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## **Population Ageing in Canada and Labour Market Challenges\***

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### **Summary**

Population ageing will be an inevitable and significant feature of the economic landscape in North America and in other major industrialised countries during the course of the 21<sup>st</sup> century. This paper provides some recent efforts made into investigating the effects of ageing on the Canadian economy and labour markets. First, the paper shows that although the rising proportion of the older workforce will generate pressures on the labour market, recent improvement in the participation rate of older workers and higher possibility of returning to the labour market, could have significant positive effects on the labour market. Second, model-based analysis suggests that the negative impact of population ageing on productive capacity could be large, but selecting more skilled immigrants, promoting later retirement and encouraging younger cohorts to invest more in human capital could mitigate the impact of ageing. Finally, it is argued that future research should put a greater emphasis on the role of globalization. A summary of several theoretical studies shows that the economic performances of an ageing economy could be reversed when different scenarios of international trade and international mobility are assumed.

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\*The views expressed in this document are solely those of the authors and do not necessarily reflect the views of Human Resources and Social Development Canada.

## 1. Introduction

It is well known that population ageing will be an inevitable and significant feature of the economic landscape in North America and in other major industrialised countries during the course of the 21<sup>st</sup> century. Population ageing is explained by a combination of demographic factors: rising life expectancy, declining fertility rates and in specific regions, emigration of young people and/or immigration of older people. Among the North American countries, Canada's population currently has the lowest fertility rate and is expected to age faster than the U.S. population. According to United Nations (UN) demographic projections (UN Population Division, 2005), the proportion of the Canadian (U.S.) population 65+ is projected to rise from 12.5% (12.3%) in 2000 to 26% (20.6%) in 2050. In contrast, the Mexican population is currently much younger than the Canadian and U.S. populations, since the population 65+ only represented 4.8% of the population in 2000. However, according to the UN, the proportion of the older Mexican population is projected to increase more rapidly over the next several decades and reach 21% of the population by 2050. For Mexico, the net emigration of young people is a key factor explaining the ageing of their population.

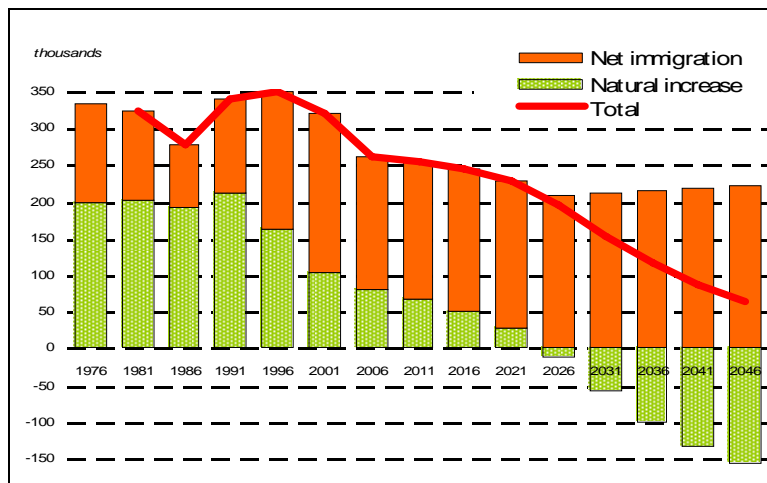
Also although by 2050, Canada is projected to have a higher proportion of older people than its North American counterparts, Canada's ageing process will not be as rapid as in Japan, by far the fastest ageing country, with the proportion of its population 65+ projected to reach 36% in 2050. Finally, the rising proportion of the older population in Europe is projected to look roughly similar to Canada, with its population 65+ rising from 14.7% of the total population in 2000 to 27.6% in 2050.

We can think of two ways in which the population is ageing. The first is that the proportion of the retired population is growing rapidly relative to the working-age population (the dependency ratio). This aspect of ageing has implications for the actuarial fairness of social security systems. The second aspect of ageing is the rise in the average age of the Canadian workforce and the relative scarcity of workers. One of the major challenges associated with workforce ageing is the reduction in the growth of the labour force or labour supply, which in turn may affect changes in living standards.

Chart 1.1 shows that the natural increase in the population of Canada has declined substantially since the 1990s. The natural increase, which was around 200 000 thousands in

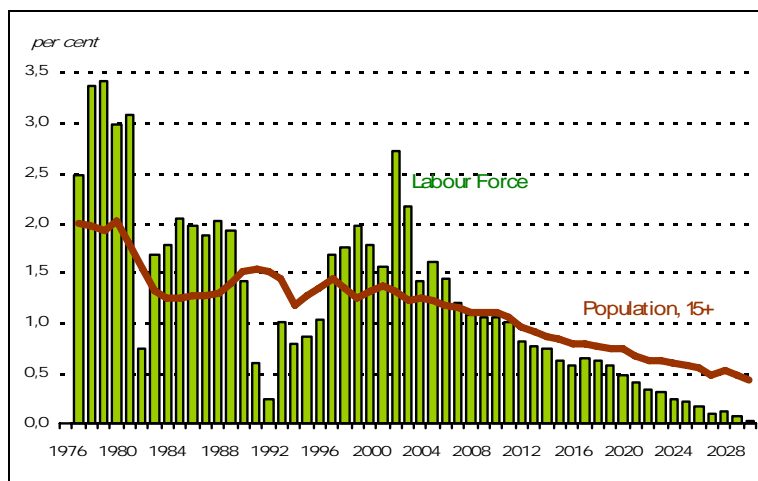
1976, is predicted to reach only 75 000 in 2006 and to continue to decline so that the natural increase will turn negative in 2026. After 2026, immigration will be the only contributing factor to Canada's population growth. Turning to labour force growth, Chart 1.2 shows that the growth rate of the population 15+ has been declining since 2000 and will continue to decline over the next decades. Consequently, total labour force growth rate is expected to reach zero by 2030.

**Chart 1.1**  
**Population Growth in Canada, 1976-2045**



Source: Human Resources and Social Development Canada

**Chart 1.2**  
**Growth in the Labour Force**



Source: Human Resources and Social Development Canada

The remainder of this text is divided as follows. Section 2 presents some stylised fact to illustrate the labour market challenges of older workers in Canada. Section 3 presents an exhaustive model-based analysis of the economic and labour market implications of population ageing in Canada. Section 4 extends this analysis by discussing the possible implication of population ageing when we account for international trade and the international mobility of labour in the analysis. Finally, Section 5 concludes.

## **2. Older Workers and Labour Market Challenges**

The rising proportion of older workers due to population ageing can influence labour market pressures in two ways. First, assuming that retirement decisions do not change, retirement rates will rise as older cohorts of baby boomers reach retirement age. This in turn will reduce aggregate labour supply, exert rising pressures on the labour market and increase the cost of labour. In addition, if labour market adjustments are too slow in certain industries and occupations to accommodate rising replacement demand, labour and skill shortages may occur. Second, since older workers will represent a greater share of the workforce over the next decades, changes in retirement behaviour will have a larger impact on aggregate labour supply. For example, a continued trend towards early retirement would exacerbate the impact of population ageing on the labour market and the economy. If, on the other hand, older workers do not imitate their predecessors and instead decide to work longer, this may significantly mitigate the effects of ageing.

In this section, we look at recent trends in retirement and labour force participation of older workers and examine the degree of labour market pressures that the ageing Canadian population may exert on the labour market.

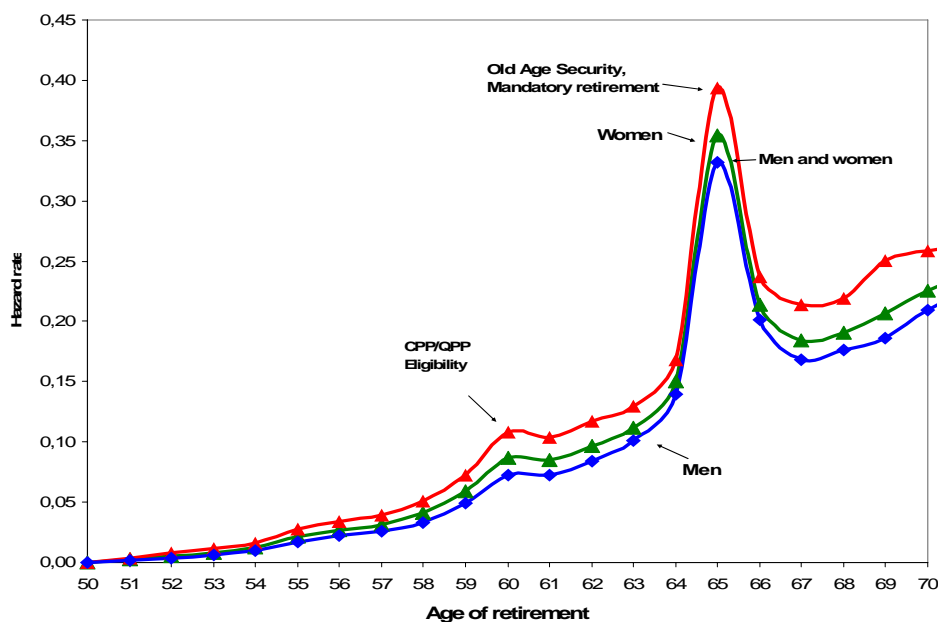
### *2.1 Effective Retirement Age*

The transition towards retirement can occur in many different ways and at different ages. Some individuals exit the labour market from a long-term job and retire permanently. Others retire more gradually, first moving from full-time to part-time employment and eventually fully retiring. Some experience a spell of unemployment or leave the labour market because of illness and never return.

To help illustrate the work-to-retirement transition, Chart 2.1 displays hazard rates of retirement per age for men and women for the period 1993 to 2001 in Canada, using

information from the Longitudinal Administrative Database.<sup>1</sup> As can be seen, the retirement hazard or risk of retirement in Canada rises gradually after age 50 and reaches two peaks. The first is at age 60 at near 9% (7% for females and 10.8% for males), when individuals become eligible to early Canada and Quebec Pension Plan (CPP/QPP) benefits and to the Spousal Allowance. After age 60, the hazard rate increases smoothly until age 65, where it reaches 35% (33% for males and 38% for females), when workers are eligible to Old Age Security/Guaranteed Income Supplement (OAS/GIS) and subject to mandatory retirement in certain provinces.

**Chart 2.1**  
**Hazard Rates of Retiring for Older Workers (Men and Women)**  
**from 1993 to 2001, by Age of Retirement**



Source: Léonard and Rainville (2006)

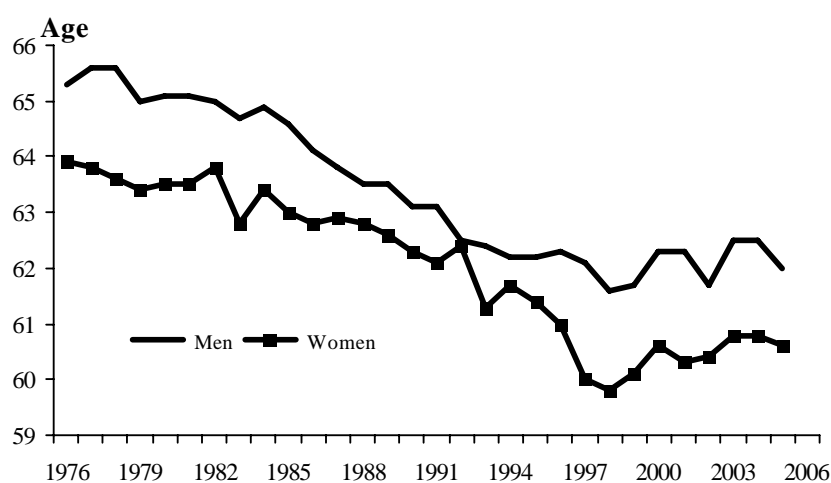
Over the past decades, despite a substantial increase in longevity, the trend in early retirement has become widespread in Canada. According to Statistics Canada, the average age of retirement has declined steadily in Canada over the period 1976 to 1998 for both men and women, from around 65 for men and 64 for women during the second half of the 1970s to 61.5 years for men and 60 for women in the late 1990s (see Chart 2.2). However, since 1998, the trend in retirement seems to have halted. In fact, from the bottom level observed in 1998,

<sup>1</sup> This chart is based on calculations made by Léonard and Rainville (2006) using Kaplan-Meier's methodology.

the average retirement age has tended to increase somewhat, ranging between 62 and 62.5 in 2003-2005 for men and around 61 for women.

The decline in the effective retirement age during the late 1970s and 1980s can in part be explained by reforms to the Canadian Income Security programs as well as by cyclical downturns. The Spousal Allowance (SA) program was introduced in 1975. The SA was designed to bridge certain individuals who are not yet eligible to receive the OAS and GIS.<sup>2</sup> The SA is paid to 60-64 year old spouses of OAS recipients, widows and widowers. According to Baker (2002), the introduction of the SA would have reduced the labour force participation of older men in eligible couples by 6 to 7 percentage points.

**Chart 2.2**  
**Average Age of Retirement by Sex, 1976-2005**



Source: Labour Force Survey, Statistics Canada

The continued drop in the effective retirement age during the first half of the 1980s could in part be explained by the effect of the 1981-1982 recession. Rising unemployment during that period provided incentives for older unemployed workers to exit the labour market. Another institutional factor, which likely played a role, is the introduction of the early retirement provision in the QPP in 1984 and in the CPP in 1987.<sup>3</sup> Baker and Benjamin (1999)

<sup>2</sup> OAS is a transfer provided to all individuals aged 65 and over who meet basic residency requirement. The benefit is clawed back at high income levels. The GIS is an additional income-tested benefit available to low-income individuals aged 65 and over.

<sup>3</sup> The Canada and Quebec Pension Plans (CPP/QPP) provide earnings-based pensions funded through payroll taxes paid by both employers and employees. The normal uptake age for the CPP/QPP is 65. Since 1984 in Quebec and 1987 in the Rest of Canada, individuals may apply for early benefits starting at age 60, subject to an actuarial reduction of 0.5% for the number of months until the individual's 65<sup>th</sup> birthday (6% per year).

have examined the introduction of early retirement provisions in Canada's Public Pension Plans. They found that reforms led to an increase in pension receipt, but had little immediate effect of labour market behaviour due to the fact that men who initially took advantage of early retirement provisions had limited labour market attachment.

Canada was hit by another major recession in 1990-1991, followed by a slow recovery. During the first half of the 1990s, the Canadian unemployment rate averaged more than 10%, compared to 7.5% in 1989, thus contributing to reduce the overall participation rate and possibly leading to involuntary retirement. Finally, the significant drop in the retirement age which occurred during the second half of the 1990s is likely explained by the effect of cutbacks in the public sector and by the restructuring and downsizing in the public sector. In fact, according to Kieran (2001), government downsizing during the mid-1990s encouraged many public servants to take early retirement packages and leave the labour market. Fortin and Fortin (2004) also argue that the elimination of government deficits during the 1990s contributed to the reduction in the effective retirement age.

## *2.2 The Proportion of Canadian Workers near Retirement*

The near-retirement rate (NRR) measures the percentage of workers who are within 10 years of the median retirement age.<sup>4</sup> It is a useful indicator to help project potential labour market pressures due to an older workforce. The NRR is influenced by two factors, the median age of retirement and the age distribution of the workforce. The NRR can be applied to an industry, an occupation, a region or simply to the whole economy. An increase in the median retirement age reduces the NRR, while a rise in the proportion of workers within 10 years of the median retirement age raises the NRR.

As can be shown in Chart 2.3, the NRR has increased continuously over the past 18 years. From 11.4% in 1987, the NRR has reached 22.1% in 2005. Between, 1987 and 1998, the rise in the NRR is due to both a reduction in the median retirement age and an increase in the proportion of older workers. After 1998, the median retirement age has stabilized or risen somewhat, thus contributing to a reduction in the NRR. However, despite this, workforce ageing has remained a dominating factor, leading to a continued increase in the NRR.

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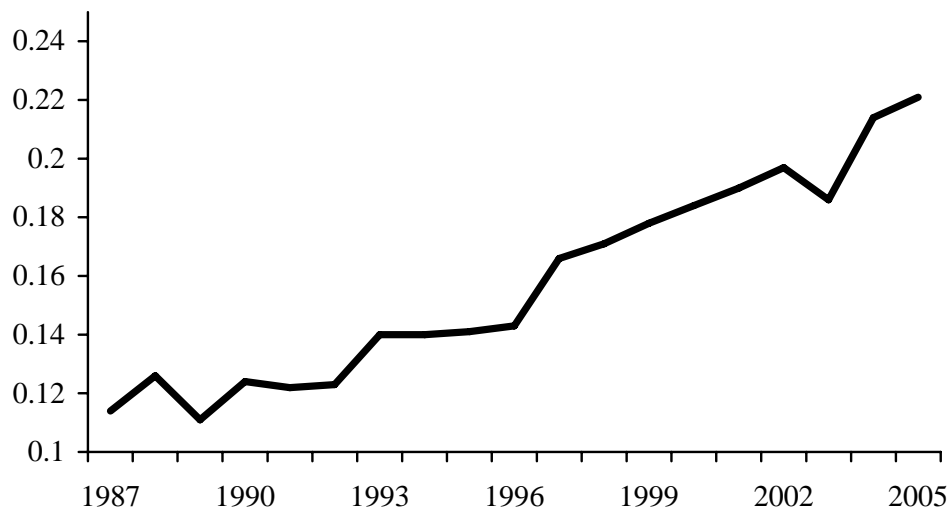
Conversely, individuals who delay receiving CPP/QPP benefits after age 65 are entitled to a 0.5% per month actuarial increase.

<sup>4</sup> For more information on the NRR, see Pold (2004).

Over the next decades, it is evident that the rising proportion of older workers will continue to exert upward pressures on the NRR. What is less certain, however, is how retirement behaviours will evolve in the future. A gradual increase in the median retirement age, for example, might mitigate labour market pressures by smoothing the rise in the NRR.

**Chart 2.3**  
**The Near Retirement Rate, 1987-2005**

**% Within 10 years of median retirement age**



Source: Labour Force Survey, Statistics Canada

Note: The near retirement rate is defined as the % of the workforce within 10 years of the median retirement age.

**Table 2.1**  
**Median Retirement Age and % of Workforce Near Retirement, by Occupation**

	Near-Retirement Rate (%)*			Median Retirement Age (Years)	
	1987	2005	Diff.	1987	2005
<b>Total, Occupation</b>	<b>11.4</b>	<b>22.1</b>	<b>10.7</b>	<b>64.3</b>	<b>61.0</b>
Management	15.4	29.0	13.6	63.1	61.4
Business, Finance and Administrative	9.9	20.7	10.8	63.8	61.9
Natural and Applied Sciences	11.6	16.9	5.2	60.8	61.2
Health	8.9	27.0	18.1	64.9	60.2
Social Science, Education, Government Services and Religion (SSEGR)	12.5	28.9	16.4	60.6	59.1
Art, Culture and Recreation	10.6	14.7	4.1	64.1	62.7
Sales and Service	11.2	16.6	5.4	63.7	62.5
Trades, Transport and Equipment Operators	13.0	20.7	7.7	63.2	61.7
Occupations Unique to Primary Industries	20.7	18.2	-2.5	65.0	67.0
Occupations Unique to production	10.5	18.1	7.6	64.2	61.8

Source: Labour Force Survey, Statistics Canada

Note: The near retirement rate is defined as the % of the workforce within 10 years of the median retirement age.

Table 2.1 presents the NRR and the median retirement age by large occupational group for the period 1987 and 2005. As shown in the table, with the exception of occupations unique to primary industries, the NRR has risen in all occupational groups between 1987 and 2005. Also among occupational groups, Health (+18.1%), SSEGSR (+16.4), management occupations (13.6) and Business, Finance and Administrative Services (10.8%) lead the upward trend in the NRR. Assuming that expansion demand remains the same across occupations, this suggests that population ageing will exert stronger labour market pressures in these occupations, unless future school leavers and new immigrants choose these occupations in greater proportion with the anticipation of faster wage growth in the future.

It is also interesting to note that for each of these 4 occupational groups, the median retirement age has come down significantly over the past 18 years, thus strongly contributing to the rise in the NRR. By contrast, the median retirement age has risen in Natural and Applied Sciences and in Primary Industry occupations, mitigating a rise in the NRR. Finally, the NRR has increased in all remaining occupational groups, but at a more moderate pace than the median for all occupations.

**Table 2.2**  
**Median Retirement Age and % of Workforce Near Retirement, by Province**

	Near-Retirement Rate (%)*			Median Retirement Age (Years)	
	1987	2002	Diff.	1987	2002
<b>Canada</b>	<b>11.4</b>	<b>19.8</b>	<b>8.4</b>	<b>64.3</b>	<b>60.6</b>
Newfoundland and Labrador (NFL)	9.6	21.6	12.0	63.3	59.6
Prince Edward Island (PEI)	10.0	24.9	14.9	65.7	59.4
Nova Scotia (NS)	10.2	21.6	11.4	63.7	59.8
New Brunswick (NB)	9.2	20.9	11.7	64.6	59.6
Quebec	10.4	21.6	11.2	64.0	59.8
Ontario	10.8	19.6	8.8	64.7	60.8
Manitoba	11.5	20.3	8.8	64.6	61.2
Saskatchewan	15.3	13.8	-1.5	64.1	65.1
Alberta	11.4	15.0	3.6	63.1	63.4
British Columbia	11.3	23.6	12.3	64.3	60.3

Source Labour Force Survey, Statistics Canada

Note: The near retirement rate is defined as the % of the workforce within 10 years of the median retirement age.

Finally, when we look at the retirement pattern by province, we can see that regional differences in demographics and retirement behaviour also influence provincial labour market

pressures at a different pace. According to Table 2.2, the Atlantic provinces (NFL, PEI, NS, NB), Quebec and British Columbia have led the reduction in the retirement trend in Canada, between 1987 and 2002, while in Saskatchewan and Alberta, the median retirement age has risen. Ontario and Manitoba are in between. These early retirement trends had a dominating impact on the NRR as the former provinces experienced the largest increase in the NRR between 1987 and 2002. At the opposite, the NRR declined somewhat in Saskatchewan and increased at a moderate pace in Alberta.

### *2.3 Labour Force Participation of Older Workers*

As indicated earlier, the rise in the proportion of older workers is inevitable and will generate upward pressures on the labour market. Future retirement trends will also have a strong influence on labour market pressures, but there is uncertainty about whether older workers will be inclined to work longer during this demographic transition, to compensate for the relative scarcity of younger workers.

Measures of effective retirement age (average and median) suggest that the decline in early retirement trend has halted since 1998, but there is no strong indication yet from this measure that the trend is reversing. It must be noted, however, that since there is no standard definition of retirement, the measure of effective age of retirement constructed by Statistics Canada must be interpreted with some care. Retirement can be defined as a reduction in hours worked, or the receipt of a pension or as a complete withdrawal from the labour market. We must also distinguish between permanent and temporary retirement. For example, there is evidence showing that a significant proportion of retirees eventually return to the labour market after exiting it.<sup>5</sup>

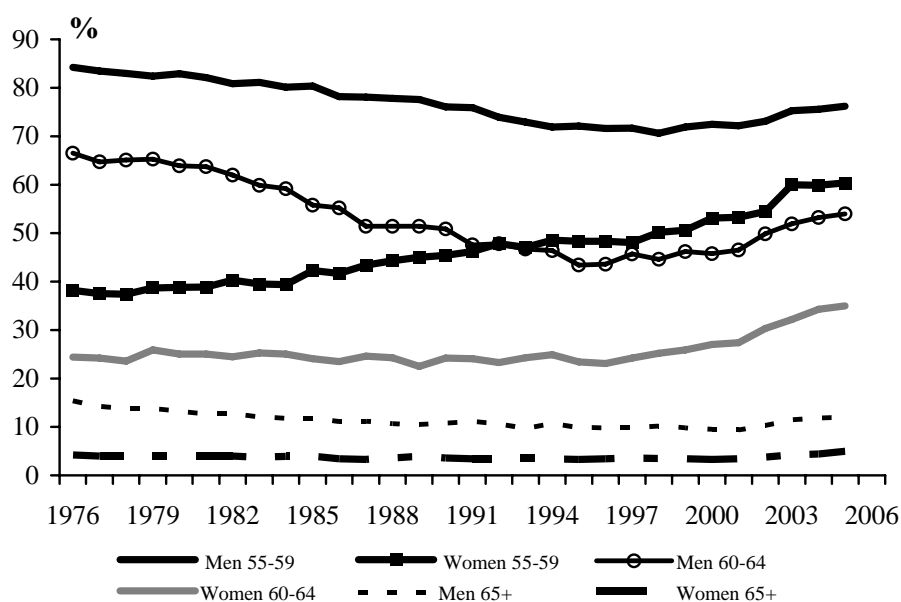
The median and average age of retirement is at best a proxy indicator of retirement behaviour. The measure reflects only those whose initial motivation for job separation was retirement. It does not account for workers who left the labour market because of an illness or a layoff and who never return. Moreover, it does not account for retirees who eventually return to the labour market. For these reasons, it is important to examine alternative measures, such as the labour force participation rate.

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<sup>5</sup> See for example, Léonard and Rainville (2006).

When we look at the participation rate of older workers (see Chart 2.3), we see that since the 1970s, the reduction in the participation rate is evident among older men, but not for women. Indeed, between 1976 and 1998, the participation rate of men 55-59 has fallen from 84.2% in 1976 to 70.6% in 1998, while the participation rate of men 60-64 has declined even more, from 66.5% to 44.6%. Since 1998, the participation rate of men 55-59 and 60-64 has increased, reaching 76.2% and 54%, respectively, in 2005. By contrast, the participation rate of women aged 55-59 has increased continuously during the past 30 years, while the participation rate of women aged 60-64 has remained virtually flat between 1976 and 1998 and increased since 1997. Therefore, the participation rate numbers not only suggest that early retirement trends have halted in 1998, but also that the participation rate of older workers has increased since.

**Chart 2.3**  
**Labour Force Participation Rate of Older Workers, by Gender, 1976-2005**

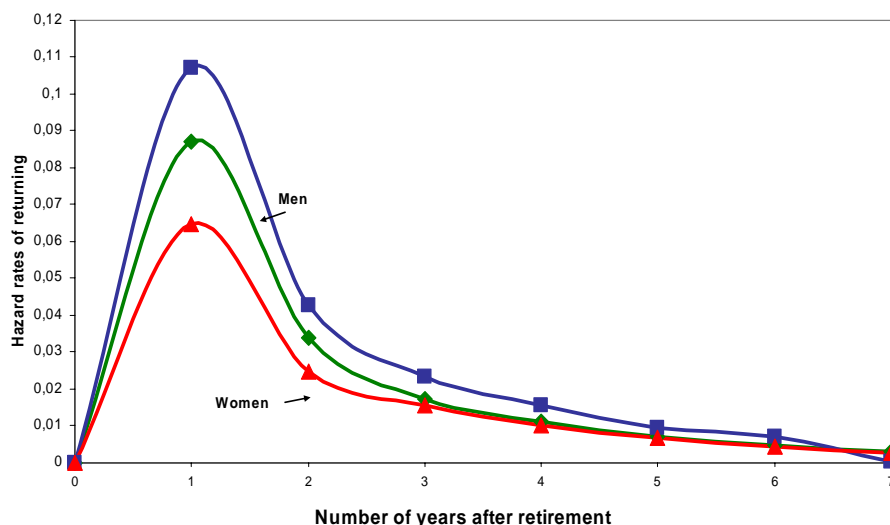


#### 2.4 Temporary Retirement and Later Return to the Workforce

Older workers enter retirement in different ways and there is evidence that a significant proportion of retirees eventually return to the labour market. Pyper and Giles (2002) have examined this issue using the Survey of Labour Income Dynamic (SLID) and found that 30% of older workers who ended a full-time job voluntarily between 1993 and 1997 began a new job within 24 months. However, the SLID has a small sample size problem when it comes to older workers.

To avoid the small sample size problem and to enhance the data accuracy, Léonard and Rainville (2006) have used the LAD to determine the number of temporary retirement, or how many retirees return to the labour market.<sup>6</sup> Looking at the longitudinal sample from 1995 to 2002, they found that 18% of retirees returned to the labour market. The analysis also shows that men are more likely to return (21.7%) than women (13.7%).

**Chart 2.4**  
**Hazard rates of returning by number of years after retirement**



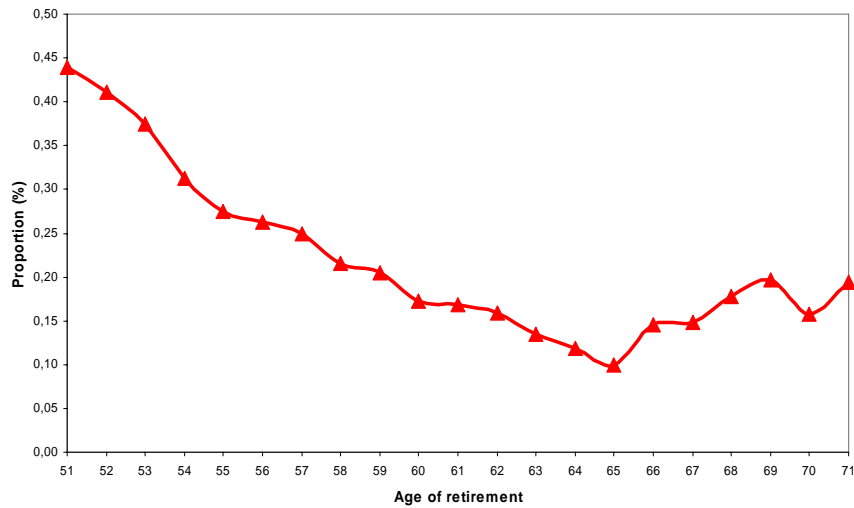
Source: Léonard and Rainville (2006)

As shown in Chart 2.4, almost half of labour market returns would occur one year after retirement. During the first year, there are almost twice as more males retirees (10.7%) who return to the labour market than women retirees (6.5%). After one year, the probability of returning to the labour market diminishes sharply, falling to 4.3% and 2.5% in the second year for men and women, respectively and further down thereafter.

Also, not surprisingly, retirees are more likely to return to the labour market when they are relatively young. Chart 2.5 shows that 44% of individuals who retire at age 51 eventually return to the labour market, compared to only 10% of individuals who retire at age 65. Another interesting phenomenon, after age 65, the proportion of retirees who return to the labour market increases relative to age 65.

<sup>6</sup> The authors use a longitudinal sample size of 10% of everyone who filled out an income tax return in a given year.

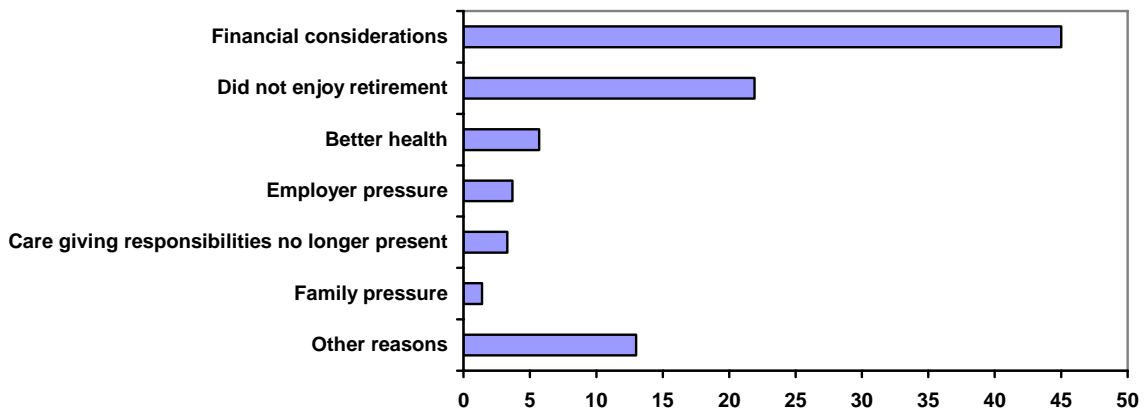
**Chart 2.5**  
**Proportion of retirees returning to the labour market, by age of retirement**



Source: Léonard and Rainville (2006)

Finally, to better understand the reasons for post-retirement behaviour, the 2002 General Social Survey (GSS) asked retirees who returned to the labour market why they did so. The survey indicates that financial consideration is the reason most frequently mentioned (45%), although non-financial factors are also important. It is also interesting to note that among those who mentioned financial motive as a reason to re-enter the labour market, 54% of them had previously left the labour market involuntarily. Among the non-financial factors, it appears that a significant proportion (22%) returned to the labour market because they did not enjoy retirement. Those who returned to the labour market because of improved health conditions represent only near 6%.

**Chart 2.6**  
**Reasons for Returning to the Labour Market**



Source: General Social Survey, 2000

All of these results suggest that we must be careful on how to interpret retirement rate data, since it appears that older individuals remain a potential source of labour, even after retirement. This phenomenon might also become more popular in the future, given that employers will need to adjust their human resources strategy to allow a greater share of older individuals in their workforce. Retirees are also increasingly healthy, they have experience and are better educated. They remain an attractive option for employers who will be facing stronger labour market pressures in the future. Hopefully market forces will override implicit barriers such as ageism (Lagacé and Tougas, 2006) and facilitate the adjustment process during the demographic transition.

### **3. An Economic Analysis of Population Ageing with Life-Cycle General Equilibrium Models**

Although population ageing is one of the most anticipated structural shocks that will affect the economy and the labour market, evaluating its outcome is a highly complex task. First, the full demographic transition is long and very gradual. Second, the macroeconomic effects are numerous, combining changes in labour supply, labour productivity, national savings, investment and international capital flow movements. Third, the fiscal impact of population ageing also matters and interacts with the macroeconomic effects. Fourth, both the macroeconomic and fiscal effects will influence production factor returns, such as the return to work, the return to physical and human capital, consumer and producer prices, the terms of trade and real world interest rates.

Given the complexity of demographic, fiscal and economic channels, the use of large-scale economic models is needed to disentangle and capture the economic interaction, with the appropriate theoretical structure. Dynamic life-cycle (overlapping-generations) general equilibrium (GE) models are well suited given that its basic structure allows to model agent's behaviour over their lifetime.<sup>7</sup> In this Section, we will discuss the results from various simulation experiments for Canada using this modelling framework.

#### *3.1 Methodological Issues*

Based on the tradition of models established by Diamond (1965) and Auerbach and Kotlikoff (1987), the dynamic general equilibrium models used for the analysis have all an

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<sup>7</sup> See, for example, Ferh *et al.* (2005), Fougère *et al.* (2004), Börsch-Supan *et al.* (2001), Équipe Ingénue (2001), Auerbach and Kotlikoff (1987), etc.

overlapping generations (OLG) structure of the Allais-Samuelson type calibrated on the Canadian economy. Economic agents (household and firms) are forward-looking. Government spending, transfers and pensions are included. National and regional governments collect taxes on labour and capital income. The models are calibrated on the Canadian economy. Depending of the version of the models we refer to, regional, heterogeneity of labour, immigration status, are considered.

### *3.2 Impact of Population Ageing on the Productive Capacity of the Canadian Economy*

In this sub-section, we discuss the economic results of a baseline scenario, with very standard demographic assumptions concerning the total fertility rate, life-expectancy, immigration assumption, etc. Please note that the simulation result presented here attempts to isolate the pure effect of ageing by showing the difference between a scenario with population ageing and with no population ageing.

The effect of population ageing on productive capacity works through several key channels. The first channel is the change in effective units of labour, which combines the impact of population ageing on the labour force participation and the quality of the workforce.<sup>8</sup> As workers age and the baby boom generation gradually transits towards retirement, the decline in the relative size of the economically active population reduces the total labour force participation and contributes negatively to real per-capita GDP relative to a situation with no population ageing.

However, during the period preceding retirement of the baby boom generation, labour productivity may arise due to an increase in the proportion of experienced workers. In addition, more recent cohorts are better educated, thus raising the proportion of skilled workers. Therefore, a more experienced and educated labour force raises the quality of the workforce, thus providing some compensating effects to the reduction in the participation rate. According to our model results, despite the increase in the quality of labour, total effective labour supply, which combines both quantity and quality of labour, is expected to fall sharply over the next several decades (see Table 3.21).

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<sup>8</sup> Effective units of labour is an indicator which combines both the number of workers and its quality (experience and skills).

<b>Table 3.21</b>								
<b>Simulated Economic Impact of Population Ageing in Canada</b>								
(per cent deviations with respect to initial steady state of no population ageing)								
	<b>2006</b>	<b>2014</b>	<b>2018</b>	<b>2026</b>	<b>2034</b>	<b>2038</b>	<b>2042</b>	<b>2050</b>
<b>Real GDP per Capita</b>	0.5	0.8	0.7	-0.3	-2.5	-4.0	-5.9	-10.5
<b>Effective labour</b>	1.9	2.3	0.6	-5.9	-15.8	-21.3	-26.8	-41.1
<b>Physical capital</b>	4.0	9.3	10.3	8.4	1.8	-3.2	-9.2	-24.3
<b>Capital-labour ratio</b>	2.1	6.9	9.6	15.3	20.9	23.0	24.1	20.1
<b>Real wage rate</b>	0.8	2.7	3.7	5.8	8.2	9.3	10.2	10.2
<b>Rental rate of capital</b>	0.8	2.7	3.7	5.8	8.2	9.3	10.2	10.2

Another factor leading to the fall in real GDP is the negative impact of ageing on national savings and investment. According to the life-cycle theory, households save during their working life, accumulating wealth for future retirement and living out of their wealth during retirement. Accordingly, the rise in the proportion of older people reduces aggregate private savings.

Population ageing also affects production factor returns. The negative labour supply shock leads to increased labour market pressures and to an increase in real wages. In addition, the more rapid decline in effective labour makes more physical capital available per unit of labour. This reduces the need for firms to invest and leads to an increase in physical capital intensity and a reduction in the rental rate of capital. The rise in physical capital intensity is amplified by the fact that labour becomes more expansive, while physical capital cheaper, encouraging them to substitute away from labour into physical capital.

### *3.3 What about the regional impact of population ageing?*

What the data shown in Table 3.21 do not illustrate is the fact that the pace of projected demographic changes in Canada will be very asymmetric across regions. For example, the Atlantic region and in particular the province of Newfoundland currently has one of the lowest fertility rate in the world, compared to the provinces of Manitoba and Saskatchewan who have a fertility rate closer to that of the United States. It is also a well known fact that although Canada attracts a high proportion of immigrants, the vast majority of them choose the provinces of Ontario and British Columbia as their regional location, although these two provinces represent just a little more than 50% of the Canadian population.

**Table 3.31**  
**Projected Regional Elderly Dependency Ratio**  
**(Population 65+/Population 15-64)**

<b>Region</b>	<b>2000</b>	<b>2030</b>	<b>2045</b>
Canada	18.4	36.5	40.4
Atlantic	18.9	48.9	61.2
Quebec	18.6	40.6	44.8
Ontario	18.4	32.9	37.0
Prairies	21.8	35.6	35.5
Alberta	15.6	32.3	37.0
British Columbia	19.4	40.2	44.6

Source: Human Resources and Social Development Canada

Table 3.31 below reports the change in projected regional elderly dependency ratios (population 65+/population 15-64) between 2000 and 2045. As it can be seen, the Atlantic region and Quebec will exhibit the largest increases in their elderly dependency ratios, while the Prairies and Ontario will have the smallest increases. The increases in Alberta and British Columbia fall in between the two extremes. Finally, as discussed in Section 2, the trend in retirement decision differs drastically across regions. The Atlantic region and the province of Quebec have the lowest effective age of retirement, at about 60 years, compared to near 65 for the province of Alberta.

When we look at the regional economic impact of population ageing, the regions can be separated in three categories: the regions that will be severely affected by population ageing (Atlantic and Quebec), the regions that will be moderately affected (Manitoba, Saskatchewan and British Columbia) and the regions that may even benefit (Ontario and Alberta), at least during the first few decades (see Table 3.31).

**Table 3.31**  
**Simulated Impact of Population Ageing on Regional Real GDP Per-Capita**  
 (per cent deviations with respect to initial steady state of no population ageing)

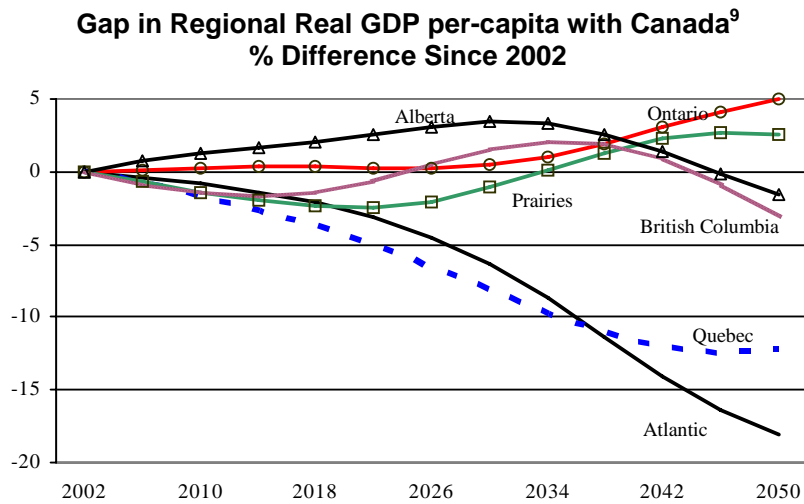
	<b>2006</b>	<b>2014</b>	<b>2018</b>	<b>2026</b>	<b>2034</b>	<b>2038</b>	<b>2042</b>	<b>2050</b>
<b>Real GDP per Capita</b>								
Canada	0.5	0.8	0.7	-0.3	-2.5	-4.0	-5.9	-10.5
Atlantic	0.1	-0.5	-1.4	-4.8	-11.2	-15.4	-19.9	-28.5
Quebec	-0.3	-1.9	-3.1	-6.9	-12.3	-15.2	-18.0	-22.8
Ontario	0.6	1.2	1.0	-0.1	-1.5	-2.1	-2.8	-5.5
Prairies	-0.3	-1.1	-1.7	-2.3	-2.4	-2.7	-3.7	-8.0
Alberta	1.3	2.5	2.7	2.8	0.8	-1.4	-4.5	-12.0
British Columbia	-0.4	-0.8	0.1	0.1	-0.5	-2.2	-5.0	-13.6

The Atlantic region and Quebec are faster ageing regions and their economies are more severely affected than the rest of Canada. The negative labour supply shock is also exacerbated by early retirement behaviour. Conversely, the provinces of Alberta and Ontario benefit from an increase in effective units of labour, until about 2018 for Ontario and 2026 for Alberta, due to both an increase in the number and quality (experience) of their workforce. Ontario also receives the greatest share of immigrants and a significant proportion is highly-skilled, thus contributing more to productive capacity. Alberta's economic situation is even more favourable because the population enjoys a higher fertility rate and its older workforce retires later than in the rest of Canada. However, as the baby boom generation eventually retire, real per-capita GDP falls more significantly than in Ontario in the long run.

Like Ontario, British Columbia is the next province benefiting the most from immigration. Consequently, its population ages less rapidly and real per-capita GDP is virtually unaffected by population ageing until 2034. Over the long run, the magnitude of the impact is similar to Alberta. Finally, the Prairies experience a moderate decline in real per-capita GDP, which begins earlier than in Ontario, Alberta and BC. Like Alberta, the Prairies benefit from a higher fertility rate and higher effective retirement age than the rest of Canada.

Chart 3.31 shows the long run impact of population ageing in Canada on regional income disparity. As can be seen, the Atlantic and Quebec relative economic situation deteriorate very substantially over the next decades. The gap in real GDP per-capita increases substantially for the Atlantic region and Quebec by 2050, while it fluctuates within a tighter margin in the rest of Canada.

Chart 3.31



### 3.4 Can we accommodate the impact of ageing by selecting more immigrants?

Among the range of policy instruments to help accommodate the economic impact of population ageing, immigration is often an option being considered. Among OECD countries, Canada ranks as one of the major immigrant receiving countries, along with Australia, the United States and New Zealand. For example, over the period 2000 to 2003, the number of recent immigrants represented 0.75% of the population per year. Also, since the early 1990s, Canada has selected more highly educated immigrants to raise the quality of the workforce.

To explore the economic effects of selecting more immigrants, we examine the marginal effect of increasing the proportion of permanent residents from 0.75% to 1% of the population, beginning in 2002 under two alternative assumptions about the skill composition of recent immigrants:

- In the first alternative scenario, we assume that the skill-composition of the additional flow of new immigrants is proportionally the same than the first

<sup>9</sup> All real GDPs per capita are normalised to one in 2002 and the regional GDP gap is measured as the percent change in regional GDP relative to the national level.

0.75%, which includes high-skilled, medium-skilled, low-skilled and unattached individuals.<sup>10</sup>

- In the second alternative scenario, we assume that the additional flow of new immigrants is composed of high-skilled immigrants only. The impact on real GDP per-capita is presented Chart 3.41.

As it can be seen, attracting more high-skilled immigrants generates substantially more benefits than raising the proportion of immigrants across all skills (including unattached individuals). When we raise the proportion of immigrants across all categories of individuals, the main economic benefits come from the demographic effect of slowing the rise in the elderly dependency ratio by attracting more young immigrants to the labour force. However, the impact on labour productivity is negligible (remember that 35% of them are unattached to the labour market). In fact, simply raising the number of immigrants across all categories has a slight negative impact during the first decades because the effect of a rise in labour supply on productive capacity is more than offset by a reduction in the capital-labour ratio and a fall in labour productivity.

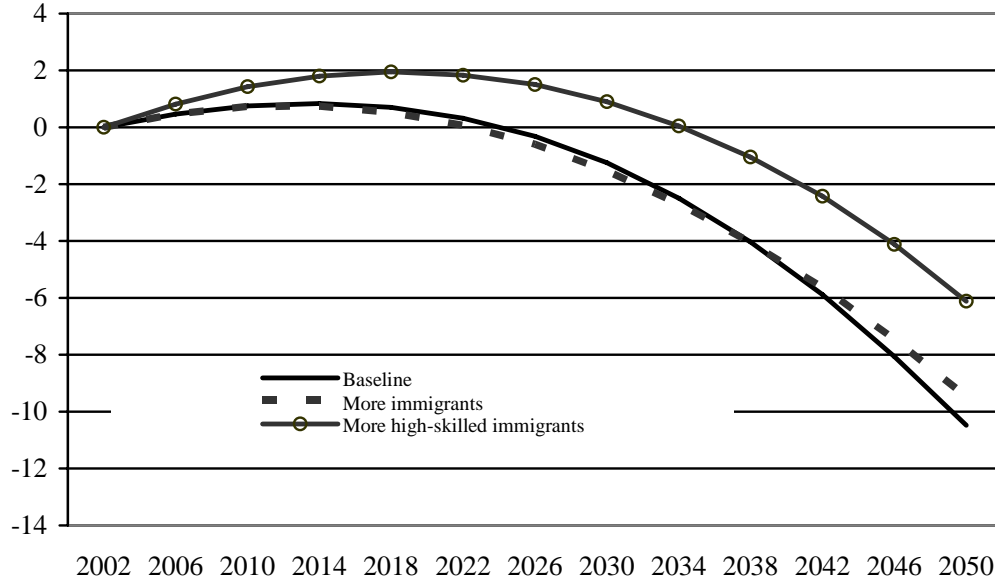
In comparison, raising the proportion of high-skilled immigrants generates net economic benefits in the medium to long run, for two reasons. First, we attract more strongly attached immigrant workers to the labour market. Second, we raise the quality and productivity of the labour force. There is, however one important drawback from this result. Table 3.41 presents the impact of raising the proportion of high-skilled workers on the skill-premium, measured as the difference between high-skilled real wage and medium or low-skilled real wage. As can be seen, the skill premium falls significantly as a result of raising the supply of high-skilled immigrants. This result raises the concern that by depressing high-skilled real wages, the return to human capital falls, thus eventually discouraging young Canadians to invest in human capital. The model used here assumes that human capital investment decisions remain fixed, which suggests that the result shown here is an upper bound.

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<sup>10</sup> According to the 2001 Census, between 1997 and 2000, 24% of recent immigrants worked in Canada as high-skilled workers, 13% as medium-skilled, 28% as low-skilled workers and 35% were unattached individuals. The model is calibrated according to these numbers.

**Chart 3.41**

**Real per-capita GDP Impact of Population Ageing According to Alternative Immigration Policy**  
 % Shock-minus-control impact



**Table 3.41**  
**Impact of Selecting more High-Skilled Immigrants on Skill-Premium Relative to the Baseline Scenario**

<b>More High-Skilled Immigrants</b>	<b>1998</b>	<b>2010</b>	<b>2022</b>	<b>2030</b>	<b>2042</b>	<b>2050</b>
<b>Skill Premium</b>						
High versus medium-skill	-0.8	-2.8	-4.6	-5.6	-7.1	-8.0
High versus low-skill	-0.8	-3.1	-5.1	-6.3	-8.0	-9.1
Medium versus low-skill	-0.1	-0.3	-0.5	-0.7	-0.9	-1.0

*3.5 What would happen if older workers retire later?*

Another policy option considered to accommodate the impact of population ageing is providing greater incentives for older workers to work longer. Several policy instruments can be considered to encourage older workers to retire later, including reforming the Canadian public pension system by eliminating early retirement incentives, eliminating mandatory retirement in the provinces that still haven't banned it, implementing income tax reforms, etc.<sup>11</sup> But before considering effective policies to increase the retirement age, it is necessary to evaluate the

<sup>11</sup> Côté (2005) presents a number of policy recommendations to encourage older workers to work longer.

marginal effect of working an extra year on productive capacity to evaluate whether the potential gains are important. To help address this issue, we simulate two alternative scenarios:

- Scenario 1 estimates the marginal effect of rising the effective age of retirement by one year in each Canadian region, beginning in 2002. This increases the average Canadian retirement age from 61.2 to 62.2.
- Scenario 2 assumes that the effective age of retirement gradually increases to 65 by 2014 and remains unchanged thereafter. This is equivalent to a total of almost a four-year increase in the effective retirement age between 2002 and 2014.

We then compare these two alternative scenarios to the baseline solution. However, since the effective age of retirement differs substantially across region in 2002, the labour force in some regions like the Prairies and Alberta reach the effective retirement age of 65 much earlier than in the rest of Canada. Finally, it is important to mention that for each alternative scenario we process the change in retirement behaviour, but do not specify a policy instrument by which this is attained.

Table 3.51 presents the marginal effect on key economic indicators of raising the effective retirement age by one year at the national level compared to the baseline scenario. As shown in the table, the one-year increase in the effective retirement age corresponds to a 2.4% increase in labour supply by 2030 relative to the baseline. It is also followed by an increase in investment. As the labour supply increases, firms raise their desired physical capital stock to equip their workers and to adapt to expected rising final demand. However, changes in physical capital do not keep pace with increases in labour supply. This leads to a slight decline in the intensity of physical capital in the economy as reflected by a reduction in the capital-labour ratio.

Although, this policy shock represents an increase in the labour supply of older workers, a one-year increase in the retirement age has a negligible impact on aggregate real wages. Finally, an increase in the supply of older workers raises the labour income tax base. In these scenarios, we assume that all governments (federal and provincials) maintain the same target for the public debt, and lower their effective tax rates on labour income accordingly. Under this assumption, the effective federal tax rate on labour income could fall by 1.6% by 2030 and lead to a rise in real wages after-tax. However, it must be noted that if

the fiscal authorities choose instead to spend the tax revenue increase on social transfers, the gains in productive capacity and in economic efficiency would likely be smaller.

**Table 3.51**  
**Simulated Impact of an Increase in the Effective Retirement Age**  
*(Percent Difference Relative to Baseline)*

	2006	2010	2022	2030	2042	2050
Real GDP per capita						
Working one extra year	1.6	1.9	2.4	2.7	3.0	3.2
Working until age 65	2.7	5.0	7.5	8.4	9.3	9.9
Capital – Labour ratio						
Working one extra year	-1.6	-1.0	-0.5	-0.4	-0.2	0.3
Working until age 65	-5.8	-7.3	-3.9	-3.8	-3.5	1.4
Real investment						
Working one extra year	5.0	4.7	4.2	4.0	3.5	3.0
Working until age 65	8.5	15.5	11.2	9.8	10.0	11.5
Labour Supply						
Working one extra year	2.0	2.1	2.4	2.4	2.3	2.1
Working until age 65	4.5	7.7	8.9	9.0	8.4	7.5
Real Wages						
Working one extra year	-0.3	-0.3	-0.1	-0.1	0.0	0.3
Working until age 65	-1.5	-2.1	-1.1	-1.1	-1.1	-0.4
Real Wages After-Tax						
Working one extra year	-0.2	0.2	0.6	0.6	1.0	1.2
Working until age 65	-1.3	-1.3	1.0	1.4	2.2	3.3
Federal Effective Labour Income Tax Rate						
Working one extra year	0.0	0.0	-1.6	-1.6	-1.6	-2.3
Working until age 65	0.0	-0.8	-5.6	-6.4	-8.8	-10.3
Canada Pension Plan Contribution Rate						
Working one extra year	-8.3	-7.9	-7.8	-7.9	-7.8	-7.7
Working until age 65	-15.0	-24.6	-25.5	-25.8	-25.1	-25.1
Quebec Pension Plan Contribution Rate						
Working one extra year	-7.8	-7.2	-7.0	-6.2	-6.2	-6.0
Working until age 65	-24.1	-39.5	-39.3	-38.8	-38.4	-38.4

The next scenario provides an estimate of the impact of a gradual increase in the effective retirement age to 65. This is equivalent to a 9% rise in the labour supply in 2030 relative to the baseline. According to this scenario, the real per-capita GDP gain reaches 8.4% in 2030 and nearly 10% by 2050. The substantial increase in labour supply also leads to a 1.2% reduction in real wages before-tax by 2050, but a 3.3% increase after-tax. Finally, working until age 65 allows about a 25% reduction in the CPP contribution rate and a 38% reduction in the QPP rate. The QPP contribution rate reduction is larger since Quebec experiences a greater increase in the effective retirement age, from 59.7 to 65.

Simulation analysis indicates that the economic and financial costs of early retirement in terms of unused productive capacity and reduced taxation base are significant. Correspondingly, the benefits of working longer are potentially large. However, the results do not reflect the use of any particular policy instrument. Therefore, the end result could be quite different for any given instrument used to achieve this.

### *3.6 Intertemporal substitution and new cohorts*

Up until now, we have been ignoring the effect of population ageing on time allocation, more specifically on time spent at work and in human capital formation. Since population ageing will significantly change production factor returns, it will very likely affect the return to work and to invest in human capital. Some factors may partly compensate for the decline in labour force growth and the induced effect on productive capacity:

- First, since the return to human capital is the discounted sum of future wage revenues, younger cohorts might be inclined to invest more in education.
- Second, a greater participation of middle-age and older workers may arise as a consequence of the increase in real wage pressures.
- Third, current cohorts of young adults are already better educated than older cohorts.

In order to explore the long-term impact of population ageing on labour supply and human capital investment decisions and evaluate the potential consequences for productive capacity, we have modified the structure of the CGE model by making labour supply and human capital investment decisions endogenous. In other words, contrary to the previous simulation results, changes in the return to work and to invest in human capital affect workers' lifetime decisions about working, education and leisure.

In the revised model, representative individuals now maximize lifetime consumption of all goods, including leisure, subject to their lifetime income and the time available. Earnings depend on an individual's level of human capital, which is determined within the model. At any age, individuals allocate a specific proportion of their time endowment toward leisure, work and human capital formation.

The role of human capital in the growth process is based on the framework used by Mankiw, Romer and Weil (1992). This implies that human capital has a direct effect on

productive capacity but no indirect one through technical progress and innovation. The opportunity cost of investing in human capital is the current wage, measuring forgone earnings. Investment returns in education and training are a stream of net revenue from future labour supply. Since the return to human capital is the discounted sum of future wage revenues, it is rational to invest in human capital when young and work a little and to invest in physical capital at middle age and older.

Two simulation experiments are undertaken. The first simulation performed (Scenario 1) examines the long-term economic and labour market impact of population ageing in Canada by assuming that time-allocation decisions will remain fixed or “exogenous”. This is equivalent to the baseline scenario presented in 3.2.<sup>12</sup> The second simulation (Scenario 2) applies the same demographic shock, but this time with endogenous time-allocation decisions.

The difference between the two scenarios will isolate the contribution of endogenous labour supply and human capital investment decisions on productive capacity in the context of demographic changes.

To undertake a retrospective and prospective analysis of the economic and labour market impact of population ageing, the simulation results are presented from 1982 to 2050 (see Table 3.61). After all, forward-looking Canadians may already be expecting and responding to prospective population ageing. Chart 3.61 also presents the impact of the demographic shock on real GDP per capita for Scenarios 1 and 2.

As indicated earlier, Scenario 1 assumes that time-allocation decisions are exogenous to the model. Therefore, changes in the return to work and to invest in human capital do not affect individuals’ labour supply and education decisions.

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<sup>12</sup> Since the model has been modified, it is important to re-examine the baseline scenario.

**Table 3.61**

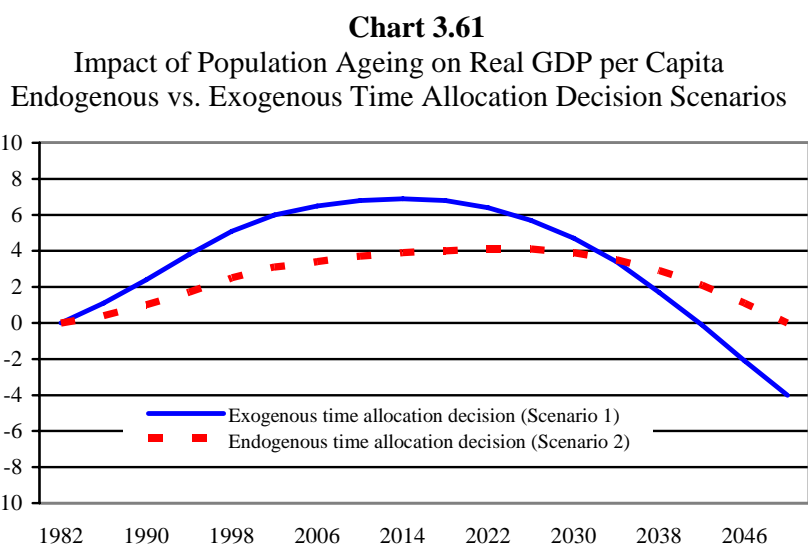
**Impact of Population Ageing on Key Macroeconomic Indicators**  
Percentage deviations with respect to initial steady state

	1986	1990	1994	2002	2006	2010	2018	2026	2034	2042	2050
<b>Real GDP per capita</b>											
<b>Scenario 1</b>	1.1	2.4	3.8	6.0	6.5	6.8	6.8	5.7	3.4	-0.1	-4.0
<b>Scenario 2</b>	0.4	1.0	1.7	3.1	3.4	3.7	4.0	4.1	3.5	2.1	0.0
<b>Capital-labour ratio</b>											
<b>Scenario 1</b>	-0.9	-0.9	0.2	5.3	8.9	12.6	20.6	29.2	37.5	43.1	42.8
<b>Scenario 2</b>	-0.6	-0.7	-0.2	2.5	4.4	6.4	10.5	15.1	19.5	22.7	23.3
<b>National savings rate</b>											
<b>Scenario 1</b>	0.6	1.0	1.4	1.3	0.6	0.0	-1.7	-3.7	-6.0	-8.3	-10.2
<b>Scenario 2</b>	0.3	0.5	0.6	0.3	-0.5	-1.2	-2.8	-4.6	-6.3	-7.9	-9.2
<b>Labour supply</b>											
<b>Scenario 1</b>	4.6	9.1	13.2	19.2	20.7	20.9	17.3	8.7	-2.8	-14.7	-25.1
<b>Scenario 2</b>	4.0	7.9	11.5	16.9	18.5	18.9	16.2	9.1	-0.8	-11.5	-21.4
<b>Effective labour supply</b>											
<b>Scenario 1</b>	5.3	10.5	15.4	22.7	24.6	25.3	22.3	13.8	1.5	-12.0	-24.1
<b>Scenario 2</b>	4.5	8.9	13.2	20.2	22.5	23.7	22.3	16.0	5.9	-5.9	-17.3
<b>Real wage rate</b>											
<b>Scenario 1</b>	-0.3	-0.3	0.0	1.6	2.6	3.6	5.8	8.0	10.0	11.3	11.3
<b>Scenario 2</b>	-0.2	-0.2	-0.1	0.7	1.3	1.9	3.0	4.3	5.5	6.3	6.5

Please note again that the results of Scenario 1 are very similar to the baseline scenario shown in Section 3.2, except that the results in Table 3.61 are shown relative to 1982 rather than 2002. According to the results of Scenario 1, following the massive labour supply shift during the 1970 and 1980s associated with the entry of the baby boom generation into the labour market, productive capacity increases substantially relative to the steady state with no population ageing. Real GDP per capita increases sharply during the 1980s, 1990s and 2000s. Eventually, as the baby boom generation gradually transits towards retirement, the impact on productive capacity stabilises and real GDP per capita begins to fall by 2014.

Between 2002 and 2050, real GDP per capita falls by about 10%, corresponding to a 0.4 percentage point annual reduction in growth. The demographic shock leads to a moderate increase in national savings during the 1980s and 1990s, and to a substantial reduction thereafter, as the baby boom generation transits towards retirement. This is accompanied by an increase in real wages as labour market pressures rise due to population ageing. Moreover, since labour becomes more costly, firms substitute away from labour into physical capital, leading to a rise in physical capital intensity and higher output per worker.

When we turn to Scenario 2, the analysis presumes that young individuals with perfect foresight will anticipate the rise in the education premium in the future due to population ageing. As a result, they invest more in education at young age to supply more skilled labour at middle age. Consequently, by spending more time in education initially, the reduction in the labour supply of young adults lowers productive capacity. However, as future cohorts of middle-age workers are more skilled and work more, the productivity gains and additional supply of skilled workers eventually reduce the cost of ageing on productive capacity (see Chart 2). As a result, the long term impact of population ageing is much smoother over the period 1982 to 2050 and the cost in term of output loss appears more moderate. Between 2002 and 2050, real GDP per capita falls by about 3.1%, compared to 10% in Scenario 1.

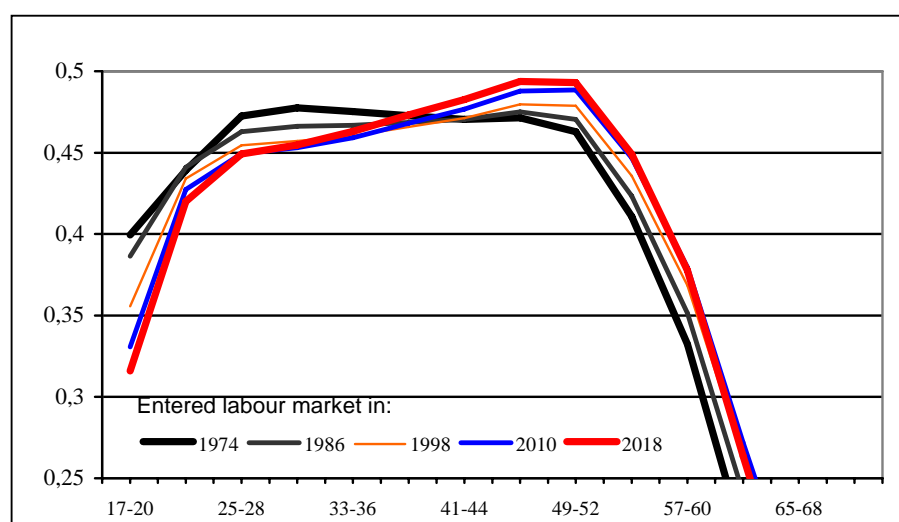


Since the labour supply increase is more moderate initially in Scenario 2, the overall impact on national savings is more negative than in Scenario 1 until about 2038. Also, given that labour supply is endogenous in Scenario 2, the effect of population ageing on real wage pressures is smaller than in Scenario 1 since both wages and hours adjust. In Scenario 1, labour market equilibrium comes exclusively from real wage changes.

Chart 3.62 provides an overview of the dynamic change in labour supply behaviour by cohort during the working life. For illustrative purposes, we examine 5 cohorts who enter the labour market in 1974, 1986, 1998, 2010 and 2018, respectively. As shown, for cohort 1974, time allocated to work rises steadily from ages 17-20 to 25-28, stabilises between 25-28 and 45-48 and declines more rapidly during pre-retirement years as the preference for leisure rises. However, for future cohorts, the labour supply behaviour changes gradually, with a

substantial reduction in time allocated to work for ages 17-20 to 37-40, which is mainly compensated by an increase in time allocated to education. At middle age (41-44), the labour supply increases and time allocated to work becomes greater than that of previous cohorts. Also, since these individuals have invested more time in human capital, they are more qualified and productive. Finally, as they get older, they work longer than previous cohorts. For example, for age groups 57-60, 61-64 and 65-68, time allocated to work increases by 14%, 23.5% and 46.7%, respectively between cohort 1974 and cohort 2018.

**Chart 3.62**  
**Impact of population ageing on time allocated to work by cohort**  
 (Average Weekly Hours for Cohorts 1974, 1986, 1998, 2010 and 2018)



### 3.7 Imperfect substitution between younger and older workers

It is well known that the proportion of older individuals will rise as a result of ageing and that the supply of older workers will become relatively more abundant than the supply of younger workers. The analysis done so far also indicates that population ageing will significantly affect production factor returns, leading to an increase in real wages and a reduction in the rate of return on capital and in real interest rates. If we assume that the substitution effect dominates the income effect and that younger and older workers are perfectly substitutable in the technology used for production, the rise in real wages could in turn stimulate the labour supply of middle-age and older workers.

However, it can be argued that workers of different ages have different attributes and are less than perfectly substitutable. Fortin and Lemieux (2006) have used an updated version

of the Card and Lemieux (2001) labour supply and demand model for Canada that allows for imperfect substitution between various age and education groups and found that although the elasticity of substitution between younger and older workers is large (*about 6*), it is significantly less than infinite.

If younger and older workers are not perfect substitutes, the impact of population ageing on real wages may differ across the various age groups. Mercenier and Mérette (2005) examine this issue using a CGE model with the same basic structure as the models used in sections 3.2-3.5 and 3.6, but with the following notable distinctions:

- Younger and older workers are imperfect substitutes. The authors use an elasticity of substitution of 3 for labour demand between younger and older workers.
- Labour supply is endogenous but human capital investment decisions are fixed or exogenous.
- Workers are homogeneous by skill.

In their simulation experiments, they find that the impact of population ageing on real wage rates differ between younger and older workers. In particular, real wages significantly increase for age groups 15 to 44 between 2002 and 2040, but decrease for older age groups. In addition, when you account for real after-tax wage rates, the impact is even more negative. When you look at the impact of ageing on labour supply decisions, they find that the real wage effect has a negative impact on the labour supply of older workers. They conclude that population ageing may lead to an increase trend in early retirement among older workers rather than a reduced trend.

#### **4. Population Ageing, International Trade and Migration**

In the analysis presented so far, we have ignored the fact that globalization and world demographic changes can also influence the economic and labour market outcome of population ageing in Canada. However, international trade and international migration have become two critical aspects in the context of globalization that need to be accounted for when analyzing the economic impacts of population ageing. On one hand, different processes of population ageing affect factor abundances across countries and their comparative advantages in international trade. The wage or lifetime-utility differentials between the fast-ageing

countries and the comparatively slower-ageing countries can provide incentives for migration. On the other hand, good and labour mobility across countries could significantly affect the economic performances of ageing countries. Thus, it is highly relevant to analyze the issue of ageing in the context of globalization.

#### *4.1 International trade and ageing*

Sayan *et al.* (2001) are the first to investigate the interactions between international trade and population ageing using OLG-GE approaches. Sayan (2005) employs a 2\*2\*2\*2 type (two-country, two-good, two-input and two-generation) dynamic OLG-GE Heckscher-Ohlin (HO) model to examine the welfare implications of free trade for two ageing countries. Ageing is modeled as two countries' population growth rates decline to zero but at different speeds during the dynamics<sup>13</sup>. Simulation results show that compared to autarky, free trade deteriorates the welfare for cohorts living in the older country. Cohorts living in the younger economy, however, gain from free trade.

Based on Sayan (2005), Zhu (2006a) provides a generalized version of 2\*2\*2\*2 type OLG-GE model to investigate the same issue: implication of trade for two ageing countries. The Armington assumption, which suggests the same kind of goods produced in different countries are no longer perfect substitutes on world market, is introduced into the model to generate a more realistic picture of trade. In addition, a series of nested CES functions are used in Zhu (2006a) to characterize the demand side. Simulation results show that compared to autarky, the older country with a faster process of ageing gains from trade, but the relatively younger country loses from trade. Chart 4.11 shows the conclusions from Sayan (2005) and Zhu (2006a).

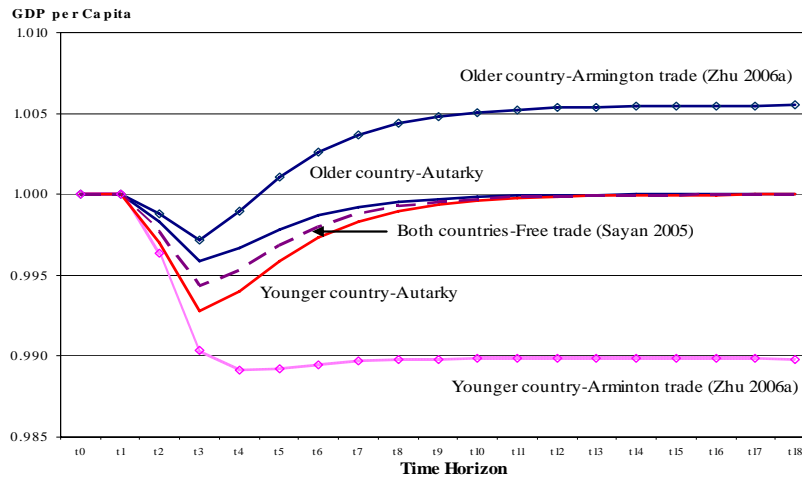
Both Sayan (2005) and Zhu (2006a) model population ageing in a unique way: two countries' population growth rates declines to zero at different speeds. Thus, the older country with a faster ageing process grows into a capital-abundant country and the labour endowment turns to be comparatively more abundant in the younger country. In the HO framework employed by Sayan (2005), each country specializes in the production and exporting of only one good that uses this country's abundant factor more intensively. Zhu (2006a), however,

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<sup>13</sup> The 1950 UN demographic projections on the average population growth rates for the 'more-developed' regions and the 'less-developed' regions are used as initial values.

assumes that each country produces and exports both goods based on the Armington assumption.

**Chart 4.11**  
**GDP per Capita for the older and the younger countries**  
**(Sayan 2005 and Zhu 2006a)**



As shown in Chart 4.11, the directions of welfare change in the older and the younger countries suggested by an Armington-type trade model (Zhu 2006a) are opposite to those by a HO-type trade model (Sayan 2005). Sayan explains the loss (gain) from trade for the older (younger) country as “a result of these changes in relative commodity and factor prices” (p.1488). Two countries’ wage rates and rental prices are found to be equalized at each time period in the free trade scenario according to the Factor Price Equalization Theorem. As a result, many variables for two countries, such as the capital-labour ratios, the wage-rental ratios and GDP per capita levels, are equalized within a HO framework.

In contrast, Zhu (2006a) suggests that the gap between two countries’ wage rates is enlarged overtime instead of being eliminated. In addition, always a larger economy with a higher population growth rate, the younger country demands more capital-intensive goods produced in the older country. This leads to a higher steady-state rental price of capital in the older country. Higher returns on production factors lead to higher lifetime income for a representative cohort. This is the source of the welfare gain for the older country. Zhu (2006a) explains the increasing and persistent gap between two countries’ welfare levels as a result of the changes of two countries’ comparative advantages and the terms of trade. These changes are determined by both the differentiated ageing processes across countries and the Armington assumption applied into the trade model. In addition, sensitivity tests by Zhu

(2006a) show that the welfare gap between two countries decreases with the increase of the value of Armington elasticity<sup>14</sup>. This gap will be finally eliminated when a very high value of Armington elasticity is assumed. This suggests the model is actually a generalization of the HO-type trade model by Sayan (2005).

Although real data is not applied by Sayan (2005) and Zhu (2006a), both studies provide a good intuition about the impact of international trade on an ageing economy, such as Canada. It is shown that international trade is not necessarily a win-win game for countries with different processes of ageing: as locally-produced goods become more substitutable with foreign products on world market, it is better for an older country to stay in autarky. If locally-produced products are more differentiated from foreign products, there is no reason for an older country to fear trade liberalization.

#### *4.2 International migration and ageing*

As discussed in sub-section 3.4, increased immigration is an option considered to accommodate the negative impacts of ageing. In the literature regarding international migration, the skill level of immigrants is considered as an important factor in determining the economic impacts of migration. For example, studies by Borjas (1994) and Leibfritz *et al.* (2003) provide some empirical evidence.

Over the past decade, the OLG-GE approach has been used to analyze international migration because of its capability to capture the cohort effects of migration. Sayan *et al.* (2001) and Iregui (2003) are two examples showing the extreme cases of international labour mobility – full migration. Sayan *et al.* (2001) assumes constant population growth rates of 20% and 5% respectively for the younger country and the older country. The younger country grows into a very large economy in the long run so that a small scale of migration equalizes two countries' population growth rates. In Iregui (2003), migration is simply modeled as the integration of global labour markets. Given that actual data of labour stock is used by Iregui (2003), the scale of migration between the developing south and the developed north regions is extremely large. Sayan *et al.* (2001) shows, using a 2\*2\*2\*2 type OLG model, that as the result of continuous migration, most steady-state values for the older country converge to those for the younger country. This means the older country loses from the inflow of foreign labour stock. The younger country, however, receives short-run gains after sending out part of

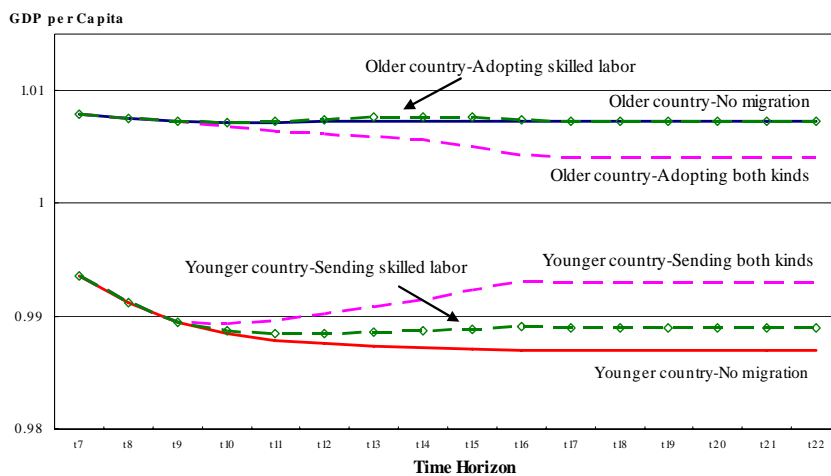
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<sup>14</sup> The Armington elasticity refers to the elasticity between imported good and locally-produced good.

its labour force. The static eight-region, one-good, two-input GE model employed by Iregui (2003) shows that the integration of labour markets could increase world output by as much as 67% because a very large scale of unskilled labour stock migrates from the younger south regions to the older north regions. In Iregui (2003), skill differential is taken into account and the impacts of migration of different kinds of labour are found to be significantly different.

To model a relatively more realistic scenario of migration, Zhu (2006b) uses a 2\*2\*2\*7 (two-country, two-good, two-input and seven-generation) OLG-GE Armington-type trade model to investigate the economic impacts of migration at different skill levels for two ageing countries. Technologies are assumed to be identical in both countries and the production of capital-intensive good requires more capital input and more skilled labour input than the production of the labour-intensive good does. Consequently, the skill composition of immigrants is critical in determining the economic impacts of migration. The decision making of migration is modeled based on Karayalcın (1994). As assumed by Sayan *et al.* (2001) and Iregui (2003), the driving force of migration is the wage differentials among countries. However, migration is limited only to a certain period of time, which is different from Sayan *et al.* (2001). In addition, it is assumed that only 0.45% of the population of the new-born generation in the younger country moves to the older country. This doubles the net increase of the older country's population because the younger country is also a larger country.

**Chart 4.21**  
**GDP per Capita for the old and the young countries before and after migration**  
**(Zhu 2006b)**



Simulation results from Zhu (2006b) show that the older country is made worse off by adopting a comparatively larger number of both skilled and unskilled immigrants.

However, a small scale of inflow of skilled labour brings temporary gains to the older country. For the younger country, it benefits from sending out part of its labour stock under both migration scenarios (Chart 4.21). In Zhu (2006b), international trade exists in all scenarios (the baseline scenario without migration and the migration scenarios) investigated. Thus, the gain or loss from migration for two countries are also explained through the changes of comparative advantage and terms of trade. For example, the inflow of skilled labour frustrates the skill premium in the older country and reduces the production cost of capital-intensive good. Consequently, the capital-labour ratio of the older country is found to be temporarily higher after migration, which enhances this country's comparative advantage in capital-intensive good. The older country temporarily gains from migration because of more favourable terms of trade. The inflow of both kinds of labour, however, is found to have a negative effect on the older country's capital-labour ratio. Thus, this country's comparative advantage in capital-intensive good is reduced compared to the baseline scenario, which makes the older country losing from migration.

Chart 4.21 suggests that migration is not a win-win game for the source and destination countries. In addition, a skill-oriented immigration policy should be effective in improving an ageing country's living standard.

Both Sayan (2001) and Zhu (2006b) are theoretical researches providing a brief picture of variable changes in ageing economies under migration scenarios. In future work, real data will be applied into a dynamic GE model to test the above conclusions and to measure the magnitudes of the impacts of international labour mobility on ageing economies. A multi-country model including Mexico, the USA and Canada may be established to investigate this issue in North-America.

## **5. Conclusion**

Many industrialised countries, including Canada, will experience accelerating processes of population ageing over the next several decades. The research on the economic impacts of ageing is especially critical for Canada, a large country but with a small and widely dispersed population. However, to evaluate the effects of such a persistent demographic shock is a highly complex job. This paper provides some recent efforts made into investigating the effects of ageing on Canadian labour markets.

First, in the aspect of microeconomics, it is shown that although the rising of the share of older workers will generate pressures on the labour market, many important factors should be considered in analyzing the impacts of ageing. Recent trend in behaviour of older workers, such as improvement of the participation rate and higher possibility of returning to the labour market, could have significant positive effects on the labour market, as suggested by recent empirical studies.

Second, in the aspect of macroeconomics, simulation results from a multi-regional OLG-GE model show a downward trend of real GDP capita for an ageing Canadian economy over the next several decades. Provincial comparisons show that low fertility rate, immigrant's regional location decisions and early retirement behaviour in the Atlantic region and Quebec make these two regions most severely affected by ageing. Several policy instruments, such as selecting more skilled immigrants, promoting later retirement and encouraging younger cohorts to invest more in human capital should be considered to compensate for the negative effects of ageing on the productive capacity of the economy.

Finally, this paper also put emphasis on the role of globalization in researches on population ageing. A summary of several theoretical studies show that the economic performances of an ageing economy could be reversed when different scenarios of international trade are assumed. Accordingly, international migration of different kinds of labour could also have diverse effects on both the source and the destination countries with different ageing processes. Thus, the introduction of a multi-country model with the application country-specific data is necessary to investigate the issue of ageing for Canadian economy.

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