

# **The Effects of Population Ageing on the Personal Income Tax Revenue in Canada: A Simulation Approach**

**Wen-Fong Lu   Wei Li   Earl Bailey\***

## **Abstract**

The Canadian population has been ageing since the 1980s with the proportion of Canadians age 65 and over continuing to increase to the middle of the century. It is envisioned that population ageing will have implications on both the government's expenditure and revenue sides. This paper focuses on the revenue implications. The major objective of the paper is to profile the ageing of the population and illustrate how it will affect the patterns of personal income and taxes at the federal level. The research is based on the Statistics Canada medium population growth projection over the period 2000 to 2026 and applying these projections to a micro-simulation model developed by the Canada Revenue Agency to make projections of federal personal income tax.

Our major findings include: In the case of the demographic approach

---

\* Although the authors are employees of the Canada Revenue Agency, the views presented in this paper do not necessarily reflect those of the Agency. The authors appreciate the comments on earlier drafts given by Allan McGrath and Thomas C. C. Chen of Nan Jeon Institute of Technology. Correspondence concerning this paper should be addressed to Wen-Fong Lu; E-mail: Wen-Fong.Lu@ccra-adrc.gc.ca

that assumes only population structure change, the total personal taxable income and the total net federal income tax over the period 2001 to 2026 will continue to increase, but the average taxable income and income tax payable per return will show a decline from 2011 when the “baby boomers” reach their retirement age. In the case of the combined demographic and income approach under the assumptions that both population will change structurally and that personal income will increase, the average taxable income and income tax payable per return will continue to increase over the whole projection period, but that the growth rate of income tax revenue is expected to slow down after 2011.

**Key Words: Population Ageing, Income Tax, Micro-Simulation Model**

# 加拿大人口老化對個人所得稅之影響

呂文峰 李 偉 Earl Bailey

## 摘 要

自 1980 年代起加拿大人口開始老化，這波人口老化將持續到本世紀中葉，這種現象勢必會影響政府的支出和稅收，因此本文著重於分析人口老化對個人所得以及聯邦稅收的影響。根據加拿大統計局的人口預測結果，我們應用加拿大國稅局的個體模擬模式 (micro-simulation model) 來預測聯邦個人所得稅。

本文分析結果指出：(1) 假設其他條件不變，只有人口結構發生變化，則每年聯邦個人所得稅總額在 2001 至 2026 年期間將繼續增加。但是，在 2011 年當嬰兒潮達到退休年齡時，每人平均應繳稅所得及應繳稅額將逐漸減少。(2) 假設人口結構及個人所得都會變化，則每年每人平均應繳稅所得及其稅額將在 2001 至 2026 年間逐漸增加。但是，在 2011 年後，其增加率將相對減低。

**關鍵字：**人口老化、所得稅、個體模擬模式

## I. INTRODUCTION

In recent decades, the proportion of senior<sup>1</sup> people in many countries has increased considerably compared to the total population growth. Canada is among this group of countries. According to Statistics Canada, the proportion of seniors in year 2000 is more than 12% and it will continue to rise to the middle of this century. Population ageing is expected to have an effect on the labour force, federal taxation, federal health care expenditures as well as other socio-economic characteristics and will place financial pressure on Canada's social system.

The major impact of population ageing on taxation is expected to on the revenues from personal income tax, which accounts for about one-half of the total federal tax revenues. Personal income tax is directly associated with people and could be significantly affected by factors associated with the socio-economic characteristics of people. Since the retired population usually earns less income than employed people, the average taxable income might decrease with population ageing. The total income tax revenue is affected not only by population ageing but also by other factors such as the number of taxpayers, their income level, and the effective income tax rate. Based on the population census and data from personal income tax returns and by using the T1 Tax Analysis Model, this paper will examine the impact of Canadian population ageing on federal income tax revenues.

## II. LITERATURE REVIEW

In recent years, there has been significant research into the potential impact of population ageing on industrialized countries' socio-economic development (Corak,

---

<sup>1</sup> Throughout this paper, the terms senior and elderly pertain to the population of 65 or more years of age.

1998; Denton and Spencer, 1999; Health Canada, 2002; Merette, 2002). However, relatively little research has been done into the taxation implications of population ageing. A U.S. study suggested that population ageing would cause a slow growth in the number of people working and paying taxes but a rapid growth in the cost of health and social security programs.<sup>2</sup> Robson (2003) predicated that Canadian taxpayers in the future would pay more for the entire package of public programs than their predecessors providing the current age/sex distribution of the public expenditure in these programs would remain the same. A study commissioned by the Group of Ten countries concluded that government revenues would be adversely affected as the baby boom generation moves from its high-income-generating years to retirement. Countries whose revenues depend heavily on income or payroll taxes would face deterioration in revenues.<sup>3</sup>

An Australian study indicated that even though population ageing would create downward pressure on total personal income tax revenue (because of the declines in the average tax paid per person in the higher age groups), several other factors such as GDP growth, labour participation rate, wage rates, etc. make it uncertain which direction total personal income tax revenue will take.<sup>4</sup> Some studies that were done by Finance Canada on the fiscal implications of population ageing show that a less than severe impact is expected to occur over the next half century. King and Jackson (2000) stated that, although ageing will have some impact on public finances, the impact will play a minor role in the interaction of all the factors that are expected to cause fiscal pressures. Jackson and Matier (2002) analyzed the long-term impact of population ageing on important revenue and expenditure categories. Under their definition of existing federal, provincial and territorial fiscal structures (all assumed

---

<sup>2</sup> United States Government Printing Office (1997).

<sup>3</sup> Group of Ten (1998).

<sup>4</sup> Department of the Treasury of Australia (2002).

to remain constant) and their criterion for long-term fiscal sustainability, their projection suggests that most governments will be in a fiscally sustainable position over the long run.

### III. PROFILE OF THE CANADIAN POPULATION AGEING

#### 1. Population Projection

In 2001, Statistics Canada published its population projections for 2000-2026. The projections use the 2000 preliminary population estimates that were based on the 1996 Census data. For the projections of the overall Canada population, there are three growth scenarios – high, medium and low growth. Table 1 summarizes the assumptions that were made in the scenarios. These assumptions reflect the following components of population growth: the total fertility rate (TFR), life expectancy at birth, immigration level, emigration rates and the number of non-permanent residents.

**Table 1. Component Assumptions for Population Projections, 2000 to 2026**

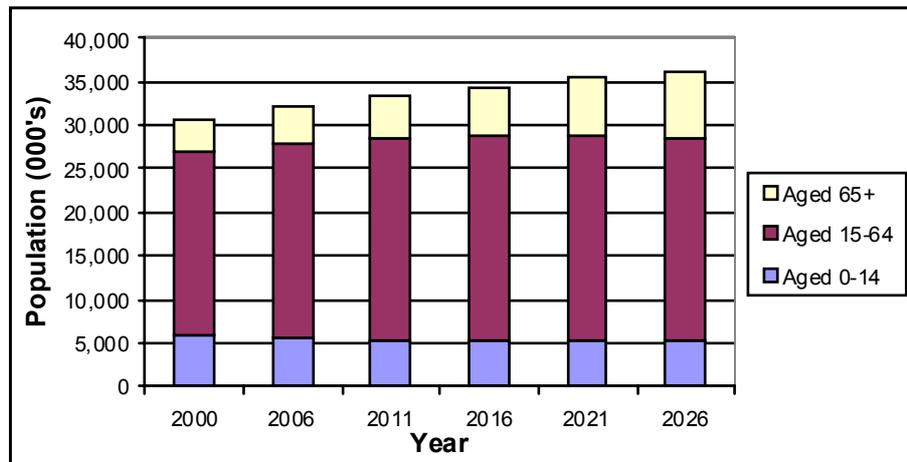
Component of Population Change	High Growth	Medium Growth	Low Growth
Total Fertility Rate	1.8	1.48	1.3
Age Expectancy at Birth (male/female)	81.5 / 85.0	80.0 / 84.0	78.5 / 83.0
Immigration (persons)	270,000	225,000	180,000
Total Emigration	This is based on the 2-year average of the age-sex specific emigration rate from 1997-1998 to 1998-1999.		
Non-Permanent Residents (persons)	240,000, assumed constant over the projection period.		

Source: Statistics Canada (2001).

Canada's TFR in 2000 was 1.49 and according to Statistics Canada (2001) the TFR in the medium assumption (obtained by averaging the low and high assumptions) will reach 1.48 children per person by 2001 and remain constant thereafter. Since the

fertility level has been quite stable in recent years, the current level is assumed to continue. Secondly, the medium life expectancy at birth, which is based on the current trend in the age-specific mortality rate, is assumed to continue to increase over the projection period in a similar way shown in the recent past. Thirdly, the medium immigration level is assumed to be the government's current target of 225,000 per year because the government has no plans to modify this quota in the short term. Fourthly, regarding the emigration assumption, it is assumed that future migration will equal the current migration level, this assumption being a confident practice in the projection of international migration. Lastly, for the years 2000 to 2003, the medium-growth consideration showed the least difference between Statistics Canada population estimates that were based on the 1996 census models when compared to Statistics Canada forecasts that were conditioned by the above components of population change. For these reasons, Statistics Canada's medium-growth quinquennial projections are chosen for this study.

Figure 1 shows the population estimates for 2000 and the population projections from 2006 to 2026. The Canadian population will increase over the next 20 to 30 years, with the total population expected to reach 33.4 million in 2011 (an 8% increase over year 2000) and 36.2 million in 2026 (an 18% increase over year 2000). Also, the distribution of population among the age groups will vary. During the 2000 to 2026 period, the population of the age groups under 15 will decrease slightly from 5.9 million to 5.4 million. The population aged 15-64 will increase moderately from 21.0 million to 23.5 million by 2016, and then decline slightly to 23.1 million by 2026. The number of persons aged 65 and over will be 4.8 million by 2011 and 7.8 million by 2026, or 1.3 and 2.0 times respectively compared to 3.9 million in year 2000.



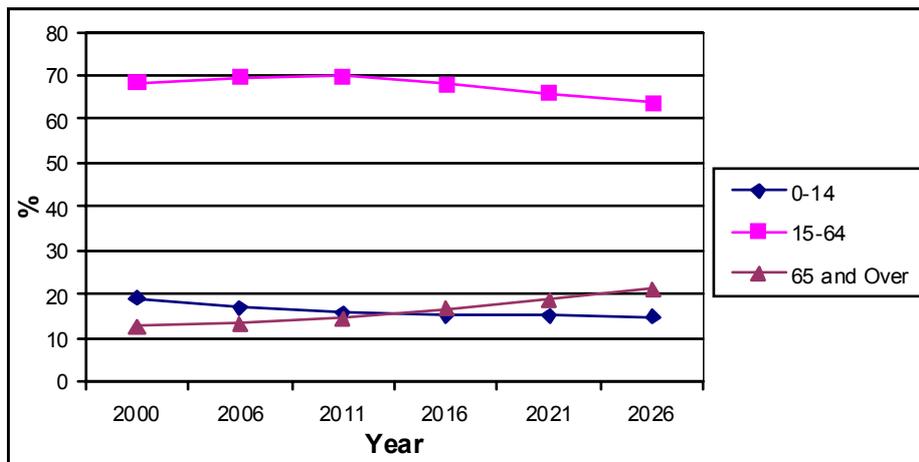
Source: Based on Statistics Canada (2001).

**Figure 1. Canadian Population Size by Age Group 2000 - 2026**

## 2. Population Ageing

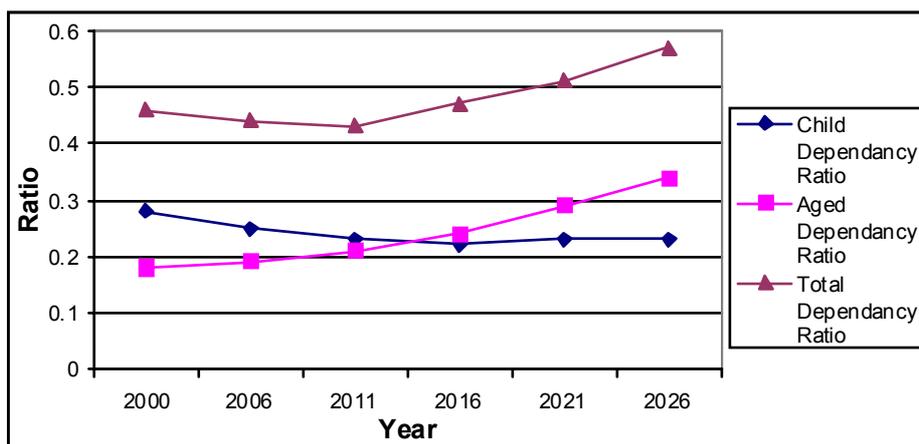
Canadian population will age faster after 2011 when the “baby boomers” (1946-1960) reach their retired age. The senior population, which was 12.6% of the total population in 2000, is expected to be 14.5% in 2011 and 21.4% in 2026 (see Figure 2). There will be one senior in every five people in year 2026. The aged dependency ratio, which is defined as the ratio of the number of persons 65 years and over to the 15-64 population, will increase from 0.18 in 2000, to 0.21 in 2011, and to 0.34 in 2026 (see Figure 3).<sup>5</sup> The child dependency ratio (the number of persons under 15 years to the 15-64 population) will decrease from 0.28 to 0.23 during the same period. The total dependency ratio (the number of persons under 15 and 65 years and over to the 15-64 age group population) will initially decrease from 0.46 to 0.44 by year 2011

<sup>5</sup> Although the aged dependency rate could continue increasing beyond 2026, the discussion of ageing implications in this paper stops at the year 2026 because of the constraint on availability of population age specific forecast data after 2026 from Statistics Canada.



Source: Based on Statistics Canada (2001).

**Figure 2. Canadian Population Age Structure 2000 - 2026**



Source: Based on Statistics Canada (2001).

**Figure 3. Canadian Population Dependency Ratios 2000 – 2026**

because of the decreasing proportion under 15, and then increase to 0.57 by year 2026, which is an increase of 0.11 over 2000. By 2026, it is implied that, on average, for every working age person there will be 0.23 children and 0.34 seniors.

According to the United Nations' estimates shown in Table 2, 14.4% of the Canadian population will be aged 65 or over in 2010 rising to 21.3% in 2025. The

**Table 2. Major Population Indicators of North American Countries, 2000 to 2025**

Indicator	2000	2005	2010	2015	2020	2025
<b>Canada</b>						
Population (thousands)	30,769	31,972	33,069	34,133	35,166	36,128
Percentage aged 0-14 (%)	19.0	17.3	15.6	14.8	14.7	14.8
Percentage aged 15-64 (%)	68.4	69.5	70.0	68.8	66.6	63.9
Percentage aged 65+ (%)	12.6	13.2	14.4	16.4	18.7	21.3
Aged dependency ratio	0.18	0.19	0.21	0.24	0.28	0.33
Median age (years)	36.9	38.9	40.6	41.9	43.0	43.9
<b>U.S.A.</b>						
Population (thousands)	285,003	300,038	314,921	329,669	344,270	358,030
Percentage aged 0-14 (%)	21.9	21.3	20.5	20.3	20.1	19.8
Percentage aged 15-64 (%)	65.8	66.4	66.7	65.5	64.0	62.4
Percentage aged 65+ (%)	12.3	12.3	12.8	14.2	15.9	17.8
Aged dependency ratio	0.19	0.19	0.19	0.22	0.25	0.29
Median age (years)	35.2	35.9	36.3	36.6	37.0	37.6
<b>Mexico</b>						
Population (thousands)	98,933	106,385	113,320	119,618	125,176	129,866
Percentage aged 0-14 (%)	33.8	31.3	28.7	26.4	24.3	22.5
Percentage aged 15-64 (%)	61.4	63.4	65.3	66.8	67.7	68.0
Percentage aged 65+ (%)	4.8	5.3	6.0	6.8	8.0	9.5
Aged dependency ratio	0.08	0.08	0.09	0.10	0.12	0.14
Median age (years)	22.9	24.7	26.6	28.5	30.6	32.7

Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2003).

corresponding values are 12.8% and 17.8% respectively in the U.S.A and 6.0% and 9.5% respectively in Mexico. Although the total dependency ratio in Canada by year 2025 will be lower than the US (0.56 versus 0.60), the aged dependency ratio, as a consequence of Canada's higher proportion of elderly people, will be higher in Canada (0.33) than that in the United States (0.29) and, most noticeably, higher than that in Mexico (0.14).<sup>6</sup> Compared to our North American neighbors, the Canadian population will be much older. The median age of Canadians will be 40.6 in 2010 and 43.9 in 2025, which are 4.3 and 6.3 years older than the respective American median ages and 14.0 and 11.2 years older than the respective Mexican median ages.

In Canada, the population will continue to age at a rapid rate into the future. The elderly proportion of the Canadian population is projected to double from 10% to 20% over the 40-year period from 1984 to 2024. In the U.S., the proportion of the elderly population is expected to double over a longer period of about 60 years.<sup>7</sup> It is worth noting that Fougere and Merette (1998) suggested that the aged dependency ratio in some OECD countries (Japan, Italy, Sweden, United Kingdom, and France) would be greater than that of Canada. This shows that although Canada's population is ageing faster than U.S. and Mexico, it will be better off than Japan and many industrialized European countries.

## IV. INCOMES AND TAXES BY AGE

### 1. Proportion of Taxable Returns

The major indicators of personal income and tax such as the proportion of

---

<sup>6</sup> Since population under 15 would pay little or no income tax and the majority of ageing population would still pay their income tax, the aged dependency ratio is more relevant to this research than the total dependency ratio from a revenue standpoint.

<sup>7</sup> Derived from the United Nations' publication at <http://esa.un.org/unpp>.

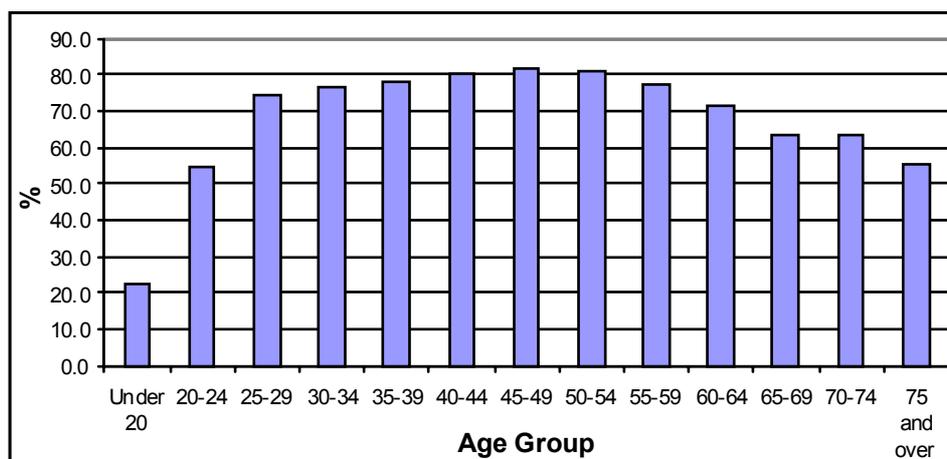
taxable returns, distribution of total income, average taxable income, average non-refundable tax credits, and average net federal income tax are all related to age. Based on the most recent available data (Year 2000), the proportion of taxable returns will be analyzed in relation to age first.

Since the Canadian personal income tax system is closely associated with the application of social development programs, a large proportion (90% of the total population aged 20 and over) submitted their tax returns for the year 2000. The percentage was higher in the older age groups than that in the younger age groups. For example, about 96% of the 65 and over age groups filed a tax return while it was about 90% in the 40-64 groups, a result that may be due to a greater incidence of means tested benefits within the senior population. However, the higher percentage in older age groups does not necessarily equate to more taxes because personal income tax is mainly determined by one's taxable income level. Furthermore, not all tax returns are taxable.<sup>8</sup>

Figure 4 shows that the proportion of the number of taxable returns to that of total returns vary in different age groups. For example, persons under 20, who have little or no tax to pay because they have relatively less income, show only 22.7% of their total tax returns to be taxable. The proportion increased with age and reached a maximum of 81.3% for persons 45-49. Then, the higher age groups showed lower percentages. The persons that were 65 and over had an average of 59.5% of their total tax returns that was taxable.

---

<sup>8</sup> A taxable return is defined as a return in which the net combined federal and provincial tax payable is at least one dollar.



Source: Based on Canada Customs and Revenue Agency (2002).

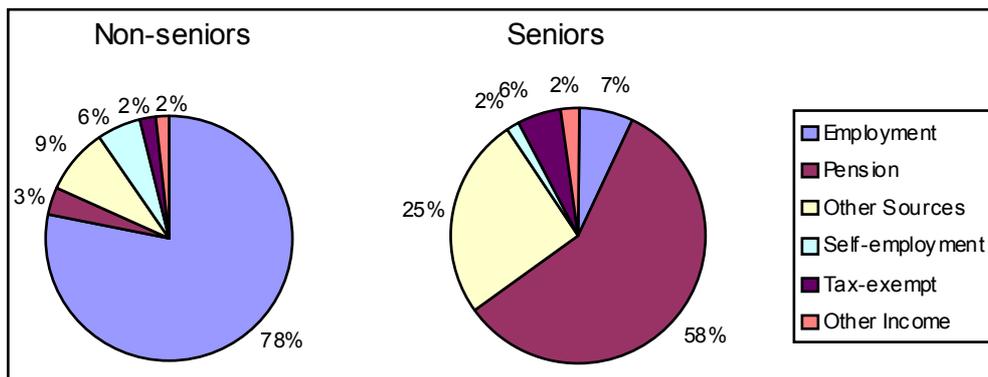
**Figure 4. Taxable Returns by Age Group (as a share of total returns) Tax Year 2000**

## 2. Income Sources

Seniors usually have less income than workers with differences in their sources of income. Figure 5 shows the sources of income.<sup>9</sup> for both seniors and non-seniors in 2000. For the non-seniors, 78% of their total income came from employment, 9% came from other sources (e.g., EI benefits, dividends, investment, rents, annuities, capital gains, and RRSP), 6% was from self-employment, and only 3% came from pensions. Tax-exempt income including workers' compensation payments, social assistance payments, and net federal supplements made up 2% of the total income. The remaining portion of income, referred to as other income, accounted for 2%.

<sup>9</sup> The reference is to the total income assessed in line 150 of the return. For more information on the total income and income items, see Canada Customs and Revenue Agency (2002).

The sources of income for seniors are quite different from that for non-seniors (see Figure 5). Pension income was the largest portion, accounting for 58% of seniors' income. Income from other sources was 25%,<sup>10</sup> while employment income was only 7%. Tax-exempt income accounted for 6%. Self-employment income and other income represented 2% each. The proportions for pension income, income from other sources and tax-exempt income were significantly more for seniors than for the non-seniors.



Source: Based on Canada Customs and Revenue Agency (2002).

**Figure 5. Sources of Income, Tax Year 2000**

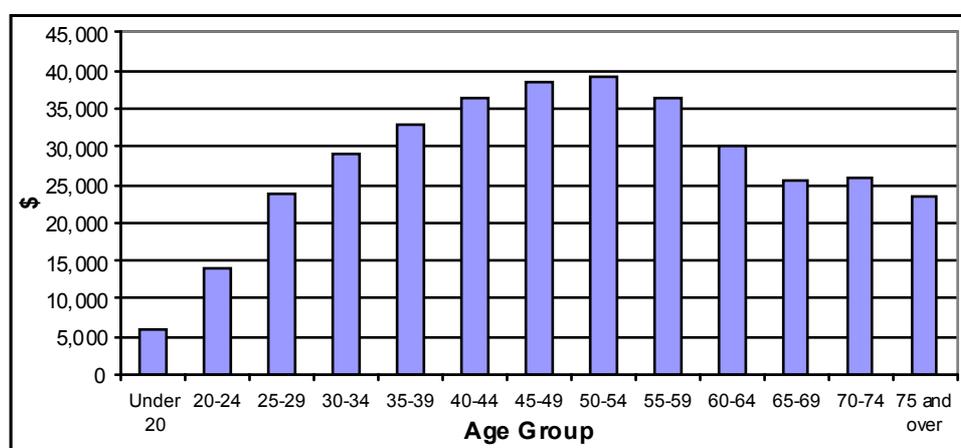
### 3. Average Taxable Income

The average taxable income is defined as the total taxable income assessed<sup>11</sup>

<sup>10</sup> RRSP income is reported as income from other sources. RRSP income for seniors accounted for only 2.4% of their total income in 2000 and, furthermore, the average RRSP income per return has shown very little change over the past ten years. This suggests that RRSP income will have only a minimal effect on the future growth of personal income and income tax providing the current pattern of RRSP income would not change too much in the future.

<sup>11</sup> Based on line 260 of the Year 2000 tax return, and this is the amount on which we calculate income tax.

divided by the total number of tax filers who reported a taxable income. Figure 6 illustrates the average taxable income by age group. For persons under 20, average taxable income was \$5,950 per person. The average increased to a maximum of \$39,146 for persons between 50 and 54, then the average decreased to the \$22,000 to \$26,000 range for persons 65 and over, the average being about 65% of the highest taxable income. Senior people had a lower average taxable income than working people aged 30-64, but better off than other younger age groups. There is no big difference in average taxable income level in the three senior age groups since the pensions are not related to seniors' age.



Source: Based on Canada Customs and Revenue Agency (2002).

**Figure 6. Average Taxable Income by Age Group Tax Year 2000**

#### 4. Average Non-Refundable Tax Credits

Non-refundable tax credits usually have predetermined common values for all Canadians, regardless of their income levels. These credits reduce their federal income tax payable, however, the excess over tax payable is not refunded. The total

tax credits are 17% of the total credit amounts including basic personal amount, age amount, spousal amount, contributions to the Canada and Quebec Pension Plans, employment insurance premiums, etc. It must be emphasized that senior tax filers whose income is less than \$49,824 may be allowed to claim an age amount up to the maximum of \$3,531. The total non-refundable tax credits are the sum of total tax credits and tax credits on donations.

In Figure 7, the average non-refundable tax credits<sup>12</sup> for the age groups between 20 to 64 were about \$1,700 per person. Note that the non-senior age groups do not show large differences because the basic personal amount is the major component of non-refundable tax credits in which the same amount is applied. However, the amount jumped to about \$2,100 for the 65-69 group, an increase of about \$400 per person. This jump is a result of seniors using the age amount. Average non-refundable tax credits for seniors in different age groups had only a small change ranging from \$2,127 to \$2,280.

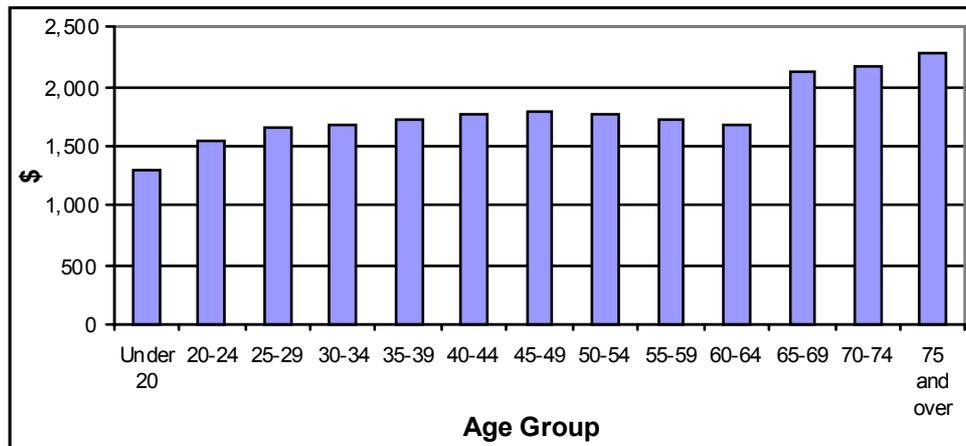
## 5. Average Net Federal Tax

Federal income tax rates for the tax year 2000 were 17% for taxable income \$30,004 or less, an additional 25% on the income under \$60,009 in excess of \$30,004 and an additional 29% on income over \$60,009. The average net federal tax for the under 20 age group was just \$881 per taxable return.<sup>13</sup> It increased rapidly with the increase of age and reached a maximum of \$7,843 per taxable return in the 50-54 age group (see Figure 8). The 65-69 age group showed an average of \$4,976 per return and remain stable for the older age groups. The taxes paid by the seniors were only

---

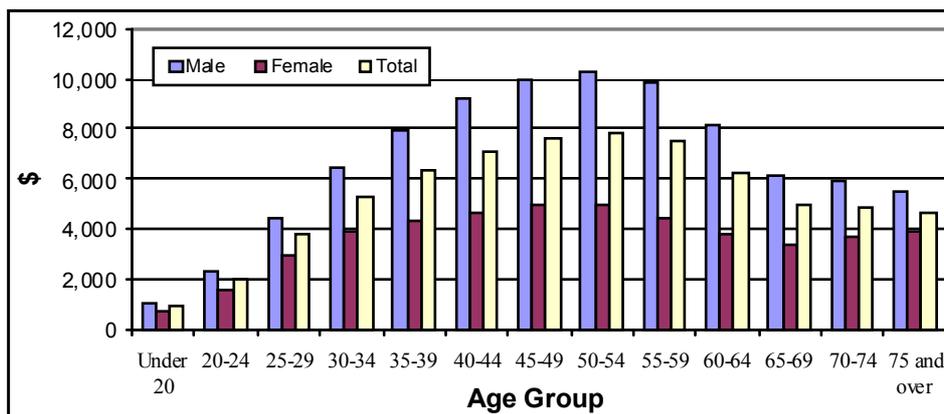
<sup>12</sup> Average non-refundable tax credit per return refers to the credit claims reported on line 350 divided by the number of returns with a non-zero claim.

<sup>13</sup> Based on line 420 of the Year 2000 tax return. The average of net federal tax is equal to the total amount of net federal tax divided by the number of taxable returns.



Source: Based on Canada Customs and Revenue Agency (2002).

**Figure 7. Average Non-Refundable Tax Credits by Age Group, Tax Year 2000**



Source: Based on Canada Customs and Revenue Agency (2002).

**Figure 8: Average Net Federal Tax by Age and Sex Tax Year 2000**

63% of the highest tax payable of the age group 50 to 54. The difference of average net federal tax between male and female was quite noticeable with the highest net tax payable for males being \$10,325 (at 50-54 age group) and only about \$5,000 for females (at 45-49 age group).

Table 3 puts the observations about income and personal income tax by age into perspective. The average net federal tax for seniors (about \$4,800) was considerably less than that of persons under 65 (about \$6,100). This observation is interpreted as seniors having, on average, higher non-refundable tax credits and lower taxable income that is mainly sourced as pension income. As the senior population grows faster relative to the rest of the population, it is expected that total individual income tax will be impacted. However, whether population ageing will reduce total federal income tax revenue depends on not only the increase of senior population but also the change of population under 30 whose average income tax were less than seniors' and the change of population 30-64 whose average income tax were more than seniors'.

**Table 3. Selected Individual Income Tax Statistics by Age Group, Tax Year 2000**

Age Group	Proportion of Taxable Returns (%)	Average <sup>14</sup> Income (\$)	Employment Income (%)	Pension Income (%)	Average Taxable Income (\$)	Average Non-Refundable Tax Credits (\$)	Average Net Federal Tax (\$)
Under 30	54.4	16,748	87.8	0.2	15,825	1,532	2,793
30-64	78.3	38,234	76.7	4.0	34,946	1,738	6,862
Under 65	72.1	32,632	78.1	3.5	29,926	1,684	6,060
65 and Over	59.5	27,406	6.9	58.5	24,629	2,210	4,809
All	69.9	31,714	67.3	11.8	28,969	1,776	5,872

Source: Based on Canada Customs and Revenue Agency (2002).

<sup>14</sup> Average income per return refers to the aggregate of all income reported on line 150 of the year 2000 tax return divided by the number of returns with a non-zero income.

## V. INCOME TAX MICRO-SIMULATION MODEL

### 1. Micro-Simulation Model

Micro-simulation models are computer-based models that operate at the micro level such as a person, family, or firm. Such models simulate how a socio-economic program could operate under proposed changes and how participants would be affected based on a large representative micro database of individual records and variables. The difference between micro- and macro-simulation models is the explanatory variables. In the former case, they represent individual characteristics but in the later, they represent collective properties. From the results of micro-simulation, conclusions that apply to macro levels of aggregation such as an entire country can be drawn. The model applies the socio-economic program rules to individual records, selects eligible records and computes the simulated results. Each record could represent an individual person or a group of individuals, depending on the ratio of the total population to the sample size.

Macro-simulation models can be static or dynamic. The static model operates on a cross-sectional database at a time point and it typically simulates the direct effects of policy changes. It can also simulate behavioural responses to program changes and can also be used to produce forecasts. The dynamic model generates a longitudinal database by applying transition probabilities to individual records and then uses the micro longitudinal data to simulate changes under proposed policy scenarios. In this way, the effects of demographic and economic processes as well as proposed policy changes can be traced.<sup>15</sup>

---

<sup>15</sup> For more information on micro-simulation model, see Citro and Hanushek (1991), Harding (1996), and Anderson (2001).

## 2. The T1 Tax Analysis Model

The T1 Tax Analysis Model<sup>16</sup> has been designed to simulate the assessment of taxes for individuals who file T1 income tax returns. The model can define what components of income to include in the calculation of total income, what exemptions and deductions to include in the determination of both net and taxable income and what items to include in the assessment of taxes and in the calculation of tax credits. It is a static micro-simulation model which cannot self adjust its inputs by using the model simulated outputs with respect to various economic, demographic, and other socio-economic variables. However, by changing population weights, it can project income tax revenues forward or backward.

The main quantitative definitions in the model that relate to this study include:

Individual total income = Sum of individual income items (such as employment income, pension, net business income, etc.)

Individual taxable income = Individual total income – Individual total deductions (such as RRSP deduction, union and professional dues, child care expenses, etc.)

Individual non-refundable tax credits = Sum of different individual tax credit amounts (such as basic personal amount, age amount, CPP or QPP contributions, etc.)  $\times$  17%

Individual net federal tax payable = Individual taxable income  $\times$  Federal tax rate – Individual non-refundable tax credits – Other credits

---

<sup>16</sup> The model is designed and run by the staff of the Statistics Division, CCRA.

Sampled total net federal tax payable = Sum of individual net federal tax payable  
(about a half million population in T1  
sample dataset)

Estimates of total net federal tax payable = Sum of (Population weights by age group  
and sex × Sampled total net federal tax  
payable by age group and sex)

The tax model itself consists of three components - the T1 Tax Analysis Model Interface (TMI) software, the manipulation system (MA), and the base file. TMI menu and dialog screens contain the elements that make up a T1 tax return and are used to organize the tax model study parameters such as the inclusion or exclusion of a subpopulation of tax filers, deciding upon which items to create or modify, and describing how the calculations are to be done. The MA system is compiled and stored as load modules on the mainframe computer. It reads in the parameters from the file created by the TMI, and applies the specified study conditions. The base file consists of all records from the T1 Statistical Sample file<sup>17</sup> for a particular tax year plus a selection of fields from the Child Tax Benefit data file, spousal data, T1 Assessing Master file, historical data, and computed tax model fields. The model study run output is a matrix file that includes the accumulated counts and amounts of selected variables.<sup>18</sup>

### 3. Implicit Assumptions in the Model Study Runs

The major objective of this study is to identify the impact of population ageing

---

<sup>17</sup> A sample of 503,180 returns was selected to form T1 sample data for 2000 tax year and represents a total of 22,237,000 returns that were filed in 2001.

<sup>18</sup> For more information on the model, see "T1 Tax Analysis Model Overview" and "T1 Tax Analysis Model Interface (TMI)-User Document" by the Personal Taxation Modelling Section, Statistics Division, CCRA.

on federal income tax in the future. However, the relationship between future population and income tax is not linear and it cannot be identified precisely by simple linear regression model. Considering the huge diversity of tax filer population, the T1 Tax Analysis Model (2000 tax year) will be used in this study. The base file in this model consists of personal income tax data for 2000. Personal income tax is essentially based on the annual income of individual persons in which standard and specific portions of the annual income are deducted leaving a net income subject to tax and tax adjustments. Various deductions from income can be affected by factors related to spousal income, dependants such as children and age as well as other factors. In this way, the income tax paid by the household unit is a direct consequence of the incomes and income taxes of the individuals that make up the household. The childcare deduction and spousal credit information, for example, are included in the personal income tax form although their amounts usually have a small effect on the key income earner of a household. This paper assumes that the tax relationship between individuals and households and family structures over the projection period will differ minimally from that in 2000. Tax parameters such as tax rates, income tax brackets, capital gains inclusion rate, dividend gross-up rate, tax credits, etc. are set according to 2000 T1 tax system. To simplify the analysis, we assume that the tax parameters will remain constant over the period of 2001-2026. The tax projections of the model were not adjusted for the federal Five-Year Tax Reduction Plan announced in budget year 2000.<sup>19</sup> Furthermore, all of the growth in income and tax comes through real value growth at constant year 2000 dollars.

Table 4 gives the population parameters for the T1 Model. The parameters are age-sex specific population ratios for future years over the base year 2000 (base year = 100). By using these population parameters (or weights) and other tax parameters

---

<sup>19</sup> Department of Finance Canada (2000).

in year 2000 tax system, T1 model can project forward.

**Table 4. Population Parameters for T1 Model, 2000 to 2026**

	2000		2006		2011		2016		2021		2026	
	Male	Female										
Under20	100	100	97	97	94	93	91	90	91	91	92	92
20-24	100	100	104	104	108	108	109	109	98	98	94	95
25-29	100	100	105	104	108	107	111	111	112	112	102	101
30-34	100	100	97	96	101	100	104	103	107	106	108	107
35-39	100	100	86	86	85	84	88	88	91	90	93	92
40-44	100	100	103	102	91	90	90	88	93	91	96	94
45-49	100	100	115	114	117	114	104	102	102	100	106	103
50-54	100	100	115	116	129	129	131	129	117	115	115	113
55-59	100	100	133	133	149	149	167	166	170	166	152	148
60-64	100	100	125	126	160	160	179	179	202	199	205	199
65-69	100	100	107	108	131	131	168	167	189	187	213	208
70-74	100	100	106	101	114	109	141	133	181	169	205	190
75 and over	100	100	120	118	134	127	149	136	175	153	219	183

Source: Calculated from the medium-growth projection by Statistics Canada (2001).

The Conference Board of Canada predicted that Canada's economy would grow at an average of 2.6 per cent yearly between 2001 and 2020. Although Canadian Canada's economy might experience a slow-down during some of the next 20-30 years, it was expected to have an overall positive growth as a result of increasing in population and productivity. Productivity is a major factor to cause income change and affect income tax payable.<sup>20</sup> From 1991 to 2000, the average annual growth rate in labor productivity was 1.86%.<sup>21</sup>

<sup>20</sup> Department of the Treasury of Australia (2002).

<sup>21</sup> Statistics Canada (2002).

Personal income level almost certainly has an effect on income tax obligations. Figure 9 shows the trend of major income items<sup>22</sup> in T1 returns in the most recent 10 years (at year 2000 constant dollar). The values represent the average of the item based on the returns that reported the item.<sup>23</sup> The average annual income increases for the major income items during the period of 1991 to 2000 were: \$349 for employment income, \$673 for commissions, \$310 for other pensions, \$687 for net professional income, \$649 for net commission income, and \$409 for net fishing income.<sup>24</sup> Other income items had a relatively small per capita amount. The increases in each income item vary significantly but the growth rate of each income type has remained relatively stable. In addition, given the short span of projection, a straight line extrapolation method is used in this research paper to predict future income for major income items.<sup>25</sup> In other words, the simulation approach is a better approach only to the

---

<sup>22</sup> Total income in T1 tax returns includes 20 income items or categories such as employment income, commission, OAS, CPP, EI, RRSP, etc.

<sup>23</sup> Average in this case means the total amount of a specified type of income in a given year divided by the total number of T1 returns reporting that specific type of income.

<sup>24</sup> We use the slopes of regression lines to indicate the increases

<sup>25</sup> The relevant regression lines are as follows:

$$\text{Employment Income} = -667283 + 349.169 * \text{Year}$$

$$R^2 = 0.909 \quad F = 79.5 \quad (-8.538) \quad (8.915)$$

$$\text{Commissions} = -1322823 + 672.718 * \text{Year}$$

$$R^2 = 0.857 \quad F = 47.8 \quad (-6.816) \quad (6.917)$$

$$\text{Other pensions or superannuation} = -607172 + 310.744 * \text{Year}$$

$$R^2 = 0.974 \quad F = 303.0 \quad (-17.044) \quad (17.407)$$

$$\text{Net professional income} = -1326160 + 686.896 * \text{Year}$$

$$R^2 = 0.554 \quad F = 10.0 \quad (-3.052) \quad (3.155)$$

$$\text{Net business commission income} = -1280932 + 648.789 * \text{Year}$$

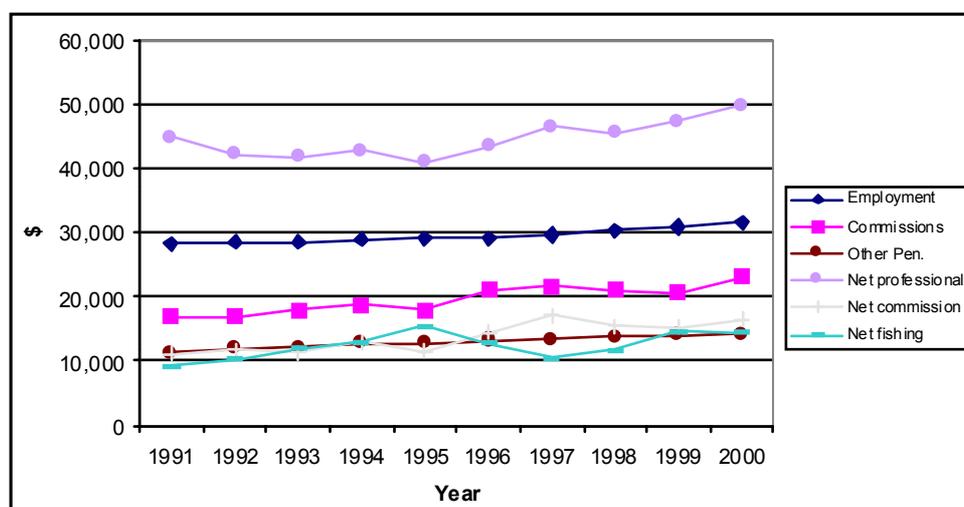
$$R^2 = 0.765 \quad F = 29.0 \quad (-5.049) \quad (5.103)$$

$$\text{Net fishing income} = -804315 + 409.261 * \text{Year}$$

$$R^2 = 0.365 \quad F = 5.0 \quad (-2.111) \quad (2.143)$$

*t* is in parenthesis. Other income items are considered as constant during the projection period, and the total personal income is the sum of all income items.

extent that it reveals far more details in the “becoming” of the taxable population.



Sources: Based on Canada Customs and Revenue Agency (2000-2002) and Revenue Canada (1993-2000?).

**Figure 9. Trend of Selected Income Items (average) Tax Years 1991 to 2000**

For the purpose of this study, we consider two different approaches to projecting income tax revenues into the future. The first approach is a demographic approach to estimate the sole effect of population ageing. In this approach, we assume that other socio-economic conditions related to personal income tax (such as income level, employment rate, employment structure, population geographic distribution, etc.) will remain constant at the year 2000 level over the period 2000 to 2026 and that only the structure of the population will change. The second approach is a demographic-income approach to estimate the combined effect of demographic change and real income level change. In this approach, we assume that not only the structure of the population will change but also the average of the selected major income items mentioned previously will change by following the historical trend indicated in

Figure 9. The future growth rates of each income item, which are needed as an input to the T1 model runs, are determined by the slopes of the historical regression lines and the number of years from the base year 2000 (see Table 5).

**Table 5. Percent Growth Rate of Income Items per Return Used as Input to the T1 Model Runs<sup>26</sup>, 2006 to 2026**

Income Items in T1 Return	2006	2011	2016	2021	2026
Employment income	5.01	10.54	16.07	21.60	27.13
Commissions	15.24	29.79	44.33	58.88	73.42
Other pensions or superannuation	13.88	24.81	35.75	46.68	57.62
Net professional income	3.91	10.81	17.71	24.60	31.50
Net business commission income	25.43	45.24	65.05	84.86	104.67
Net fishing income	15.72	29.93	44.14	58.35	72.56
Others	0.0	0.0	0.0	0.0	0.0

Note: Based on the slopes of the regression lines over the past ten years.

## VI. RESULTS OF THE INCOMES TAX SIMULATIONS

### 1. Demographic Approach

Table 6 summarizes the results of the income tax simulations under the demographic approach. The steady growth of Canadian total population in the next 26 years will bring the number of total returns to increase as well as the number of taxable returns. However, the growth rate of number of taxable returns will slow down significantly between 2021 and 2026. The proportion of taxable returns

<sup>26</sup> The percentage growth rates in this table were calculated for the 6, 11, 16, 21 and 26-year intervals from 2000 as a base year. The growth rates for each item are changing over the years and can be different from the historical growth rates. Although each individual had his or her own set of income items in 2000, the average rate of increase for each income item for each interval indicated in the table was applied to each individual.

among the total returns will decrease from 69.2% in 2000 to 68.4% in 2026.

The total income will continue to grow over the projection period, from \$696 billion in 2000 to \$796 billion in 2011, to \$883 billion in 2026. The reasons for these changes stem from the increase in the workforce population and the contribution from seniors' population. The increase will become much smaller during 2021-2026. The proportion of employment income will drop from 68% in 2000 to 65% in 2011, to 59% in 2026. The proportion of pension income will increase from 11% in 2000 to 13% in 2011, to 17% in 2026.

Total taxable income will increase from \$619 billion in 2000 to \$708 billion in 2011 to \$770 billion in 2021, but from 2021 to 2026 it will only increase by \$9 billion. The average taxable income will rise from \$29,914 in 2000 to \$30,189 in 2006, and then decline to \$30,178 in 2011 and \$29,791 in 2026. The average taxable income per return in 2026 will be \$123 less than it was in 2000.

Total non-refundable tax credits will climb from \$39.5 billion in 2000 to \$45.1 billion in 2011 and to \$51.6 billion in 2026, which represent increases of \$5.6 billion and \$12.1 billion respectively over year 2000. Of the increments, \$2.9 billion and \$11.3 billion will be contributed by the age amount tax credits that accounted for 52% and 93% of the total increments in 2011 and 2026 over 2000. The average non-refundable tax credits will increase from \$1,778 in 2000 to \$1,791 in 2011 to \$1,836 in 2026. Population ageing is the critical factor that causes the increase in the reported tax credit amounts.

The net federal tax will rise from \$90.9 billion in 2000 to \$104.2 billion in 2011 and to \$113.9 billion in 2026. The average net federal tax per taxable return will increase from \$5,906 in 2000 to \$5,974 in 2006 and to \$5,976 in 2011, then it will go

down to \$5,949 in 2016 and to \$5,922 in 2026. This result can be explained as a consequence of population ageing. Population structure change during 2000-2011 will not have a negative effect on federal income tax revenue, but after 2011, when population ageing becomes more and more severe, it will show some negative effects.<sup>27</sup>

**Table 6. Study Run Results of T1 Tax Model Demographic Approach, 2000 to 2026 (constant 2000 dollars)**

	2000 <sup>28</sup>	2006	2011	2016	2021	2026
Number of total returns (thousands)	22,237	23,868	25,171	26,389	27,669	28,119
Number of taxable returns (thousands)	15,394	16,555	17,440	18,228	19,068	19,226
Proportion of taxable returns (%)	69.2	69.4	69.3	69.1	68.9	68.4
Total income (billions \$)	695.6	754.3	796.1	832.1	873.1	882.5
Employment income (%)	67.5	66.3	64.8	62.8	61.2	58.9
Pension income (%)	10.9	11.6	12.6	14.0	15.1	16.8
Other sources (%)	12.0	12.4	12.8	13.4	13.8	14.6
Self-employment income (%)	5.3	5.3	5.3	5.2	5.1	5.0
Tax-exempt (%)	2.6	2.6	2.7	2.8	2.9	3.0
Other income (%)	1.7	1.7	1.8	1.8	1.8	1.8
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0
Average total income per return (\$)	32,332	32,631	32,628	32,500	32,500	32,281
Total taxable income (billions \$)	618.7	670.8	708.0	740.2	777.0	785.6
Average taxable income per return (\$)	29,914	30,189	30,178	30,043	30,022	29,791
Total non-refundable credits (billions \$)	39.5	42.6	45.1	47.5	50.3	51.6
Age amount credits (billions \$)	11.3	12.6	14.2	16.6	19.4	22.6
Other credits (billions \$)	28.2	30.0	30.9	30.9	30.8	29.0
Average non-refundable credits per return (\$)	1,778	1,785	1,791	1,803	1,818	1,836
Net federal tax (billions \$)	90.9	98.9	104.2	108.4	113.4	113.9
Average net federal tax per taxable return (\$)	5,906	5,974	5,976	5,949	5,948	5,922
Taxable income / Total income	0.89	0.89	0.89	0.89	0.89	0.89
Non-refundable credits / Taxable income	0.06	0.06	0.06	0.06	0.06	0.07
Net federal tax / Taxable income	0.15	0.15	0.15	0.15	0.15	0.14

<sup>27</sup> Here Year 2011 should be around 2011 (i.e. it could be a year before 2011 or after 2011), and the specific year cannot be identified here since we only have five-year population and income tax projection data from 2000 to 2026.

<sup>28</sup> The values for year 2000 are based on the T1 Model runs.

Tax yield is indicated by the three ratios shown in the last three rows of Table 6. In the case of the demographic approach, all three ratios show very little change over the period 2000 to 2021 and it shows the effect of population ageing on tax yield is also limited. But by year 2026, the increase in the ratio of non-refundable tax credits over taxable income (0.06 to 0.07) associated with an increasing senior population leads to a lower ratio for the net federal tax over taxable income, from 0.15 to 0.14. Therefore, if other things being equal, population ageing will have some effect on federal income tax system in 2026 when the number of senior population reaches the maximum and higher income working age population (aged 30-64) starts to decline.

## **2. Demographic-Income Approach**

Table 7 summarizes the results under the demographic-income approach. Compared with the demographic approach, there will be more taxable returns in the demographic-income approach. The proportion of number of taxable returns will be 71.7% in 2026, 3.3% higher than that in the demographic approach in the same year (68.4%) and 2.5% higher than that in the demographic-income approach in 2000 (69.2%).

The total income will reach \$867 billion in 2011 to \$1,073 billion in 2026, increases being 25% and 54% respectively over the year 2000 income. The introduction of the factor of wage rate change accounts for an additional \$71 billion and \$191 billion respectively in total income over the demographic approach. Similar to the demographic approach, the proportion of employment income will fall, and the proportion of pension income will rise during the period of 2000-2026.

With the income items growing over the 2001-2026 projection period, total taxable income will rise to \$778 billion in 2011 and \$975 billion in 2026, increases of \$70 billion and \$190 billion respectively over the demographic approach. The

average taxable income per return will increase to \$33,117 in 2011 and to \$36,918 in 2026, which represents an average annual increase of \$269 per return from 2000 to 2026.

**Table 7. Study Run Results of T1 Tax Model Demographic-Income Approach, 2000-2026 (constant 2000 dollars)**

	2000	2006	2011	2016	2021	2026
Number of total returns (thousands)	22,237	23,868	25,171	26,389	27,669	28,119
Number of taxable returns (thousands)	15,394	16,868	17,933	18,888	19,881	20,167
Proportion of taxable returns (%)	69.2	70.7	71.2	71.6	71.9	71.7
Total income (billions \$)	695.6	787.0	866.6	942.4	1,026.6	1,073.4
Employment income (%)	67.5	66.8	65.8	64.5	63.5	61.6
Pension income (%)	10.9	11.8	12.9	14.4	15.6	17.3
Other sources (%)	12.0	11.9	11.8	11.8	11.8	12.0
Self-employment income (%)	5.3	5.3	5.3	5.2	5.2	5.1
Tax-exempt (%)	2.6	2.5	2.5	2.5	2.4	2.5
Other income (%)	1.7	1.7	1.7	1.6	1.5	1.5
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0
Average total income per return (\$)	32,332	34,045	35,515	36,809	38,212	39,267
Total taxable income (billions \$)	618.7	703.4	778.2	849.9	929.5	975.2
Average taxable income per return (\$)	29,914	31,610	33,117	34,443	35,856	36,918
Total non-refundable credits (billions \$)	39.5	42.6	45.2	47.7	50.4	51.7
Age amount credits (billions \$)	11.3	12.4	13.7	15.9	18.3	21.1
Other credits (billions \$)	28.2	30.3	31.5	31.8	32.1	30.7
Average non-refundable credits per return (\$)	1,778	1,788	1,796	1,809	1,824	1,841
Net federal tax (billions \$)	90.9	106.8	121.5	135.8	151.8	162.0
Average net federal tax per taxable return (\$)	5,906	6,334	6,777	7,189	7,635	8,032
Taxable income / Total income	0.89	0.89	0.90	0.90	0.91	0.91
Non-refundable credits / Taxable income	0.06	0.06	0.06	0.06	0.05	0.05
Net federal tax / Taxable income	0.15	0.15	0.16	0.16	0.16	0.17

The total non-refundable tax credits show little difference from those in the demographic approach: \$45.2 billion in 2011 and \$51.7 billion in 2026. The age amount credit remains as the major contributor to the total non-refundable tax credits in the projection period.

An important observation is that the total net federal tax will continue to increase over the next 26 years from \$91 billion in year 2000 to \$122 billion in 2011 to \$162 billion in 2026. In terms of growth rates, the average annual compound growth rate over the period 2000 to 2011 will be 2.8%, which exceeds the average growth rate of 1.9% for the period 2011 to 2026. This indicates that the growth of total net federal tax will slow down over the latter part of the projection period. The average tax per taxable return will also continue to increase at its own average annual compound growth rate of 1.3% to \$6,777 in 2011 and at a rate of 1.1% over 2011 to 2026 to a level of \$8,032.

Under the demographic-income approach, which allows for changes in income, the three tax yield ratios show some changes. By year 2026 the ratio of taxable income to total income will increase from 0.89 to 0.91 or the ratio of deduction to total income will reduce by 2 percentage points. The ratio of non-refundable tax credits will decrease by 0.01 to 0.05 and the ratio of the net federal tax will increase over from 0.15 in year 2000 to 0.17 in year 2026.

## VII. CONCLUSION

Canadian ageing will be a significant factor in the next 20 to 30 years. The proportion of the population aged 65 and over of the total population will reach about 15% in 2011 and 21% in 2026. The Canadian population will age faster than other North American countries. According to CCRA 2000 personal income tax information,

personal income tax is related to age and changes by age. On average, the seniors' population has historically had pension income as their major source of income and has had less taxable income and paid less tax than persons aged 30-64, who make up the vast majority of the workforce. Therefore, population ageing will have some impacts on personal income tax revenue.

The micro-simulation tax projections carried out under the demographic approach suggest that population ageing will cause average taxable income to decrease and non-refundable tax credits will rise significantly from 2011. Although the total personal income tax will not decrease over the whole projection period, 2000 to 2026, the growth is projected to be very slow. Furthermore, the average federal net tax per taxable return will start to decline within the period 2011 to 2026. Projections under the demographic-income approach suggest that the total and average taxable income and federal income tax will continue to increase over 2001 to 2026. However, the average annual compound growth rate will be slower over the latter part of the projection period, i.e., from 2011 to 2026.

The overall effect of population ageing on personal income tax relates not only to the proportion of the senior population but also to the proportion of the working age population. During the years 2000 to 2011, not only will the proportion of the senior population increase, but also the proportion of the working age population will experience an increase with the result that the average federal income tax per return will actually rise slightly. From year 2011 when the proportion of the senior population starts to increase rapidly and the proportion of the working age population starts to drop, Canadian population ageing will have a negative effect on federal personal income tax revenue. However, the population ageing may not have a severe impact on personal income tax because the expected personal income increase, which was realized in the past, will have a positive effect on income tax revenue in the future.

Overall, the growth of the concentration of seniors in our population over time could lead to a slower growth rate in federal income tax revenues over the next 26 years, especially after 2011. However, based on the projections mentioned previously, it will not reduce the number of taxable returns and the total personal income tax revenue because there will be the growth of the total population and an increase in the total personal income in real terms.

## REFERENCES

- Anderson, J. M. 2001. *Models for Retirement Policy Analysis*. Report to the Society of Actuaries, <http://www.soa.org/research/macrodemographic/Macrodemographic.html>
- Canada Customs and Revenue Agency. 2000-2002. *Income Statistics 2000-2002*. Ottawa: CCRA.
- Canada Customs and Revenue Agency. 2002. *Income Statistics 2002-2000 Tax Year*. <http://www.ccr-aadrc.gc.ca/tax/individuals/stats/gb00/pst/interim/universe-e.html>.
- Citro, C. F. and E. A. Hanushek (eds.) 1991. *The Uses of Microsimulation Modelling, (vol. 1): Review and Recommendations*. Washington, D.C: National Academy Press.
- Corak, M. (ed.) 1998. *Government Finances and Generational Equity* (Cat. No. 68-513-XIB). Ottawa: Statistics Canada.
- Denton, F. T. and B. G. Spencer. 1999. "Population Aging and Its Economic Costs: A Survey of the Issues and Evidence." *Social and Economic Dimensions of an Aging Population Research Papers*, McMaster University.
- Department of Finance Canada. 2000. *Budget 2000: Five-Year Tax Reduction Plan*. Ottawa: Finance Canada.
- Department of the Treasury of Australia. 2002. "Intergenerational Report 2002-03." *2002-03 Budget Paper, No.5*. Canberra.
- Fougere, M. and M. Merette. 1998. "Population Ageing and Economic Growth in Seven OECD Countries." *Department of Finance Working Paper*. Ottawa: Department of Finance.
- Group of Ten. 1998. "The Macroeconomic and Financial Implications of Ageing Populations." *Bank for International Settlements*. <http://www.bis.org/publ/gten04.htm>
- Harding, A. (ed.) 1996. *Microsimulation and Public Policy, North Holland*. Contributions to Economic Analysis 232. Amsterdam
- Health Canada. 2002. *Canada's Aging Population*. Ottawa: PWGSC.
- Jackson, H. and C. Matier. 2002. "Public Finance Implications of Population Ageing: An Update." *Department of Finance Working Paper*. Ottawa: Department of Finance.
- King, P. and H. Jackson. 2000. "Public Finance Implications of Population Ageing."

- Department of Finance Working Paper*. Ottawa: Department of Finance.
- Merette, M. 2002. "The Bright Side: A Positive View on the Economics of Ageing." *Choices Economic Growth*, Vol.8, No. 1, Montreal: IRPP.
- Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2003. *World Population Prospects, The 2002 Revision and World Urbanization Prospects: The 2001 Revision*. <http://esa.un.org/unpp>.
- Robson, W. B. P. 2003. "Time and Money: The Fiscal Impact of Demographic Change in Canada." *Commentary*, No.185. Toronto: C. D. Howe Institute.
- Revenue Canada. 1983-1999. *Taxation Statistics 1983-1999*. Ottawa: Revenue Canada.
- Statistics Canada. 2001. *Population Projections for Canada, Provinces, and Territories 2000-2026* (Catalogue No. 91-520). Ottawa: Statistics Canada.
- \_\_\_\_\_. 2002. *CANSIM II* (tables 383-0001 and 383-0005). Ottawa: Statistics Canada.
- The Conference Board of Canada (2003), *Canadian Outlook Long-Term economic Forecast: 2003*, Conference Board of Canada, Ottawa.
- United States Government Printing Office. 1997. *Economic Report of the President 1997*. Washington, D.C.