A General Equilibrium Investigation of Labour Shortage in the Health Care Sector in the Context of an Aging Population

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1. **Introduction**

Throughout the next century, the average age of the population will rise as the "baby boom" cohort progresses through the age structure. The industrialized nations will not only experience population growth, but also a significant restructuring of the population will occur.

Many economic institutions made it clear that managing the aging transition is going to be one of the most challenging tasks of this century. In 1994, the World Bank referred to this challenge as a "crisis," and this view has been echoed by the OECD (1998), the Canadian Auditor General (1998), and a former Secretary of Commerce in the United States (Peterson, 1999) who emphasized that the aging crisis will cause the world's wealthiest nations to be bankrupt.

As for Canada, the population aged 65 and over will reach between 20 and 25 percent of the total Canadian population between 2025 and 2031. Although the timing of this trend is somewhat later for Canada than it is for some northern and western European countries, policy makers in Canada and in many other countries of the OECD are receiving conflicting messages about what the future growth of the elderly population will mean for the provision of health care services and health care expenditures.

In this report, the aim is to identify and evaluate the inter-regional, inter-sectoral and occupational impact that population would have on labour market shortage in the health care sector. To achieve this purpose, a computable general equilibrium model is built. The model is calibrated on various sources of Canadian data. Then, taking into account the upcoming structural demographic shift and the changing consumption preferences of age groups, we simulate the inter-regional, inter-sectoral and occupational effects.

Next section talks about Canadian demographic in general. Then in Section 3, a literature review is made to analyze the macroeconomic impact of aging. In Section 4, population aging's impact on health care expenditure in Canada is specifically reviewed. The model is described in Section 5. Then in Section 6, the data and calibration procedure is introduced. In Section 7, we report the demographic structure of the six regions of the model for the next two decades. We report and analyze the simulation results in Section 8, including an interesting part where we give an example of how the model can be used to project future labour market imbalance. Specifically in health care section, three simulation experiments were done and results are also reported in Section 8. Section 9 offers some conclusion marks.

2. Canadian Demographics

As in many other industrialized countries, the demographic structure of Canada is undergoing changes that will profoundly alter the age profiles of its population over the next 50 years. In the most recent population projections by Statistics Canada, the total population in 2031 is forecast to range from 35.5 million to 46.9 million and the elderly population is likely to range between 25 and 30 percent of the total population[1].

At the core of any discussion of the economic costs of population aging is the demographic prospects, in particular future changes in age distribution. The change in age distribution over the three decades is striking. In 1966 more than 42 percent of the population were 'young' which was defined as people under the age of 20; in 1996, only 27 percent were 'young', while the proportion in 'middle age' (20 to 64) had increased from 50 to 61 percent. Seniors that age 65 and over are one of the fastest growing population groups in Canada, comprising 12 percent of the total population in the late 1990s compared with 10 percent in 1981 and 5 percent in 1921. By 2041 they are projected to comprise 23 percent of the population when the baby boom generation (born between 1946 and 1965) begins reaching age 65. Among seniors, those aged 85 and over are the fastest growing age group, almost doubling their numbers between 1981 and 1998. The majority (57 percent) of seniors are women. Over one quarter (27 percent) are immigrants. Most (93 percent) live at home in a private household and most (68 percent) live in households headed by a senior. Ninety percent of these senior homeowners have paid off their mortgage. Most (57 percent) live with their spouse; 7 percent live with members of their extended family; 29 percent live on their own; and 7 percent live in a long-term care institution.[2] (More detailed information is available in Appendix 1)

[1] Robson."Will the Baby Boomers Bust the Health Budget?", 2001
[2] Statistics Canada, 1999

3. Macroeconomic Issues of Aging

Population aging is not only a social security issue, but also a powerful demographic force that can generate significant macroeconomic consequences. The effects of an aging population on the following macroeconomic elements are discussed: population composition, demand and government spending, consumption and savings rate, and the labour market.

Population composition: the changing demographic structure of the population that is expected in the coming years many have a significant impact on the economy. We discuss the demographic change using dependency ratio. The dependency ratio is the ratio of the combined child population (aged 0 to 14) and elderly population (aged 65 and over) to the working age population (aged 15 to 64)[3]. The total dependency ratio is the sum of elderly dependency ratio and youth dependency ratio. Population aging problem means the elderly dependency ratio will be raised in the future. For instance, during the period 2015-2025, when the baby boomer generation retires, the number of employed will decrease relative to the number of dependents. In other words, the old-age dependency ratio which measures the number of the number of dependents relative to the number of employed, is expected to rise considerably over the next three decades.

In particular, Masson and Tryon (1990)'s study revealed increased ratios for all of the selected countries by the year 2025. A change in the age structure of the population ultimately affects such factors as consumption patterns, saving propensity, and other macroeconomic characteristics[4]. For example, Disney (1996) claims that as the 'aged dependency ratio' rises, the capacity to pay social security pensions is diminished, which turn to enhance the individual uncertainty attached to prospective incomes. Disney also adds two caveats to this argument. If young people expect to live longer after retirement, they may increase their savings to compensate. Also, if each new generation expects to have higher lifetime income, their absolute saving may increase.

[3] From Statistic Canada: http://www.statcan.ca/english/freepub/82-221-XIE/01201/community/community.htm#pop

[4] Paul R. Masson and Ralph W. Tryon, "Macroeconomic Effects of Projected Population Aging in Industrial Countries", *IMF Staff Papers*, 1990 Vol. 37

Nevertheless, "there is a crude negative relationship between saving rates and dependency ratios."[5]

Demand pattern changes and government spending: As the population ages, the scale and structure of demand changes. And it is imperative to recognize that the patterns of demand are different among different age groups (Johnson 1992). In response to these changing consumer needs, the government spending and transfer program such as education, health care, and public pension are sensitive to the demographic structure of the population. For instance, an aging population will have a greater demand for services concerning medical issues and pension benefits, while a young population stimulates public education needs.

Consumption: Generally, aggregate consumption increases with a rise in the dependency ratio. Masson (1990)'s model examines consumption as a function of financial and "human" wealth. The results of this function indicate that, as the population ages throughout the next century, the level of consumption will increase, too.[6]

However, Johnson (1992) argues that when emphasizing with demand, it is essential to examine not only the general level of consumption, but also the age-specific expenditure patterns. In other words, consumption is not only the result of age, but also of lifetime employment and savings patterns. According to Johnson, there are three influences of consumption: age, cohort, and period effects. As consumers age and alter their consumption levels and demand, producers must accordingly shift towards the production of demanded goods and services. Because of this, some of the goods and services sector of the economy may suffer whereas some others benefit as the population ages. [7]

Savings rate: The economic impact of the large changes in the age structure of the population that are now taking place throughout the developed world will depend on how saving varies with age, Weil(1994). Macroeconomic studies find that large elderly populations depress savings. Much of the belief in the dissaving of the elderly comes from the Life Cycle Hypothesis.

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[5] Disney, Richard. "*Aging and Saving*". Fiscal Studies. Vol. 17. No. 2, 1996
[6] Masson, Paul R. and Tryon, Ralph W. "Macroeconomic Effects of Projected Population Aging in Industrial Countries", IMF Staff Papers, September 1990

The Life Cycle Hypothesis states that households consumption-savings behavior changes with age. Its basic tenet is that "Assuming a well-functioning capital market, the individual consumer or household will attempt to smooth consumption expenditure over the lifetime, consuming more than income (dissaving) in the early part of the working life when wages are relatively low and when family formation and purchase of durables (notably housing acquisition) take place, and saving in later middle age as housing loans are paid off and children leave home. Assuming net wealth is maximized at retirement, no bequest motive and a well-functioning annuity market (provision of pensions), wealth is then reduced by dissaving to zero at the expected time of death" (Disney, 1996, pp 88). The life-cycle theory of saving indicates that saving is positive for the middle-age and negative for the young and the old. As a result, when people become older, the savings rate will do downtrend since less people are in the middle-age cohorts, which consequently drives the savings rate down. As already talked about in the demographic composition section, the rise of the dependency ratio also implies that a bigger proportion of the population will reduce the saving rates.

The study of Larmer (2002) also supports the life cycle theory. She finds that as in the case with senior families, uattached persons experience a certain depletion of their assets as they age. "The non-financial assets tend to reduce in size as unattached seniors move into the oldest (80+) group." Larmer gives the reasons such as selling for a house or car.[8]

Borsch-Supan (1992) studies the case of Germany, based on German income and expenditure surveys. His study offers a very different view of the elderly and saving rates than the Life Cycle Hypothesis. He claims that although wealth is declining between age 60 and 70, it increases again after age 70, such a point that the very old have the highest savings rates among all age groups and accumulate wealth rather than decumulate it. The main observation of this study is a U-shaped saving profile that describes a decline in savings until about age 70, followed by a rapid increase in net saving past that age. The statistic result of Borsch-Supan shows that net savings at very old age (80 and above) are about 50% higher that at retirement.

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[7] Johnson, Paul and Falkingham, Jane, "*Aging and the Macroeconomy*" in Ageing and Economic Welfare, Sage Publications, Newberry Park, California, 1992.

[8] Catherine L.Larmer. "Older Canadians: A Closer Look at their Financial Security", *manuscript*, HRDC, 2002

Borsch-Supan also proposes that there is a relationship between the increase of savings and the decrease of consumption by the elderly. In addition, Disney(1996) suggests three other reasons for the decline in consumption that accompanies aging: people are more risk averse with age, retirement income may be less than expected, and retirement may take place earlier than anticipated. A final proposed reason for the increase in savings, or at least the insignificant dissaving, that is exhibited by the elderly when studied on an individual level is a desire to prepare for emergencies.

In summing up, both the bequest motive and the dependency ratio can help to explain why macro studies reveal that large elderly populations tend to depress savings rates. On the other hand, Borsch-Supan's study of Germany, the decrease of consumption with age, and the preparation for emergency all contributes to understanding why micro studies tend to reveal insignificant dissave, or even increased savings among the elderly groups.

Labour force: In addition to affecting consumption levels, an aging population alters the composition of the labour force. All things considered, the labour force, like the population, is likely to experience a considerable amount of aging in the decades ahead.

Spence (1999)'s projections suggest that aging of the population and labour force, and associated reductions in their rates of growth, are inevitable. Many other studies also warn of an aged society that is unproductive and inept. One reason for these limitations stems from a common Western prejudice against the elderly members of society. In general, labour market opportunities are limited for an older population.

According to Johnson (1992), the most important labour market effect of a demographic change is not the size of the labour force, but rather its age structure. The age structure affects macroeconomic performance because workers of different ages are not perfect substitutes for each other. From a macroeconomic perspective, the effects of a changing age structure may depend on the impact of aging on human capital accumulation.

According to Fougère and Mérette(2000) and Mérette(2002), aging will raise relative wages and reduce capital returns. In such a context, young and future generations may be willing to invest more in human capital. If so, the whole economy will benefit from that.

Productivity level: It is important to recognize that population change affects not only the demand side of the economy, but also the supply side. That is, it affects the nation's productive capacity as well as the ways in which the national product is used. The pessimistic views argues that as aging occurs, the labour force growth decreases, as well as the national savings rate, which in result in slower real potential output growth and the living standard. For example Simon (1977) argues that a decline in savings and a decline in capital accumulation result in a loss of dynamic innovative spirit. Furthermore, Denton and Spencer (1999) state that there will be a decrease in the growth of living standards (GDP per capita) without substantial improvement in productivity per worker.

In response to such pessimistic projections, optimists such as Habakkuk (1962) believe that technical innovations are greatest when labour growth is scarce, because technical progress is labour saving. Fougère and Mérette (2000) and Mérette (2000) suggest that with increased investment in human capital, the quality of labour and hence its productivity will improve.

Summary: The studies discussed above provide an understanding of the potential macroeconomic consequences of aging. Despite such conflicting results from the studies, one point remains clear. That is: demographic change will affect the long run performance of developed economies. The change in the age structure of the population has the potential to alter consumption, savings, labour force, and productivity level. However, the scale of these changes is yet to be observed.

Most of studies cited above have concentrated on the national and macroeconomic effects of population aging. In this paper, we will try to investigate microeconomic effect of population aging on Canadian health care sector. Our aim is to investigate the inter-regional, inter-sectoral and occupational restructuring of final demands due to forthcoming changes in the population, and its potential consequences on the composition (by qualification and profession) of the labour force. Before describing the general equilibrium model, we review next the literature on the impact of aging on the health care section.

4. Impact of Aging on Health Care Sector

Two schools of thought

Over the past 20 years, total health care spending in Canada increased, on average, at an annual rate of 7.4 percent. Health budgets have grown rapidly again more recently with government finances in better condition. To place the current situation in perspective, Table 1 shows the major dimensions of total health care spending (public plus private) in Canada over the past 20 years.

Table 1. Dimensions of health care spending in Canada, selected fiscal years

	Health care spending $billions			Average annual percentage change in spending		
Health care spending	1980-81	1992-93	2000-01	1980-81 to 1992-93	1992-93 to 2000-01	1980-81 to 2000-01
Public	17.5	52.3	69.0	9.6	3.5	7.1
Private	5.8	18.7	28.6	10.3	5.4	8.3
Total	23.3	71.0	97.6	9.7	4.1	7.4

Source: Health Canada (2001)

Population aging relative to population growth is considered to be more responsible for the growth in health expenditure since older people consume more health products and services. As shown in Table 2, the share of seniors (65 and older) in the total population edged up over the past 20 years, increasing from 9.4 percent in 1980 to 12.5 percent in 2000 (or an average of 0.16 percentage points per year). The share of the population age 65 and over is projected to go to 18 percent by 2020 and to 25 percent by 2040, while the number of seniors per 100 working age people rises from 18 percent to 28 percent and then to 41 percent.[9] By the year 2026, Canadians over the age of 65 will represent more than one-fifth of the total population. The feature of the future is that the population aging process will accelerate as the share of the senior population increase in the decades ahead. Moreover, older people consume more health-related goods and services than younger people, and. The data from Health Canada shows that the average cost of health care per person in the age group 65-74 is more than three times the average cost per person in the 25-44 age groups.

[9] Robson, William B.P. "*Will the Baby Bommers Bust the Health Budget? Demographic Changes and Health Care Financing Reform*". C.D.Howe Institute Commentary No.148, February, 2001

Demographic change will exert steady pressure on health care budgets. Different provinces will feel these pressures to markedly different degrees.

Table 2. Population shares by selected age groups, selected years, 1980-2026

Fiscal Year	Percentage of population, by age group		
	65+	75+	85+
1980-81	9.4	3.5	0.8
1990-91	11.3	4.5	1.0
2000-01	12.5	5.6	1.4
2011-12	15.9	7.0	1.8
2021-22	19.5	8.5	2.3
2026-27	21.4	9.5	2.6

Source: Health Canada (2001); Statistics Canada (2001)[10]

Over the past 20 years, various demographers, economists, sociologists and other social scientists have projected the impacts of a growing aging population on the Canadian health care system. In this section, their predictions with respect to the size of the elderly population, health care expenditures, percentage of gross domestic product and so on are reviewed.

There are two schools of thought on the role that the future aging population will have on health care expenditures. Foot (1982, 1996), Henripin (1994), Marzouk (1991) and Robson (2001) are representatives of those who believe that the future growth of the elderly population will generate major increases in health expenditures which are not likely sustainable given the current organization and funding of health care in Canada. In contrast, Fellegi (1988), Masson (1990), Denton and Spencer (1985, 1995, 1997), Joe Ruggeri (2002) and Mérette (2000)are representative of those who believe that health care expenditures will increase as a result of the growth in the elderly population, but most of growth in health care expenditures will be manageable.

Almost all of the health projection models developed in Canada relies on Statistics Canada population projections. There are two sources of difference in projections. One comes from different Census year used to make the projections since Statistics

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[10] Ruggeri, Joe. "*Population Aging, Health Care Spending and Sustainability: Do we really have a crisis?*", September, 2002

Canada regularly updates the base year population data, fertility rates, mortality rates and net international migration rates. The second refers to the use by Statistics Canada of the four scenarios that based on various assumptions about fertility, mortality, immigration and migration since 1971. For instance, the choice of a scenario based on high fertility rate will generate projections significantly different from a scenario based on low fertility rate providing that all other things being equal. So we have to understand that the researchers' assumption choices determined some differences in their projections about the future size of the elderly population and future health care spending.

Pessimistic theorists

Foot (1982) used Projection Series No. 1 and the 1972-2001 and the 1976-2001 series for his population projections. Foot states that real per capita costs for physician services will grow between 2001 and 2031 by 7.5 and 30.9 percent respectively. Foot also argues that over the period 1981 to 2031, there will be shifts from health resources for the young to health resources for the aging population and "the percentage of hospital services attributable to persons aged 65 and over will increase." The other worth noting element of his projections is that that by 2011 all of the current hospital capacity will be overwhelmed in taking care of the baby boomers that require medical care.

Foot (1996) updated his view on the impact of the aging population on future health care costs in his "*Boom, Bust & Echo: How to Profit from the Coming Demographic Shift*", which affects almost all decision-makers and policy-makers across all sectors of the Canadian economy. While insisting what he argued in his more analytical work of the 1980s, Foot argues that it is a mistake to close hospitals now since they will be needed to accommodate given the size of the baby boom cohort in the coming decades.

Taking into account the age distribution of the elderly population and their differential rates of utilization of health services to project the impacts of the elderly population on future health care expenditure, Marzouk (1991) distinguishes between the population aged 65 to 74 and the population aged 75 and over in his model. If the ratio of those 75 and over compared to those 65 to 74 increases over time, expenditures will increase more rapidly for the elderly population since the 75 and over cohort uses more services per capita. Marzouk concluded that if the elderly population is treated as only one cohort and only the changes in utilization patterns is considered, then the increase in the percentage of health care spending to GDP is relatively modest. However, if link the changes in utilization patterns to the demographic shifts, the increase in health care expenditure to GDP is much more substantial.[11]

Henripin (1994) projected for Québec though arguing that the results would be similar for all of Canada. He employs what he terms a "parsimonious framework". Using three different population projections, he applies a "production function and three 'need' functions: expenditures on children, on health care and on pensions" Henripin (1994, pp 80). For various time periods up to 2040, he then derives quantitative estimates expressed as the percentage of net domestic product (NDP) required for expenditures on children, health care and pensions. As projection results, Henripin estimates that in 2040 there will be almost a doubling of the percentage of NDP spent on health care from 6.6 to 12.8 resulting from the growth in the elderly population with replacement level fertility rates.[12] When using more lower levels of fertility, the percentage of NDP which will have to be dedicated to future health care expenditures is even more greater. A unique element to Henripin's analysis is that he simulates what it will take to reduce the cost of health care by 10 percent by changing women's life-time employment, postponing retirement or increasing current fertility rates. However, none of these options would be easy for the government policy to accomplish.

Robson (2001) estimates that the provincial health care spending will grow from 6.1 percent of Canada's gross domestic product (GDP) in 2000 to 7.4 percent by 2020 and 10.0 percent by 2040. Health care spending share with respect to government budget will rise form 35 percent in 2000 to 42 percent in 2020 and 57 percent in 2040. In present value terms, the projections suggest implicit health care liabilities comparable to more familiar figures for public sector debt, an amount equal to $530 billion, which is more than 50 percent of Canada's present GDP. For several provinces and

[11] Marzouk, M.S. "*Aging, age-specific health care costs and the future health care burden in Canada*", Canadian Public Policy. Vol. 17, No. 4, 1991. pp.473-489
[12] Henripin, J. "*The financial consequences of aging*", Canadian Public Policy. Vol. 20, No. 1, 1994

territories the liability exceeds 60 percent of current GDP, a sign of remarkable fiscal pressure in the coming decades.[13] Robson argues that the baby boomers present an unsustainable challenge to Canada's health care system.

Robson (2001) adds that even with support from immigration, population growth slows during 2020-40 period and virtually ceases by the end of projection. Growth in the working-age population (age 15 through 64) is, on average, even more restrained. When the focus shifts to the older population, unsurprisingly, as the baby-boom generation passes the age 65, it will be of large increase. Inter-provincial variations in the growth of the senior group are also considerable.

Robson proposed two ways to deal with the health care challenge: one is that a seniors health grant and a seniors health account would be compatible with many other reforms to Canada's public health care system; the other is that reforming federal-provincial transfers by repackaging a portion of the CHST as a per senior grant that grows with the older population of each province would create a system that would be more robust in the face of pressures that aging will put on different provinces.

Optimistic theorists

Among the early efforts at projecting the impact of the aging population on future health care costs, Denton and Spencer (1983) represents a shift away from simple linear extrapolations. In contrast to the early attempts by Gross and Schwenger (1981) and Foot (1982) at projecting the impact of the aging population on future health costs, Denton and Spencer (1983) used integrated models of demographics and the economy to project the future impacts of population change on health and social expenditures. On the demographic side, only Denton and Spencer's (1983) high fertility projection is close to those in the most recent projections available from Statistics Canada. On the health expenditure side of their projections, Denton and Spencer (1983) generate results where health care costs as a percent of Gross National Product (GNP) range from 8.9 to 9.2 percent of GNP in 2031 depending on the scenario chosen.

[13] Robson, William B.P. "*Will the Baby Bommers Bust the Health Budget? Demographic Changes and Health Care Financing Reform*". C.D.Howe Institute Commentary No.148, February, 2001

Their work (1995, 1997) also represents a shift in thinking away from the "crisis" view represented by the following views: First, health care and social security expenditures will absorb an increasing share of GDP while education expenditures as a percentage of GDP will decline in the future. Spencer (1997) criticizes that it makes little sense to consider in isolation only those expenditure categories (such as health care and old age security) that might be expected to increase, and then to claim that there is a crisis. Secondly, the relative decline in education expenditures and improvements in health care technology and efficiency will only offset some of the increases in health care expenditures. Thirdly, population aging relative to population growth is seen to be more responsible for the growth in expenditures. Most importantly message is that the future growth in health care expenditures which are due to population aging should be manageable, but the level of manageability will be dependent to some extent on the offsets from declining education expenditures and savings in the health care sector resulting from new technologies and internal efficiencies.[14]

Fellegi (1988) using the 1986 population projections supports the views of Denton and Spencer (1983). The low projection case demonstrates that the increase in the elderly population has only a modest effect on the increase in future health care expenditures. The high projection case demonstrates that rising health care costs have a much greater impact on future health care costs than demographic changes. He argues that if the unit costs of health care grow at a similar rate to the rate of growth in the economy, then the working age population's ability to carry the costs of the health care system will not change in the future.[15]

Masson (1990) also observes that with the population ages, government expenditure on medical care, as a percentage of GDP, will increase. However, this increase will be offset by a decrease in spending on education. It is important to note that both healthcare and education spending comprise goods and services expenditures, so they will act to increase aggregate demand. On the other hand, the results reveal that spending on pension benefits will increase by 5-10 percent in the first decades of the next century. Masson's model examines several countries and found that government

[14] Denton, F.T. and Spencer, B.G.. "*Demographic change and the cost of publicly funded health care*", Canadian Journal on Aging. Vol. 14, No. 2, 1995

[15] Fellegi, I. "*Can We Afford an Aging Society?*" Canadian Economic Observer, No.10, October, 1988

spending will be largest in Japan, Germany, and Italy, and smallest in the U.S. and Canada. Mérette (2002) suggests that health care pressure on government expenditures in Canada will be offset by favorable revenues arising from private pension withdrawals.[16]

The issue of sustainability is the main subject that discussed by Ruggeri (2002). He identifies three aspects of sustainability. The first relates to the ability of the economy to sustain current and projected levels of health care spending. The second issue involves the capacity of the full fiscal system (all governments combined) to withstand the pressures of rising health care expenditures. The third concern focuses on the ability of provincial/territorial governments to fulfill their constitutional commitment for the provision of health care. His projection is that by the year 2026-2027, with population aging, health care spending is projected to claim 43.2 cents of each dollar of provincial/territorial revenues. Ruggeri argues that if there is an issue of sustainability, it must have a fiscal dimension because in terms of its share of GDP, health care spending is quite sustainable currently as well as for the future.[17]

Summary

The work discussed in this section reviews two kinds of thought on the impact of future aging population will have on health care sectors. Foot (1982, 1996), Henripin (1994), Marzouk (1991) and Robson (2001) are examples of what was previously labeled the crisis theorists. Although they choose different methodologies and thus get different projections, the conclusions they drew are similar, that is, the future growth of the elderly population will generate prodigious pressure in health expenditures which are not likely sustainable given the current organization and funding of health care in Canada. In contrast, Fellegi (1988), Masson (1990), Denton and Spencer (1985, 1995, 1997), Ruggeri (2002) and Mérette (2002) are representative of the manageable theorists. Their projections suggest that as the population ages, health care expenditures will increase, but most of this will be manageable because of some combination of the reallocation of expenditures, concomitant increases in productivity and offsets resulting from decrease within education sector, new technologies and

[16] Mérette, Marcel. "*The bright side: A positive view on the economics of aging*", 2002
[17] Ruggeri, Joe. "*Population Aging, Health Care Spending and Sustainability: Do we really have a crisis?*", 2002

efficiencies improvements within the health care sector, and new tax revenue arising from private pension withdrawals.

Non-demographic factors

Demographic change is certainly important when it comes to health and long-term care costs, but demographics alone do not determine future health status and needs of an aging population. In other words, aging is not the only reason for increasing of healthcare expenditure. Other dynamic factors that are important include the increasing life expectancy, the epidemiology of diseases, various components of health care delivery (for instance, home care, technology drugs, physician behavior, etc.) health and disability, trends in family formation, pensions, public policies, and private sector activities. Foot (1996) raises a number of other issues which ought to be considered in any new projection models which might be developed, for example, the shift to the private sector and fee-for-service payment systems. Each of these factors has the potential to moderate the financial impact of an aging society on public health and long-term programs.

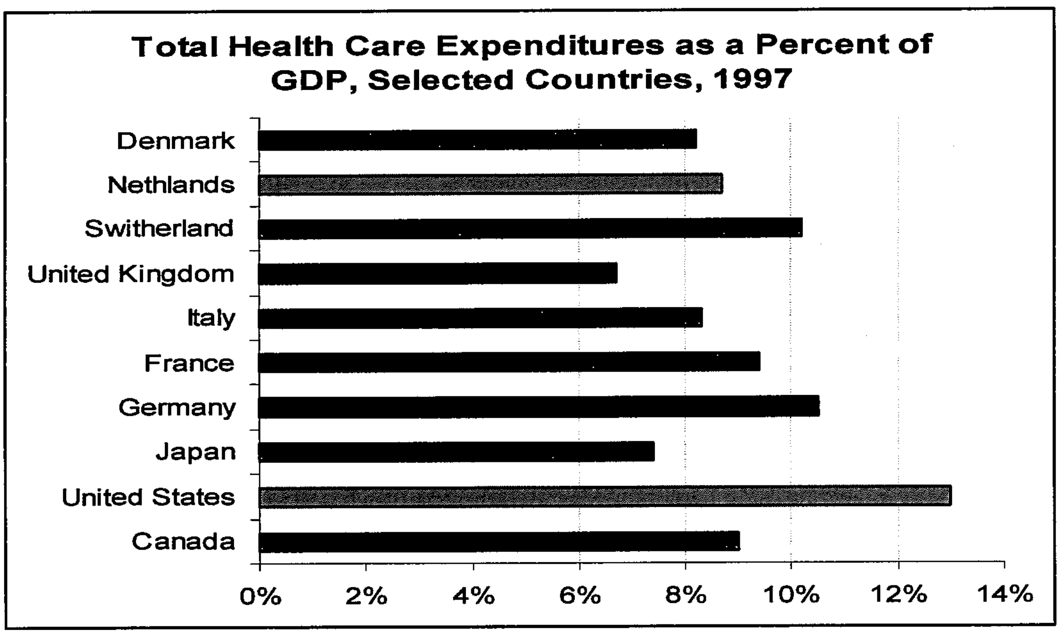
In summing up, there are widely held belief that there is considerable evidence that the growth of the elderly population, is only one element (and likely not the major element) that driving the growing expenditures in Canadian health care systems. Moreover, the future health expenditures might decline as the result of improved technology, drug therapies or the substitution of home care services for institutional care. Thirdly, the growth of the elderly population will be very unevenly distributed through Canada and this will result in different delivery of health care in different places. Finally, we need to carefully think how disability, health status and economic status have the impact on the nature of the economic life as the Canadian economy restructures and finds its way in an increasingly global economy.

Canada in international scenario

Since population aging is a widespread phenomenon among developed countries, some international comparisons are helpful. In comparison to many of the countries in western and northern Europe, Canada remains a relatively "young" country. Based on OECD data and projections, the "elderly dependency ratios" show that Japan's elderly dependency ratio was higher than the Canadian ratio by 1980, higher than the US ratio by the early 1990s, higher than the EC ratio by the late 1990s, and is projected to be the highest among the OECD countries for the next three decades and beyond. In the contrast, Canadian ratios are noticeably lower than that of the European Community as a whole. The elderly dependency ratio in Canada is likely to increase rather little until after 2010, and then to continue to be lower than that of Japan and the EC, and slightly above that of the US. [18]

With regard to total health care expenditure as a percent of GDP, Canada ranked forth in the amount spent on health care behind the United States, Switzerland and Germany. However, there are some OECD counties which are already ahead of Canada in terms of the size of their elderly population, however they spend less on health care and achieve similar health care outcomes than Canada.

Table 3.



Source: World Health Organization, 2000[19]

The international scan shows that most countries and international institutions now believe that the growth of the elderly populations and the impact it will have on health care expenditure is manageable through a mixture of overall economic growth and prudent adoption of greater efficiencies and cost effective measure. Even in the case of World Bank (1994) which continues to use "crisis" rhetoric, their message is that there is a window of opportunity to make changes which will avert "the old age

[18] www.oecd.org
[19] www.who.int/en/

crisis".[20] Thus in the case that we in Canada are relatively well positioned, by international standards, the challenge should be manageable through sophiscate research and effective methods.

5. The Model

In this paper, we simulate the inter-regional, inter-sectoral, and occupational effects, especially on labour market by taking into consideration the upcoming structural shift of the Canadian population. A computable general equilibrium model that comprises 6 Canadian regions with 6 different age groups (from 15 to 85) within each, 14 sectors and about 25 different occupations distinguished by profession categories and skill levels is built to analyze the inter-regional consequences of population aging in Canada. The model is calibrated on various sources of Canadian data.

The equations of the model can be grouped into those related to the productions sector, the household behavior, the government sector (including the pension system), and the aggregation and equilibrium conditions. For producers, they maximize their profits by minimize costs subject to their technology constraints. Specifically, labour demand are differentiated by different types of labour services from different professions with different qualifications. Households want to maximize their utility subject to wealth constraint. The economic behaviour of an individual, including consumption behaviour, changes with age. In general, Canadians follow lifecycle behaviour. That is young Canadians borrow to invest in human capital and the middle-age work more to acquire assets to secure future consumption. Then senior Canadians prefer leisure time and consume considerable health care services. A regional government supply public goods, issue government bonds, and obtain revenues from labour, consumption and capital tax. The equilibrium condition for the market for goods states that in each region total supply must be equal to total demand.

Sets and indices

There are I fully endogenous and symmetric Canadian regions indexed by i, or j and a reduced form residual rest of the world indexed *row* in a subset denoted *RoW*. The set of all regions is denoted II and indexed by ii or jj (ii=1,…,II).

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[20] World Bank "*Averting the Old Age Crisis: Policies to Protect the Old and Promote Growth*",1994

There are S sectors of production indexed by s,ss (s=1,…,S) in each region. Labour is distinguished by qualifications, within different occupations or professions grouped in different types and qualifications. We identify the set of qualifications by *Iqual* (*iqual*=1,…,*Iqual*), the set of occupations by *Iprof*(*iprof*=1,…,*Iprof*), and the set of labour types by *Itype*(*itype*=1,…,*Itype*).(See Appendix 2)

At each period in time (time is indexed t) there are G (g=1,…,N) generations that coexist. We index by gj (gj=1,…,GJ) the working generations, and by gm (gm=GJ+1,…, G) the retired.

Producers s of region j at time t

There are two inputs factors of production, which are capital services denoted $K^{dem}_{j,s,t}$ and different types of labour services form different professions with different qualifications, denoted $L^{Qual}_{j,s,itype,iprof,iqual,t}$. Producers use factors of productions and intermediate input goods from sectors ss, the latter in amount $X_{ss,j,s,t}$. Each input is bought at market prices, respectively $\text{Rent}_{j,t}$, $w^{Qual}_{j,itype,iprof,iqual,t}$ and $P^c_{j,ss,t}$. Note that factor prices are the same for all sectors but specific to each region: factors are assumed mobile between sectors but immobile between regions.

When producers make the production decision, they would have to minimize the total costs in producing good s in amount $Z_{j,s,t}$, therefore they would solve the following problem:

$$\underset{XS_{SS,J,S,T},K^{dem}_{j,s,t},L^{dem}_{j,s,itype,iprof,iqual,t}}{Minimize} \sum_{ss} P^c_{j,ss,t} XS_{ss,j,s,t} + \text{Re}\,nt_{j,t} K^{dem}_{j,s,t} + \sum_{\substack{itype\\iprof\\iqual}} w^{Qual}_{j,itype,iprof,iqual,t} L^{Qual}_{j,s,itype,iprof,iqual,t}$$

We use CD(.;Sc,α), as for the Cobb-Douglas form, parameterized by the scaling parameter Sc and the expenditure shares α, and CES(.;α,σ), as for a constant-elasticity-of-substitution form with share parameters α and substitution elasticity σ.

$$Z_{j,s,t}=CD(X_{j,s,t},Q_{j,s,t};Sc^{Z}_{j,s,t},\alpha^{Q}_{j,s}) \qquad (P_{j,s,t})$$

$X_{j,s,t}$=CES($XS_{ssj,s,t}$; $\alpha^{XS}_{SS,j,s}$, $\sigma^{X}_{j.s}$) $(P^{X}_{j,s,t})$

$Q_{j,s,t}$=CD($K^{dem}_{j,s,t}$, $L^{dem}_{j,s,t}$;$Sc^{Q}_{j,s,t}$, $\alpha^{K}_{j,s}$) $(P^{Q}_{j,s,t})$

$L^{dem}_{j,s,t}$=CES($L^{type}_{j,s,itype,t}$; $\alpha^{Ltype}_{j,s,itype}$, $\sigma^{Ldem}_{j.s}$) $(wage_{j,s,t})$

$L^{type}_{j,s,t}$=CES($L^{Prof}_{j,s,itype,iprof,t}$; $\alpha^{Lprof}_{j,s,itype,iprof}$, $\sigma^{Ltype}_{j.s,itype}$) $(w^{Type}_{j,s,itype,t})$

$L^{Prof}_{j,s,itype,iprof,t}$=CES($L^{Qual}_{j,s,itype,iprof,iqual,t}$; $\alpha^{Lqual}_{j,s,itype,iprof,iqual}$, $\sigma^{Prof}_{j.s,iprof}$) $(w^{Prof}_{j,s,itype,iprof,t})$

The optimality conditions of the problem are the following:

(1) $Z_{j,s,t}= Sc^{Z}_{j,s,t}\ X^{1-\alpha^{Q}_{j,s}}_{j,s,t}\ Q^{\alpha^{Q}_{j,s}}_{j,s,t}$

(2) $P^{X}_{j,s,t}X_{j,s,t} = (1-\alpha^{Q}_{j,s})P_{j,s,t}Z_{j,s,t}$

(3) $P^{Q}_{j,s,t}Q_{j,s,t} = \alpha^{Q}_{j,s}P_{j,s,t}Z_{j,s,t}$

The production of output $Z_{j,s,t}$ requires therefore to combine, in fixed expenditure shares, intermediate inputs and value added, respectively in amount $X_{j,s,t}$, $Q_{j,s,t}$, where $Sc^{Z}_{j,s}$ is the scaling parameter and $\alpha^{Q}_{j,s}$ the value added share. Because the output is homogeneous of degree one with respect to $X_{j,s,t}$ and $Q_{j,s,t}$, we have $P^{Z}_{j,s,t}Z_{j,s,t} = P^{X}_{J,S,T}X_{j,s,t} + P^{Q}_{j,s,t}Q_{j,s,t}$. The homogeneity also implies that $1-\alpha^{Q}_{j,s}$ is intermediate input share and $\alpha^{Q}_{j,s}$ the value added share of output.

The aggregate intermediate input is a CES mix of market goods in quantities $XS_{ssj,s,t}$, which is the quantity of goods *ss* demanded by section *s* of region *j*. In the equation below, $\alpha^{XS}_{s,j,s}$ is the expenditure share and $\sigma^{X}_{j,s}$ is the elasticity of substitution between aggregate intermediate goods price $P^{X}_{j,s,t}$ and specified intermediate good price $P^{c}_{j,ss,t}$. When $P^{X}_{j,s,t} = P^{c}_{j,ss,t}$, parameter $\alpha^{XS}_{s,j,s}$ determines the demand proportion of $XS_{ss,j,s,t}$ to aggregate intermediate good demand $X_{j,s,t}$. When $P^{c}_{j,s,t}$ declines or/and when $P^{X}_{j,s,t}$ increases, the demand for $XS_{ss,j,s,t}$ increases. To what extent the relative prices

$\left[\frac{P^X_{j,s,t}}{P^c_{j,ss,t}}\right]$ changes to modify the demand structure will depend on the elasticity of substitution $\sigma^X_{j,s}$.

(4) $XS_{ss,j,s,t} = \alpha^{XS}_{ss,j,s}\left[\frac{P^X_{j,s,t}}{P^c_{j,ss,t}}\right]^{\sigma^X_{j,s}} X_{j,s,t}$

Given the CES mix structure, the price of the aggregate intermediate input $P^X_{j,s,t}$ has also is CES relationship with respect to specific intermediate good price.

(5) $P^{X^{1-\sigma^X_{j,s}}}_{j,s,t} = \sum_{ss} \alpha^{XS}_{ss,j,s} P^{c^{1-\sigma^X_{j,s}}}_{j,ss,t}$

The value added is produced using capital $K^{dem}_{j,s,t}$ and aggregate labour services $L^{dem}_{j,s,t}$. The value added technology has a CD form. Rental return to capital, rent and wage rate, $wage_{j,s,t}$ equal the marginal product of capital and labour respectively:

(6) $Q_{j,s,t} = Sc^Q_{j,s} K^{dem^{\alpha^K_{j,s}}}_{j,s,t} L^{dem^{1-\alpha^K_{j,s}}}_{j,s,t}$

(7) $Rent_{j,t} K^{dem}_{j,s,t} = \alpha^K_{j,s} P^Q_{j,s,t} Q_{j,s,t}$

(8) $wage_{j,s,t} L^{dem}_{j,s,t} = (1-\alpha^K_{j,s}) P^Q_{j,s,t} Q_{j,s,t}$

The $\sigma^{Ldem}_{j,s}$ is the elasticity of substitution between wage of specific type labour $w^{Type}_{j,s,itype,t}$ and aggregate wage level $wage_{j,s,t}$. When the wage level in this type of labour is equal to the aggregate wage level, parameter $\alpha^{Ltype}_{J,s,itype}$ determines the labour demand proportion $L^{dem}_{j,s,t}$ to specific type labour demand $L^{Type}_{j,s,itypet}$. The extent to which the relative wage $\left[\frac{wage_{j,s,t}}{w^{Type}_{j,s,itypet}}\right]$ changes labour demand for itype occupation depends on the elasticity of substitution $\sigma^{Ldem}_{j,s}$. When $w^{Type}_{j,s,itype,t}$ increase with respect to aggregate wage ($wage_{j,s,t}$), $L^{Type}_{j,s,itype,t}$ the demand for the corresponding type of labour increases.

(9) $L^{Type}_{j,s,itype,t} = \alpha^{Ltype}_{j,s,itype}\left[\frac{wage_{j,s,t}}{w^{Type}_{j,s,itype,t}}\right]^{\sigma^{Ldem}_{j,s}} L^{dem}_{j,s,t}$

Given the CES mixture, the aggregate wage is determined by a CES relationship with respect to the wage of the specific type of occupation.

(10) $wage^{1-\sigma^{Ldem}_{j,s}}_{j,s,t} = \sum_{itype} \alpha^{Ltype}_{j,s,itype} w^{Type^{1-\sigma^{Ldem}_{j,s}}}_{j,s,itype,t}$

The aggregate labour service is a CES mixture of different types of labour $L^{Type}_{j,s,itype,t}$, each of these types being a different CES combination of professions $L^{Prof}_{j,s,itype,iprof,t}$, which themselves result from a CES combination of different qualifications $L^{Qual}_{j,s,itype,iprof,iqual,t}$. This multilevel CES aggregation structure captures the different nature of labour inputs. Associated with each constraint of the firm's cost minimization problem are shadow prices, which are indicated in brackets and linked by CES price structure.

(11)

$$w^{Type\ \ 1-\sigma^{Ltype}_{j,s,itype}}_{j,s,itype,t} = \sum_{iprof} \alpha^{Lprof}_{j,s,itype,iprof} w^{Prof\ \ 1-\sigma^{Ltype}_{j,s,itype}}_{j,s,itype,iprof,t}$$

$$(12)\ L^{Prof}_{j,s,itype,iprof,t} = \alpha^{Lprof}_{j,s,itype,iprof} \left[\frac{w^{Type}_{j,s,itype,t}}{w^{Prof}_{j,s,itype,iprof,t}}\right]^{\sigma^{Ltype}_{j,s,itype}} L^{Type}_{j,s,itype,t}$$

$$(13)\ w^{Prof\ \ 1-\sigma^{Lqual}_{j,s,iqual}}_{j,s,itype,iprof,t} = \sum_{iqual} \alpha^{Lqual}_{j,s,itype,iprof,iqual} w^{Qual\ \ 1-\sigma^{Lprof}_{j,s,iprof}}_{j,s,itype,iprof,iqual,t}$$

$$(14)\ L^{Qual}_{j,s,itype,iprof,iqual,t} = \alpha^{Lqual}_{j,s,itype,iprof,iqual} \left[\frac{w^{Prof}_{j,s,itype,iprof,t}}{w^{Qual}_{j,s,itype,iprof,iqual,t}}\right]^{\sigma^{Lprof}_{j,s,iprof}} L^{Prof}_{j,s,itype,iprof,t}$$

Household g of region j at time t

An Allais-Samuelson overlapping generations framework characterizes households, so that the model is based on the life-cycle theory of saving behavior. Each individual lives six adult periods of ten years, retiring after five periods. In each period, the oldest generation dies and a new generation enters the labour force, which implies that at any point in time six generations are alive. The working life starts at the age of 15; younger children are assumed to be fully dependent on their parents to which they constitute no extra burden nor provide any felicity. Perfect foresight individuals retire from the labour market at the age of 64 and die at age 74. In every region, each new generation's problem consists in a first step to maximize an intertemporal utility function of consumption and bequest subject to a lifetime income. The utility function is time-separable and of the constant elasticity of substitution type:

(15)

$$U_{j,t} = \frac{1}{1-\theta}\sum_{g=1}^{6}\left(\frac{1}{1+\rho}\right)^{g}\left(Con_{j,g,t+g-1}^{1-\theta} + \beta_g^{\theta} RBeq_{j,g,t+g-1}^{1-\theta}\right) \qquad \theta>0,\ \beta_{g\neq 6}=0,$$

$\beta_{g=6}>0$

where $Con_{j,g,t}$ is consumption of an individual living in region j of age group g at time t, ρ the pure rate of time preference, θ the inverse of the intertemporal elasticity of substitution, β_g is a constant parameter and $RBeq_{j,g,t}$ denotes bequests (in real terms). This equation states that the welfare of an individual is a weighted sum of 6 periods of consumption from age group g=1 at period t to age group g=6 at t+5, plus the (positive) utility to bequest for g=6 in period t+5. Leisure does not enter into the utility function since individual's labour supply is assumed to be exogenous.

The bequest specification follows Blinder (1974) and gives rise to intergenerational transfers in addition to public old-age pension benefits. It is noteworthy that this specification of the utility function yields very different results than the alternative of introducing the utility of future generations directly into the utility function of current generations. In the presentation chosen here, the felicity from bequest is independent of the present value of cash receipts extending beyond the death of the current generation; hence, the timing of government expenses have an effect on the current generation's utility.

Assuming no borrowing constraints and perfect capital markets, the present value of household wealth $W_{j,t}$, is the discounted sum of lifetime labour income $LInc_{j,g,t}$ net of taxes but inclusive of public old-age pensions $Pens_{j,g,t}$ and inheritance $Inh_{j,g,t}$:

(16)

$$W_{j,t} = \sum_{g=1}^{6}\left(\frac{1}{1+R\mathrm{int}_{t+g-1}(1-\tau^{K})}\right)^{t}(LInc_{j,g,t+g-1}(1-\tau^{w}_{j,t+g-1} - CtR_{t+g-1}) +$$

$$(1-\tau^{w}_{j,t+g-1})\, Inh_{j,g,t+g-1} + Pens_{j,g,t+g-1})$$

Labour income depends on the individual's age-dependent productivity (earnings) profile. In this model the earnings profile is assumed to be identical across region. To be more precise, the earnings profile ($EP\,g$) is a quadratic function of age (g) with parametric values chosen to ensure that the maximum is reached between mid-life and retirement:

(17) $$EP_g = \gamma + \lambda g - \psi g^2, \qquad \gamma, \lambda, \psi \geq 0,$$

As labour embodies the earnings profile, we can define the labour income of a individual in working age group *gj* in region *j* at time *t* as being the wage times labour supply times the earning profile, in which wage is dependent of different types of labour services from different professions with different qualifications:

(18) $$LInc_{j,gj,t} = \sum_{\substack{itype \\ iprof \\ iqual}} w^{qual}_{j,itype,iprof,iqual,t} L^{\sup}_{j,itype,iprof,iqual,gj,t} EP_{gj}$$

Pension benefits of the retirees are proportional to their lifetime labour earnings. The fraction is determined by the pension replacement rate *PensR* that applies identically everywhere in Canada. As people work for 5 periods and then retire, pension benefits can be expressed as:

(19) $$Pens_{j,gm,t} = PensR \frac{1}{5} \sum_{gj} LInc_{j,gj,t-5+gj}$$

Differentiating the household utility function with respect to individual's lifetime budget constraint yields the following first-conditions for consumption and bequests:

(20) $$Con_{j,g+1,t+g} = \left[\frac{(1 + R\text{int}_{t+g}(1-\tau^K))}{1+\rho_j} \frac{P^{Con}_{j,g,t+g-1}}{P^{Con}_{j,g+1,t+g}} \right]^{(1/\theta)} Con_{j,g,t+g-1}$$

(21) $$RBeq_{j,g,t} = \beta_g Con_{j,g,t}$$

We can see that consumption is increasing over the life cycle when the rate of interest rate of the capital tax is greater than the pure rate of time preference, all that adjusted by the evolution of the consumer price index ($P^{Con}_{j,g,t+g}$).

Bequests are distributed at the end of each generation's lifetime (generation *gn*). Inheritances arising from the oldest age group's bequests that equally distributed to all working generations *gj*:

(22) $$Inh_{j,gj,t} Pop_{j,gj,t} = \frac{1}{5} P^{Con}_{j,gn,t} RBeq_{j,gn,t} Pop_{j,gn,t}, \quad gj=1,2,...5;\ gn=6$$

where $Pop_{j,gj,t}$ is the number of people living in region *j* of age group *g* at time *t*. It is divided by 5 because there are five working periods. The inheritance is defined in current prices and the population growth rate is treated as exogenous.

In the second step of the optimization problem, households must allocate their consumption expenditures among the available final goods s. Again we assume a CES aggregator. Accordingly, the first-order conditions stipulate that region j household's consumption of good s of generation g at time t ($ConS_{j,s,g,t}$) is determined by the following equations, the price of $ConS_{j,s,g,t}$ is $P^{c}_{j,s,t}$:

$$(23) \qquad {P^{Con}_{j,g,t}}^{1-\sigma^{Con}_{J,g}} = \sum_{s} \alpha^{ConS}_{j,s,g} {P^{c}_{j,s,t}}^{1-\sigma^{Con}_{J,G}}$$

$$(24) \qquad ConS_{j,s,g,t} = \alpha^{ConS}_{j,s,g} \left[\frac{P^{Con}_{j,g,t}}{P^{c}_{j,s,t}} \right]^{\sigma^{Con}_{J,G}} Con_{j,g,t}$$

where $\alpha^{ConS}_{j,s,g}$ is a parameter representing the preference of residents of region j for good s, and $\sigma^{Con}_{J,G}$ is the consumption elasticity of substitution. When the price of good s in region g $P^{c}_{j,s,t}$ increases, household's consumption of good s of generation g region j at time t ($ConS_{j,s,g,t}$) will decrease. One thing worth noting is that since the composition of consumption baskets varies across generations. For example, as the older population consumes more health services than younger ones, the aggregate consumer price index that is dependent on age group may differ.

Investors of region j at time t

Households in region j invest in physical capital $Kij_{i,j,g,t}$ and in bonds $Bij_{i,j,g,t}$. Financial markets are efficient and perfectly integrated. In other words, all assets are perfect substitutes and traded on international markets. So households are indifferent in their allocation of savings between physical ownership titles and bonds issued by regional governments. In this model, it is assumed that both asset holdings by local residents are characterized by home bias (captured by calibrated portfolio shares).

Capital goods are built using a CES investment technology that also allows for substitution between different market goods. Therefore, choosing the optimal constituting mix, we have the form of region investment ($InvS_{j,s,t}$) similar to that of regional consumption:

(25) $$P_{j,t}^{Inv^{1-\sigma_j^{Inv}}} = \sum_s \alpha_{j,s}^{InvS} P_{j,s,t}^{c\ \ 1-\sigma_j^{Inv}}$$

(26) $$InvS_{j,s,t} = \alpha_{j,s}^{InvS} \left[\frac{P_{j,t}^{Inv}}{P_{j,s,t}^{c}} \right]^{\sigma_j^{Inv}} Inv_{j,t}$$

where $\alpha_{j,s}^{InvS}$ is a parameter of the CES investment technology and α_j^{Inv} is the corresponding elasticity of substitution. When the price of aggregate investment $P_{j,t}^{Inv}$ increases, regional investment on good s will increase.

The regional stock of physical capital at time t +1 is a function of the regional investment at time *t* plus the depreciated value of regional stock of physical capital at time *t*. When investment $Inv_{j,t}$ increases, the regional stock of physical capital broadens. However, it narrows with the constant depreciation rate $DepR_j$.

(27) $$Kstock_{j,t+1} = Inv_{j,t} + (1 - DepR_j)Kstock_{j,t}$$

The one period expected rate of return on capital $RRet_{j,t}$, from a unit of physical capital bought at time t -1, is a function of its expected real rental price minus the depreciation rate, plus the anticipated capital gains. Algebraically, we have the following equation:

(28) $$RRet_{j,t} = \frac{Rent_{j,t} + (1 - DepR_j)P_{j,t}^{Inv}}{P_{j,t-1}^{Inv}}$$

The government of region j at time t

Regional government gain tax revenues from labour and capital income, as well as consumption expenditure. Its spending includes government consumption $Gov_{j,t}$, and debt interest payments. Government consumption spending is allocated across sectors using a CES aggregator. The share parameter α determines the proportion of regional government spending on good s to total government spending in region j at time t. When the price of good s in region j at time t increases, government spending for good s in region j at time t declines.

(29) $$P_{j,t}^{Gov^{1-\sigma_j^{Gov}}} = \sum_s \alpha_{j,s}^{GovS} P_{j,s,t}^{c\ \ 1-\sigma_j^{Gov}}$$

$$(30) \qquad GovS_{j,s,t} = \alpha_{j,s}^{GovS} \left[\frac{P_{j,t}^{Gov}}{P_{j,s,t}^{c}} \right]^{\sigma_j^{Gov}} Gov_{j,t}$$

When tax revenues come short of total government consumption and interest debt payment, the government issues new bonds at time t+1 to satisfy its budget constraint. Accordingly, the budget constraint of the government is:

$$(31) \qquad P_{j,t}^{Gov}\, Bond_{j,t+1} + \sum_g Pop_{j,g,t} \{ \tau_{j,t}^{w} (LInc_{j,g,t} + Pens_{j,g,t}) + \tau_{j,t}^{Con} P_{j,t}^{Con} Con_{j,g} +$$

$$\tau_{j,t}^{K} \sum_i \left(\frac{R\text{int}\, J_{i,t-1} P_{i,t}^{Gov}}{P_{i,t-1}^{Gov}} - 1 \right) P_{i,t-1}^{Gov} Bij_{i,j,g,t} + \tau_{j,t}^{K} \sum_i (R\text{Re}t_{i,t-1} - 1) P_{i,t-1}^{Inv} Kij_{i,j,g,t} \}$$

$$= P_{j,t}^{Gov} Gov_{j,t} + \left(\frac{R\text{int}\, J_{j,t-1} P_{j,t}^{Gov}}{P_{j,t-1}^{Gov}} \right) P_{j,t-1}^{Gov} Bond_{j,t}$$

On the left hand of the equation, we have the value of new bonds that are issued at time *t+1* and all the tax revenues government arising at time *t* from labour income, capital returns and consumption expenditure. On the right hand side of the equation, we have government consumption plus debt interest payments.

Pay-as-you-go pension benefits are financed by contribution rates on wage earnings. With population ageing, the contribution rate is expected to rise. But as the program is considered nation-wide, no inter-regional consequences are expected. The pension program is represented by the following equation; the total pension of the retiring population equals the total income of the working population times CtR_t, the national contribution rate for the pay-as-you-go program:

$$(32) \qquad \sum_j Pop_{j,gn,t} Pens_{j,gn,t} = CtR_t \sum_j \sum_{gj} Pop_{j,gj,t} LInc_{j,gj,t}$$

Region J's foreign trade in goods at time t

All agents with region j make use of a composite good indexed s, which is priced at $P_{j,s,t}^{c}$. The aggregate demand for specific good is adding-up all individual demands, including the intermediate good input demand, the consumption of the population, the investment and the government spending:

$$(33) \qquad \sum_{ss} XS_{s,j,ss,t} + \sum_g Pop_{j,t,g} ConS_{j,s,g,t} + InvS_{j,s,t} + GovS_{j,s,t}$$

The traditional Armington assumption is used here to allocate this demand between regions. That is, although individual producers are microscopic price takers, goods of sectors s are assumed differentiated in demand by their geographic origin. A fictitious importer accordingly chooses the optimal basket of domestic and interregional/international goods in each sector, using a CES ($E_{ii,j,s,t}$; $\alpha^{E}_{ii,j,s}$ $\sigma^{c}_{j,s}$) aggregator. The price $P^{c}_{j,s,t}$ can be expressed as a function of each supplying region's producer price $P_{j,s,t}$:

$$(34) \qquad {P^{c}_{j,s,t}}^{1-\sigma^{c}_{j,s}} = \sum_{ii} \alpha^{E}_{ii,j,s} {P_{ii,s,t}}^{1-\sigma^{c}_{j,s}}$$

and the associated demand system is:

(35)

$$E_{ii,j,s,t} = \alpha^{E}_{ii,j,s} \left[\frac{P^{c}_{j,s,t}}{P_{ii,s,t}} \right]^{\sigma^{c}_{j,s}} \left\{ \sum_{ss} XS_{s,j,ss,t} + \sum_{g} Pop_{j,t,g} ConS_{j,s,g,t} + InvS_{j,s,t} + GovS_{j,s,t} \right\}$$

$E_{ii,j,s,t}$ is the demand at time *t* by region *j*, for good *s* produced in region *ii*. The share parameter α determines the proportion of region *j*'s demand for specific good *s* of total aggregate demand for good *s*. The extent to which changes in relative prices modify the composition of the demand depend on the substitution elasticity σ. For instance, if the price of good s produced in region *ii* decline with respect to the price of the same good produced in other regions, region *j*'s demand for good s through all regions will increase.

The rest of the world at time t

The rest of the world serves to close the model. It is described by a reduced form: its prices and income are exogenously held constant. The rest of world's demand for region j's good s depends on the region's sectorial competitiveness, which depends on the scaling parameter $Sc^{E}_{j,row,s}$ and substitution elasticity η_s.

$$(36) \qquad E_{j,row,s,t} = Sc^{E}_{j,row,s} \left[\frac{P_{row,s,t}}{P_{j,s,t}} \right]^{\eta_s} \qquad \eta_s > 0$$

Consistent with the reduced from description of the rest of the world, it is assumed that the rest of world neither borrow nor lend internationally, so that its trade with Canadian economy as a whole is calibrated as balanced, and remains such at all t:

(37) $$\sum_{ii}\sum_{s} P_{ii,s,t} E_{ii,row,s,t} = \sum_{s} P_{row,s,t} \sum_{ii} E_{row,ii,s,t}$$

To describe the equation in words, we can say that at all *t*, the total value of the rest of world's importation from Canada equals the total value of exportation towards Canadian regions from the rest of the world.

Equilibrium Conditions

--Market Clearing for goods:

The model assumes that all markets are perfectly competitive. The equilibrium condition for the market for goods states that in each region output (supply) must be equal to total demand.

(38) $$Z_{j,s,t} = \sum_{ii} E_{j,ii,s,t}$$

The stocks of labour and physical capital are considered immobile across regions, so a market exists for these two factors of production. The stock of effective labour is the number of individuals times their corresponding productivity level.

--Full employment of labour:

(39) $$\sum_{gj} Pop_{j,gj,t} L^{\sup}_{j,itype,iprof,iqual,gj} EP_{gj} = \sum_{s} L^{qual}_{j,s,itype,iprof,iqual,t}$$

--Full employment of capital:

(40) $$Kstock_{j,t} = \sum_{s} K^{dem}_{j,s,t}$$

--Full integrated asset markets:

As bonds and capital shares are perfect substitutes, expected returns on bonds equal expected return on capital shares.

(41) $$\frac{R\text{int}\, J_{j,t} P^{Gov}_{j,t+1}}{P^{Gov}_{j,t}} = R\text{Re}t_{j,t+1}$$

As financial capital is assumed perfectly mobile across regions, an interest parity condition applies across regions.

(42) $$R\text{int}_t = \frac{R\text{int}\, J_{j,t} P^{Gov}_{j,t+1}}{P^{Gov}_{j,t}}$$

This completes the models description. As the regional markets for financial assets are fully integrated, supply must equal demand. It is easy to check that the model implies asset market clearing at each t:

$$(43) \qquad \sum_j \sum_g Pop_{j,g,t} Lend_{j,g+1,t+1} = \sum_j P^{Gov}_{j,t} Bond_{j,t+1} + P^{Inv}_{j,t} Kstock_{j,t+1}$$

Prices of the rest of the world are chosen as numéraire. A static (steady state) version of the model is easily found by setting t-1= t = t+1 in all equations.

6. Data and Calibration

Calibration of the model is trying to fit a macroeconomic long run steady state consistent with many detailed microeconomic concerns. The challenge is to build a Social Accounting Matrix (SAM) constrained on the preference patterns of the different age groups, the sectoral and regional production, and the distribution of different types of professions and skills. Also, the SAM must be consistent with macroeconomic aggregates such as regional output, consumption, investment, and inter-regional trade data flow. Moreover, the calibration procedure must guarantee an inter-temporal consistency of the model since the model is dynamic and characterized by an overlapping generation's structure. For instance, at the individual levels, consumption and savings decisions must be compatible with aggregate inter-temporal prices such as the rate of interest. In addition, the amount of savings must be sufficient to cover the stocks of assets existing in the economy. As this is a model that contains many regions, sectors, age groups and types of professions and labour skills, to ensure consistency between all macroeconomic and microeconomic data that coming from different sources is a very challenging task. In the following, we explain the data sources and calibration procedure.

There are seven regions of the model: the rest of world (RoW) and six Canadian regions. They are respectively: the Atlantic provinces (ATL) composed of Newfoundland, Nova Scotia, New Brunswick, the Price Edward Island; the province of Quebec (QUE); the province of Ontario (ONT); the Prairies (PRA) composed of Manitoba, Saskatchewan, North West Territories and the Nunavut; the province of Alberta (ALB); the British Columbia region composed of the British Columbia province and Yukon.

The inter-regional trade flows were taken from the 1999 Interprovincial and international Trade Flows Matrix calculated by Statistics Canada.[21] The model contains 14 sectors in each region. Table 4 summarizes the aggregation rule applied to the large Statistic Canada Table:

Table 4. Sectors of the Economy

	Model Acronym
1. Primary	PRI
2. Manufacture and Public Utility	MAN
3. Construction	CST
4. Transport and Storage	TRA
5. Communication	COM
6. Wholesaling and Retailing	CGD
7. Finance, Insurance and Real Estate Services	FAI
8. Professional Services to Firms and Publicity	SEP
9. Computer and other Services to Firms	ICS
10.Public Administration	ADM
11. Education	EDP
12. Health	SAN
13. Accommodation and Leisure Services	HRD
14. Other Services	AUT

One of the original elements of the model is that we divided labour into many categories of profession and skills. The categories were defined by the National Occupational Classification Matrix 2001 supplies by Human Resources and Development Canada (HRDC). Table 5 summarizes the 10 different professions and 5 skill levels of the matrix.

Table 5. Professions and Qualification Levels

Professions
1. Business, finance and administration occupations
2. Natural and applied sciences and related occupations
3. Health occupations
4. Occupations in social science, education, government service and religion
5. Occupations in arts, culture, recreation and sport
6. Sales and services occupations
7. Trades, transport and equipment operators and related occupations
8. Occupations specific to primary industry
9. Occupations specific to processing, manufacturing and utilities
10. Management
Qualification Levels
1. Management occupation
2. Occupations that usually require university education
3. Occupations that usually require college education or apprenticeship training
4. Occupations that usually require secondary school and/or occupation specific training

[21] Statistics Canada, Systems of National Accounts, Input-Output Division, Table 386-001

5. On-the-job training is usually provided for these occupations

(See Appendix 2 and Appendix 3)

Table 6 reports some calibrated values for parameters and variables. Canadian GDP is normalized to one. As a result, the regional GDPs in Table 3 are shares of national activity generated in each region. Government debt and public expenditures (on health care and on education) are reported with respect to regional GDP. As we can see in the table, the debt-GDP ratios are particularly small in the west part of the country (ALB, BCO). Public health care with respect to GDP is distributed uneven through the whole country but is always larger than public education in all regions. The capital tax is higher than two other tax rates everywhere in Canada and reaches its maximum in Ontario (ONT).[22]

Table 6. Parameters and Exogenous Variables

	ATL	QUE	ONT	PRA	ALB	BCO
GDP	.057	.213	.414	.069	.120	.127
Government Debt/GDP	.422	.433	.288	.226	.018	.110
Public Health Care/GDP	.077	.066	.053	.066	.045	.070
Public Education/GDP	.060	.052	.032	.039	.041	.045
Wage tax rate	.318	.374	.313	.295	.304	.318
Capital tax rate	.382	.478	.562	.407	.384	.446
Consumption tax rate	.234	.219	.200	.193	.137	.199

However, because of the lack of statistical evidence on regional differences, many parameters are assumed identical across the country. This is in particular the case for household preferences in the sense that both inter-temporal and inter-regional elasticity of substitution, as well as bequest rates are common to all regions. As shown in Table 7, we choose the value of the inter-temporal elasticity of substitution $1/\theta$ as 0.175, which is slightly lower than the 0.25 used by Auerbach and Kotlikoff (1987). For the value of inter-regional elasticities of substitution ($\sigma_{j,s}^{Con}, \sigma_{j,s}^{Inv}, \sigma_{j,s}^{Gov}$), as no literature is available, we choose a value of 2.5, which seems a reasonable average. The bequest parameter (BeqR) was set to be 0.40; the inheritance rate (InhR) was set to be 0.20 as private bequests are assumed equally distributed among the working age groups. The pension replacement rate (PenR) was set to be 0.30. The various labour

[22] Regional GDP are for 1998 and were taken from Statistics Canada, Cansim Matrix 9014-9024; effective tax rates from Charbonneau (1997); public debt, health care and education spending were calculated from data supplied in King and Jackson (2000).

demand substitution elasticities ($\sigma^{Ldem}_{j,s}, \sigma^{Ltype}_{j,s,itype}, \sigma^{Lqual}_{j,s,iqual}$) were inferred from Mercenier and Mérette (2002). The elasticity across types of occupations ($\sigma^{Ldem}_{j,s}$) is assumed to be small (here set to be 0.5) and identical across any combination of two of the three type of labour. Since professions of type 2 are more heterogenous and more knowledge specific, the elasticity for itype=2 is 1.3, the smallest of all. And the elasticities for itype1 and itype3 are 2.0 and 2.5 respectively as it is assumed that it is relatively more difficult for firms to substitute among professions of type 1 than of type 3. Furthermore, as it is reasonable to believe that the labour demand elasticity across profession ($\sigma^{Prof}_{j,s,iprof}$) is greater than across occupations, it is set to be 3.0 in this model. The elasticity of substitution for intermediate goods ($\sigma^{X}_{j,s}$) is set to be 2.0 and identical for all regions and sectors. A calibrated interest rate (*R*int) is 3.8 percent and is applied in all regions as financial assets are perfectly substitutable and mobile across regions. This is the rate necessary to generate large enough life-cycles savings to match data on stocks of physical capital and of government bonds in the Canadian economy.[23] Finally, the calibrated depreciation rate equals 5.1 percent, whereas the export price elasticities (η_s) to the RoW are set to be 5.0 in all sectors.[24]

Table 7. Parameters common to all regions

$1/\theta$	.175	$\sigma^{Ldem}_{j,s}$	0.5
$\sigma^{Con}_{j,s}$	2.5	$\sigma^{Ltype}_{j,s,itype}$, *itype*=1	2.0
$\sigma^{Inv}_{j,s}$	2.5	$\sigma^{Ltype}_{j,s,itype}$, *itype*=2	1.3
$\sigma^{Gov}_{j,s}$	2.5	$\sigma^{Ltype}_{j,s,itype}$, *itype*=3	2.5
$\sigma^{c}_{j,s}$	3.0	$\sigma^{Prof}_{j,s,iprof}$	3.0
BeqR	.40	$\sigma^{X}_{j,s}$	2.0
InhR	.25	*R*int	.038
PensR	.3	*DepR*	.051
η_s	5		

Because preferences are assumed to be perfectly identical across Canada, spending shares with respect to various industrial goods and services are also assumed to be identical across the country. However, the spending shares alter along the lifestyle. Table 5 reports the spending shares for the six age groups of the model. Note that the

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[23] In their pioneer computable OLG work, Auerbach and Kotlikoff (1987) use an interest rate equal to 7.3 percent.
[24] It is clear form the model description, the RoW plays no role here other than to match base year data; therefore, adopting high export price elasticity values is both realistic and consistent with the model structure.

shares in each column of Table 8 sum to one.

Table 8. Spending shares by age group (%)

Age-group	15-24	25-34	35-44	45-54	55-64	65-85
PRI	2.9	3.2	3.3	3.5	3.9	3.8
MAN	22.8	18.4	19.2	19.0	19.1	20.8
CST	16.8	16.5	14.8	12.2	11.5	12.7
TRA	4.6	3.2	3.0	3.1	3.1	2.9
COM	2.5	1.9	1.7	1.6	1.8	2.1
CGD	14.0	11.3	11.8	11.6	11.7	12.7
FAI	3.9	8.4	8.6	9.4	8.6	6.2
ADM	13.0	24.2	24.5	26.0	24.4	19.4
SEP	0	0	0	0	0	0
ICS	0	0	0	0	0	0
EDP	3.1	1.0	0.7	1.3	0.8	0.1
SAN	1.1	0.8	1.1	1.3	1.6	2.6
HRD	9.1	7.2	6.8	6.8	7.5	8.0
AUT	3.0	3.7	4.4	4.1	5.9	8.7

Spending shares have been calculated using the 1999 consumer's spending survey data of Statistics Canada. From that survey, goods and services were gathered into the 14 types of goods included in this model. Moreover, a SAS simulation program has been used to calculate consumption behavior parameters of the six different age groups consumers of the model. Of the results shown in Table 5, a few observations deserve attention. Firstly, consumer's spending shares equal zero in SEP and ICS sectors no matter what age group since these sectors refer to services to enterprises and firms use these goods as inputs. Secondly, spending to some sectors is very sensitive to different age groups. For example, young people spend more in education (EDP) while middle age spend more in finance, insurance and real estate services (FAI). Obviously and reasonably, elder people spend more in health care (HRD) than other age groups. It is worth noting that because of the public nature of education and health care services in Canada that are funded mostly by governments, the size of their spending shares here, which reflects private spending only, is relatively small. Thirdly, using the education and health care share with respect to GDP reported in Table 3, government expenditures are divided into four types: health (HRD), education (EDP), construction (CST), and administration (ADM) as a residual. This permits to capture the real nature of current government expenditures. However, it does not make these expenditures sensitive to changes in the composition of the population. We will discuss further this issue below.

It is clear that when a country's demographic structure changes, public health and education expenditures will both alter throughout the process of aging. Obviously, the sensitivity will depend on the distribution of these expenditures per age group. Table 9 reports the dollar share of public health care and education received by individuals of different age groups. It is assumed that the distribution is identical across regions. As shown in the table, the public health care expenditure is increasing as the individual ages. While an individual of age group 15-24 receives 6 percent of each per capita dollar spent in public health care, an individual of age 65-84 receives as much as 36.0 percent. In the contrast, what do individuals receive in education is decreasing as they become older. In other words, health care is concentrated among the older age groups, whereas education expenditure clusters in the youngest and the middle age groups. Obviously, given these contrasting distributional expenditures, population aging will increase governments' spending on health care with respect to education.

Table 9. Public Expenditure per Age Group (Dollar share per capita, %)

Age-group	15-24	25-34	35-44	45-54	55-64	65-84
Health	6.0	8.0	10.0	15.0	25.0	36.0
Education	26.0	40.0	20.0	7.0	5.0	2.0

To ensure a macroeconomic equilibrium, we must have data for both supply and demand side. For the supply side of the economy (for example, output, capital stock, and labour), it is easier to find published data than for household's behavior. For this reason, the calibration of the model mainly bases on the demand side. It includes the determination of the life-cycle consumption profile, the consumer's rate of time preference, and government expenditure besides those for health care and for education. Firstly, we calibrate these aggregate variables to be consistent with steady state equilibrium and base year dataset. Then we adjust the sectoral structure of consumption baskets across age groups accordingly. The structure of wealth portfolios is determined through similar way. It is assumed that these portfolios have the same structure for all age groups.

7. Regional Demographic Projections

The aging process will affect all Canadian regions though the impact is distributed unevenly. When looking at projections of future demographic structure for the six Canadian regions by Mercenier and Mérette (2002), the following points are worth noting: Firstly, during year 2000, which is the base year, the middle age individuals represent the most important age group in all regions across Canada. Secondly, as aging occurs, the baby boomers, who turn out to be in the 65-85 age group, will be the most important one in all regions as early as 2030. Thirdly, the speed of the aging process differs a lot across regions. "At 2030, the old-age dependency ratio will reach as much as 45 percent in the Atlantic region and 42.8 percent in Quebec. That ratio will be much smaller in the rest of the country, reaching 34 percent in Ontario, 35.5 percent in Prairies and in Alberta, and 37.1 percent in British Columbia. A similar conclusion emerges for year 2040." [25]

The simulation experiments we did in this paper will consist to change the composition of the population to match those projected by demographers for the next two decades. Final and intermediate demands will be affected and we will analyze the inter-regional, inter-sectoral and occupational effects arising from these changes.

8. Simulation Results

The computable general equilibrium model was solved using the General Algebraic Modeling System (GAMS). We report next the baseline scenario results followed by experiments on the health care sector.

A. Baseline scenario

The objective of the paper is to investigate the inter-regional, inter-sectoral, and inter-occupational effects on labour market arising from the changes in aggregate consumption demand due to population aging in Canada. So, we assume that labour supply and the capital stock are constant at the regional level in simulation experiments to control for macroeconomic effects and thus isolate the demand from the supply effects. Thus, the evolution of the aggregate private and public demands will involve relative changes across regions, sector and occupations rather than aggregate changes. This strategy ensures us to link the simulation results to the demand side effects rather to a mix of both supply and demand effects. In the model, regional GDPs respond only to inter-sectoral and inter-regional reallocations that follow changes in relative prices. In Table 10 below, we report regional percentage changes in GDP in the investigated year 2020 with respect to the base year 2000. As we can see, although unevenly distributed, there are only small relative changes in

[25] Mercenier and Mérette. "The Economic Impact of Aging on Production Sectors and Occupations in Six

GDP when production factors (labour and capital) are held constant at the regional level.

Table 10. GDP, % change with respect to base year 2000

	ATL	QUE	ONT	PRA	ALB	BCO
2020	1.78	1.18	-0.04	-0.51	4.04	0.30

Output

Table 11 reports percentage changes in real output by sector of production with respect to the base year data. The figures show that there are significant changes in real output for the education and health care sectors. Although total factors of production at the regional level to their initial level are fixed, the changes of real output for health care services (*SAN*) and education (*EDP*), are two of the greatest in absolute value for year 2020. While being around 10 percent for all regions, in some regions such as in the Atlantic and Alberta regions, output changes are close or even greater than 15 percent. Also, we find that in all regions, the health services (*SAN*), the transport and storage (*TRA*), the communication (*COM*), and the primary (*PRI*) are those that have larger positive changes. The accommodation and leisure services (*HRD*) increases too, especially in the Atlantic, Quebec and Alberta regions. In contrast, the construction (*CST*) and the education (*EDP*) sectors have negative real output changes with respect to the base year data.

Table 11. Output Changes, year 2020 (% changes w.r.t base year 2000)

Sectors	ATL	QUE	ONT	PRA	ALB	BCO
PRI	3.34	3.75	4.58	4.98	0.92	4.63
MAN	1.50	1.22	2.39	3.15	0.93	2.29
CST	-2.59	-2.00	-3.21	-4.16	-2.10	-3.25
TRA	4.13	3.52	3.41	4.50	2.72	3.26
COM	4.78	4.36	1.91	1.50	10.74	3.08
CGD	-0.72	-0.46	-0.31	-0.11	1.82	0.04
FAI	2.03	0.19	-1.00	-0.68	4.87	-0.59
SEP	0.07	0.20	0.95	0.46	-1.94	0.43
ICS	-0.17	0.06	0.96	0.47	-2.12	0.40
ADM	0.79	0.53	0.49	0.24	1.81	-0.13
EDP	-15.8	-12.25	-9.10	-8.20	-10.53	-10.70
SAN	14.55	13.64	7.44	7.60	15.04	9.89
HRD	6.59	4.39	1.87	1.49	7.83	1.77
AUT	3.23	2.22	0.78	-0.31	4.74	1.42

Occupational Wages

In the model, labour markets are in equilibrium and labour supplies are exogenous.

Canadian Regions", 2002,pp 22

Changes in relative wage rates imply the relative scarcity of labour. As for output prices, wage rates were all normalized to one in the base year so that figures reported in Table 10 are indices comparing to benchmark year. Furthermore, in the simulation exercises, we control for the supply side effects. As a result, the relative wage changes reported here reported only reflect inter-sectoral reallocation effects and are abstract from the expected decline in the growth rate of aggregate labour supply. From this perspective, the relative wage changes are substantial and signal considerable adjustment challenges to come in the labour market.

Table 12 shows that health occupations (Prof 3) will benefit large increases in wages, for all skill levels (Qual2, Qual3, and Qual4). In the contrary, relative wages for occupations in trades, transport, and equipment operators and relative occupations (Prof7), will be hurt by changes in demand induced by population aging, especially at the lowest skill level (Qual5).

Table 12 . Wage indices by occupations, year 2020

Iprof	*Iqual*	ATL	QUE	ONT	PRA	ALB	BCO
Prof1	Qual2	1.02	1.01	1.00	0.99	1.04	1.00
Prof1	Qual3	1.02	1.01	1.00	0.99	1.05	1.00
Prof1	Qual4	1.02	1.01	1.00	0.99	1.05	1.00
Prof4	Qual2	1.02	1.01	1.00	0.99	1.05	1.00
Prof4	Qual3	1.02	1.02	1.00	0.99	1.05	1.01
Prof10	Qual1	1.02	1.01	0.99	0.99	1.04	1.00
Prof2	Qual2	1.03	1.02	1.01	1.00	1.05	1.01
Prof2	Qual3	1.03	1.02	1.01	1.00	1.05	1.01
Prof3	Qual2	1.07	1.06	1.03	1.02	1.12	1.05
Prof3	Qual3	1.08	1.06	1.03	1.02	1.12	1.05
Prof3	Qual4	1.08	1.05	1.03	1.02	1.13	1.05
Prof5	Qual2	1.04	1.02	1.01	1.00	1.07	1.02
Prof5	Qual3	1.04	1.02	1.01	1.00	1.07	1.02
Prof6	Qual3	1.04	1.02	1.00	1.00	1.08	1.01
Prof6	Qual4	1.04	1.02	1.00	1.00	1.08	1.02
Prof6	Qual5	1.03	1.02	1.00	1.00	1.08	1.02
Prof7	Qual3	0.99	0.99	0.97	0.97	1.01	0.98
Prof7	Qual4	1.00	1.00	0.98	0.98	1.01	0.99
Prof7	Qual5	0.99	1.00	0.97	0.97	1.01	0.98
Prof8	Qual3	1.01	1.02	1.00	1.00	1.02	1.00
Prof8	Qual4	1.01	1.02	1.01	1.00	1.01	1.00
Prof8	Qual5	1.00	1.01	0.99	0.98	1.02	0.99
Prof9	Qual3	1.00	1.00	1.00	1.00	1.01	1.00
Prof9	Qual4	1.00	1.00	1.00	1.00	1.01	1.00
Prof9	Qual5	1.00	1.00	1.00	1.00	1.01	1.00

Sensitivity analysis for occupation elasticities

Since professions of type 2 are more heterogenous and more knowledge specific, the elasticity for *itype*=2 is 1.3, the smallest of all. And the elasticities for *itype1* and *itype3* are 2.0 and 2.5 respectively as it is assumed that it is relatively more difficult for firms to substitute among professions of type 1 than of type 3.

When we increase the labour demand elasticity across profession ($\sigma^{Prof}_{j,s,iprof}$) from 3 to 4, the effect on wage rates across professions is more spread out (see Appendix 5a). It is not surprised to find the contrast results when we decrease the labour demand elasticity across profession ($\sigma^{Prof}_{j,s,iprof}$) from 3 to 2 (see Apendix 5b). In addition, when we increase all the labour demand elasticity across type ($\sigma^{Ltype}_{j,s,itype}$) by 20 percent (now they are 2.4 for type 1, 1.56 for type 2 and 3.0 for type 3), wage rates change in opposite directions. In other words, now it is easier for firms to substitute among professions of all types. As a result, some occupations benefit while others lose from this change. Specific to health care section, health occupation (Prof3), which is included in type 2, will experience a negative wage rate change at all skill levels (Qual2, Qual3 and Qual4). Another result worth noticing is that when $\sigma^{Ltype}_{j,s,itype}$ increase for type 3, occupation relative to trades, transport and equipment (Prof7) will benefit from the change while the other two in type 3, which are occupations specific to primary industry (Prof8) and occupations specific to processing, manufacturing and utilities (Prof9) will be hurt by the fact that it comes relatively less difficult for firms to substitute among professions of type 3.

In the above mentioned three simulation experiments, although the results show changes in wage rates, the changes are very small, some even not noticeable. However, in the experiment when we change the magnitude of the labour demand elasticity across type ($\sigma^{Ltype}_{j,s,itype}$) between type 2 and type 3 (now they are 2 for type 1, 2.5 for type 2 and 1.3 for type 3). In other words, the labour demand elasticity for type 2 increases while that for type 3 decreases. Not surprisingly, health occupation (Prof3) will again experience a negative wage rate change at all skill levels (Qual2, Qual3 and Qual4). And the changes for Prof 7, Prof 8 and Prof 9 are in opposite direction comparing to last experiment. For type 1, although the labour elasticity across type does not change, occupations are still affected by the change in magnitude between type 2 and type 3 and, what is more, in a larger amount comparing to previous experiments. (For GAMS results, please refer to Appendix 5a-5d)

Through these four experiments on labour demand elasticity, we find that while the absolute value of elasticity does not matter much, the order of magnitude of elasticity can cause larger changes in wage rates.

What we did up to now is to show changes in relative scarcity of labour qualifications through changes in relative wage rates. Thus, in all the experiments, the excess labour demand does not change at all. Though wage rate change is, strictly speaking, the only correct measure of relative scarcity, one might wish to have some approximate quantification of this scarcity in terms of labour markets imbalance.

Projecting Future Labour Imbalances

In the model we assume labour markets balance. Therefore, the cost of labour relative to capital will change as population ages and aggregate demands change. A result of it is that firms will want to adjust their production technologies by substituting capital to labour. Because the demographic shock will affect each labour category differently, the relative scarcity across professions and qualifications will also be affected and substitution among some labour categories will result.

To have some approximate quantification of the relative scarcity in terms of labour markets imbalance as an alternative way instead of wage rate change, we modify the model and substitute a partial equilibrium to the labour market equilibrium conditions, a condition that freezes the relative price of all primary factors at their pre-shock equilibrium level. Through this way, we get some measure of the excess labour demands or supplies that might result from the demographic shock.

Note that, even though one might find it useful to look at numbers reported in following Tables, these are not entirely meaningful, because households' budget constraints cannot be satisfied.[26] In addition, by relaxing the labour market equilibrium condition, labour supply only appears in the model through the budget constraints of household. As a result, there is income leakage and Walras' law is no

[26] In this experiment, given the relative prices they face, competitive firms hire as much labour as they feel profitable to and produce goods with this labour, even though it might be in fact unavailable.

longer satisfied.

In Tables 13 the excess demands of each category of labour qualifications within occupations are reported, measured as percent of the benchmark employment level. We find that the demographic shock will have very different impact on two groups of regions within Canada: excess labour demands in the Atlantic Provinces, Alberta, Quebec and British Columbia, are more substantial than those in Ontario and the Prairies. Besides, labour excess demands will be more intensive in the health profession (Prof3) in every region comparing to other professions.[27]

Table 13. Excess Labour Demands, year 2020 (as % of initial employment in 2000)

Iprof	*Iqual*	*ATL*	*QUE*	*ONT*	*PRA*	*ALB*	*BCO*
Prof1	*Qual2*	-0.44	-0.25	-0.28	-0.20	-0.27	-0.19
Prof1	*Qual3*	-0.40	-0.42	-0.24	-0.24	-0.22	-0.26
Prof1	*Qual4*	-0.39	-0.41	-0.28	-0.22	-0.25	-0.28
Prof4	*Qual2*	-0.86	-0.71	-0.61	-0.36	-0.51	-0.54
Prof4	*Qual3*	0.05	0.42	0.489	0.31	0.89	0.89
Prof10	*Qual1*	-0.31	-0.27	-0.21	-0.17	-0.12	-0.20
Prof2	*Qual2*	-0.50	-0.39	-0.27	-0.28	-0.34	-0.23
Prof2	*Qual3*	-0.57	-0.45	-0.34	-0.31	-0.41	-0.39
Prof3	*Qual2*	3.96	4.78	2.57	2.11	4.67	4.33
Prof3	*Qual3*	6.72	4.39	2.88	1.90	4.37	3.17
Prof3	*Qual4*	6.70	2.92	3.62	4.31	6.91	4.87
Prof5	*Qual2*	-0.35	-0.29	-0.29	-0.23	-0.29	-0.29
Prof5	*Qual3*	-0.43	-0.41	-0.29	-0.14	-0.35	-0.11
Prof6	*Qual3*	-0.34	-0.35	-0.33	-0.28	-0.33	-0.42
Prof6	*Qual4*	-0.01	-0.08	-0.07	-0.04	0.10	0.17
Prof6	*Qual5*	0.05	-0.02	0.00	0.09	0.14	0.10
Prof7	*Qual3*	-0.22	-0.30	-0.19	-0.16	-0.16	-0.29
Prof7	*Qual4*	-0.25	-0.24	-0.16	-0.10	-0.12	-0.16
Prof7	*Qual5*	-0.40	-0.64	-0.30	-0.30	-0.38	-0.46
Prof8	*Qual3*	-0.12	-0.03	-0.06	-0.10	-0.10	-0.14
Prof8	*Qual4*	-0.18	-0.04	-0.08	-0.09	-0.01	-0.11
Prof8	*Qual5*	-0.48	-0.45	-0.41	-0.35	-0.27	-0.33
Prof9	*Qual3*	-0.05	0.02	0.00	-0.05	-0.06	-0.01
Prof9	*Qual4*	-0.04	0.01	0.00	0.00	-0.04	-0.01
Prof9	*Qual5*	-0.01	0.04	0.02	0.05	-0.01	0.01

B. Simulation experiments on health care sector

[27] While the results are consistent with the relative wages effects, we would like to inform the readers again that they are partial equilibrium results, which may lead to the overestimation of excel labour demand.

To further analyze the impact on labour market that changes in health care sector through the aging process will has, the following three simulation experiments were conducted.

Denote by DH the public expenditure share per age group for health care reported in Table 9 above. The original DH distribution composition and changes we made are shown in Table 14.

Table 14. DH distribution in three scenarios

Age group	15-24	25-34	35-44	45-44	55-64	65-85
DH original data (Table 9)	0.06	0.08	0.10	0.15	0.25	0.36
DH longer life expectancy	0.05	0.07	0.08	0.12	0.20	0.48
DH technical improvement	0.07	0.10	0.12	0.18	0.24	0.29
DH uneven distribution	ATL,QUE,ONT experience technical improvement while PRA, ALB, BCO experience no change					

1. Longer-life expectancy

Development (OECD) countries now accounts for 45 to 80 percent of remaining life expectancy at age 65 (Jacobzone, 1999)[28]. However, the major economies have been experiencing a increasing in life expectancy (see Appendix 6). Age-specific mortality rates have declined substantially over the past half century, increasing life expectancy at birth by almost eight years. Some of the improvement in mortality rates will even improve life expectancy at age 90. As people will live longer, they will be healthier most of the time and health care needs will be postponed further down to the end of life.[29]Corresponding to this potential change, we make the DH distribution more intensive at the last period of life, say, from 65-85.

Table 15 shows the change of wage indices comparing to year 2020 (Table10). We find that the wage rates of health occupation (Prof3) benefit at all skill levels (Qual2, Qual3 and Qual4). While occupations in arts, culture, recreation and sport (Prof5) and

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[28] Jacobzone, S. "Ageing and Care for Frail Elderly Persons: An Overview of International Perspectives," *Labour Market and Social PolicyOccasional Paper No. 38.* OECD 1999

[29] Bertless, Gary. "*Does Population Aging Represent a Crisis for Rich Societies?*" The Brookings Institution, January, 2002

sales, services occupation (Prof6) also share a minor increase in wage rates, all other occupational wages will be hurt by the change.

Table 15. Wage changes (%) w.r.t. baseline scenario, year 2020

Longer life expectancy scenario

Iprof	*Iqual*	*ATL*	*QUE*	*ONT*	*PRA*	*ALB*	*BCO*
Prof1	*Qual2*	-0.0015	-0.0012	-0.0006	-0.0004	-0.0004	-0.0005
Prof1	*Qual3*	-0.0015	-0.0011	-0.0006	-0.0003	-0.0004	-0.0005
Prof1	*Qual4*	-0.0014	-0.0009	-0.0006	-0.0003	-0.0001	-0.0001
Prof4	*Qual2*	-0.0009	0.0000	0.0001	0.0001	0.0008	0.0007
Prof4	*Qual3*	-0.0014	-0.0011	-0.0005	-0.0002	-0.0003	-0.0005
Prof10	*Qual1*	-0.0003	-0.0002	-0.0001	-0.0001	0.0000	0.0004
Prof2	*Qual2*	-0.0004	-0.0003	-0.0001	-0.0001	-0.0001	0.0003
Prof2	*Qual3*	0.0108	0.0107	0.0051	0.0036	0.0097	0.0093
Prof3	*Qual2*	0.0132	0.0102	0.0052	0.0034	0.0094	0.0083
Prof3	*Qual3*	0.0133	0.0087	0.0058	0.0050	0.0114	0.0098
Prof3	*Qual4*	0.0002	0.0001	0.0000	0.0001	0.0004	0.0005
Prof5	*Qual2*	0.0001	-0.0001	0.0000	0.0002	0.0002	0.0006
Prof5	*Qual3*	0.0003	0.0001	0.0001	0.0001	0.0005	0.0005
Prof6	*Qual3*	0.0006	0.0006	0.0004	0.0003	0.0008	0.0009
Prof6	*Qual4*	0.0007	0.0004	0.0004	0.0004	0.0008	0.0008
Prof6	*Qual5*	-0.0009	-0.0014	-0.0003	-0.0001	-0.0004	-0.0008
Prof7	*Qual3*	-0.0008	-0.0011	-0.0003	0.0000	-0.0003	-0.0006
Prof7	*Qual4*	-0.0013	-0.0018	-0.0004	-0.0002	-0.0006	-0.0009
Prof7	*Qual5*	-0.0005	-0.0004	-0.0001	-0.0001	-0.0003	-0.0005
Prof8	*Qual3*	-0.0005	-0.0002	-0.0001	-0.0001	-0.0001	-0.0005
Prof8	*Qual4*	-0.0011	-0.0013	-0.0005	-0.0002	-0.0004	-0.0007
Prof8	*Qual5*	-0.0002	-0.0002	0.0000	0.0000	-0.0002	-0.0002
Prof9	*Qual3*	-0.0002	-0.0002	0.0000	0.0000	-0.0001	-0.0002
Prof9	*Qual4*	-0.0001	-0.0001	0.0001	0.0001	0.0000	-0.0002
Prof9	*Qual5*	-0.0015	-0.0012	-0.0006	-0.0004	-0.0004	-0.0005

When we switch to partial labour market equilibrium, that is to freeze the wage rate to get the changes in excess labour demands, we find that there will be a greater increase in excess labour demand for health occupations (Prof3) and an increase in sales and services occupations (Prof6) at lower levels (Qual4 and Qual5). For browsing detailed results, please see Appendix 7a.

2. Technical improvement in health care sector

As mentioned before, there may be offsets to increasing health care expenditures resulting from new technologies and efficiencies improvements within the health care sector. In this case, the DH share will be distributed more evenly among all age groups. Elder people no longer have a share that is much larger than younger people.

The simulation results are shown in Table 16. We find that contrary to last experiment, the wage rates of health occupation (Prof3) decrease at all skill levels (Qual2, Qual3 and Qual4) with a larger extent than Prof5 and Prof6, while almost all other occupations' wage rates increase.

Table 16. Wage changes (%) w.r.t. baseline scenario, year 2020
Technical improvement in all regions

Iprof	*Iqual*	*ATL*	*QUE*	*ONT*	*PRA*	*ALB*	*BCO*
Prof1	*Qual2*	0.0015	0.0009	0.0007	0.0005	0.0005	0.0004
Prof1	*Qual3*	0.0015	0.0012	0.0007	0.0005	0.0005	0.0006
Prof1	*Qual4*	0.0015	0.0012	0.0007	0.0005	0.0005	0.0006
Prof4	*Qual2*	0.0013	0.0009	0.0008	0.0005	0.0002	0.0002
Prof4	*Qual3*	0.0009	0.0001	0.0000	0.0000	-0.0009	-0.0009
Prof10	*Qual1*	0.0014	0.0011	0.0007	0.0005	0.0003	0.0005
Prof2	*Qual2*	0.0003	0.0001	0.0001	0.0001	0.0000	-0.0004
Prof2	*Qual3*	0.0003	0.0003	0.0002	0.0001	0.0001	-0.0003
Prof3	*Qual2*	-0.0109	-0.0106	-0.0065	-0.0054	-0.0113	-0.0105
Prof3	*Qual3*	-0.0134	-0.0101	-0.0068	-0.0052	-0.0110	-0.0092
Prof3	*Qual4*	-0.0134	-0.0087	-0.0075	-0.0073	-0.0132	-0.0109
Prof5	*Qual2*	-0.0002	0.0000	0.0000	-0.0002	-0.0005	-0.0007
Prof5	*Qual3*	-0.0002	0.0001	0.0001	-0.0002	-0.0003	-0.0007
Prof6	*Qual3*	-0.0004	-0.0002	-0.0001	-0.0002	-0.0006	-0.0005
Prof6	*Qual4*	-0.0007	-0.0007	-0.0005	-0.0004	-0.0009	-0.0011
Prof6	*Qual5*	-0.0008	-0.0005	-0.0004	-0.0005	-0.0009	-0.0010
Prof7	*Qual3*	0.0009	0.0012	0.0004	0.0002	0.0004	0.0008
Prof7	*Qual4*	0.0007	0.0011	0.0003	0.0001	0.0004	0.0006
Prof7	*Qual5*	0.0011	0.0017	0.0006	0.0004	0.0008	0.0011
Prof8	*Qual3*	0.0005	0.0003	0.0003	0.0002	0.0003	0.0005
Prof8	*Qual4*	0.0005	0.0002	0.0002	0.0002	0.0002	0.0004
Prof8	*Qual5*	0.0011	0.0012	0.0007	0.0005	0.0006	0.0008
Prof9	*Qual3*	0.0002	0.0001	-0.0001	0.0000	0.0001	0.0003
Prof9	*Qual4*	0.0002	0.0001	0.0000	-0.0001	0.0002	0.0003
Prof9	*Qual5*	0.0001	0.0001	-0.0001	-0.0001	0.0002	0.0002

Not surprisingly, in excess labour demand results, it is shown that except a decrease in the excess labour demand of health occupation (Prof3) and lower skill levels of Prof6, all other occupations will have a larger excess labour demand than base scenario in 2020. (See Appendix7b)

3. Uneven distribution among regions

In the last experiment, we set an ideal assumption that all regions experience a technical improvement in health care sector. However, in reality it may come unevenly distributed across Canada. So in this experiment, we assume that only ATL, QUE and ONT will experience the technical improvement, while the rest of the country, PRA, ALB and BCO experience no change. The simulation results are shown in Table 17. We find that in ATL, QUE and ONT, where technical improvement take place, the wage rates of health occupation (Prof3) and Prof 5 and Prof 6 at all levels decrease while other occupations experience a wage rate decrease. It is surprising to notice that in the regions where there is no technical improvement, wage rates in health occupation (Prof3) also decrease, but in a much smaller extent. Thus we could assume that technical changes, although in several regions, may have an influence on the wages in health care sector of the whole country. For other occupations in PRA, ALB and BCO, wage rates move to the opposite direction comparing to ATL, QUE and ONT.

Table 17. Wage changes (%) w.r.t. baseline scenario, year 2020
Technical improvement only in ATL QUE and ONT

Iprof	*Iqual*	*ATL*	*QUE*	*ONT*	*PRA*	*ALB*	*BCO*
Prof1	*Qual2*	0.0016	0.0010	0.0008	-0.0001	-0.0004	-0.0003
Prof1	*Qual3*	0.0016	0.0013	0.0008	-0.0002	-0.0004	-0.0003
Prof1	*Qual4*	0.0016	0.0013	0.0008	-0.0002	-0.0004	-0.0002
Prof4	*Qual2*	0.0014	0.0010	0.0009	-0.0002	-0.0004	-0.0002
Prof4	*Qual3*	0.0011	0.0002	0.0001	-0.0001	-0.0003	-0.0003
Prof10	*Qual1*	0.0016	0.0012	0.0008	-0.0002	-0.0005	-0.0003
Prof2	*Qual2*	0.0004	0.0002	0.0001	-0.0002	-0.0003	-0.0002
Prof2	*Qual3*	0.0005	0.0003	0.0002	-0.0001	-0.0003	-0.0002
Prof3	*Qual2*	-0.0107	-0.0105	-0.0064	-0.0002	-0.0004	-0.0003
Prof3	*Qual3*	-0.0132	-0.0100	-0.0067	-0.0002	-0.0004	-0.0002
Prof3	*Qual4*	-0.0133	-0.0087	-0.0074	-0.0002	-0.0004	-0.0003
Prof5	*Qual2*	-0.0001	0.0001	0.0000	-0.0003	-0.0004	-0.0003
Prof5	*Qual3*	-0.0001	0.0002	0.0001	-0.0002	-0.0004	-0.0003
Prof6	*Qual3*	-0.0002	-0.0001	0.0000	-0.0003	-0.0005	-0.0003
Prof6	*Qual4*	-0.0005	-0.0005	-0.0004	-0.0003	-0.0005	-0.0004
Prof6	*Qual5*	-0.0007	-0.0004	-0.0003	-0.0003	-0.0005	-0.0004
Prof7	*Qual3*	0.0011	0.0013	0.0005	-0.0004	-0.0005	-0.0004
Prof7	*Qual4*	0.0009	0.0012	0.0004	-0.0002	-0.0004	-0.0003
Prof7	*Qual5*	0.0013	0.0019	0.0007	-0.0003	-0.0005	-0.0004
Prof8	*Qual3*	0.0006	0.0003	0.0003	-0.0001	-0.0003	-0.0003
Prof8	*Qual4*	0.0006	0.0003	0.0002	0.0000	-0.0001	-0.0002
Prof8	*Qual5*	0.0012	0.0013	0.0008	-0.0002	-0.0004	-0.0002
Prof9	*Qual3*	0.0002	0.0001	-0.0001	-0.0002	-0.0003	-0.0001
Prof9	*Qual4*	0.0003	0.0002	0.0000	-0.0001	-0.0002	-0.0001
Prof9	*Qual5*	0.0002	0.0001	0.0000	-0.0001	-0.0002	-0.0001

With technical improvements in ATL, QUE and ONT, the excess labour demand for health occupation (Prof3) decrease in these regions while it increase in region PRA, ALB and BCO. In this sense it is not consistent with wage rate changes. However, we should always remember that the excess labour demand is just a reference signal since it is partial market equilibrium experiment. (See Appendix 7c)

Conclusion

This report describes the motivation, the structure and the calibration procedure of a computable general equilibrium model developed by Mercenier and Mérette (2002). The aim of this report is to investigate further the consequences on the composition of the labour force due to aging population in Canada. To this end, the general equilibrium model is calibrated on various sources of Canadian data. Then, taking into account the upcoming structural demographic shift and the changing consumption preferences of age groups, we simulate different scenarios and analyse the inter-regional, inter-sectoral and occupational effects through simulation results.

For real output, there are significant changes in real output for the education and health care sectors. Although total factors of production at the regional level to their initial level are fixed, the changes of real output for health care services and education, are two of the greatest in absolute value for year 2020 comparing to the base year scenario. For occupational wages, simulation results show that health occupations will benefit large increases in wages for all skill levels. On the contrary, relative wages for occupations in trades, transport, and equipment operators and relative occupations, will be hurt by changes in demand induced by population aging, especially at the lowest skill level.

To have some approximate quantification of the relative scarcity in terms of labour market imbalance as an alternative way instead of wage rate change, we modify the model and substitute a partial equilibrium to the labour market equilibrium conditions, a condition that freezes the relative price of all primary factors at their pre-shock equilibrium level. Through this way, we get some measure of the excess labour demands or supplies that might result from the demographic shock. Simulation results show that labour excess demands will be more intensive in the health profession (Prof3) in every region comparing to other professions.

Furthermore, to analyze the impact on labour market that changes in health care sector through the aging process will have, three simulation experiments were conducted. Firstly, when we assume longer life expectancy, wage rates of health occupation benefit at all skill levels, while most of other occupational wages are hurt by the change. Secondly, when we assume technical improvement in health care sector, simulation results show an almost opposite result comparing to the first experiment, that is, the wage rates of health occupation decrease at all skill levels while almost all other occupations' wage rates increase. Finally, when we assume uneven technical improvement among regions, we find that in ATL, QUE and ONT, where technical improvement take place, the wage rates of health occupation at all levels decrease while most of other occupations experience a wage rate decrease. It is also interesting to notice that in the regions where there is no technical improvement, wage rates in health occupation also decrease, but in a much smaller extent.

Obviously, population aging will affect regions, production sectors and occupations differently. Various simulation experiments were conducted to this end. The results of simulations of this general equilibrium model show that private consumption and public expenditure changes due to aging will have a significant impact in the labour market, especially in health care sector in Canada.

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www.cdhowe.org	C.D.Howe Institute
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www.hc-sc.gc.ca	Health Canada
www.imf.org	International Monetary Fund
www.oecd.org	Organization for Economic Co-operation and Development
www.statcan.ca	Statistics Canada
www.socserv.socsci.mcmaster.ca/sedap	Social and Economic Dimensions of an Aging Population, McMaster University
www.who.int/en	World Health Organisation
www.worldbank.org	World Bank

Appendix

Appendix 1. Canada Health Care Data

Canada

Population estimates		
Indicator	Value	
Total population (000), 2000	30,757	
Annual population growth rate (%), 1990 to 2000	1.1	
Dependency ratio (per 100), 2000	46	
Percentage of population aged 60+ years, 2000	16.7	
Total fertility rate, 2000	1.6	
Health indicators, 2000		
Indicator	Value	Uncertainty Interval
Child mortality (probability of dying under age 5 years) (per 1000)		
Males	6	5 - 6
Females	5	4 - 5
Adult mortality (probability of dying between 15 and 59) (per 1000)		
Males	101	96 - 105
Females	57	53 - 60
Life expectancy at birth (years)		
Males	76.0	75.6 - 76.5
Females	81.5	81.1 - 81.9
Healthy life expectancy at birth (years)		
Total population	70.0	
Males	68.3	66.9 - 69.7
Females	71.7	70.0 - 73.5
Healthy life expectancy at age 60 (years)		
Males at age 60	15.4	14.6 - 16.3
Females at age 60	17.8	17.0 - 18.6
Expectation of lost healthy years at birth due to poor health (years)		

Males	7.7	
Females	9.8	
Percentage of total life expectancy lost due to poor health (%)		
Males	10.2	
Females	12.0	

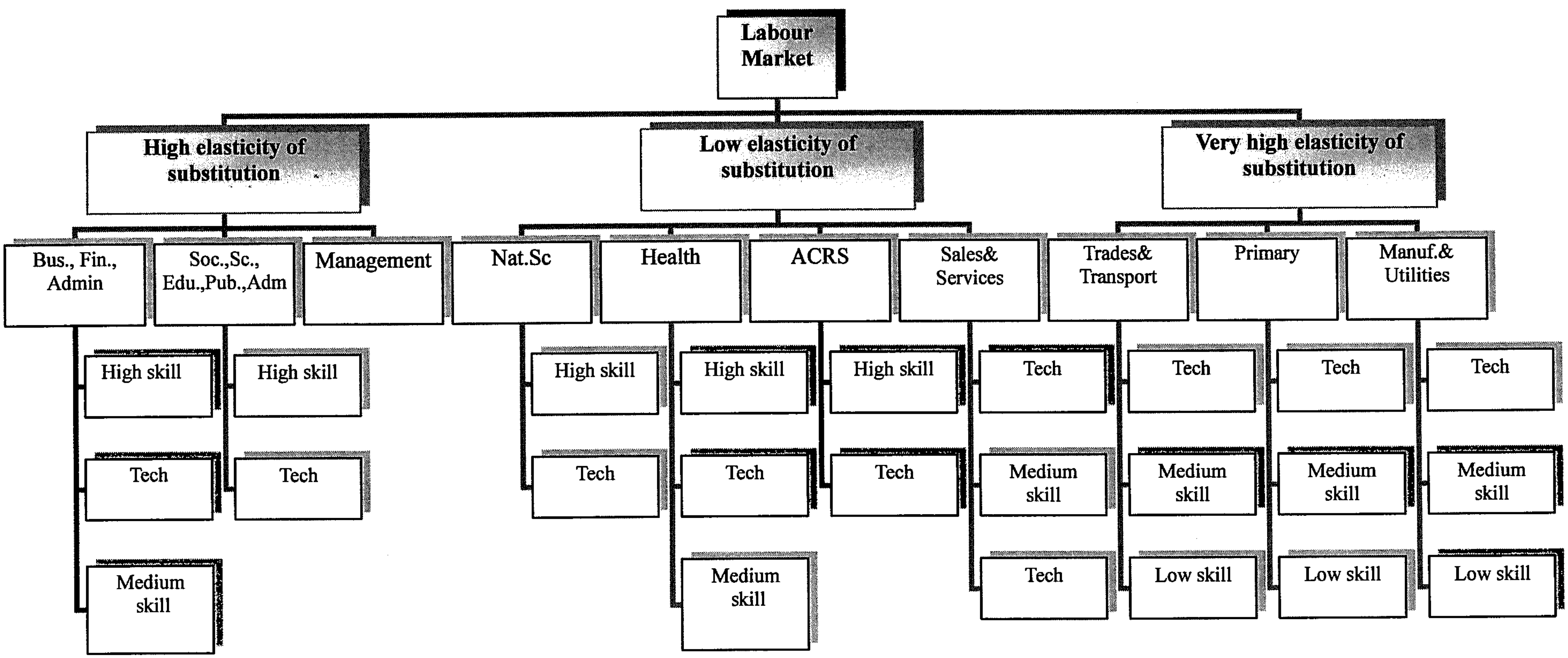
Selected national health accounts indicators	
Indicator	Value
GDP per capita (international dollars), 1998	25,018
Total health expenditure	
Total health expenditure as % of GDP, 1998	9.3
Total expenditure on health per capita (US $ at official exchange rate), 1998	1,847
Total expenditure on health per capita (international dollars), 1998	2,363
Public health expenditure	
Public health expenditure as % of total health expenditure, 1998	70.1
Public health expenditure as % of general government expenditure, 1998	14.7
Public expenditure on health per capita (US $ at official exchange rate), 1998	1,296
Public expenditure on health per capita (international dollars), 1998	1,657
Sources of public health expenditure	
Social security expenditure on health as % of public expenditure on health, 1998	1.7
Tax funded expenditure on health as % of public expenditure on health, 1998	98.3
External resources for health as % of public expenditure on health, 1998	.0

Private health expenditure	
Private expenditure on health as % of total expenditure on health, 1998	29.9
Sources of private health expenditure	
Private insurance on health as % of private expenditure on health, 1998	37.5
Out-of-pocket disbursements for health as % of private expenditure on health, 1998	55.60

Source:HealthCanada

Appendix 2.

Structure of the labour market



Appendix 3.

Occupation Types

Type 1						
Profession 1				Profession 4		Profession 10
Qual. 2	Qual. 3	Qual. 4	Qual. 5	Qual. 2	Qual.3	Qual.1

Type 2									
Prof. 2		Prof. 3			Prof. 5		Prof.6		
Qual.2	Qual.3	Qual.2	Qual.3	Qual.4	Qual.2	Qual.3	Qual.3	Qual.4	Qual.5

Type 3								
Profession 7			Profession 8			Profession 9		
Qual.3	Qual.4	Qual.5	Qual.3	Qual.4	Qual.5	Qual.3	Qual.4	Qual.5

Appendix 4.
Regional Governments' Spending, year 2020 (%changes w.r.t. base year)

	ATL	QUE	ONT	PRA	ALB	BCO
CST	0.35	-2.26	-0.89	-0.85	1.23	-1.90
ADM	-3.15	-4.44	-3.61	-2.98	-3.87	-4.74
EDP	-18.25	-14.50	-11.22	-9.29	-14.99	-13.17
SAN	21.76	19.36	13.61	12.05	20.04	15.94

Appendix 5a .

Wage changes (%) w.r.t. baseline scenario, year 2020

$\sigma^{Prof}_{j,s,iprof}$ increase from 3 to 4

Iprof	*Iqual*	*ATL*	*QUE*	*ONT*	*PRA*	*ALB*	*BCO*
Prof1	*Qual2*	0.0002	0.0004	0.0000	0.0003	0.0009	0.0002
Prof1	*Qual3*	0.0001	0.0000	0.0002	0.0002	0.0002	0.0003
Prof1	*Qual4*	0.0000	0.0000	-0.0001	-0.0001	-0.0004	-0.0001
Prof4	*Qual2*	0.0002	0.0003	0.0002	0.0001	0.0001	0.0003
Prof4	*Qual3*	-0.0005	-0.0009	-0.0005	-0.0002	0.0000	-0.0008
Prof10	*Qual1*	0.0001	0.0000	0.0001	0.0001	0.0000	0.0000
Prof2	*Qual2*	0.0002	0.0000	0.0000	0.0000	0.0002	0.0001
Prof2	*Qual3*	-0.0001	0.0001	0.0002	0.0001	-0.0002	0.0001
Prof3	*Qual2*	0.0008	-0.0004	0.0002	0.0004	0.0003	-0.0001
Prof3	*Qual3*	-0.0013	-0.0006	-0.0001	0.0004	0.0009	0.0009
Prof3	*Qual4*	-0.0009	0.0009	-0.0001	-0.0012	-0.0016	-0.0003
Prof5	*Qual2*	-0.0004	-0.0001	0.0000	0.0000	-0.0011	-0.0001
Prof5	*Qual3*	0.0004	0.0002	0.0001	0.0001	0.0008	0.0001
Prof6	*Qual3*	0.0000	0.0000	0.0001	-0.0001	0.0003	0.0003
Prof6	*Qual4*	-0.0002	-0.0002	-0.0001	-0.0001	-0.0001	-0.0003
Prof6	*Qual5*	0.0004	0.0002	0.0002	0.0002	0.0000	0.0003
Prof7	*Qual3*	0.0005	0.0003	0.0003	0.0005	0.0004	0.0004
Prof7	*Qual4*	-0.0013	-0.0007	-0.0015	-0.0019	-0.0012	-0.0014
Prof7	*Qual5*	0.0007	0.0002	0.0014	0.0009	0.0002	0.0011
Prof8	*Qual3*	-0.0006	-0.0007	-0.0006	-0.0009	0.0002	-0.0004
Prof8	*Qual4*	-0.0005	-0.0012	-0.0023	-0.0014	0.0006	-0.0011
Prof8	*Qual5*	0.0008	0.0017	0.0019	0.0029	-0.0007	0.0013
Prof9	*Qual3*	0.0001	0.0000	-0.0001	0.0000	0.0000	0.0001
Prof9	*Qual4*	0.0001	0.0000	0.0000	0.0001	0.0000	0.0001
Prof9	*Qual5*	-0.0001	0.0000	0.0000	-0.0005	0.0002	-0.0002

Appendix 5b .

Wage changes (%) w.r.t. baseline scenario, year 2020

$\sigma^{Prof}_{j,s,iprof}$ decrease from 3 to 2

Iprof	*Iqual*	*ATL*	*QUE*	*ONT*	*PRA*	*ALB*	*BCO*
Prof1	*Qual2*	-0.0004	-0.0007	0.0000	-0.0004	-0.0016	-0.0004
Prof1	*Qual3*	-0.0002	0.0000	-0.0004	-0.0005	-0.0004	-0.0005
Prof1	*Qual4*	0.0001	0.0002	0.0001	0.0003	0.0008	0.0004
Prof4	*Qual2*	-0.0004	-0.0005	-0.0003	-0.0002	-0.0001	-0.0004
Prof4	*Qual3*	0.0011	0.0020	0.0011	0.0006	0.0002	0.0014
Prof10	*Qual1*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Prof2	*Qual2*	-0.0005	0.0000	0.0000	-0.0001	-0.0004	-0.0001
Prof2	*Qual3*	0.0001	-0.0001	-0.0003	-0.0002	0.0004	-0.0001
Prof3	*Qual2*	-0.0017	0.0008	-0.0004	-0.0007	-0.0005	0.0002
Prof3	*Qual3*	0.0025	0.0011	0.0002	-0.0008	-0.0016	-0.0014
Prof3	*Qual4*	0.0017	-0.0018	0.0002	0.0023	0.0033	0.0007
Prof5	*Qual2*	0.0008	0.0004	-0.0001	-0.0001	0.0021	0.0001
Prof5	*Qual3*	-0.0009	-0.0003	-0.0001	-0.0001	-0.0014	-0.0004
Prof6	*Qual3*	0.0000	-0.0001	-0.0001	0.0000	-0.0006	-0.0005
Prof6	*Qual4*	0.0003	0.0003	0.0002	0.0000	0.0002	0.0004
Prof6	*Qual5*	-0.0009	-0.0004	-0.0004	-0.0006	0.0000	-0.0006
Prof7	*Qual3*	-0.0009	-0.0007	-0.0006	-0.0012	-0.0009	-0.0008
Prof7	*Qual4*	0.0024	0.0014	0.0027	0.0036	0.0023	0.0027
Prof7	*Qual5*	-0.0014	-0.0003	-0.0027	-0.0019	-0.0002	-0.0021
Prof8	*Qual3*	0.0011	0.0010	0.0010	0.0015	-0.0005	0.0006
Prof8	*Qual4*	0.0008	0.0020	0.0041	0.0025	-0.0009	0.0020
Prof8	*Qual5*	-0.0014	-0.0027	-0.0030	-0.0048	0.0012	-0.0023
Prof9	*Qual3*	-0.0001	-0.0001	0.0002	-0.0001	-0.0002	-0.0001
Prof9	*Qual4*	-0.0001	-0.0001	0.0000	-0.0003	0.0001	-0.0001
Prof9	*Qual5*	0.0004	0.0000	0.0001	0.0010	-0.0002	0.0004

Appendix 5c .

Wage changes (%) w.r.t. baseline scenario, year 2020

$\sigma^{Ltype}_{j,s,itype}$ type1=2.4, type2=1.56,type3=3.0, all increase by 20 percent

Iprof	*Iqual*	*ATL*	*QUE*	*ONT*	*PRA*	*ALB*	*BCO*
Prof1	*Qual2*	0.0000	0.0000	0.0000	0.0001	-0.0003	-0.0001
Prof1	*Qual3*	0.0000	0.0000	0.0000	0.0000	-0.0003	0.0000
Prof1	*Qual4*	0.0000	0.0000	0.0000	0.0000	-0.0003	0.0000
Prof4	*Qual2*	-0.0003	-0.0004	-0.0004	-0.0001	-0.0007	-0.0004
Prof4	*Qual3*	-0.0002	-0.0004	-0.0004	-0.0001	-0.0008	-0.0005
Prof10	*Qual1*	0.0005	0.0004	0.0006	0.0007	0.0004	0.0007
Prof2	*Qual2*	0.0012	0.0007	0.0001	0.0000	0.0030	0.0008
Prof2	*Qual3*	0.0012	0.0008	0.0001	0.0000	0.0031	0.0008
Prof3	*Qual2*	-0.0060	-0.0051	-0.0034	-0.0031	-0.0064	-0.0048
Prof3	*Qual3*	-0.0059	-0.0050	-0.0034	-0.0030	-0.0065	-0.0048
Prof3	*Qual4*	-0.0059	-0.0051	-0.0035	-0.0031	-0.0064	-0.0048
Prof5	*Qual2*	-0.0001	-0.0001	-0.0002	0.0001	0.0004	0.0002
Prof5	*Qual3*	-0.0002	-0.0002	-0.0001	0.0002	0.0002	0.0002
Prof6	*Qual3*	0.0002	0.0002	0.0005	0.0004	-0.0007	0.0005
Prof6	*Qual4*	0.0002	0.0002	0.0004	0.0004	-0.0006	0.0004
Prof6	*Qual5*	0.0002	0.0002	0.0005	0.0004	-0.0006	0.0003
Prof7	*Qual3*	0.0005	0.0004	0.0010	0.0010	0.0000	0.0008
Prof7	*Qual4*	0.0004	0.0005	0.0011	0.0011	0.0001	0.0009
Prof7	*Qual5*	0.0004	0.0004	0.0008	0.0010	0.0001	0.0007
Prof8	*Qual3*	-0.0011	-0.0015	-0.0012	-0.0014	-0.0011	-0.0013
Prof8	*Qual4*	-0.0012	-0.0013	-0.0010	-0.0014	-0.0009	-0.0011
Prof8	*Qual5*	-0.0014	-0.0019	-0.0014	-0.0018	-0.0013	-0.0014
Prof9	*Qual3*	-0.0008	-0.0005	-0.0017	-0.0021	-0.0005	-0.0016
Prof9	*Qual4*	-0.0007	-0.0005	-0.0017	-0.0020	-0.0004	-0.0016
Prof9	*Qual5*	-0.0007	-0.0005	-0.0017	-0.0019	-0.0004	-0.0015

Appendix 5d .
Wage changes (%) w.r.t. baseline scenario, year 2020
$\sigma^{Ltype}_{j,s,itype}$ type1=2.0, type2=2.5,type3=1.3, change the order of magnitude between type2 and type3

Iprof	*Iqual*	*ATL*	*QUE*	*ONT*	*PRA*	*ALB*	*BCO*
Prof1	*Qual2*	-0.0007	-0.0005	-0.0004	-0.0006	-0.0012	-0.0007
Prof1	*Qual3*	-0.0006	-0.0004	-0.0004	-0.0007	-0.0010	-0.0006
Prof1	*Qual4*	-0.0006	-0.0004	-0.0005	-0.0007	-0.0010	-0.0006
Prof4	*Qual2*	-0.0007	-0.0004	-0.0003	-0.0006	-0.0010	-0.0005
Prof4	*Qual3*	-0.0006	-0.0004	-0.0002	-0.0006	-0.0012	-0.0005
Prof10	*Qual1*	-0.0006	-0.0003	-0.0002	-0.0005	-0.0009	-0.0005
Prof2	*Qual2*	0.0025	0.0016	-0.0011	-0.0015	0.0086	0.0011
Prof2	*Qual3*	0.0026	0.0016	-0.0010	-0.0015	0.0090	0.0013
Prof3	*Qual2*	-0.0183	-0.0155	-0.0114	-0.0104	-0.0197	-0.0156
Prof3	*Qual3*	-0.0182	-0.0156	-0.0114	-0.0105	-0.0198	-0.0156
Prof3	*Qual4*	-0.0184	-0.0155	-0.0114	-0.0104	-0.0194	-0.0155
Prof5	*Qual2*	-0.0014	-0.0013	-0.0018	-0.0011	0.0007	-0.0007
Prof5	*Qual3*	-0.0014	-0.0013	-0.0016	-0.0011	0.0003	-0.0007
Prof6	*Qual3*	-0.0004	-0.0001	0.0005	0.0000	-0.0032	0.0002
Prof6	*Qual4*	-0.0003	-0.0001	0.0004	-0.0001	-0.0030	-0.0001
Prof6	*Qual5*	-0.0004	-0.0001	0.0005	0.0000	-0.0031	0.0000
Prof7	*Qual3*	-0.0025	-0.0024	-0.0046	-0.0050	-0.0017	-0.0040
Prof7	*Qual4*	-0.0025	-0.0024	-0.0050	-0.0050	-0.0015	-0.0041
Prof7	*Qual5*	-0.0024	-0.0021	-0.0036	-0.0046	-0.0017	-0.0033
Prof8	*Qual3*	0.0048	0.0055	0.0056	0.0058	0.0035	0.0055
Prof8	*Qual4*	0.0048	0.0050	0.0044	0.0057	0.0029	0.0050
Prof8	*Qual5*	0.0062	0.0084	0.0073	0.0087	0.0053	0.0067
Prof9	*Qual3*	0.0028	0.0017	0.0066	0.0081	0.0007	0.0063
Prof9	*Qual4*	0.0029	0.0018	0.0067	0.0081	0.0008	0.0063
Prof9	*Qual5*	0.0027	0.0017	0.0067	0.0076	0.0007	0.0061

Appendix 6
Increases in Life Expectancy in Major Economies around the World

Country	1950-1955	1970-1975	1990-1995	Improvement 1950s-1990s
Canada	69.08	73.15	78.50	9.42
France	66.52	72.35	77.15	10.63
Germany	67.50	71.00	76.00	8.5
Italy	66.00	72.11	77.16	11.16
Japan	66.94	73.30	79.50	15.56
UK	69.18	72.01	76.17	6.99
US	69.02	71.30	75.66	6.64

Source: Managing the Global Ageing Transition, a conference report, Switzerland, 2001

Appendix 7a. **Excess Labour Demands changes (%) w.r.t baseline scenario 2020**
Longer life expectancy scenario

Iprof	*Iqual*	*ATL*	*QUE*	*ONT*	*PRA*	*ALB*	*BCO*
Prof1	*Qual2*	-0.2927	-0.2574	-0.2192	-0.1942	-0.2521	-0.2061
Prof1	*Qual3*	-0.2927	-0.2788	-0.2323	-0.1974	-0.2583	-0.2112
Prof1	*Qual4*	-0.2931	-0.2675	-0.2267	-0.1923	-0.2491	-0.1921
Prof4	*Qual2*	-0.1044	-0.1006	-0.1198	-0.1234	-0.0256	0.0171
Prof4	*Qual3*	0.9614	0.4940	0.2476	0.1897	0.2677	0.3177
Prof10	*Qual1*	-0.3375	-0.3732	-0.2615	-0.2180	-0.3381	-0.3061
Prof2	*Qual2*	-0.2934	-0.2550	-0.2170	-0.1913	-0.2398	-0.2081
Prof2	*Qual3*	-0.3015	-0.3036	-0.2357	-0.1977	-0.2653	-0.2404
Prof3	*Qual2*	0.2963	0.3148	0.2227	0.1805	0.2472	0.2672
Prof3	*Qual3*	0.2957	0.3162	0.2227	0.1804	0.2473	0.2663
Prof3	*Qual4*	0.2960	0.3173	0.2230	0.1814	0.2483	0.2648
Prof5	*Qual2*	-0.1694	-0.2082	-0.1923	-0.1538	-0.1158	-0.0959
Prof5	*Qual3*	-0.2193	-0.2309	-0.2058	-0.1841	-0.1982	-0.0430
Prof6	*Qual3*	-0.2904	-0.2615	-0.2256	-0.1913	-0.2496	-0.2136
Prof6	*Qual4*	1.8148	0.5110	0.2970	-0.1604	0.3724	0.3537
Prof6	*Qual5*	0.4859	-0.4123	0.4615	0.1828	0.2962	0.3003
Prof7	*Qual3*	-0.6291	-0.6505	-0.3870	-0.3044	-0.5125	-0.4588
Prof7	*Qual4*	-0.3963	-0.5143	-0.3088	-0.2573	-0.3764	-0.4122
Prof7	*Qual5*	-0.5020	-0.4308	-0.3496	-0.2493	-0.3557	-0.3823
Prof8	*Qual3*	-0.4593	-0.6780	-0.3510	-0.2147	-0.3386	-0.3618
Prof8	*Qual4*	-0.3586	-0.2528	-0.2226	-0.1982	-0.7453	-0.2976
Prof8	*Qual5*	-0.3423	-0.3353	-0.2488	-0.2029	-0.2768	-0.2987
Prof9	*Qual3*	-0.4160	0.3097	0.7500	-0.1914	-0.2771	-0.6456
Prof9	*Qual4*	-0.4541	-0.3939	0.3158	-11.0000	-0.3192	-0.4536
Prof9	*Qual5*	-0.1935	0.3737	0.2653	0.1932	-0.0584	0.3333

Appendix 7b. **Excess Labour Demands changes (%) w.r.t baseline scenario 2020**
Technical improvement in all regions

Iprof	*Iqual*	*ATL*	*QUE*	*ONT*	*PRA*	*ALB*	*BCO*
Prof1	*Qual2*	0.2946	0.2554	0.2788	0.2773	0.2962	0.2312
Prof1	*Qual3*	0.2954	0.2764	0.2953	0.2803	0.3038	0.2375
Prof1	*Qual4*	0.2954	0.2655	0.2879	0.2721	0.2925	0.2165
Prof4	*Qual2*	0.1057	0.1001	0.1520	0.1716	0.0299	-0.0186
Prof4	*Qual3*	-0.9411	-0.4868	-0.3165	-0.2986	-0.3148	-0.3560
Prof10	*Qual1*	0.3400	0.3699	0.3327	0.3117	0.3973	0.3442
Prof2	*Qual2*	0.2954	0.2530	0.2758	0.2737	0.2816	0.2344
Prof2	*Qual3*	0.3032	0.3005	0.2996	0.2849	0.3118	0.2700
Prof3	*Qual2*	-0.2961	-0.3109	-0.2844	-0.2742	-0.2906	-0.2995
Prof3	*Qual3*	-0.2957	-0.3122	-0.2844	-0.2741	-0.2908	-0.2985
Prof3	*Qual4*	-0.2961	-0.3132	-0.2847	-0.2741	-0.2919	-0.2968
Prof5	*Qual2*	0.1717	0.2069	0.2442	0.2161	0.1367	0.1084
Prof5	*Qual3*	0.2214	0.2292	0.2620	0.2566	0.2330	0.0495
Prof6	*Qual3*	0.2930	0.2595	0.2870	0.2734	0.2935	0.2403
Prof6	*Qual4*	-1.7037	-0.5025	-0.3821	0.1684	-0.4367	-0.3955
Prof6	*Qual5*	-0.4783	0.4171	-0.5769	-0.2923	-0.3487	-0.3353
Prof7	*Qual3*	0.6309	0.6431	0.4939	0.4518	0.6033	0.5150
Prof7	*Qual4*	0.3979	0.5084	0.3939	0.3776	0.4421	0.4619
Prof7	*Qual5*	0.5040	0.4262	0.4458	0.3672	0.4182	0.4291
Prof8	*Qual3*	0.4601	0.6644	0.4493	0.3151	0.3985	0.4063
Prof8	*Qual4*	0.3598	0.2416	0.2850	0.2847	0.8868	0.3333
Prof8	*Qual5*	0.3444	0.3324	0.3165	0.2931	0.3257	0.3352
Prof9	*Qual3*	0.4181	-0.3161	-0.8333	0.2753	0.3266	0.7215
Prof9	*Qual4*	0.4587	0.3636	-0.2632	15.0000	0.3741	0.5052
Prof9	*Qual5*	0.1935	-0.3763	-0.3316	-0.2936	0.0657	-0.3788

Appendix 7c. Excess Labour Demands changes (%) w.r.t baseline scenario 2020
Technical improvement only in ATL, QUE and ONT

Iprof	*Iqual*	*ATL*	*QUE*	*ONT*	*PRA*	*ALB*	*BCO*
Prof1	*Qual2*	0.2902	0.2534	0.2738	0.0306	0.0026	0.0214
Prof1	*Qual3*	0.2902	0.2747	0.2895	0.0317	0.0045	0.0216
Prof1	*Qual4*	0.2900	0.2638	0.2826	0.0345	0.0032	0.0222
Prof4	*Qual2*	0.1026	0.0987	0.1480	0.0269	0.0016	0.0129
Prof4	*Qual3*	-0.9919	-0.4887	-0.3200	0.0243	0.0007	0.0054
Prof10	*Qual1*	0.3359	0.3692	0.3288	0.0330	0.0093	0.0186
Prof2	*Qual2*	0.2912	0.2510	0.2703	0.0271	0.0012	0.0184
Prof2	*Qual3*	0.2992	0.2990	0.2952	0.0249	0.0015	0.0148
Prof3	*Qual2*	-0.2967	-0.3109	-0.2852	0.0043	0.0002	0.0015
Prof3	*Qual3*	-0.2959	-0.3122	-0.2849	0.0044	0.0002	0.0013
Prof3	*Qual4*	-0.2962	-0.3133	-0.2849	0.0014	0.0001	0.0010
Prof5	*Qual2*	0.1677	0.2051	0.2394	0.0301	0.0031	0.0150
Prof5	*Qual3*	0.2174	0.2273	0.2571	0.0412	0.0020	0.0299
Prof6	*Qual3*	0.2883	0.2584	0.2827	0.0296	0.0036	0.0166
Prof6	*Qual4*	-1.8333	-0.5025	-0.3881	0.1471	0.0115	0.0200
Prof6	*Qual5*	-0.4896	0.4218	-0.6923	0.0361	0.0091	0.0292
Prof7	*Qual3*	0.6313	0.6441	0.4949	0.0179	0.0102	0.0098
Prof7	*Qual4*	0.3959	0.5084	0.3920	0.0207	0.0042	0.0111
Prof7	*Qual5*	0.5027	0.4258	0.4458	0.0198	0.0044	0.0104
Prof8	*Qual3*	0.4567	0.6576	0.4461	0.0099	-0.0032	0.0101
Prof8	*Qual4*	0.3541	0.2303	0.2756	0.0125	-0.0943	0.0063
Prof8	*Qual5*	0.3409	0.3313	0.3131	0.0254	0.0044	0.0108
Prof9	*Qual3*	0.4076	-0.3484	-1.2500	0.0172	-0.0108	-0.1139
Prof9	*Qual4*	0.4472	0.3030	-0.5263	-1.0000	-0.0150	-0.0825
Prof9	*Qual5*	0.1129	-0.3871	-0.3571	-0.0114	-0.0730	-0.1667