.

For example, if the highest proportion of contributors of a cohort of persons over its entire contributory period is 80%, then 10% (i.e., half of the proportion not contributing for that year) are assumed to never contribute and 90% (i.e., the difference between 100% and 10%) are assumed to contribute randomly, if ever possible (e.g., if the contributory period were limited to one year in the above case, the percentage never contributing would be 20% instead of 10%).

vi) Drop-out period

Assumptions must be made regarding the child-rearing period and the years for which contributions are made over age 65:

- **Period during which the contributor had at least one dependent child under 7 years of age**
  Because the actual proportions of males benefiting from the child-rearing drop-out provision are very small, it was assumed that all years of child-rearing would relate to female contributors. In any event, this alternative approach has no significant effect on financial projections. For a female born in a given calendar year, the cumulative number of years to be dropped on account of the child-rearing drop-out provision was computed for each year during her contributory period. The calculation uses actual past and future assumed fertility rates (adjusted, to correspond to Canada less Québec, by weighting them by the population for the appropriate age, and calendar year and residence) to yield the number of children born so far to the female. Assuming a uniform age difference of exactly two years between any two consecutive births, the child-rearing period could then be computed taking into account the limit of seven years per child. Further, since years of child-rearing are not necessarily the years of lowest earnings, only half of the computed period was taken into account.
- **Years for which contributions are made over age 65**
  The provision for the replacement of earnings under age 65, by any higher earnings beyond age 65, is assumed to have a nil effect on retirement benefits.

vii) Retirement election proportions and retirement prevalence rates

The assumed proportions, by age, sex and calendar year, of contributors electing to start receiving the retirement pension at a given age (last birthday) were determined by extrapolating the corresponding CPP experience (see section 1(f) above) for 1987 to 1993. These proportions correspond to the ratio of the number of emerging retirement beneficiaries to the product of the population times the retirement benefit eligibility rate ELIRET (described in section 3(g) below).

$$ELECT_x^N = \frac{NUMRET_x^N}{POP_x^N * ELIRET_x^N}$$

Given the negligible proportion of contributors actually electing to start receiving the retirement pension after age 65, it was decided to assume that all contributors would be retired by age 65. For each year after 1993, the retirement election proportion for age 65 was taken as 100% minus the sum of proportions experienced by, or assumed for, the underlying cohort (of contributors reaching age 65 in the given year) for ages 60 to age 64. With this approach, it is implicitly assumed that all eligible contributors will have applied for the retirement pension by age 65.

Retirement prevalence rates were derived from the retirement election proportions using the following formula:

$$RETPRV_x^N = \sum_{t=60}^{x-1} ELECT_t^{N-(x-t)} + ELECT_x^N * \frac{YBE^N}{EMPEAR_x^N}$$

In the above equation for the retirement prevalence rate, the ratio YBE/EMPEAR (where EMPEAR corresponds to the average employment earnings at age x during year N) is meant to reflect the effect of the portion of earners, retiring during year N, who entail a reduction in the proportion of contributors. It accordingly corresponds to those who earn less than the YBE from 1 January to retirement during the year.

The retirement election proportions, and the underlying prevalence rates of retirement, are used for the following four estimates:

- the emergence of retirement benefits (using election proportions) described in section 3(i)i) below
- the adjustment (using election proportions), for benefits computation purposes, of average pensionable earnings at ages 60 to 70 (described in section 3(e) below)
- the reduction (using prevalence rates) effect of early retirement on disability incidence rates (described in section viii) below)
- the limit (using prevalence rates) on combined survivor-retirement pensions (described in section 3(i)iii) below)

A sample of some past actual and future assumed retirement election proportions and prevalence rates is shown below by age, by sex and by calendar year.

RETIREMENT ELECTION PROPORTIONS

	Year	Age at Retirement 60	61	62	63	64	65
Males	1987*	.27	.21	.25	.27	.31	.88
	1988*	.23	.09	.10	.10	.15	.69
	1989*	.23	.07	.07	.07	.11	.58
	1990*	.25	.07	.07	.06	.09	.54
	1991*	.27	.08	.08	.07	.09	.52
	1992*	.29	.08	.07	.06	.08	.41
	1993*	.31	.08	.07	.07	.08	.48
	1994	.31	.08	.08	.07	.08	.48
	1995	.31	.08	.08	.07	.08	.46
	1996	.31	.08	.08	.07	.08	.43
	1997	.31	.08	.08	.07	.08	.41
	1998	.31	.08	.08	.07	.08	.38
	1999+	.31	.08	.08	.07	.08	.38
Females	1987*	.35	.24	.26	.26	.33	.68
	1988*	.30	.10	.10	.10	.18	.51
	1989*	.31	.08	.07	.07	.13	.43
	1990*	.31	.07	.06	.06	.10	.40
	1991*	.32	.08	.06	.06	.09	.37
	1992*	.34	.07	.06	.06	.09	.33
	1993*	.35	.08	.07	.06	.08	.34
	1994	.35	.08	.07	.06	.08	.42
	1995	.35	.08	.07	.06	.08	.41
	1996	.35	.08	.07	.06	.08	.40
	1997	.35	.08	.07	.06	.08	.37
	1998	.35	.08	.07	.06	.08	.36
	1999+	.35	.08	.07	.06	.08	.37

RETIREMENT PREVALENCE RATES

	Age at Retirement 60	61	62	63	64	65	66	67	68	69	70
1987*	0.03	0.02	0.03	0.03	0.04	0.15	1.00	1.00	1.00	1.00	1.00
1988*	0.02	0.28	0.22	0.26	0.29	0.42	0.88	1.00	1.00	1.00	1.00
1989*	0.02	0.24	0.37	0.32	0.36	0.51	1.00	0.88	1.00	1.00	1.00
1990*	0.02	0.24	0.31	0.44	0.40	0.55	1.00	1.00	0.88	1.00	1.00
1991*	0.03	0.25	0.31	0.38	0.51	0.57	1.00	1.00	1.00	0.88	1.00
1992*	0.03	0.28	0.33	0.39	0.45	0.66	1.00	1.00	1.00	1.00	1.00
1993*	0.03	0.30	0.36	0.41	0.46	0.60	1.00	1.00	1.00	1.00	1.00
1994	0.03	0.32	0.38	0.43	0.48	0.61	1.00	1.00	1.00	1.00	1.00
1995	0.03	0.32	0.40	0.45	0.50	0.62	1.00	1.00	1.00	1.00	1.00
1996	0.03	0.32	0.40	0.47	0.53	0.64	1.00	1.00	1.00	1.00	1.00
1997	0.03	0.32	0.40	0.47	0.55	0.66	1.00	1.00	1.00	1.00	1.00
1998	0.03	0.32	0.40	0.47	0.55	0.68	1.00	1.00	1.00	1.00	1.00
1999+	0.03	0.32	0.40	0.47	0.55	0.68	1.00	1.00	1.00	1.00	1.00
1987*	0.06	0.04	0.05	0.05	0.07	0.19	1.00	1.00	1.00	1.00	1.00
1988*	0.05	0.37	0.26	0.28	0.30	0.47	0.68	1.00	1.00	1.00	1.00
1989*	0.05	0.31	0.46	0.36	0.39	0.56	0.84	0.68	1.00	1.00	1.00
1990*	0.05	0.32	0.39	0.53	0.44	0.60	0.87	0.84	0.68	1.00	1.00
1991*	0.05	0.32	0.39	0.45	0.60	0.62	0.89	0.87	0.84	0.68	1.00
1992*	0.06	0.33	0.40	0.45	0.52	0.76	0.88	0.89	0.87	0.84	1.00
1993*	0.06	0.35	0.41	0.46	0.52	0.68	1.00	0.88	0.89	0.87	1.00
1994	0.06	0.37	0.43	0.47	0.53	0.70	0.92	1.00	0.88	0.89	1.00
1995	0.06	0.36	0.44	0.50	0.54	0.70	1.00	0.92	1.00	0.88	1.00
1996	0.06	0.36	0.44	0.51	0.57	0.71	1.00	1.00	0.92	1.00	1.00
1997	0.06	0.36	0.44	0.51	0.57	0.73	1.00	1.00	1.00	0.92	1.00
1998	0.06	0.36	0.44	0.51	0.57	0.74	1.00	1.00	1.00	1.00	1.00
1999+	0.06	0.36	0.44	0.51	0.57	0.73	1.00	1.00	1.00	1.00	1.00

* Proportions for these years are actual experience proportions

viii) **Disability incidence and termination rates**

Actual disability incidence rates (DIR, i.e., number of new cases as a proportion of the eligible population) by age and sex for each year of the study period (1976-1993) were developed as the ratio of the number of emerging disability beneficiaries (NUMDIS) to the product of the population (POP), the disability flat-rate benefit eligibility rate (ELIDFR, described in section 3(g) below) and the complement of the retirement prevalence rate (RETPRV; see previous page).

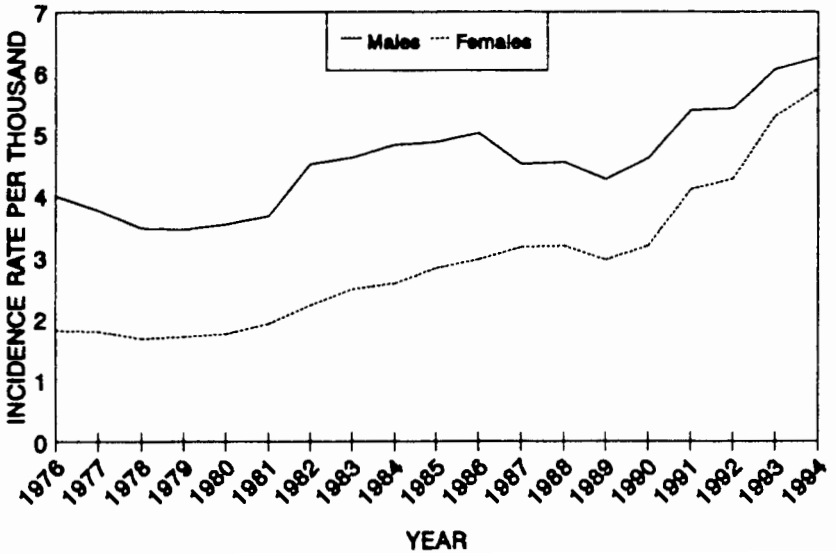
$$DIR = \frac{NUMDIS}{POP * ELIDFR * (1 - RETPRV)}$$

Actual disability termination rates were obtained, separately for death and recovery, by age, sex, duration, for each year from 1976 to 1993, as the ratio of the number of cases dying of, and recovering from, disability, respectively, at a particular duration (i.e., disability year) to the corresponding number of original emergences. In respect of any individual case exposed to risk (death and recovery) only partially during any year of disability due to occurrence of the risk or to the starting or termination of the study period, the denominator (number of original emergences) was adjusted in accordance with the Balducci formula (i.e., ${}_{1-t|}q_{x+t} = (1-t)*q_x$). The total (death and recovery) disability termination rate for each age-sex cell was obtained as the sum of the death and recovery rates minus the product of the two same rates.

Historical values of disability incidence and termination rates obtained using the above procedures are summarized in the graphic and the table below.

DISABILITY INCIDENCE RATES

(All ages combined 1976-1994)



ACTUAL DISABILITY TERMINATION RATES PER 1000

Attained YEAR	DURATION OF DISABILITY 1	2	3	4	5	6+	
1976	100.207	88.419	66.819	60.690	57.613	47.487	
1977	118.273	108.888	81.129	63.887	60.419	57.387	
1978	137.027	99.261	67.936	62.832	65.817	53.070	
1979	144.219	97.624	70.600	63.475	55.748	53.955	
1980	137.481	91.778	71.906	56.494	52.873	51.421	
1981	136.766	94.509	72.736	60.781	53.720	48.481	
1982	111.181	76.792	52.788	47.005	45.944	41.416	
1983	120.260	81.536	56.598	44.873	42.267	41.730	
1984	110.926	83.068	56.549	46.798	43.997	40.203	MALES
1985	112.913	79.354	59.063	51.563	47.675	42.547	
1986	103.997	79.723	57.260	53.912	45.261	41.463	
1987	102.011	69.527	49.185	43.629	40.255	40.333	
1988	93.034	74.563	49.992	41.687	39.111	38.645	
1989	99.786	72.904	52.097	41.128	37.839	39.412	
1990	93.455	69.987	48.125	39.905	35.818	35.724	
1991	80.659	62.471	44.706	34.357	33.750	32.757	
1992	82.207	60.846	45.142	37.615	32.486	32.546	
1993	105.692	58.774	41.957	34.036	30.112	30.377	
AVERAGE	107.339	77.357	55.106	46.227	42.199	38.717	
1976	53.571	54.991	37.135	32.277	42.395	37.411	
1977	69.379	64.249	44.681	43.572	39.386	43.982	
1978	87.146	57.879	42.217	31.156	39.703	35.425	
1979	98.511	58.400	45.178	31.981	26.701	32.445	
1980	87.708	62.861	37.984	34.874	29.942	25.845	
1981	93.267	68.996	39.850	32.893	31.774	26.645	
1982	85.591	61.156	37.312	26.030	27.225	23.929	
1983	96.825	60.515	38.742	25.198	18.017	22.395	
1984	82.206	53.623	38.815	30.640	25.386	21.629	FEMALES
1985	92.152	60.442	39.042	31.092	24.150	23.647	
1986	87.152	63.601	39.248	25.421	20.808	22.782	
1987	78.471	51.954	37.214	27.394	17.127	22.362	
1988	69.120	51.041	34.092	21.091	22.620	19.941	
1989	70.073	51.814	36.863	26.415	26.002	20.394	
1990	64.902	47.769	31.750	22.657	18.457	19.447	
1991	56.965	46.621	33.040	19.615	15.869	16.899	
1992	56.320	45.156	30.396	21.944	17.028	17.894	
1993	83.284	42.136	24.048	19.130	18.492	15.153	
AVERAGE	75.663	52.949	35.016	25.422	22.095	20.297	

It can be seen from the preceding graphic and table that the incidence (i.e., number of new cases as a proportion of the eligible population) and duration of disability have gradually increased since 1980. The annual rate of change in incidence rates has been particularly acute in 1993, and, on the basis of preliminary data, to a lesser extent in 1994. Our studies of benefits statistics indicate that the observed increases in incidence of disability over the years are quite uniform by age, sex, province, elapsed duration, and cause of disability (however, musculoskeletal and mental cases have been subject to somewhat higher than average increases). The CPP disability patterns of both incidence and termination appear to track closely, since 1980, the U.S. experience with its Old Age, Survivor and Disability Insurance (OASDI) program. On the other hand, the Québec Pension Plan has not shown any corresponding increase in either the incidence or the duration of disability since 1988.

After having discussed all these findings with relevant officers responsible for the administration of the CPP in the Department of Human Resources Development Canada, and accounting for their view that the current levels of disability incidence are not expected to return to their previous levels, it was decided to adopt the following disability assumptions for purposes of this report:

Incidence rates

- The aggregate (all ages combined) incidence rate for 2000 and subsequent years is taken to be 5.5 per 1,000 of persons irrespective of sex. This aggregate incidence rate, which corresponds closely to the 1991-1992 experience for males, was distributed by age in accordance with the average 1987-1991 experience for each sex. For the previous report, the aggregate incidence rate assumed for 2000 and subsequent years was 4.19 for males and 2.14 for females.
- For intervening years (1994 to 1999), the male and female rates by age are assumed to increase through 1995 in a manner consistent with their respective actual 1988-1994 patterns of increase, and then to decrease gradually, until 2000, towards the assumed aggregate ultimate level of 5.5.

Termination (death and recovery) rates

The following termination rates are deemed to apply by age, sex and duration on an attained calendar year basis (i.e., on all cases being in pay during the attained calendar year irrespective of the calendar year of emergence of disability):

- The 1992 experience is assumed to apply for 1993 to 1995.
- The average 1976-1993 experience is assumed to apply for 2000 and subsequent calendar years.
- For intervening years, i.e., 1996 to 1999, the assumed rates are those obtained by linear interpolation between the rates experienced in 1992, and the average 1976-1993 experience assumed for 2000 and subsequent years.

A sample of the assumed disability ultimate incidence and termination rates is shown in the following tables.

ULTIMATE DISABILITY INCIDENCE RATES

(number of new cases as a proportion of the eligible population)
assumed for 2000 and subsequent years
per 1,000 **persons**

Age	Males	Females
20	0.227	0.112
25	0.506	0.616
30	1.269	1.405
35	1.861	2.501
40	2.822	3.878
45	4.435	5.930
50	8.694	11.216
55	17.774	18.795
60	28.488	23.533
Average	5.500	5.500

ULTIMATE DISABILITY TERMINATION RATES

(assumed for 2000 and subsequent years)
per 1,000 **beneficiaries**

Age at disablement	Year of Disability 1	2	3	4	5	6 & over	Attained Age
Males							
20	134.662	181.647	143.156	96.758	68.868	49.840	25
25	129.709	149.106	121.218	84.667	61.759	40.750	30
30	126.617	129.847	101.246	71.373	54.407	32.432	35
35	122.737	117.655	91.769	57.342	46.900	28.678	40
40	120.129	106.846	73.340	51.988	42.537	28.031	45
45	125.606	95.792	60.266	47.098	40.363	29.321	50
50	127.083	85.193	55.305	44.014	39.164	36.067	55
55	107.530	72.878	48.260	43.585	40.711	42.711	60
60	89.507	61.942	48.020	46.161	43.371	0.000	65
Females							
20	103.173	133.140	102.647	81.509	46.610	34.259	25
25	97.778	109.435	80.909	62.643	38.626	28.867	30
30	96.739	85.310	62.922	45.346	32.029	24.506	35
35	99.785	74.784	50.323	35.235	25.489	19.944	40
40	103.152	72.671	46.801	31.303	21.801	17.844	45
45	104.214	64.961	45.297	27.169	21.138	17.150	50
50	90.539	58.017	36.513	23.858	21.220	18.514	55
55	71.320	47.478	28.911	22.747	21.243	20.823	60
60	58.169	37.988	27.317	22.481	21.319	0.000	65

ix) Proportions of contributors married at death

The assumed proportions of contributors married at time of their death were determined from benefits statistics as at 31 December 1993 (see 1(f) above). The number of emerging surviving spouse benefits, sorted according to the age and sex of the deceasing contributing spouse, was divided by the number of all emerging death benefits relating to the same age and sex. This measure corresponds exactly to the proportion required for the valuation of survivor benefits since eligibility for survivor benefits is the same as for death benefits. For each age-sex cell, the resulting actual proportions, averaged over 1984 to 1993, were:

- Smoothed; with only a few slight adjustments required for this purpose.
- Uniformly adjusted, for each age, so that the overall average over all ages combined, separately for each sex, equals the actual average for 1993.

The resulting adjusted proportions are deemed to correspond to 1993. On the basis of the trends shown by past experience, the proportions assumed for the projection period were obtained by decreasing geometrically these 1993 proportions by 1% and 3% for males and females, respectively, for both 1994 and 1995. Proportions are assumed to remain constant (ultimate) after 1995. Sample ultimate values are shown below.

ASSUMED ULTIMATE PROPORTIONS OF CONTRIBUTORS MARRIED AT DEATH

Age	Males	Females
20	.0410	.0335
25	.1797	.1808
30	.3650	.3700
35	.4999	.5376
40	.6029	.6114
45	.6798	.6311
50	.7274	.6249
55	.7406	.6019
60	.7449	.5386
65	.7395	.4472
70	.7314	.3455
75	.6950	.2353
80	.6401	.1390
85	.5566	.0682
90	.4461	.0221

x) **Proportion of survivors emerging under age 45 with reduced benefits**
Surviving spouses emerging under age 45, if then not disabled and in the absence of any eligible children under their care, are only entitled to reduced survivor benefits. To account for this provision, it was assumed that 75% of all surviving spouses emerging under age 45 would then be disabled or have at least one eligible dependent child.

xi) **Distributions of spouses by age**
The distributions of spouses by age are required in the valuation process for:

- The survivorship of survivor benefits' beneficiaries.
- The estimate of the effect of limits applying to combined pensions.
- The estimates of orphan's benefits, regarding the numbers of children born to the female spouses of deceased male contributors.

For a cohort of married contributors of a given age and sex at time of death, the distribution of their spouses by age is assumed, on the basis of past experience, to be constantly equal, over the projection period, to the actual distribution, averaged over the 1982 to 1991 observation period, derived from benefits statistics (see section 1(f) above). The more current 1984 to 1993 averages are so close to the 1982-1991 averages used for the previous report that it was not deemed necessary to change the latter.

The assumed distributions of spouses by age are fully shown on the following page.

ASSUMED DISTRIBUTIONS OF SPOUSES BY AGE

Age of wife at her death	Age of widower at wife's death															
	15-19 %	20-24 %	25-29 %	30-34 %	35-39 %	40-44 %	45-49 %	50-54 %	55-59 %	60-64 %	65-69 %	70-74 %	75-79 %	80-84 %	85-89 %	90+ %
15-19	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20-24	0.0	21.4	56.5	15.3	5.3	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25-29	0.0	2.2	34.4	40.4	17.4	3.8	1.4	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.1	0.0
30-34	0.0	0.3	3.9	37.1	41.7	12.3	2.1	1.7	0.6	0.2	0.1	0.0	0.0	0.0	0.0	0.1
35-39	0.0	0.0	0.5	5.4	42.0	38.7	9.4	2.8	0.9	0.2	0.1	0.0	0.0	0.0	0.0	0.0
40-44	0.0	0.0	0.1	1.1	7.1	39.0	36.2	11.8	3.2	1.1	0.3	0.1	0.0	0.0	0.0	0.0
45-49	0.0	0.0	0.1	0.1	1.7	7.1	36.1	37.6	12.9	3.3	0.8	0.2	0.1	0.0	0.0	0.0
50-54	0.0	0.0	0.0	0.0	0.4	1.4	6.8	34.8	39.9	12.5	3.1	0.7	0.2	0.1	0.0	0.0
55-59	0.0	0.0	0.0	0.0	0.1	0.5	1.8	8.1	37.4	36.9	11.3	3.1	0.7	0.1	0.0	0.0
60-64	0.0	0.0	0.0	0.0	0.0	0.2	0.7	2.0	9.7	37.8	34.1	11.7	2.9	0.6	0.1	0.0
65-69	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.8	3.1	11.9	38.0	32.2	10.5	2.6	0.5	0.1
70-74	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.2	4.7	13.7	37.7	31.0	9.3	1.8	0.1
75-79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	2.2	5.0	17.5	42.1	25.4	6.0	1.0
80-84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	1.0	2.3	7.2	22.2	42.4	20.8	3.6
85-89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.4	3.9	12.3	29.2	38.0	13.9
90+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1	7.1	0.0	7.1	14.3	28.6	35.7

Age of husband at his death	Age of widow at husband's death															
	15-19 %	20-24 %	25-29 %	30-34 %	35-39 %	40-44 %	45-49 %	50-54 %	55-59 %	60-64 %	65-69 %	70-74 %	75-79 %	80-84 %	85-89 %	90+ %
15-19	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20-24	9.0	65.8	21.8	2.4	0.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25-29	1.0	27.8	55.0	12.3	2.7	0.8	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30-34	0.1	4.1	31.9	49.3	11.2	2.5	0.5	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35-39	0.0	0.8	7.1	32.1	48.0	9.2	1.9	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40-44	0.0	0.3	1.9	8.5	35.7	42.3	8.7	1.6	0.6	0.2	0.1	0.0	0.0	0.0	0.0	0.0
45-49	0.0	0.1	0.5	2.3	10.5	36.2	39.4	8.5	1.8	0.5	0.2	0.0	0.0	0.0	0.0	0.0
50-54	0.0	0.1	0.2	0.7	3.2	11.1	33.9	38.6	9.2	2.3	0.6	0.2	0.0	0.0	0.0	0.0
55-59	0.0	0.0	0.1	0.3	1.2	3.4	10.6	33.4	38.4	9.9	2.0	0.6	0.1	0.0	0.0	0.0
60-64	0.0	0.0	0.0	0.1	0.5	1.2	3.4	11.0	33.9	38.1	9.5	1.9	0.5	0.1	0.0	0.0
65-69	0.0	0.0	0.0	0.0	0.2	0.5	1.1	3.4	12.7	36.3	35.7	8.3	1.4	0.3	0.0	0.0
70-74	0.0	0.0	0.0	0.0	0.1	0.2	0.4	1.2	4.6	16.1	37.4	31.8	7.0	1.0	0.1	0.0
75-79	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.5	1.8	6.4	18.9	37.3	28.7	5.5	0.6	0.1
80-84	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.8	2.8	8.8	21.8	38.0	23.7	3.3	0.3
85-89	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.4	1.1	4.5	11.5	26.7	37.3	16.3	1.7
90+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	3.2	8.9	16.8	32.2	28.7	9.4

xii) Proportions of children at school in age-range 18-25

Assumed proportions of children at school in age group 18-25 are required for the valuation of children's benefits (Disabled Contributor's Child and Orphan). They were taken from Statistics Canada publication *Education in Canada* (catalogue 81-229 for 1988-1989) and are assumed to be constant over the projection period.

PROPORTIONS OF CHILDREN AT SCHOOL

Age	Proportion at school
18	0.57
19	0.44
20	0.33
21	0.25
22	0.18
23	0.12
24	0.08
25	0.08

xiii) Distribution, by amount, of average retirement pensions

Since earnings-related benefits are computed for age-sex cohorts of persons as opposed to individual persons, a distribution of average retirement pensions by amount is required for estimating the effect of limits applying to the earnings-related portion of combined survivor-retirement and survivor-disability pensions, and to the death benefit.

Distributions, expressed as a percentage of the CPP maximum annual retirement pension and available from benefits statistics (see section 1(f) above) for six categories of amount (0-20%, 20-40%, 40-60%, 60-80%, 80-99% and 100%), of past actual emerging retirement pensions, grouped by age, sex and calendar year, were used as a basis for developing a mathematical formula reproducing closely these actual distributions.

This formula produces a continuous distribution that varies according to the ratio of the average retirement pension over the maximum retirement pension. Distributions were then retained only for each of the 100 integer values of the ratio equal to 1%, 2%, and so on up to 100%. For each of these 100 values of the ratio, the average retirement pension continuous distribution, expressed as a proportion of the maximum retirement pension, was aggregated within each of 20 equal groups of persons in the cohort. For this purpose, persons in the cohort are sorted by order of magnitude of their earnings.

A sample of the resulting model distribution is shown below for 21 values selected from the retained 100 values of the ratio.

The distribution of the average retirement pension, as defined above, is assumed to be static over the years. However, it is nonetheless effectively dynamic since it is properly designed to apply to the average retirement benefit factor computed, as described in section 3(h) below, on a dynamic basis, i.e., varying by age and sex and year of emergence of the retirement pension. If, for example, the average retirement pension of a cohort of contributors retiring in a given year is equal to 70% of the maximum retirement pension applicable to cases emerging during that year, the table below indicates that 5% of the cohort have a retirement pension averaging 6.8% of the maximum retirement pension, the next 5% have a retirement pension averaging 15.6% of the maximum retirement pension, and so on, with the twentieth (as well as the previous one) 5% sub-group of the cohort having a retirement pension averaging 100% of the maximum retirement pension. Summing these 20 average percentages and dividing by 20 accordingly equals the underlying ratio of 70%. For any value of the ratio falling in between two consecutive values of the 100 model values, linear interpolation is used to determine the desired distribution of the average retirement pension.

DISTRIBUTION OF THE AVERAGE RETIREMENT PENSION AS A PROPORTION OF THE MAXIMUM PENSION

	Rank of each of the 20 5%-categories of persons in the cohort																			
Ratio	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.01	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.011	0.013
0.05	0.014	0.019	0.021	0.023	0.025	0.026	0.027	0.028	0.029	0.030	0.032	0.034	0.037	0.041	0.047	0.057	0.072	0.097	0.134	0.208
0.10	0.020	0.030	0.036	0.040	0.043	0.046	0.048	0.050	0.052	0.055	0.059	0.064	0.070	0.080	0.095	0.116	0.150	0.206	0.288	0.452
0.15	0.026	0.041	0.051	0.057	0.062	0.066	0.069	0.072	0.076	0.080	0.086	0.094	0.104	0.119	0.142	0.175	0.228	0.315	0.442	0.695
0.20	0.031	0.051	0.064	0.074	0.082	0.089	0.095	0.101	0.108	0.115	0.125	0.137	0.154	0.176	0.207	0.252	0.319	0.422	0.560	0.837
0.25	0.037	0.061	0.078	0.091	0.102	0.111	0.120	0.129	0.139	0.151	0.164	0.181	0.203	0.233	0.273	0.329	0.409	0.530	0.679	0.979
0.30	0.039	0.068	0.090	0.110	0.128	0.145	0.161	0.177	0.194	0.213	0.234	0.257	0.285	0.318	0.361	0.416	0.492	0.599	0.731	0.983
0.35	0.042	0.074	0.103	0.129	0.154	0.178	0.201	0.225	0.250	0.275	0.303	0.333	0.366	0.404	0.449	0.504	0.574	0.669	0.782	0.987
0.40	0.044	0.081	0.116	0.148	0.180	0.211	0.242	0.273	0.305	0.338	0.372	0.408	0.447	0.489	0.536	0.591	0.656	0.738	0.833	0.992
0.45	0.046	0.088	0.128	0.167	0.206	0.244	0.282	0.321	0.360	0.400	0.441	0.484	0.528	0.575	0.624	0.678	0.738	0.808	0.885	0.996
0.50	0.048	0.095	0.141	0.186	0.232	0.277	0.323	0.369	0.415	0.463	0.510	0.559	0.609	0.660	0.712	0.766	0.821	0.877	0.936	1.000
0.55	0.053	0.110	0.169	0.228	0.285	0.341	0.395	0.446	0.496	0.544	0.591	0.636	0.681	0.725	0.769	0.813	0.858	0.906	0.952	1.000
0.60	0.058	0.126	0.197	0.269	0.339	0.405	0.467	0.524	0.577	0.626	0.671	0.713	0.753	0.790	0.826	0.861	0.895	0.936	0.968	1.000
0.65	0.063	0.141	0.226	0.311	0.393	0.469	0.539	0.601	0.657	0.707	0.751	0.790	0.824	0.855	0.883	0.909	0.932	0.965	0.984	1.000
0.70	0.068	0.156	0.254	0.352	0.446	0.533	0.611	0.679	0.738	0.789	0.831	0.867	0.896	0.920	0.940	0.956	0.969	0.994	1.000	1.000
0.75	0.080	0.193	0.316	0.435	0.541	0.632	0.708	0.771	0.821	0.862	0.894	0.920	0.941	0.957	0.970	0.978	0.985	0.997	1.000	1.000
0.80	0.091	0.229	0.379	0.518	0.636	0.732	0.806	0.862	0.904	0.935	0.957	0.974	0.985	0.993	0.999	1.000	1.000	1.000	1.000	1.000
0.85	0.157	0.383	0.556	0.677	0.764	0.828	0.876	0.915	0.941	0.960	0.974	0.984	0.991	0.996	0.999	1.000	1.000	1.000	1.000	1.000
0.90	0.223	0.537	0.733	0.836	0.892	0.925	0.946	0.967	0.978	0.985	0.990	0.994	0.997	0.998	1.000	1.000	1.000	1.000	1.000	1.000
0.95	0.473	0.735	0.885	0.951	0.977	0.988	0.991	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

3. Methodology

(a) General Approach

Given the inherent complexity of the valuation methodology and the intent here to facilitate its comprehension as much as possible, it is appropriate at this stage to point out two significant characteristics of the general approach underlying the valuation methodology.

i) The actuarial approach used for projections is macro-simulated as opposed to micro-simulated. One of the important characteristics of such macro-simulation is that projections are made relying on grouped, as opposed to individual, data (mainly numbers of persons and earnings). This results in the need for a considerably smaller volume of data to be processed. Using micro-simulation, individual benefits can be easily determined via calculations involving individual data. Using macro-simulation, only aggregate benefits (i.e., combined by age and sex separately for each year of benefit emergence) can be obtained directly, since the data used in the computational processes are aggregate values. Through macro-simulation, the average initial annual retirement pension of all persons (as opposed to all contributors) born in a given calendar of birth, split by sex is obtained, generally speaking (i.e., ignoring the 25% benefit proportion, the wage escalation provision, he drop-out provisions, etc.), by summing, over the contributory period of this cohort, the annual products of the proportion of contributors by the average pensionable earnings deemed to apply to the given cohort, and by dividing this sum by the number of years included in the contributory period. The preceding formula reproduces correctly the average employment earnings of the cohort, except that it implicitly assumes that the average annual earnings of those who die before retirement is exactly the same as all other persons of the underlying age-sex cohort for each calendar year until the year of death. This formula was retained given that this implicit assumption is generally reasonable. A minor exception occurs in respect of the year in which a contributor dies, when, on average, employment earnings would be earned for only half of a year. However, given the low proportions of deaths before retirement, such part-year earnings have a negligible effect on the financial projections.

ii) All projections are made using 1966 as the starting point of projections instead of the beginning (1994) of the statutory valuation period. This is done for the following three reasons:

- The valuation methodology can be validated for the pre-valuation years (1966 to 1993) by comparing the values (benefits, contributions, numbers of beneficiaries, of contributors, etc.) computed for these years with actual results. The computerized valuation system incorporates an extensive

methodology validation process that examines the numbers and amounts of all past benefits by age (both at emergence and attained), by sex and by calendar year. Other information on the methodology validation process is provided in section 1(f)i) above.

- The projection of those benefits already in pay on the valuation date (31 December 1993) is fully integrated with that of benefits emerging after this date, thus ensuring full consistency of the various valuation processes used for these two series of beneficiaries.

- Certain amendments to the plan, e.g., the one underlying *Bill C-57*, which is the subject of the CPP thirteenth statutory actuarial report, instate beneficiaries rejected before the effective date of the amendment. Though such instatements are made without retroactive payments, their proper evaluation can be made only by hypothetically instating them at the prior rejection date.

(b) Projection of Economic Indices

i) Consumer Price Index (CPI)

The CPI is projected for each calendar year of the valuation period by increasing geometrically its most recent average, over the 12-month period ending in December, in accordance with the assumed annual increase in prices. Designating this assumed rate of increase in prices as "c" (e.g., $c = 0.035$ in respect of a 3.5% assumption), the CPI for a given calendar year is accordingly obtained by multiplying the previous year's CPI by "1+c".

ii) Pension Index (PI)

The PI for a given calendar year corresponds to the CPI averaged over the 12-month period ending in October of the previous year. It is therefore computed simply as the sum of 5/6 of the previous year's CPI plus 1/6 of the CPI for the year preceding that previous year. PI values are used for the price escalation of benefits.

iii) Average Industrial Aggregate Wage (AIAW)

The most current (1993) value for the AIAW is projected into the future using the assumed annual rate of increase in earnings (see section 2(a) above) in a manner exactly parallel to that for the CPI projections. Values of the AIAW are used in projecting future values of the YMPE.

iv) Year's Maximum Pensionable Earnings (YMPE)
Year's Basic Exemption (YBE)

The YMPE is projected for each calendar year of the valuation period by increasing its most recent unrounded value in accordance with the applicable increase in the AIAW computed as above. This AIAW increase applicable to the YMPE of a given year, to produce the YMPE for the following year, is the one experienced on average during the 12-month period ending with 30 June of the given year. Therefore, the increase factor corresponds on average to the ratio of the AIAW as at 1 January of the given year to that as at 1 January of the preceding year. Since AIAWs computed as described in paragraph iii) above correspond to 1 July as opposed to 1 January, the YMPE for a given calendar year is accordingly obtained by multiplying the previous year's unrounded YMPE by the square root of the ratio of the AIAW for the previous year to the AIAW for the third year preceding the given year, and by rounding the result to the next lower multiple of $100. The calculation of the unrounded YMPE for a given calendar year N can therefore be expressed as:

$$YMPE_N = YMPE_{N-1} * \sqrt{\frac{AIAW_{N-1}}{AIAW_{N-3}}} = YMPE_{N-1} * \sqrt{(1+s_{N-2})(1+s_{N-1})}$$

where s_N corresponds to the assumed annual increase in average employment earnings from year N-1 to year N.

The unrounded value of the YMPE is $34,947.78 for 1995. The first year for which YMPEs were projected is therefore 1996.

For any year, the YBE is obtained by taking 10% of the rounded value of the YMPE computed for that year and by rounding the result to the next lower multiple of $100.

v) Earnings Index

In the computation of actual CPP earnings-related benefits, each year's pensionable earnings are escalated (see definition of pensionable earnings in paragraph 1 of Appendix A). To reflect this plan provision, an earnings index is computed for each year as the ratio of the YMPE averaged over the last three years to the Pension Index (PI) for the given year. The denominator of the year's earnings index is the year's PI instead of the year's YMPE for the following two reasons:

- the year's YMPE adjustment is included in the calculation of the average earnings-related benefit factor (see paragraph 3(h)i) below);
- the price indexation of CPP earnings-related pensions involves the ratio of the Pension Index (PI) of the year of payment to the PI of the year of emergence of the benefit. It is accordingly convenient and efficient for computational purposes to include the year-of-emergence PI in the denominator of the earnings index. Then, ignoring survivorship considerations, the computation of benefits for any year following emergence can simply multiply the emergence year's benefits by the PI for the payment year.

vi) Maximum Retirement Pension

With the exception of the actuarial adjustment in connection with the variable retirement age provision, the maximum annual pension payable in respect of a retirement benefit emerging in a given year is equal to 25% of the year's three-year average YMPE. Then, for computational efficiency as well as consistency with the structure and usage of the earnings index described above, this maximum pension is divided by the year's PI. The maximum pension is used to:

- identify the limit, incidentally equal to the maximum retirement pension, applying to combined survivor-retirement and survivor-disability pensions;
- compute the ratio (see section 2(b)xiii) above) used for the distribution of average retirement pensions involved in estimating the effect of the limits on combined earnings-related survivor-retirement and survivor-disability pensions as well as on the death benefit (see sections (i)iii) & (i)iv) below);
- adjust benefit eligibility rates (see section 3(g) below) whenever required for consistency purposes.

(c) Proportions of Earners, Average Employment Earnings and Distributions of Earners and Earnings

As mentioned in section 1(e) above, earnings statistics are combined into quinquennial age groups. Since the valuation process works on an individual age basis, actual past (1966-1992) Proportions of Earners, Average Employment Earnings and Distributions of Earners and Earnings are disaggregated to an individual age basis using appropriate interpolation formulae.

They are also adjusted so that the age corresponds to 1 July instead of 31 December of the relevant calendar year. This is required because the valuation methodology is designed on an average mid-year basis. For this purpose, specific 4-pivotal point actuarial interpolation formulae were developed.

A sample of past actual and future assumed proportions of earners and average employment earnings, and of the assumed (constant over the years) distributions of earners and of their average employment earnings over 78 earnings categories is shown in the tables below. The past actual proportions of earners differ slightly from those of the previous report because of the change in the population definition introduced with the 1991 census.

PROPORTIONS OF EARNERS
(past actual adjusted and future assumed)

	Calendar year					
Age	1980	1990	2000	2025	2050	2100
Males						
20	0.8967	0.7878	0.8600	0.8600	0.8600	0.8600
25	0.9445	0.9335	0.9600	0.9600	0.9600	0.9600
30	0.9784	0.9228	0.9900	0.9900	0.9900	0.9900
35	0.9747	0.9431	1.000(*)	1.000(*)	1.000(*)	1.000(*)
40	0.9436	0.9598	0.9700	0.9700	0.9700	0.9700
45	0.9331	0.9556	0.9500	0.9500	0.9500	0.9500
50	0.9113	0.9288	0.9000	0.9000	0.9000	0.9000
55	0.8829	0.8682	0.8700	0.8700	0.8700	0.8700
60	0.7673	0.6973	0.7200	0.7200	0.7200	0.7200
65	0.4722	0.3149	0.3600	0.3600	0.3600	0.3600
Females						
20	0.7990	0.7227	0.8036	0.8700	0.8700	0.8700
25	0.7612	0.8679	0.8082	0.8430	0.8500	0.8500
30	0.6938	0.7984	0.7666	0.7833	0.7900	0.7900
35	0.6804	0.8179	0.7729	0.8211	0.8500	0.8500
40	0.6786	0.8429	0.7981	0.8270	0.8500	0.8500
45	0.6470	0.7706	0.7479	0.7939	0.8400	0.8400
50	0.5878	0.7109	0.7441	0.7650	0.7858	0.7900
55	0.4937	0.6278	0.6318	0.6936	0.7553	0.7800
60	0.3559	0.4242	0.4151	0.4362	0.4573	0.4700
65	0.1847	0.1640	0.1501	0.1347	0.1193	0.1100

(*) Rates higher than one, which were limited to one, may be explained as follows:

1. Earners include all persons who ever had earnings during the year, whereas the population count is taken as at mid-year and does not record the number of all persons who ever lived in Canada during the year.
2. The undercount adjustments made to the census populations may be underestimated for certain ages.
3. The possession of more than one Social Insurance number by some individuals and the consequent overcount of earners.
4. The presence of individuals who have employment earnings, but are not included in the population count, such as students with working permits but no landed immigrant status, and persons with business visas.
5. The presence of dual earners, who would be included both as CPP contributors and Québec Pension Plan contributors.
6. The fact that the Armed Forces personnel and the members of the RCMP who are employed in Québec or outside Canada, contribute to the Canada Pension Plan. They are therefore included in the numerator (numbers of earners) of the proportions but not in the denominator (population of Canada excluding Québec).

AVERAGE EMPLOYMENT EARNINGS
(past actual adjusted and future assumed)

	Age	Calendar year 1980	1990	2000	2025	2050	2100
Males	20	8285	10065	11389	34454	101984	906300
	25	13860	20645	25668	77390	228638	2025805
	30	17604	27879	35848	106693	312450	2735905
	35	20190	32503	42185	125099	364407	3166759
	40	21046	36220	46905	138470	403405	3503574
	45	21025	38110	50149	147619	430181	3722518
	50	20688	37481	50798	148642	431180	3719690
	55	19555	33920	45075	133338	387959	3347098
	60	17450	30364	39748	118046	344652	2996859
	65	10044	17170	23670	69948	203870	1792366
Females	20	5839	8238	9963	31098	94259	864766
	25	9007	15750	21589	67824	206658	1907978
	30	9701	18064	26080	84082	260945	2463051
	35	9782	19725	28392	93283	292318	2787746
	40	9909	21467	31572	103261	323621	3084349
	45	9889	21659	32537	107294	338778	3243992
	50	9836	20531	31619	104989	332684	3205618
	55	9485	18348	27774	93528	297865	2876836
	60	9276	16911	24936	83829	266948	2588078
	65	6045	9979	14753	49451	157403	1545206

ASSUMED DISTRIBUTIONS OF EARNERS (*)
(actual adjusted distributions averaged over 1988 to 1992)

	Earnings category (*)	Age										
		18	20	25	30	35	40	45	50	55	60	65
MALES	5	0.0340	0.0324	0.0310	0.0290	0.0278	0.0264	0.0262	0.0264	0.0333	0.0528	0.1112
	10	0.0700	0.0626	0.0565	0.0526	0.0500	0.0478	0.0473	0.0475	0.0586	0.0822	0.1672
	20	0.1401	0.1243	0.1088	0.1005	0.0975	0.0952	0.0958	0.0978	0.1154	0.1385	0.2468
	30	0.2114	0.1914	0.1663	0.1522	0.1457	0.1409	0.1417	0.1453	0.1686	0.1961	0.3110
	40	0.2836	0.2630	0.2225	0.1996	0.1912	0.1848	0.1856	0.1909	0.2200	0.2483	0.3651
	50	0.3531	0.3357	0.2765	0.2451	0.2361	0.2278	0.2289	0.2358	0.2684	0.2989	0.4143
	60	0.4182	0.4031	0.3289	0.2912	0.2822	0.2740	0.2756	0.2836	0.3166	0.3484	0.4603
	70	0.4782	0.4634	0.3800	0.3402	0.3325	0.3262	0.3302	0.3386	0.3674	0.3976	0.5029
	80	0.5330	0.5167	0.4310	0.3930	0.3894	0.3884	0.3959	0.4054	0.4259	0.4476	0.5429
	90	0.5826	0.5641	0.4827	0.4499	0.4538	0.4574	0.4643	0.4739	0.4925	0.5028	0.5818
	100	0.6273	0.6068	0.5337	0.5118	0.5226	0.5294	0.5342	0.5427	0.5580	0.5627	0.6224
	200	0.8786	0.8770	0.9259	0.9464	0.9419	0.9380	0.9324	0.9283	0.9174	0.9046	0.8716
	500	0.9945	0.9979	0.9999	0.9997	0.9996	0.9995	0.9994	0.9993	0.9982	0.9998	0.9848
	1000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
FEMALES	5	0.0278	0.0294	0.0396	0.0468	0.0443	0.0379	0.0355	0.0375	0.0437	0.0595	0.1010
	10	0.0590	0.0583	0.0712	0.0816	0.0773	0.0669	0.0626	0.0655	0.0748	0.0944	0.1594
	20	0.1215	0.1177	0.1309	0.1449	0.1384	0.1226	0.1162	0.1197	0.1336	0.1542	0.2403
	30	0.1878	0.1849	0.1891	0.2022	0.1965	0.1793	0.1732	0.1781	0.1936	0.2095	0.3050
	40	0.2560	0.2551	0.2465	0.2589	0.2537	0.2351	0.2294	0.2374	0.2587	0.2721	0.3617
	50	0.3240	0.3248	0.3010	0.3102	0.3075	0.2901	0.2857	0.2944	0.3159	0.3288	0.4131
	60	0.3897	0.3918	0.3531	0.3593	0.3605	0.3445	0.3416	0.3518	0.3724	0.3814	0.4601
	70	0.4521	0.4532	0.4036	0.4072	0.4101	0.3972	0.3956	0.4062	0.4266	0.4338	0.5054
	80	0.5111	0.5088	0.4512	0.4532	0.4579	0.4481	0.4483	0.4571	0.4766	0.4829	0.5465
	90	0.5657	0.5585	0.4968	0.4978	0.5050	0.5008	0.5024	0.5077	0.5234	0.5285	0.5840
	100	0.6153	0.6033	0.5415	0.5421	0.5533	0.5553	0.5590	0.5595	0.5679	0.5709	0.6186
	200	0.8874	0.8816	0.9057	0.9039	0.9020	0.9052	0.9056	0.9004	0.8974	0.8997	0.8697
	500	0.9968	0.9988	0.9997	0.9984	0.9988	0.9990	0.9989	0.9986	0.9970	0.9959	0.9893
	1000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

* Percentage of earners earning less than the *earnings category* percentage of the average earnings of the age-sex cell.

ASSUMED DISTRIBUTIONS OF EMPLOYMENT EARNINGS (*)
(actual adjusted distributions averaged over 1988 to 1992)

	Earnings category (*)	Age										
		18	20	25	30	35	40	45	50	55	60	65
	5	0.0009	0.0008	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0007	0.0011	0.0023
	10	0.0036	0.0031	0.0026	0.0024	0.0023	0.0022	0.0022	0.0022	0.0026	0.0033	0.0064
	20	0.0141	0.0124	0.0105	0.0096	0.0095	0.0094	0.0095	0.0098	0.0113	0.0118	0.0182
	30	0.0319	0.0292	0.0249	0.0225	0.0215	0.0208	0.0210	0.0216	0.0246	0.0260	0.0341
	40	0.0572	0.0543	0.0446	0.0391	0.0374	0.0361	0.0363	0.0376	0.0425	0.0443	0.0530
	50	0.0885	0.0870	0.0689	0.0596	0.0577	0.0555	0.0558	0.0578	0.0643	0.0671	0.0751
MALES	60	0.1242	0.1240	0.0977	0.0849	0.0831	0.0809	0.0815	0.0841	0.0908	0.0942	0.1004
	70	0.1632	0.1631	0.1309	0.1168	0.1158	0.1149	0.1170	0.1199	0.1239	0.1262	0.1280
	80	0.2043	0.2031	0.1691	0.1564	0.1585	0.1617	0.1664	0.1701	0.1678	0.1637	0.1580
	90	0.2464	0.2433	0.2131	0.2049	0.2133	0.2203	0.2246	0.2283	0.2244	0.2107	0.1911
	100	0.2888	0.2838	0.2615	0.2636	0.2787	0.2887	0.2910	0.2937	0.2867	0.2677	0.2297
	200	0.6413	0.6692	0.8188	0.8653	0.8504	0.8428	0.8306	0.8194	0.7800	0.7379	0.5782
	500	0.9648	0.9867	0.9996	0.9982	0.9978	0.9973	0.9964	0.9959	0.9884	0.9973	0.9032
	1000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	5	0.0007	0.0007	0.0009	0.0011	0.0010	0.0009	0.0008	0.0008	0.0010	0.0013	0.0021
	10	0.0031	0.0029	0.0033	0.0037	0.0035	0.0030	0.0028	0.0029	0.0033	0.0039	0.0064
	20	0.0125	0.0119	0.0122	0.0131	0.0126	0.0113	0.0109	0.0111	0.0121	0.0128	0.0183
	30	0.0291	0.0287	0.0268	0.0274	0.0271	0.0256	0.0252	0.0258	0.0272	0.0266	0.0344
	40	0.0530	0.0533	0.0469	0.0472	0.0471	0.0451	0.0448	0.0464	0.0499	0.0485	0.0542
	50	0.0836	0.0847	0.0714	0.0702	0.0713	0.0698	0.0702	0.0721	0.0756	0.0740	0.0773
FEMALES	60	0.1197	0.1215	0.1001	0.0972	0.1005	0.0997	0.1009	0.1036	0.1067	0.1028	0.1031
	70	0.1603	0.1614	0.1328	0.1284	0.1328	0.1340	0.1360	0.1390	0.1419	0.1369	0.1325
	80	0.2045	0.2030	0.1686	0.1628	0.1686	0.1721	0.1755	0.1771	0.1794	0.1737	0.1633
	90	0.2508	0.2452	0.2073	0.2007	0.2086	0.2169	0.2215	0.2202	0.2191	0.2124	0.1951
	100	0.2979	0.2878	0.2497	0.2428	0.2546	0.2687	0.2753	0.2694	0.2614	0.2526	0.2279
	200	0.6785	0.6880	0.7726	0.7587	0.7458	0.7562	0.7568	0.7411	0.7221	0.7221	0.5894
	500	0.9798	0.9925	0.9983	0.9913	0.9929	0.9939	0.9935	0.9917	0.9819	0.9765	0.9239
	1000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

* Percentage of average employment earnings earned by earners earning less than the *earnings category* percentage of the average earnings of the age-sex cell

(d) Proportions of Contributors

In respect of a given calendar year, one of the conditions to be a CPP contributor is to have employment earnings over the YBE. Proportions of contributors are accordingly determined by multiplying proportions of earners by the complement of the fraction of earners earning less than the YBE. This fraction was determined for each age, sex and calendar year by expressing the YBE as a percentage of average employment earnings and using the distribution of earners described in paragraph (c) above. The resulting proportions of contributors are those used for the calculation of average contributory earnings.

Sample values of these proportions of contributors are shown below.

PROPORTIONS OF CONTRIBUTORS
(used for contributory earnings computation purposes)

		Year				
	Age	1990	2000	2020	2050	2100
Males	18	0.327	0.430	0.434	0.427	0.420
	20	0.649	0.664	0.667	0.662	0.659
	25	0.864	0.878	0.879	0.877	0.875
	30	0.874	0.933	0.933	0.931	0.929
	35	0.902	0.952	0.952	0.950	0.949
	40	0.923	0.930	0.929	0.928	0.926
	45	0.921	0.913	0.913	0.912	0.910
	50	0.895	0.865	0.865	0.863	0.862
	55	0.825	0.824	0.824	0.822	0.820
	60	0.643	0.661	0.660	0.659	0.657
	65	0.246	0.279	0.279	0.277	0.276
Females	18	0.270	0.348	0.411	0.428	0.435
	20	0.569	0.598	0.646	0.659	0.662
	25	0.766	0.709	0.738	0.752	0.753
	30	0.705	0.677	0.694	0.706	0.709
	35	0.733	0.693	0.733	0.772	0.775
	40	0.772	0.733	0.758	0.788	0.790
	45	0.710	0.692	0.730	0.784	0.787
	50	0.650	0.685	0.705	0.731	0.738
	55	0.561	0.568	0.618	0.689	0.715
	60	0.367	0.361	0.379	0.404	0.418
	65	0.116	0.107	0.101	0.088	0.083

Proportions of contributors from the above table, used for contributory earnings computation purposes, were then adjusted, for benefit computation purposes, to reflect the effect of the provision for the equal apportionment, between spouses, of unadjusted pensionable earnings upon marital union breakdown. This provision is designed to affect benefits but not contributions. For benefit purposes, the effect of this provision on proportions of contributors was accordingly accounted for using appropriate mathematical formulae, on the basis of the assumptions described in section 2(b)iv) above.

Sample values of proportions of contributors, adjusted for credit-splitting on spousal union breakdown, are shown in the table below.

PROPORTIONS OF CONTRIBUTORS
(used for benefit computation purposes)

		Year				
	Age	1990	2000	2020	2050	2100
Males	18	0.328	0.431	0.436	0.431	0.424
	20	0.657	0.674	0.679	0.676	0.673
	25	0.879	0.890	0.891	0.890	0.889
	30	0.891	0.941	0.941	0.940	0.938
	35	0.917	0.959	0.959	0.958	0.957
	40	0.935	0.939	0.940	0.939	0.938
	45	0.930	0.923	0.923	0.923	0.921
	50	0.903	0.876	0.876	0.876	0.874
	55	0.833	0.831	0.832	0.832	0.831
	60	0.648	0.665	0.665	0.664	0.662
	65	0.246	0.279	0.279	0.277	0.276
Females	18	0.280	0.380	0.423	0.433	0.440
	20	0.619	0.642	0.676	0.683	0.684
	25	0.817	0.780	0.800	0.809	0.810
	30	0.775	0.762	0.774	0.782	0.784
	35	0.793	0.767	0.797	0.826	0.828
	40	0.817	0.786	0.806	0.829	0.831
	45	0.757	0.741	0.772	0.818	0.820
	50	0.692	0.720	0.737	0.760	0.766
	55	0.594	0.599	0.645	0.710	0.734
	60	0.385	0.379	0.397	0.421	0.434
	65	0.116	0.107	0.101	0.088	0.083

(e) Average Pensionable Earnings

Average pensionable earnings by age, sex and calendar year, unadjusted for the earnings index (i.e., the wage escalation factor), correspond, for a given cohort, to the average portion of individual employment earnings below the YMPE for this cohort's earners earning more than the YBE. Average pensionable earnings are accordingly computed by removing from average employment earnings the earnings of earners earning less than the YBE and the portion of earnings in excess of the YMPE. Since earnings statistics are aggregate (by age, sex and calendar year) as opposed to individual, such removal is made using the distributions of earners and earnings (see section (c) above). The formula below used for the computation of average pensionable earnings (used for the later calculation of contributory earnings purposes, but before the adjustments later required for benefits calculation purposes) applies for each age, sex and calendar year:

$$\mathbf{PENEAR} = \frac{\mathbf{EMPEAR*(EU - EL) + YMPE*(1 - CU)}}{\mathbf{1 - CL}}$$

where:

PENEAR = Average Pensionable Earnings
EMPEAR = Average Employment Earnings
CL = Proportion of earners earning less than the YBE (computed using the distribution of earners)
CU = Proportion of earners earning less than the YMPE (computed using the distribution of earners)
EL = Proportion of employment earnings in the age-sex cell attributable to earners earning less than the YBE (computed using the distribution of earnings)
EU = Proportion of employment earnings in the age-sex cell attributable to earners earning less than the YMPE (computed using the distribution of earnings)

Sample values of unadjusted Average Pensionable Earnings, which are the earnings used for calculating contributory earnings, are shown below. For comparison purposes, the YMPE is also shown, for the selected years, at the end of the table.

AVERAGE PENSIONABLE EARNINGS
(used for contributory earnings computation purposes)

		Year				
	Age	1990 $	2000 $	2020 $	2050 $	2100 $
Males	18	7149	9257	22372	83023	741663
	20	11626	13987	33876	125509	1120527
	25	19401	25410	61364	227429	2030563
	30	22577	30536	73358	271580	2421910
	35	23701	32317	77539	287507	2564200
	40	24408	33367	80023	297057	2654557
	45	24620	33803	81044	301161	2691239
	50	24405	33715	80737	299497	2673257
	55	23351	32071	76945	285186	2539216
	60	22394	26780	64287	238117	2121588
	65	17037	20009	47926	176348	1571561
Females	18	5864	8069	19835	75144	686564
	20	9993	12622	31140	117853	1076859
	25	16648	22989	56737	215135	1969204
	30	18120	25757	63922	244160	2248181
	35	18714	26513	66073	253605	2340453
	40	19458	27821	69100	264667	2438265
	45	19466	28114	69997	268891	2479244
	50	18868	27635	69054	265618	2454888
	55	17661	25754	64999	251463	2331565
	60	17123	21218	53691	208225	1937348
	65	12633	15665	39963	156246	1480110
	YMPE ==>	28900	40100	96400	361300	3263900

Average pensionable earnings from the above table, used for average contributory earnings computation purposes, were then adjusted for benefit computation purposes, to reflect the effect of:

i) **Retirement pensions commencing before age 65**
Retirement pensions commencing before age 65 have the effect of reducing the amount of contributions that would otherwise have been made to CPP. Such effect is already accounted for in the average pensionable earnings described and shown above. For benefit computation purposes, however, such effect must be removed in respect of contributors having not yet retired at a given age before age 65. This was done by dividing the above average pensionable earnings by the difference between unity and 40% (assuming retirements are taking place mid-year, and taking into account the fact that higher paid earners will have made more than 50% of their normal contributions by mid-year) of the appropriate retirement election proportion (see 2(b)vii) above).

ii) Credit-splitting on spousal union breakdown.
This provision is designed to affect benefits but not contributions. For benefit purposes, the effect of this provision on average pensionable earnings was accordingly accounted for using appropriate mathematical formulae, on the basis of the assumptions described in section 2(b)iv) above.

Sample values of average pensionable earnings, adjusted for benefit computation purposes as described above, are shown below. For comparisons purposes, the YMPE is also shown, for the selected years, at the end of the table.

AVERAGE PENSIONABLE EARNINGS
(used for benefits computation purposes)

		Year				
		1990	2000	2020	2050	2100
	Age	$	$	$	$	$
Males	18	7113	9171	22149	82108	733487
	20	11351	13621	33060	122610	1095545
	25	18610	24319	58950	219043	1958845
	30	21275	28793	69422	257810	2304552
	35	22355	30584	73847	275534	2464354
	40	23263	31800	76615	285788	2560078
	45	23521	32311	77840	291034	2606314
	50	23443	32436	77893	289820	2592050
	55	22570	31080	74763	278066	2481213
	60	21966	29945	71957	266708	2377537
	65	21764	23651	56650	208449	1857638
Females	18	5748	7747	19516	74445	680130
	20	9538	12071	30102	114186	1043498
	25	16221	22002	54488	206657	1887027
	30	17667	24826	61502	234365	2149265
	35	18467	25900	64598	248241	2281218
	40	19346	27335	67824	259815	2385868
	45	19255	27558	68648	264490	2432204
	50	18621	27188	67831	260841	2406303
	55	17390	25272	63846	247741	2296903
	60	16834	24141	61088	237053	2205041
	65	15010	18344	46795	182957	1733150
	YMPE ==>	28900	40100	96400	361300	3263900

(f) Average and Total Contributory Earnings
Average contributory earnings were computed in respect of any given age-sex-year cell of contributors by subtracting the YBE from the average Pensionable Earnings computed for contributory earnings purposes (as opposed to benefits computation purposes).

AVERAGE CONTRIBUTORY EARNINGS

	Age	YEAR 1990 $	2000 $	2020 $	2050 $	2100 $
Males	18	4349	5257	12772	46923	415363
	20	8826	9987	24276	89409	794227
	25	16601	21410	51764	191329	1704263
	30	19777	26536	63758	235480	2095610
	35	20901	28317	67939	251407	2237900
	40	21608	29367	70423	260957	2328257
	45	21820	29803	71444	265061	2364939
	50	21605	29715	71137	263397	2346957
	55	20551	28071	67345	249086	2212916
	60	19594	22780	54687	202017	1795288
	65	14237	16009	38326	140248	1245261
Females	18	3064	4069	10235	39044	360264
	20	7193	8622	21540	81753	750559
	25	13848	18989	47137	179035	1642904
	30	15320	21757	54322	208060	1921881
	35	15914	22513	56473	217505	2014153
	40	16658	23821	59500	228567	2111965
	45	16666	24114	60397	232791	2152944
	50	16068	23635	59454	229518	2128588
	55	14861	21754	55399	215363	2005265
	60	14323	17218	44091	172125	1611048
	65	9833	11665	30363	120146	1153810
	YMPE ==>	28900	40100	96400	361300	3263900
	YBE ==>	2800	4000	9600	36100	326300

In respect of a given age-sex cell, total contributory earnings for a given year were calculated as the product of:

- the proportion of contributors computed for contributory earnings purposes (as opposed to benefits computation purposes),
- the average contributory earnings computed as above, and
- the population number.

Total contributory earnings for the given year were obtained by summing contributory earnings computed for each age-sex cell. Total annual contributions for each past year (1966 to 1992), obtained as the product of the total contributory earnings computed as above and the actual contribution rate, are very close to those taken from earnings statistics, which validates average contributory earnings used for benefit computation purposes. Indeed, the deviation is -0.2% on average for 1983 to 1992, and 0.8% for 1971 to 1992. However, computed contributions are 3.0% (1983-1992) and 4.2% (1971-1992) lower than corresponding actual contributions as taken from monthly information reports. Total future contributory earnings computed as above were accordingly increased by 3.0% which accounts for the non-refundable portion of employers' contributions corresponding to contributions in excess of the maximum contribution (arising generally in respect of employees with multiple employers during a year) or to contributions made in respect of employees earning less than the YBE during a given year.

Total contributions so projected for 1994 and 1995 are compared below with those projected by the Finance Ministry for accounting purposes. Considering the relatively small difference between these two projections, and that they will both be eventually replaced by actual results, it was not deemed necessary to adjust the actuarial projections.

	1994	1995
Finance (cash basis)	$ 9.647 billion	$11.270 billion
Finance (accrual basis)	$10.200 billion	$11.325 billion
This report	$10.415 billion	$11.390 billion

(g) Benefit Eligibility Rates

i) Introduction

As mentioned in appendix A (plan provisions), the eligibility for CPP benefits varies according to the type of benefit involved. Although the eligibility rules themselves do not vary as between the flat-rate and the earnings-related portions of a given type of benefit, it will be seen below that each portion requires a distinct eligibility factor for valuation purposes.

ii) Usage

Benefit eligibility rates are used in the valuation process for the computation of historical retirement election proportions (see section 2(b)vii) above) and of benefits of all types except retirement.

iii) General approach

Benefit eligibility rates are computed using mathematical formulae that were developed so as to closely reproduce the outcome of a distinct earnings micro-simulation ancillary model. The model takes into account the applicable eligibility rules for each type of benefit, the assumed proportions of contributors and average employment earnings for all existing and future cohorts of earners, and the proportions, determined in accordance with the assumed 50% employment mobility rate (see 2(b)v) above), of persons who never contribute and of persons who contribute randomly.

Observed data on benefit eligibility rates show some unexplained inconsistencies. It was therefore not possible to use them for either computing the eligibility rates required for the valuation, or validating the eligibility rates derived for the valuation process.

iv) Retirement benefits

To be eligible for a retirement pension, a person must have made contributions, i.e., have had employment earnings in excess of the YBE, for at least one calendar year over his/her contributory period. In accordance with the assumed 50% employment mobility rate, the micro-simulation ancillary model produces retirement benefit eligibility rates corresponding closely in most cases to the value half way between the highest annual proportion of contributors over the contributory period of a cohort and unity. Therefore,

$$\mathbf{ELIRET = 0.5*(MAXPRC + 1)}$$

where ELIRET = retirement benefit eligibility rate
MAXPRC = highest annual proportion of contributors over the contributory period of a given sex, birth-year cohort.

v) **Flat-rate benefits**

Given the relative complexity of the eligibility rules in respect of other types of benefits (disability and survivor), more complex mathematical formulae had to be developed reflecting the results from the micro-simulation model.

Mathematical formulae, relying exclusively on the relevant proportions of contributors for all age-sex cohorts involved over the years in the valuation process, were therefore developed for the determination of all past and future eligibility rates separately for disability (ELIDFR) and survivor (ELIWFR) flat-rate benefits.

vi) **Earnings-related benefits**

The average earnings-related benefit factors (see section (h) below), to which disability and survivor benefit eligibility rates described above should normally apply, already implicitly incorporate the value of ELIRET, the retirement benefit eligibility rate. Therefore, the disability and survivor benefit eligibility rates, ELIDFR and ELIWFR, developed for flat-rate benefit purposes must be divided by the retirement benefit eligibility rate, ELIRET, for purposes of computing the earnings-related portion of these two types of benefit. This operation converts these eligibility rates into gross proportions of earnings eligible for the earnings-related portion of the disability or survivor benefit:

disability gross eligible earnings proportion = ELIDFR/ELIRET
survivor gross eligible earnings proportion = ELIWFR/ELIRET

Moreover, since the eligibility rules for disability and survivor benefits are more stringent than for retirement pensions, contributors eligible for either a disability or survivor benefit have on average a lesser number of years of nil earnings than contributors solely eligible for a retirement benefit. They consequently have higher aggregate earnings than contributors solely eligible for a retirement pension. In accordance with the outcome of the ancillary micro-simulated earnings model, the above ratios were consequently adjusted accordingly as follows:

ELIDER = {ELIDFR/ELIRET}*(2/3) + 1/3
ELIWER = {ELIWFR/ELIRET}*(2/3) + 1/3

where ELIDER and ELIWER are the net proportions of earnings eligible for disability and survivor earnings-related benefits, respectively.

vii) Consistency tests

Extensive testing was conducted thereafter to ensure that the results from the application of all these formulae are consistent. For example,

- disability and survivor benefit eligibility rates ELIDFR and ELIWFR should, for any age-sex-year cell, be lower than the retirement benefit eligibility rates ELIRET given that eligibility for retirement benefits is in all cases less stringent than for disability or survivor benefits.

- the average retirement pension, converted from a *per population* basis (i.e., averaged over total population at the given age and sex) to a *per beneficiary* (i.e., averaged over the number of retirement pension beneficiaries) by dividing it by the retirement benefit eligibility rate ELIRET, should correspond to statistics on the actual average retirement pension.

Retirement benefit eligibility rates are computed for ages below the minimum retirement age (60) because they are required in the computation of eligibility rates for the earnings-related portion of the disability and the survivor benefits.

The following five tables show samples of these benefit eligibility rates.

ELIGIBILITY RATES

Probability of being eligible for retirement benefits (ELIRET)

	Age at retirement										
Year	20	25	30	35	40	45	50	55	60	65	
2000	0.837	0.945	0.970	0.995	0.970	0.973	0.991	0.995	0.995	0.984	
2025	0.840	0.946	0.970	0.979	0.980	0.979	0.979	0.980	0.995	0.970	Males
2050	0.838	0.945	0.970	0.979	0.979	0.979	0.979	0.979	0.979	0.980	
2000	0.821	0.890	0.891	0.924	0.896	0.903	0.909	0.896	0.862	0.841	
2025	0.841	0.902	0.900	0.902	0.905	0.905	0.903	0.901	0.924	0.898	Females
2050	0.841	0.905	0.905	0.913	0.914	0.914	0.913	0.911	0.909	0.907	

Probability of being eligible for disability benefits (ELIDFR)

	Age at disablement									
Year	20	25	30	35	40	45	50	55	60	
2000	0.728	0.934	0.967	0.977	0.967	0.959	0.941	0.942	0.908	
2025	0.738	0.936	0.968	0.979	0.977	0.973	0.962	0.947	0.915	Males
2050	0.735	0.935	0.968	0.978	0.976	0.972	0.962	0.946	0.914	
2000	0.673	0.880	0.878	0.881	0.878	0.883	0.879	0.879	0.827	
2025	0.737	0.888	0.886	0.892	0.895	0.894	0.890	0.877	0.846	Females
2050	0.739	0.891	0.891	0.903	0.905	0.906	0.900	0.884	0.863	

Proportion of earnings eligible for earnings-related disability benefits (ELIDER)

	Age at disablement									
Year	20	25	30	35	40	45	50	55	60	
2000	0.913	0.992	0.998	0.988	0.998	0.990	0.966	0.965	0.942	
2025	0.919	0.993	0.999	0.999	0.998	0.995	0.988	0.978	0.946	Males
2050	0.918	0.993	0.999	0.999	0.998	0.995	0.988	0.977	0.956	
2000	0.879	0.992	0.990	0.969	0.987	0.985	0.978	0.988	0.973	
2025	0.917	0.989	0.989	0.992	0.992	0.992	0.990	0.982	0.944	Females
2050	0.919	0.990	0.990	0.992	0.993	0.994	0.990	0.980	0.966	

Probability of being eligible for survivor benefits (ELIWFR)

	Age of deceased contributor at widow/er/hood										
Year	20	25	30	35	40	45	50	55	60	65	
2000	0.695	0.936	0.965	0.990	0.968	0.971	0.989	0.994	0.993	0.978	
2025	0.698	0.938	0.965	0.975	0.976	0.976	0.975	0.976	0.991	0.964	Widows
2050	0.697	0.938	0.964	0.975	0.975	0.976	0.976	0.976	0.976	0.973	
2000	0.679	0.870	0.885	0.917	0.893	0.900	0.904	0.891	0.843	0.807	
2025	0.699	0.895	0.893	0.895	0.898	0.898	0.896	0.895	0.916	0.884	Widowers
2050	0.699	0.897	0.898	0.907	0.909	0.909	0.907	0.905	0.902	0.894	

Proportions of earnings eligible for earnings-related survivor benefits (ELIWER)

	Age of deceased contributor at widow/er/hood										
Year	20	25	30	35	40	45	50	55	60	65	
2000	0.887	0.994	0.996	0.997	0.999	0.999	0.999	0.999	0.999	0.995	
2025	0.888	0.995	0.996	0.997	0.997	0.998	0.997	0.998	0.997	0.996	Widows
2050	0.887	0.995	0.996	0.997	0.997	0.998	0.998	0.998	0.997	0.996	
2000	0.884	0.985	0.995	0.995	0.997	0.997	0.996	0.997	0.986	0.972	
2025	0.887	0.994	0.995	0.995	0.995	0.995	0.995	0.996	0.994	0.990	Widowers
2050	0.887	0.995	0.995	0.995	0.996	0.996	0.996	0.996	0.995	0.990	

(h) Average Earnings-Related Benefit Factor

The average earnings-related benefit factor is designed to produce, when multiplied by the population and the Pension Index of a given calendar year successively for both sexes and all relevant ages, the total annual earnings-related benefit expenditure for that year.

i) Gross factor

In respect of a given cohort of contributors, the gross (i.e., before accounting for the drop-out provisions and the Earnings Index) average earnings-related benefit factor was determined by sex and calendar year for each (attained) age from 18 to 70, as the product of 0.25 (the retirement pension benefit proportion) and the ratio of:

- the sum, over the elapsed contributory period (i.e., from age 18 to the attained age), of the ratios of:
  - the product of the year's proportion of contributors (adjusted for benefit computation purposes) times the year's average pensionable earnings (adjusted for benefit computation purposes), to
  - the YMPE, to
- the elapsed contributory period at the attained age.

$$BENFAC_{attained\ age} = 0.25 * \frac{\sum_{I=18}^{attained\ age} \left(\frac{PROCON_I * PENEAR_I}{YMPE_{N+I-18}} \right)}{CONPER_{attained\ age}}$$

where

I = age
N = year during which the contributor attains age 18
BENFAC = gross average earnings-related benefit factor
PROCON = proportion of contributors (adjusted for benefit purposes)
PENEAR = average wage-unescalated pensionable earnings (adjusted for benefit purposes)
CONPER = elapsed contributory period

ii) Accounting for the drop-out provisions

- **Amount of lowest earnings to be dropped-out**

The earnings/YMPE ratios that have to be dropped out from the numerator of the gross average benefit factor described above, in respect of an individual, are the lowest annual earnings/YMPE ratios for a number of years equal to half (see assumption described in section 2(b)vi) above) of the child-rearing period plus 15% of the residual contributory period. Since the general valuation approach is based on macro-simulation (aggregate), there is no explicit way of determining the lowest earnings/YMPE ratios of each

individual that would have to be dropped out from the denominator above to account for these two drop-out provisions.

Consequently, on the basis of the outcome of the micro-simulation model described in section (g) above, the following formula was developed for determining the multiplying factor DROFAC.

Range of PRCFAC	Multiplying factor DROFAC
0.0 to 0.5	PRCFAC /10.
0.5 to 1.0	PRCFAC - 0.45
1.0 to MAXFAC	$0.55 + 0.45 * \frac{(PRCFAC-1)}{(MAXFAC-1)}$

where:
PRCFAC = Average contributing proportion factor = DROPRO/(1-AVRPRC)
DROPRO = Drop-out proportion (i.e., 15% + child rearing percentage period)
AVRPRC = Average proportion of contributors over the elapsed contributory period
MAXFAC = Maximum average contributing proportion factor = 1/(1-AVRPRC)

It can thus be seen that the multiplying factor DROFAC varies according to the total drop-out percentage (15% plus the child-rearing period as a percentage of the elapsed contributory period) and the average proportion of contributors over the elapsed contributory period.

The multiplying factor DROFAC is designed so that when multiplied by the sum, for a number of years equal to the total drop-out period, of the products of the successive lowest proportions of contributors and the lowest successive average earnings, it gives the amount of earnings deemed to be dropped from the numerator above in connection with the drop-out provisions.

- **Period to be dropped-out**
  The average period that has to be dropped from the contributory period (i.e., the denominator of the gross average benefit factor described above), is computed as the sum of the three periods determined as follows in respect of the disability, the child-rearing and the 15% drop-out provisions.

  The disability period was determined, by age, sex and calendar year, using the assumed disability incidence and termination rates, the disability benefit eligibility rates and the appropriate actuarial formula (i.e., for a given attained age, the sum of the products, in respect of each age from 18 to the one preceding the attained age, of the disability incidence rate by the elapsed duration of disability, such duration being computed relying on disability termination rates).

In accordance with:

- the prescribed limit of 7 years per child,
- the assumed age difference of 2 between any two consecutive children,
- and the assumed effect of 50% in connection with employment earnings during the child rearing period not all being lowest earnings,

the child-rearing drop-out period was determined, for females, as 50% of:

{7*(NUMCHI)}, if NUMCHI < 1,
and
{7*(1)} + {2*(NUMCHI-1)}, if NUMCHI >or= 1

where NUMCHI, not necessarily an integer, is the average number of children (born so far to a female contributor) computed using the Canada and Québec fertility rates adjusted, to correspond to Canada less Québec, by taking as weights the relevant populations. In accordance with the assumption described in section 2(b)vi) above, the child-rearing period was uniformly set equal to zero in respect of male contributors.

The drop-out period in respect of the 15% provision was determined as 15% of the difference between the elapsed contributory period and the disability and child-rearing periods computed as above at the contributor's attained age.

iii) Accounting for the Earnings Index (wage escalation)

The average earnings-related benefit factor, was finally determined by multiplying the gross factor (see item i) above), adjusted for the drop-out provisions (see item ii) above), by the Earnings Index which accounts for the wage escalation provision underlying the calculation of the initial rate of a benefit when it emerges.

(i) Annual Expenditures

i) Retirement Pensions

In accordance with the eligibility rules, CPP retirement pensions became payable for the first time in 1967.

Hence, for each cohort of contributors reaching a given retirement age from 60 to 70 in each of the calendar years from 1967 to 2100, an average retirement benefit factor was computed, by age, sex and calendar year of emergence of the pension, as the product of:

- the assumed proportion of contributors electing to retire,
- the actuarial adjustment factor in connection with the flexible retirement age provision, and
- the average earnings-related benefit factor (see section (h) above).

These benefit factors correspond to the annualized rate of retirement pension, averaged for the population (as opposed to contributors), payable during the year of emergence of the pension.

It was assumed that retirements occur mid-year on average. Therefore, the retirement pension expenditure for the year of emergence was taken as 50% of the annualized rate of pension multiplied by the population for the appropriate age (60 to 70), sex and calendar year.

The retirement pension expenditure for each year following the year of retirement of a given age-sex-year population cohort, until the year during which the cohort attains age 106, was computed as the product of:

- The relevant annualized average rate of retirement pension payable during the year of emergence (described above).
- The population for the appropriate attained age (61 and over), sex and calendar year (which implicitly accounts for the survivorship of the cohort).
- The Pension Index (which accounts for the CPI escalation of a pension each year after its emergence).

The retirement pension expenditure for the beneficiary's year of death is assumed to be 50% of the annualized pension. This is implicitly accounted for in the approach described above, since the population is computed as at mid-year.

The amount of all retirement pensions payable during any given past or future calendar year were obtained by simply summing the annual expenditure, applying for the given calendar year as described above, in respect of all age-sex cohorts having emerged in the given and each of the previous calendar years.

As part of the methodology validation process, the amounts of total annual retirement pensions computed as above were compared to their CPP historical data counterparts for 1966 through 1993. The comparisons revealed that the actual retirement benefits tend to be about 99.3% of the corresponding projected benefits. On the basis of an actuarial study of the mortality of the beneficiaries of a CPP retirement pension, the 0.7% deviation apparently arises primarily from the average difference of about 10% in mortality rates between the general population and persons receiving a CPP retirement pension. Given:

- the consistency of the 0.7% deviation over time,
- the lack of time in completing the above preliminary mortality study, and
- the margin provided by the assumed future improvements in life expectancy,

a constant experience adjustment factor of 1.000 was applied to all of the past and future retirement pensions calculated using the methodology described above.

However, in order to account for the exact distribution by age and sex of retirement pensions already in pay at the end of 1993, computed retirement pensions deemed to be payable during 1993 were replaced, by age and sex, by benefits actually paid during that year (see, in section 1(f) above, benefits statistics adjusted to match results shown in monthly information reports), and projected until death of the last survivor using the methodology described above for the survival of the computed emerging retirement pensions.

ii) Disability Pensions

In accordance with the eligibility rules, CPP disability pensions became payable for the first time in 1970. Hence, the general approach used to estimate disability pensions was to:

- Compute the initial value of flat-rate benefits emerging by age and sex each year after 1969 as the product of:
  - the actual or assumed disability incidence rate;
  - the probability (ELIDFR) of being eligible for disability benefits;
  - the annual amount of the disability flat-rate benefit (projected using the PI);
  - the population.

- Compute the initial value of earnings-related benefits emerging by age and sex each year after 1969 as the product of:
  - the actual or assumed disability incidence rates;
  - the proportion (ELIDER) of earnings eligible for disability benefits;
  - 0.1875, corresponding to the applicable earnings-related disability benefit proportion, i.e., 75% of the retirement pension proportion of 25%;
  - the average earnings-related benefit factor (see section (h) above);
  - the population.

- Project by age and sex initial flat-rate and earnings-related benefits to each future year until termination (due to recovery, death, or attaining age 65) using year after year actuarial formulae incorporating the disability termination rates for the appropriate duration and the Pension Index.

Total disability benefits for any particular year are equal to 100% of the sum of the annualized disability pensions projected to that year in respect of all age-sex cohorts having emerged so far. However, assuming that emergences and terminations occur on average at mid-year, 50% was used instead of 100% in respect of cases having either emerged or terminated during the given year.

Through the methodology validation process, emerging disability benefits and disability benefits in pay computed as above by age, sex and type of benefit (flat-rate, earnings-related) for each past applicable year (1970 to 1993) were compared with actual data. The outcome of this process shows actual over expected experience ratios generally close to 98% and 94% for flat-rate, respectively. The following experience adjustment factors were accordingly applied in projecting future disability benefits using the above methodology.

	Benefits	
Sex	Flat-Rate	Earnings-related
Male	0.980	0.962
Female	0.977	0.917

However, in order to account for the exact distribution of disability benefits already in pay at the end of 1993 by age, sex and year of emergence, computed disability benefits deemed to be payable during 1993 were replaced, separately by age, sex and year of emergence, by benefits actually paid during that year (see, in section 1(f) above, benefits statistics adjusted to match results shown in monthly information reports) and projected until termination (due to recovery, death, or attaining age 65) using the disability termination rates and the Pension Index.

iii) Survivor Pensions

In accordance with the eligibility rules, CPP survivor pensions became payable for the first time in 1968. Hence, for each year after 1967, the numbers of male and female deaths, taken from demographic projections for each individual age 18 and over, were multiplied by proportions of contributors married at death (see section 2(b)ix) above) to produce all the numbers of spousal deaths emerging by age, sex and calendar year.

For purposes of the flat-rate portion of survivor pensions, the numbers of spousal deaths, by sex and by calendar year, were categorized by age of the surviving spouses using the age distributions described in section 2(b)xi) above, and each resulting number was multiplied by:

- The annual flat-rate benefit amount (projected using the PI).
- The probability (ELIWFR), for the deceased spouse, of being eligible for survivor benefit.
- The appropriate factor accounting for the reductions of survivor pensions in respect of survivors emerging under age 45 without dependent children and not disabled (see section 2(b)x) above).
- The appropriate factor accounting for the limit applying to combined survivor-disability pensions. This factor is equal to the difference between unity and the disability prevalence rate described in section 2(b)viii) above.

For purposes of the earnings-related portion of the survivor pensions, the numbers of spousal deaths, by sex and calendar year, were categorized by age of the surviving spouses using the age distributions described in section 2(b)xi) above, and each resulting number was multiplied by:

- The average earnings-related benefit factor for the deceased spouse (see section (h) above).
- The proportion ELIWER of the deceased spouse's earnings eligible for a survivor benefit.
- The appropriate factor accounting for the reductions of survivor pensions in respect of survivors emerging under age 45 without dependent children and not disabled (see section 2(b)x) above).
- The appropriate factor accounting for the limit applying to combined survivor-retirement and survivor-disability pensions. This factor was computed using the maximum retirement pension, the assumed distribution of average retirement pensions described in section 2(b)xiii) above, and the retirement and disability prevalence rates described in sections 2(b)vii) and 2(b)viii) above, respectively.

The annual initial amount of all survivor pensions emerging by year as well as by age and sex of the surviving spouse, computed as described above, was then projected to each subsequent year:

- Surviving beneficiaries by applying actuarial formulae incorporating actual or assumed mortality rates (see section I-2(b) above) which were adjusted to correspond to Canada less Québec by taking as weights the population for the

appropriate age, sex, year and geographic component (i.e., Canada or Québec), and further adjusted, using results of an actuarial study of the mortality of QPP survivors, to reflect the higher mortality of widows and widowers as compared to that of the general population.
- Making allowance for the Pension Index (CPI) escalation.
- Multiplying by 0.375 for ages under 65, and by 0.60 for ages 65 and over of the surviving spouse, to account for the applicable survivor earnings-related benefit proportion.

Total survivor benefits for any particular year are equal to 100% of the sum of the annualized survivor pensions projected to that year in respect of all age-sex cohorts of survivors having emerged so far. However, assuming that emergences and terminations occur mid-year on average, 50% is used instead of 100% in respect of cases having either emerged or terminated during the given year.

Through the methodology validation process, emerging survivor benefits and survivor benefits in pay computed as above by age, sex and type of benefit (flat-rate, earnings-related) for each past year (1968 to 1993) were compared with actual data. Irrespective of the further methodology improvements made since the completion of the fourteenth report, the outcome of this process still shows significant differences between actual and expected values for widowers. The relatively low level of past actual widowers benefits as compared to those computed could be due to a significant proportion of widowers' benefits not being applied for in the case of death of eligible female contributors, or to an overestimate of the proportion ELIWFR of females giving entitlement at death to a widower's benefit, or to a combination of both. In any event, due to these significant differences, it was decided to adjust estimates of all future survivor benefits, determined using the above methodology, by applying the following experience factors varying by sex and by type of benefit:

EXPERIENCE ADJUSTMENT FACTORS FOR SURVIVOR BENEFITS

Widows		Widowers	
Flat-Rate	Earnings-Related	Flat-Rate	Earnings-Related
0.924	0.889	0.569	0.561

Moreover, in order to account for the exact distribution of survivor benefits already in pay at the end of 1993 by age, sex and year of emergence, computed benefits deemed to be payable during 1993 were replaced by benefits actually paid during that year (re: benefits statistics, section 1(f) above, adjusted to match results shown in monthly information reports, section 1(c) above) and projected until death of the last survivor using the methodology described above for the survival of the computed emerging survivor pensions.

iv) Death Benefits

In accordance with the eligibility rules, CPP death benefits became payable for the first time in 1968. Hence, the amount of lump sum death benefits payable each year after 1967 was determined by age and sex as the product of:

- the number of deaths, derived by sex for each individual age 18 and over consistent with the population data and projections;
- 50% of the average earnings-related benefit factor (the lump sum death benefit is equivalent to six months of a retirement pension) reduced, using the maximum retirement pension and the assumed distribution of average retirement pensions (see section 2(b)xiii) above), to allow for the provision limiting the death benefit to 10% of the YMPE for the year of death.
- the proportion (ELIWER) of the deceased contributor's earnings eligible for survivor benefits (the eligibility for death benefits is the same as for survivor benefits).

Through the methodology validation process, death benefits so computed for males and females were multiplied by experience adjustment factors of 0.91 and 0.77, respectively, to account for the difference between actual results of recent years and those computed as above. The relatively low level of past actual female death benefits as compared to those computed could be due to a significant proportion of CPP death benefits not being applied for in the case of death of eligible female contributors, or to an overestimate of the proportion ELIWFR of females eligible for the death benefit, or to a combination of both. These significant differences will be the subject of further research for purposes of the next report.

v) Children's Benefits

In accordance with the eligibility rules, Disabled Contributor's Child's (DCC) and Orphan benefits became payable for the first time in 1970 and 1968, respectively. Hence, the numbers of DCC and Orphan benefits emerging each year after 1969 and 1967, respectively, were determined, as described below, so as to correspond to the number of children born, up to the date of emergence, to the previously computed number, emerging during the given year, of beneficiaries of disability and/or survivor pensions.

For this purpose, the numbers of emerging disabled contributors and surviving spouses were first split by age, sex and calendar year. Canada fertility rates, adjusted to correspond to Canada less Québec, by taking as weights the population for the appropriate age, sex, year and geographic component (i.e., Canada or Québec), were then applied appropriately to these numbers, i.e., to

- the female disabled contributors and the spouses of male disabled contributors, and to
- the widows and the deceased spouses of widowers,

for the appropriate age of the female. For this purpose, the age of spouses of male disabled contributors were distributed in accordance with the assumed distribution of spouses by age (section 2(b)xi) above). As for the demographic projections (see section I above), the constant proportion of male births was assumed to be 1.056 of female births.

The resulting emerging numbers of children by age, sex and calendar year were thereafter survived, from one year to the next, incorporating the following reasons for termination of benefits:

- Attainment of age 25 by the child. For this purpose, use was made of mortality rates determined by age as the yearly ratios of the number of deaths to the population, both taken from demographic projections (see section I above).

- Stopping full attendance at school while over age 18. For this purpose, the assumptions described in section 2(b)xii) above were used.

- Regarding DCC benefits only, termination (recovery, death or attainment of age 65) of the parent's disability benefits. For this purpose, the assumed disability termination rates (see section 2(b)viii) above) were used.

Total children's benefits were then obtained for any given calendar year as the product of:

- the sum of all child beneficiaries having emerged so far, and having survived until that date, and.

- the applicable annualized amount of the child flat-rate benefit obtained by adjusting the actual 1995 rate in accordance with the Pension Index. However, assuming that emergences and terminations occur mid-year on average, 50% instead of 100% of the annualized amount was used in respect of cases emerging or terminating during the year.

The actual DCC and Orphan benefits paid each year from 1966 to 1993 were compared by age with the corresponding benefits computed by age for each of these years using the above approach. They correspond quite steadily by age and by calendar year to about 102.1% and 88.2%, of benefits computed as above, for DCC and Orphan benefits, respectively. Accordingly, DCC and Orphan benefits projected for all years after 1993 were increased by 2.1% and reduced by 11.2%, respectively. The relatively low level of past actual orphan benefits as compared to those computed could be due to a significant proportion of CPP death benefits not being applied for in the case of death of eligible female contributors, or to an overestimate of the proportion ELIWFR of females eligible for the death benefit, or to a combination of both. These significant differences will continue to be the subject of further research for purposes of the next report.

vi) **Administrative Expenses**

On the basis of past average experience, CPP annual administrative expenses were assumed constant at 0.1% of total annual contributory earnings.

-III- PAY-AS-YOU-GO RATES, CONTRIBUTION RATES AND ACCOUNT

1. Data (year-end amounts)

(a) Historical (1966 to 1993)

i) taken from HRDC Monthly Information Reports:
- the Account
- the Operating Balance
- the amount of investment earnings from the Operating Balance
- total expenditures

ii) taken from CPP Investment Fund Reports prepared by the Department of Finance:
- the Fund (i.e., loans made to provinces each month)
- the average nominal annual interest rate, compounded semi-annually, applying to loans made during the year

iii) taken from the *CPP Act*:
- the annual contribution rates

iv) taken from section II-3(f) above:
- contributory earnings

(b) Projection period (1994 to 2100)

- the annual contribution rates for the remainder of the 25-year period of the Schedule to the Act
- the projected contributory earnings (from section II-3(f) above)
- the projected total expenditures (from section II-3(i) above)

2. Assumptions (including interest)

(a) Interest rate applying to the CPP Fund (loans to provinces)

On the basis of
- the average long-term, medium-term and short-term past experiences of the annual yield on long-term investments, and
- the current outlook of the economy,

it was decided to maintain at 6%, as in the most recent four CPP actuarial reports, the assumed ultimate (i.e., for 2000 and subsequent years) annual nominal (compounded semi-annually) rate of interest applying to new loans made to provinces during the year. For the period 1995 to 1999, the assumed rates were obtained by interpolation from the 1993 actual rate and the ultimate rate of 6%.

ANNUAL NOMINAL RATES OF INTEREST ASSUMED TO APPLY TO NEW CPP LOANS
(the rate shown for 1994 corresponds to the average experience for that year)

Year						
1994	1995	1996	1997	1998	1999	2000+
8.03%	9.0%	8.4%	7.8%	7.2%	6.6%	6.0%

The ultimate assumption of 6%, coupled with the ultimate assumption of 3.5% for increases in the CPI, implies an assumed real rate of investment earnings of 2.415% (i.e., 1.06/1.035 - 1). For a fund invested entirely at rates reflecting long-term Government of Canada bond rates, this real rate is deemed to be close to the rate that might be expected to be earned over long periods on the basis of past experience. In any event, it must be recognized that although rates of interest may have a significant effect on the ratio of the Account to expenditures, they do not have a significant effect on contribution rates, unless a relatively high degree of funding is contemplated. In this latter context, the assumed rate of interest is highly significant in calculating both the contribution rate on an actuarially funded basis and the related unfunded actuarial liability (see Appendix C).

(b) Interest rate applying to the CPP Operating Balance

Since the Operating Balance is generally invested in very short-term securities, it is assumed to be totally reinvested yearly and to earn an effective rate of 5%, i.e., the assumed nominal rate of interest on new loans (i.e., on 20-year securities) less 1%. This assumed difference of 1% very closely corresponds to the actual average interest rate differential experienced from 1966 to 1993. By using a lower assumed interest rate for the Operating Balance, the assumed ultimate combined (i.e., Fund and Operating Balance) yield on the Account is accordingly less than 6%. For example, this combined ultimate yield would be 5.875% if one assumed that the year-end Account is exactly equal to twice the expenditure of the ensuing year and the year-end Operating Balance is exactly equal to 1/4 of this expenditure.

(c) Timing of new loans made during the calendar year

Of all new loans to provinces during any calendar year, 60% are assumed to be made during the first half of the year. This percentage reflects the timing of contributions received during the year; indeed, earners with earnings above the YMPE would normally complete the full payment of their contributions once they have earned the YMPE during the year. This 60% assumption corresponds to the underlying actual average experience for 1966 to 1993. It is used, for a given calendar year, in connection with the new loans arising out of the first semi-annual coupon payable from the new loans made in the first six months of that calendar year.

3. Methodology

(a) Pay-as-you-go Rates

The pay-as-you go rate for a given year corresponds to the ratio of the year's total expenditures to the year's total contributory earnings.

(b) Contribution Rates

As required by the Act, contribution rates were computed under two scenarios, i.e., 1A and 1B (see section III-1 of this report), whereby the existing 25-year (1992-2016) schedule of contribution rates would apply until 2016 (scenario 1A) and 1996 (scenario 1B), respectively, and the *15-year formula* would start applying in 2017 and in 1997, respectively, and would be renewed every 5 years thereafter.

For Account projections, the *15-year formula* was accounted for through an iteration process whereby the Account is projected, as described in section (d) below, using successive multiples of 0.01% of constant annual change (positive or negative) from the contribution rate for 1996 (in respect of scenario 1B), and retaining the lowest multiple which produces an Account/Expenditure ratio of at least 2 at the end of 2011. This iteration process is then similarly repeated, in accordance with the prescribed timing for quinquennial reviews of the schedule of contribution rates, for each subsequent 5-year period, i.e., 2002 to 2006, 2007 to 2011, and so on until the 2097-2101 period.

(c) Contributions

The amount of total annual contributions corresponds, for a given year, to the product of the year's contribution rate and the year's total contributory earnings.

(d) Account

As for the projection of contributory earnings and expenditures, Account calculations are made using 1966 as the starting point of the projections, rather than the beginning (1994) of the valuation period. This is done for the following three objectives:

- The reproduction, for methodology validation purposes, of the past values of the Account, the Fund and the Operating Balance.
- The availability of a reliable set of 1993 values for the proper projection of the Account to 1994 and subsequent years. The projection of the Account is accordingly started accurately by using the actual important components of the Account, e.g., the amount, the yield and the 20-year renewal date of each loan made each year from 1966 to 1993.
- This approach facilitates the integration of the existing components of the Account with those emerging after the valuation date, thus ensuring full consistency of the valuation process as it applies to past and future values.

i) Annual increase in the Account

The Account at the end of a given year is obtained by adding to the previous year-end Account the year's increase in the Account. This increase corresponds to the sum of the cash flow (year's excess of contributions over expenditures) and the investment earnings. Due to the distinctive investment peculiarities of the two main components of the Account (the Operating Balance and the Fund), the annual increase in the Account is computed as the sum of the respective annual increases in the Operating Balance and the Fund.

ACCOUNT INCREASE = OPERATING BALANCE INCREASE + FUND INCREASE

These two main components of the annual increase in the Account were computed as follows:

ii) Annual increase in the Operating Balance

The Operating Balance at the end of a given year, deemed to correspond to the expenditures of the first three months of the ensuing year, is first computed as follows:

YEAR-END OPERATING BALANCE =
3/32 of year's expenditure + 5/32 of ensuing year's expenditure

The annual increase in the Operating Balance (DELOPE) for a given year is then easily obtained by taking the difference between the year-end Operating Balance and the corresponding amount for the previous year.

It is important to note at this point that the increase in the Operating Balance (DELOPE) originates from the investment earnings from the Operating Balance (INVOPE) and the residual amount (DELOPE-INVOPE), positive or negative, corresponding to an amount otherwise available for loans to provinces (i.e., an increase in the Fund). To compute this residual amount, required for the computation of the yearly fund increase described below, DELOPE is obtained as described above and INVOPE is obtained using the following approximation formula for the internal rate of return on the Operating Balance:

$$INTOPE_N = 2*INVOPE_N / \{OPEBAL_{N-1} + OPEBAL_N - INVOPE_N\}$$

where INTOPE corresponds to the actual or assumed annual rate of return on the Operating Balance as described in section 2(b) above, and $OPEBAL_{N-1}$ and $OPEBAL_N$ corresponds the Operating Balance at the end of years N-1 and N, respectively.

iii) Annual increase in the Fund

The annual increase in the Fund (DELFUN) is computed by relying on the following relationship:

DELFUN = (CASHF - (DELOPE-INVOPE) + CUMINVDELFUN)*(1+0.5*0.6*INTFUN)

where **CASHF** = the year's cash flow (i.e., contributions minus expenditures)

DELOPE-INVOPE = the year's residual amount described above

CUMINVDELFUN = the year's investment earnings from all loans made in previous years (in other words from all previous annual Fund increases). In respect of each such previous year, the component of CUMINVDELFUN is equal to that year's Fund increase (DELFUN) times that year's actual or assumed interest rate (INTFUN) on new loans made during the year. These calculations were made taking into account the renewal new money interest rate applying (actual or assumed) every 20 years after a loan is originally made. If the amount to be invested in any year (DELFUN) should turn out to be negative, investment maturities (additional to normal 20-year renewals) are assumed for that year, sufficient to provide a positive investment, and to release sufficient cash in that year to meet all expected expenditures. These additional maturities are assumed to be implemented on the *first-in, first-out* basis as stated in the Act.

1 + 0.5*0.6*INTFUN = the factor, which increases the yearly gross amounts available for loans, i.e.,
CASHF - DELOPE + INVOPE + CUMINVDELFUN,
in accordance with the additional availabilities arising out of the first semi-annual interest coupon earned on loans made during the first six months of the given year (INTFUN and 0.6 are assumptions described in sections 2(a) and 2(c) above).

Once the Account has been so computed in respect of any year prior to the projection period (1966 to 1993), it is recomputed by adjusting the 0.6 factor (in connection with the timing of investments) so that the computed Account is equal to its actual known value. Each of the annual adjusted timing of investment factors is very close to the actual ones for 1966 to 1993, indicating that the methodology used for account projections is acceptable. For methodology validation purposes, the annual increase in the Fund (loans to provinces), computed as described above, was compared with actual data; *actual over expected* ratios obtained in this manner are very close to 1 for most years. The greatest deviation is +2.7% for 1989 followed by a deviation of -3.5% for 1990; these largely counterbalancing deviations are due to the fact that the amounts made available loaned to provinces in a given year are determined on the basis of short term forecasts of expected cash flows.

APPENDIX C

FULL FUNDING, UNFUNDED LIABILITY AND INTERNAL RATE OF RETURN

1. Discussion on actuarial funding

The CPP is financed on a pay-as-you-go basis slightly modified for the provision of a relatively small fund (i.e., the Account) targeted to correspond, at the end of any year, to twice the total expenditure of the ensuing year. Thus, like comparable social insurance programs of other countries, the CPP is not actuarially funded. On the other hand, in the field of private pensions, full funding is the standard practice.

Nevertheless, it is interesting to know the level of the contribution rate and of the related unfunded liability that might be considered appropriate if the benefits provided by the Canada Pension Plan were to be funded by means of a normal pension trust. In this vein, the concept of the internal rate of return will also be briefly discussed.

2. Key assumptions

The unfunded actuarial liability is calculated as the amount that theoretically would be required to be invested on the valuation date. It is therefore extremely sensitive to the rate of interest assumed applicable at that date. For example, if there is a drop in interest rates, all other things being equal, the unfunded liability would appear to have increased very substantially in the following year, merely because the amount of the unfunded liability was not invested during a year of high interest rates. To avoid these somewhat artificial fluctuations, the calculations of the entry age normal cost and of the unfunded liability were based only on the ultimate economic assumptions described in Appendix B.

3. Variations in assumptions

Each of the key assumptions has, on the pay-as-you-go rate, an effect possibly different from that on the entry-age normal contribution rate. The table below summarizes these differences.

Assumption changed	Effect on CPP contribution rate	
	Pay-as-you-go	Entry-age normal
(a) Interest rate	independent	varies inversely, other things being equal
(b) Rate of increase in earnings	varies inversely	varies directly
(c) Rate of increase in prices	varies directly	varies directly
(d) Real rate of increase in earnings (i.e., differential between earnings and prices increases)	varies inversely	may vary directly or inversely depending on the net effect of change in both: • the real interest rate (interest rate less rate of price increases), • the difference between the rate of interest and the rate of increase in earnings
(e) Fertility	varies inversely	negligible (affects only volume of children's benefits)
(f) Immigration	varies inversely	varies directly

4. Methodology

The concept of actuarial funding carries with it the concept of an unfunded actuarial liability arising from the lack of contributions prior to the inception of the Plan and the collection of contributions since the inception of the Plan at a rate below the entry-age normal rate. The contribution rates quoted in this appendix, as well as the related unfunded liability, were developed by the entry-age normal actuarial cost method. This method aims at a level percentage of contributory earnings to be contributed during the active lifetime of a normal cohort of entrants sufficient to support all benefits payable to them and their beneficiaries.

(a) Entry-age normal actuarial cost

The entry-age normal cost was determined, using the methodology described in section II of Appendix B, as the ratio, in respect of the cohort of people aged 18 on average on their nearest birthday on 31 December 1993, of:

- the present value of all future annual expenditures, to
- the present value of all future annual contributory earnings.

These present values were determined using the assumed ultimate rate of interest but not the rates of increase in average earnings and prices which are already accounted for in the calculation of expenditures and contributory earnings.

(b) Unfunded actuarial liability

An amount, hypothetically invested in mid-1994, was determined, using the methodology described in section III of Appendix B, by an iteration process such that together with:

- the Account as at 31 December 1993,
- future (post-1993) contributions at the entry-age (18) normal actuarial cost rate collected in respect of the cohort of eligible (earnings higher than the Year's Basic Exemption) people aged 18 and over on 31 December 1993, and
- total investment earnings from the Fund and the Operating Balance,

it would be just sufficient to pay all future benefits and administrative expenses in respect of those eligible persons aged 18 and over on 31 December 1993. The unfunded actuarial liability as at 31 December 1993 was taken as the amount so obtained but further discounted for one-half year's interest.

5. Results

If the CPP were actuarially funded, the Account at the end of 1993 would be equal, on the basis of the ultimate main assumptions of this report, to $529.2 billion, i.e., is the sum of the actual value of the CPP Account at the end of 1993 ($41.7 billion) and the unfunded liability shown below ($487.5 billion).

Economic Assumptions			Entry Age Normal Actuarial Cost	1993 Year-End Unfunded Actuarial Liability
Increase in CPI	Increase in Earnings	Interest on New Loans		
(%)	(%)	(%)	(%)	($ billions)
3.5	4.5	6.0	10.50	487.5

The unfunded actuarial liability may be expected to grow each year in the future by:

- the amount of interest accruing thereon at the assumed rate; and
- the difference between contributions at the hypothetical entry-age normal actuarial cost rate and contributions actually collected, plus the interest accruing on this difference. These increases in the unfunded actuarial liability are offset to some extent by the difference between interest at the actual and assumed rates (and there may be other sources of gains and losses).

6. Internal rate of return

The projected gross (i.e., before accounting for administrative expenses) internal rate of return in respect of contributions and benefits of a fully funded pension plan is equal to the assumed interest rate used for the calculation of contribution rates. Therefore, if the CPP were fully funded and the assumptions underlying the full cost of 10.50% materialized, its gross internal rate of return would be equal to 6%.

On the other hand, the projected gross internal rate of return under an earnings-related pension plan being financed on a pay-as-you-go basis and having become fully stabilized, is theoretically (mathematically) equal to the assumed annual rate of increase in total employment earnings. If the CPP would meet exactly all these criteria, its gross internal rate of return would accordingly correspond to the annual increase in contributions (because they are determined as a percentage of earnings), or to the annual increase in expenditures (because under a pure pay-as-you-go system contributions are equal to benefits), or still to the population annual rate of increase (i.e., about 0.5%) compounded with the assumed annual rate of increase in average employment earnings (i.e., 4.5%). Therefore, the projected CPP internal rate of return would under these conditions correspond to about 5%, which incidentally corresponds quite closely to the average annual rate of increase from 2075 to 2100 in contributions or in expenditures shown in the main table of financial projections of this report.

Actually, the CPP is not really quite stabilized (especially in respect of the gradual transition of the population from a baby-boom to a baby-bust scenario), is not run on a pure pay-as-you-go basis (because of the maintenance of a 2-year account), and is not a pure earnings-related program (because of its various flat-rate benefit components). Exact calculations of the CPP net internal rate of return using the data, methodology and assumptions of the previous (fourteenth) report as at 31 December 1991 were made for specific cohorts of contributors in order to validate the differences between the results using the mathematical theory mentioned above and the financial projections of this report. These exact calculations are shown below on a net basis (the effect of administrative expenses is about 0.04%):

Year of Birth	Contributions ($ millions)	Benefits ($ millions)	Benefits/ Contributions	Net internal rate of return (%)
1911	107	5,104	47.7	31.1
1929	1,037	29,150	28.1	16.6
1948	10,310	118,355	11.7	9.0
1968	48,947	312,763	6.6	6.4
1988	168,251	901,366	5.4	5.2
2012	532,978	2876,702	5.4	5.1

The ratios shown in the fourth column of the above table indicate that for every $1 of contributions, the cohort born in each of the indicated year would get back in benefits from $47.70 to $5.40, respectively. The corresponding net internal rates of return are 31.1% and 5.1%. Because the cohort born in 2012 will start contributing in 2030, i.e., at a time when contribution rates would be practically stable, the table results are quite consistent with the theoretical results whereby the ultimate internal rate of return is about 5.0%.

APPENDIX D

INDEX OF KEY WORDS AND ACRONYMS