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Incentives for Early Retirement in Canada's Defined-Benefit Public and Private Pension Plans: An Analysis with a Dynamic Life-Cycle CGE Model

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Abstract

This paper reviews the incentive effects of Canada's public pension system and defined-benefit employer pension plans on early retirement behaviour. It uses a dynamic applied general equilibrium overlapping generations model to quantify the impact of these incentives on labour supply, productive capacity and economic welfare and evaluates some options to reduce these incentives. Simulation analysis indicates that eliminating the main work disincentive effects of the Canadian public pension system on retirement behaviour would have a moderate positive impact on the labour supply of older workers in low- and medium-skilled occupations, but a marginal effect on high-skilled workers. On the other hand, the main distortionary effects of defined-benefit private pension plans are significantly larger for all skills groups, but particularly for older workers in high-skilled occupations.

Résumé

Cet article se penche sur les effets incitatifs à la retraite anticipée du régime canadien de pensions publiques et des régimes privés d'employeurs. Un modèle d'équilibre général calculable dynamique à générations imbriquées est utilisé pour quantifier l'impact de ces incitatifs sur l'offre de travail, la capacité de production et le bien-être. De plus, quelques scénarios de politiques visant à réduire les incitatifs à la retraite anticipée sont examinés. Les résultats de simulation indiquent qu'une élimination des effets incitatifs à la retraite anticipée du régime de pensions publiques aurait un impact positif mais faible sur l'offre de main-d'œuvre des travailleurs âgés dans les professions à faible et moyen niveaux de compétences, mais un impact très minime sur les travailleurs plus hautement qualifiés. D'un autre côté, les effets incitatifs à la retraite anticipée des régimes d'employeurs à prestations définies sont beaucoup plus grands et ont beaucoup plus d'influence sur le comportement des travailleurs dans les professions à compétences élevées.

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1. Introduction

Canadians are retiring when they are younger than the statutory retirement age of 65, the age at which they become eligible for unreduced public benefits. According to Statistics Canada, the average age of retirement has declined steadily in Canada over the 1976 to 1998 period from around 65 for men and 64 for women during the second half of the 1970s to 61.5 years and 60 years respectively by the late 1990s. However, since 1998, the trend in retirement seems to have halted. In fact, from the lowest level observed in 1998, the average retirement age has tended to increase somewhat, ranging between 62 and 62.5 years in 2003-2005 for men and around 61 years for women.

Some studies have shown that the cost of early retirement is substantial in terms of unused productive capacity and hours of work (e.g. Fougère *et al*. 2005, PRI 2005, Rowe and Nguyen 2003, Herbertsson and Orszag 2001). Also, in the context of population ageing, the negative labour supply shock due to early retirement will intensify given that there will be more and more people in the 55-64 age group. According to Human Resources and Social Development Canada - Policy Research Directorate's demographic projections, the proportion of the population 55-64 will increase by about 50% between 2000 and 2020.

Canada's public pension system generates work disincentives for older workers. Although it is generally acknowledged that these disincentives are small compared to many other OECD countries (Gruber and Wise, 2004), several commentators have suggested that the C/QPP system should be reformed (Guillemette 2004, Milligan 2005).

There is also some evidence that defined-benefit employer pension plans in Canada provide incentives to retire before the age of 65. According to Pescarus and Rivard (2005), of the 13 private pension plans they examined, all of them offer the strongest incentives to retire before age 60.

The objective of this article is three fold. First, it reviews the incentive effects of Canada's public pension system and defined-benefit private pension plans on early retirement behaviour. Second, it uses a dynamic applied general equilibrium overlapping generations (OLG) model of the type developed by Auerbach and Kotlikoff (1989) to quantify their

impact on labour supply, productive capacity and economic welfare. Third, it evaluates some options to reduce early retirement incentives.

The OLG model used in this paper captures the economic impact of projected future demographic changes and the incentive effects of policy through the life-cycle. Moreover, in the spirit of Becker (1965), the model uses a time allocation structure where labour supply, human capital and leisure/retirement decisions are endogenous. We also innovate by modeling the retirement incentives from Canada's public and private pension plans. The incentives are expressed as implicit tax rates for workers and are derived from a pension calculator that takes into account the interactions between the various elements of Canada's Public Pension System and defined-benefit employer pension plans. The LifePaths model from Statistics Canada was also used to generate detailed information on RPP and RRSP contributions and benefits to help calibrate the OLG model.

Simulation analysis indicates that eliminating the main work disincentive effects of the Canadian public pension system on retirement decisions would have a moderate positive impact on the labour supply of older workers in low- and medium-skilled occupations, but a marginal effect on high-skilled workers. The impact on high-skilled workers comes mainly from the elimination of the OAS claw back. Eliminating early retirement incentives in public pensions would also be welfare enhancing. Although lifetime leisure would decrease, it is generally more than compensated by increases in lifetime consumption. Several reform options are also examined to make the program near incentive-neutral. Among those, raising the actuarial adjustment in C/QPP has the most favourable impact. However, delaying the statutory retirement age is not a viable option, since the macroeconomic impact is virtually zero.

The analysis also shows that the main distortionary effects of defined-benefit private pension plans are significantly larger than those in public pensions and generate more work disincentive effects on older workers in high-skilled occupations. The cost of early retirement in terms of unused productive capacity associated with DB employer pensions is about seven times larger than that in the public pension system. Finally, it must be noted that since the mid-1980s, the proportion of members of private plans that are covered by DB plans has

decreased from 95% in 1984 to 84% in 2006. This reduction in the proportion of plans members in DB plans has likely contributed to an overall reduction in work disincentives. A continued declining trend in the proportion of DB plans over the next decades, if it materializes, could also help to further reduce the impact of early retirement incentives.

The remainder of this paper is divided as follows. Section 2 presents an overview of early retirement incentives from the Canadian public pension system and private pension plans. Section 3 provides estimates of early retirement incentives from both public and private pension plans in the form of implicit tax rates using a pension calculator. Section 4 describes the CGE model used for the analysis and discusses the key parameter values. Section 5 presents simulation results of the impact of early retirement incentives from both public and private pension plans on the economy and labour market, simulates some policy options to eliminate work disincentive effects in public pension plans and examines a likely scenario of further reduction in the proportion of defined-benefit private pension plans. Section 6 presents some sensitivity analysis. Finally, Section 7 provides some concluding remarks.

2. Incentives to Early Retirement

This section provides an overview of early retirement incentives in both Canadian public and private pension plans. Following Stock and Wise (1990), retirement incentives inherent in defined-benefit pension plans can be decomposed into wealth and accrual (substitution) effects. First, pensions increase an individual's wealth. Assuming leisure is a normal good, an increase in pension wealth - the present value of future retirement benefits - will lead an individual to consume more of every thing, including leisure. Second, an accrual or substitution effect exists when pension wealth varies according to the retirement age. The accrual effect can be defined as the difference in pension wealth between taking retirement now and one year later. When it is positive, meaning that working one additional year increases pension wealth, there is an incentive to continue working; when negative, there is an incentive to retire.

If retirement benefits are based solely on contributions and do not depend on the age of retirement, the accrual effect is zero and the retirement decision is entirely based on the

trade-off between additional leisure and consumption. Accordingly, defined-contribution pension plans have no accrual effect, only a wealth effect.

In the remaining part of this section, we will discuss in more details the source of early retirement incentives in both Canadian public and private pension systems.

2.1 Canada's Public Income Security System

Older individuals face financial disincentives to continue working originating from the public pension system, which is primarily composed of two program groups: Old Age Security (OAS) programs and Canada/Quebec Pension Plans (C/QPP)[1]. The combined OAS programs represent a similar share of retirement income as C/QPP. For example, net C/QPP payments represented $33.5 billions in 2006, compared with $31.0 billion for all OAS programs[2].

The basic OAS pension is offered to all individuals 65 years of age and older who meet residency requirements. The maximum benefit was $497.83 per month in July 2007 (benefits are adjusted quarterly reflecting changes to the Consumer Price Index). Continuing to work past age 65 does not affect OAS benefits, unless the individual's annual income (other than from OAS pension programs) is higher than $63,511 (in 2007), in which case 15% of the excess income is clawed back. This mainly affects highly-skilled individuals.

On top of the Old Age Security basic pension, the Guaranteed Income Supplement (GIS) provides additional money to low-income individuals 65 years of age and older. In July 2007, the maximum monthly benefit was $414.96 for each member of a couple and $628.36 for singles. The GIS is reduced by 50 cents for singles and 25 cents each for couples for every dollar of family income excepting OAS. This means that GIS benefits are zero when monthly family income (excepting OAS) is higher than $1,256.72 for singles and $1,659.84 for couples. Continuing to work past age 65 will reduce GIS for all workers. However, highly-

[1] Québec workers do not participate in the CPP, but rather in the Québec pension plan, which is very similar to the CPP.

[2] Data for section 2.1 come from Human Resources and Social Development Canada, *The CPP & OAS Stats Book 2007*.

skilled workers are more likely to have income from other sources (savings, private pensions, RRSPs, etc.). Thus, whether they work or not, they will not likely receive the GIS. Therefore, the GIS will be a greater disincentive to work for low-skilled individuals (starting at age 65).

The OAS system also has another feature, the Allowance (formerly known as the Spousal Allowance), which is paid to low-income 60-64 years-old spouses of GIS recipients, widows and widowers. In July 2007, the maximum monthly benefit was $912.79 for a spouse or partner and $1011.80 for a survivor. The maximum monthly Allowance is reduced by 75 cents for every dollar of other income. The Allowance is a disincentive to work, mainly for low-skilled workers aged 60 to 64 years old. However, the uptake of this program is very low (94,000 recipients in 2006 compared with 4.3 million for OAS and 1.5 million for GIS), since its requirements apply to few individuals.

The C/QPP is an earnings-based pension plan. It is compulsory from age 18 and covers almost all workers in Canada. It is funded by a payroll tax. In 2007, contributions for both the employee and the employer were 4.95% of annual earnings between $3,500 (the year's basic exemption) and $43,700 (the year's maximum pensionable earnings), for a maximum annual contribution of $1,989.90. Benefits are calculated as 25% of a person's pensionable earnings over the period the individual is aged 18 to 65, with the lowest-earning 15% of months in that period being dropped from the calculation. Therefore, someone with earnings above the maximum pensionable earnings for at least 85% of the 47 years between 18 and 65 will earn the maximum benefit of $863.75 per month in 2007.

The normal uptake for the C/QPP is age 65, although retirement pensions can begin between ages 60 and 70. Early retirement is penalized by 0.5% a month, so that if C/QPP is taken at age 60, benefits are decreased by 30%. Similarly, retiring after age 65 increases the benefits by 0.5 % a month, for a maximum of 30% if C/QPP is taken at age 70. Individuals have to stop working if they want to claim early C/QPP.

Before age 60, C/QPP constitutes an incentive to work, since working one additional year will increase future benefits for most workers, because of the possibility of dropping the 15% worst months in terms of earnings from the calculation of benefits. Between age 60 and 65, working one additional year means losing one possible year of C/QPP benefits. On the

other hand, it also means that benefits will be increased by 6% over the rest of the individual's lifetime (because of the accrual adjustment), maybe more considering working one more year would help increase the number of years with high income (the 15% drop rule). However, this 6% rate is insufficient to compensate for the lost year of benefits, so overall, between 60 and 65, C/QPP offers a disincentive to continued work.

Overall, the public system offers positive work incentives until age 60, because before this age, working longer increases future C/QPP benefits. At age 60, disincentives begin, caused by the possibility of collecting C/QPP benefits, in which case the person has to stop working. At this age, working one more year doesn't increase future benefits enough to compensate for the loss of one year of benefit. The interaction between C/QPP and GIS is a major disincentive to continue working between age 60 and 65: working one additional year increases the value of future C/QPP payments, mainly because of the actuarial adjustment, but at the same time diminishes future GIS benefits by 50 cents for every dollar of increased C/QPP benefits. The Allowance is also a disincentive to work between age 60 and 64, but the effect is very small as few people benefit from it. At age 65, OAS and GIS programs start. The basic OAS pension is reduced for high-income individuals who continue working. GIS, which is intended for low-income individuals, is also reduced by 50 cents for every dollar of income earned.

2.2 Registered Private Pension Plans (RPPs)

RPPs are retirement income plans provided by employers or unions. These plans are provided voluntarily, and take two basic forms: defined benefit (DB) and defined contribution (DC).

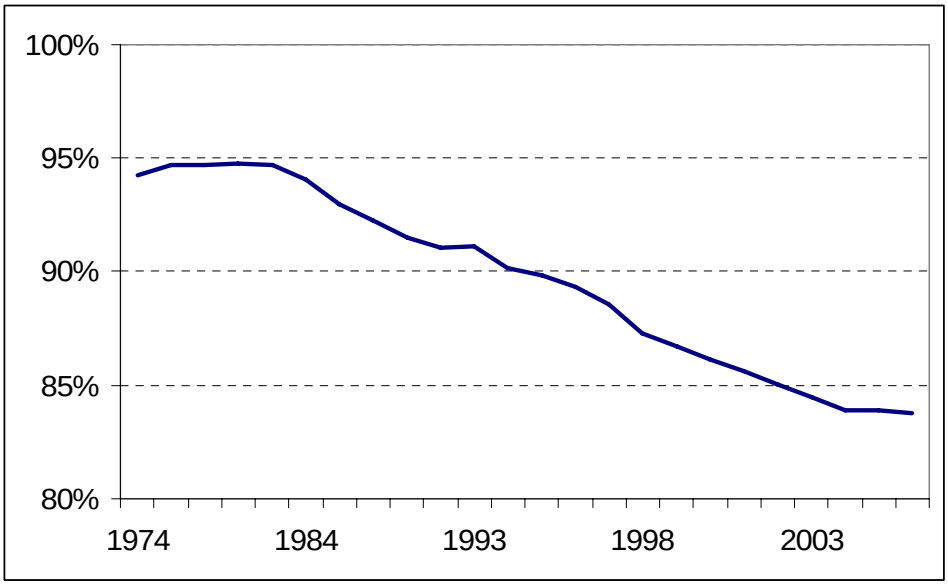
DB plans are funded by contributions of employers and employees, and are based on the cost of providing future benefits, which are defined in the plan text. The benefits are normally based on the number of years of service with the employer, and are often a percentage of the earnings of the individual during his whole career, or the best or last years of the worker's career. Benefits normally start at a certain age or after a certain number of years of service with the employer (or a combination of the two). There can be penalties for

those who choose to retire before they reach the required number of years of service or age. Therefore, DB benefits vary according to retirement age.

A DC plan is a retirement plan wherein a certain amount of money is set aside by employers every year. Employees can also contribute as much as they want. The benefits are not specified and are based on the return on investment and how much each employee contributed. Since benefits are not determined by rules linked to retirement age, as in DB plans, DC plans do not have accruals. They affect retirement decisions only through the wealth effect.

The percentage of beneficiaries of private pension plans (DB or DC) starts to be significant in the 53-56 year old group (9%), becomes stronger (around 26%) in the 61-64 group, and is highest among high-skilled individuals[3].

Chart 2.1
Proportion of private pension plan members covered by a DB plan, Canada, 1974-2006



Source: Statistics Canada, Pension Plans in Canada Survey

In 2006, 84% of members of private pension plans were covered by DB plans. As shown in Chart 1, the proportion of members of a private plan covered by a DB plan (rather

[3] The data source for the coverage by skills level and age group is the 1999 Survey of Financial Security.

than a DC plan) has steadily declined since the mid-80s. This shift towards DC plans was also experienced in the U.S., but to a much larger extent. Munnell and Perun (2006), using the U.S. Survey of Consumer Finances, illustrate that the proportion of members of private plans covered only by DB plans decreased significantly, from 62% in 1983 to just 20% in 2004.

3. Estimates of incentives to early retirement from public and private pension plans

This section provides estimates of early retirement incentives from both public and private pension plans, in the form of implicit tax rates, using a pension calculator to estimate pension accruals. Please note that the accrual effects are calculated by skill level since the CGE model used in this paper has three representative workers by skill – low-, medium- and high-skilled workers.

This type of pension calculator was introduced by Stock and Wise (1990) and was recently used by Baker, Gruber and Milligan (2003) and Milligan and Schirle (2006). Pension accruals are expressed as implicit tax rates by dividing the accrual for one particular retirement age by average earnings at that age.

In this exercise, we first calculate Income Security Wealth (ISW) from public sources. The pension calculator incorporates all of the rules used to calculate C/QPP, GIS and OAS entitlements in 2001. The Allowance is not included in the pension calculator, because it is only paid in very specific situations; the uptake of the Allowance is also quite small, so incorporating this program would have a negligible effect on work disincentives in aggregate.

Data from the 2001 Census are used to construct age-specific lifetime earnings profiles for the different workers by skill levels in the model. Earnings data are for full-time employees. We assume smoother earnings profile and calculate predicted earnings rather than actual earnings by estimating a simple regression of earnings on a constant, age and age squared as independent variables. These earnings profiles are used to calculate C/QPP, GIS and OAS entitlements for retirement at each age starting at 53. C/QPP payments are received starting at age of retirement or age 65, whichever is earlier. GIS is received at retirement age or age 65, whichever is later. OAS always begins at 65, because all seniors start receiving at least some OAS benefits at this age, unless their income is very high (more than $100,000 in

2007 – which is greater than the income of our representative high-skilled worker). Lifetime pension receipts are then discounted for time-preferences and survival probabilities to give a measure of ISW at each potential retirement age. The individual rate of time preference is set at 0.03, which is common in the literature, and survival probabilities come from Statistics Canada's Life Tables.[4] ISW is compared between subsequent retirement ages to determine raw accruals, which are then divided by age-specific earnings to express them as an implicit tax on earnings.

Table 3.1 shows the average implicit tax rates by age group and skill level. A negative sign means there is a disincentive to continue working at this age. Implicit tax rates are generally positive before age 60, as continuing to work increases future C/QPP benefits.

Table 3.1
Average implicit tax rate, by age of retirement and skill level, public pensions only

Age	Low-skilled	Medium-skilled	High-skilled
55-56	2.3	2.4	2.4
56-57	2.2	2.2	2.2
57-58	1.7	1.8	1.6
58-59	1.7	1.8	1.6
59-60	1.8	1.9	1.7
60-61	-3.6	-3.5	2.7
61-62	-6.9	-7.2	1.5
62-63	-9.7	-10.0	0.0
63-64	-12.1	-10.8	-1.2
64-65	-14.8	-5.4	-2.7
65-68	-1.7	0.0	-2.8
69+	-1.9	0.0	-2.2

The implicit tax rate is the difference in income security wealth if retirement occurs at age x and at age x-1, divided by earnings at age x-1. A negative sign means there is a disincentive to continue working.

Starting at age 60, disincentives arise because of the possibility of taking early C/QPP. This is mainly the case for low or medium-skilled individuals, because their earnings are lower, and because the lost year of C/QPP benefit represents a higher share of their earnings. Also, contrary to the high-skilled individuals, they are more likely to receive GIS in the future. Therefore, continuing to work, while increasing their C/QPP entitlement, will also decrease their GIS entitlement. The disincentive usually grows from 60 to 65, because the

[4] Statistics Canada, Life Tables, Canada, Provinces and Territories, 2000-2002.

penalty for taking C/QPP before age 65 decreases: the lost year of C/QPP becomes of a higher value. In the meantime, future GIS entitlements decrease to a greater extent, because every dollar of increase in C/QPP entitlement reduces future GIS benefits by 50 cents.

After age 65, the disincentives are the following: for the low-skilled, the only disincentive is the loss of one year of GIS benefit. For the medium-skilled who take their retirement after age 65, the C/QPP benefit is high enough that they don't get any GIS benefit, so there are no more disincentives. The high-skilled don't receive any GIS benefit as well, but their OAS benefits are reduced if they continue to work because their earnings are higher than the threshold of $63,511.

We then introduced private plans in the pension calculator. Since there is not one unique private pension plan but thousands of them, we had to illustrate the disincentive effect of such plans for a representative agent, using the average benefit received from private plans by age group and skill level, from the Survey of Financial Security of 1999. We then multiply these numbers by the proportion of beneficiaries of DB plans in each age group and skill level. Table 3.2 shows the results of this calculation. We start by measuring the work disincentives at age 55, which is the normal uptake in many pension plans; data also shows that the uptake starts increasing within the 53-56 age group. The disincentive reaches a maximum at age 61-64, and we keep it constant afterwards, even though data shows that benefits decrease after this age. We believe this observed decline in the data reflects the financial situation of older cohorts rather than an actual decrease in benefits after 64.

Table 3.2

Average benefits from DB plans for representative agents, by age group and skill level

Age group	Low-skilled	Medium-skilled	High-skilled
55-56	$894	$2,039	$4,175
57-60	$1,474	$2,696	$6,287
61 and more	$3,208	$4,702	$9,454

Survey of Financial Security, Statistics Canada, 1999

Table 3.3 shows the new implicit tax rates, when both public and private plans are included, as well as the difference between these new implicit tax rates and the rates from Table 1, where only public plans were included. This difference can be roughly seen as the

effect of private plans on implicit tax rates (a negative signs means the disincentive increases).

Including private pension plans in the pension calculator increases to a great extent the work disincentives, especially after age 61, and more so for the high and medium skilled than for low-skilled workers. This is because a higher proportion of high-skilled workers are covered by such plans and their benefits are higher.

Table 3.3
Average implicit tax rate, by age of retirement and skill level, private and public plans and difference with Table 1 (public plan only)

Age group	Public and private plans			Private plans only		
	Low-Skilled	Medium-Skilled	High-Skilled	Low-Skilled	Medium-Skilled	High-Skilled
55-56	-0.5	-2.7	-4.4	-2.8	-5.1	-6.8
56-57	-0.6	-2.9	-4.7	-2.8	-5.1	-6.8
57-58	-3.2	-5.6	-8.9	-4.9	-7.3	-10.4
58-59	-3.1	-5.5	-8.8	-4.9	-7.3	-10.4
59-60	-3.1	-5.4	-8.8	-4.9	-7.3	-10.4
60-61	-8.5	-10.9	-7.8	-4.9	-7.3	-10.4
61-62	-18.5	-21.6	-14.8	-11.6	-14.4	-16.2
62-63	-21.2	-24.4	-16.3	-11.6	-14.4	-16.2
63-64	-23.7	-25.2	-17.4	-11.6	-14.4	-16.2
64-65	-26.4	-19.8	-18.9	-11.6	-14.4	-16.2
65-68	-14.8	-17.3	-20.0	-13.1	-17.3	-17.2
69+	-16.5	-20.2	-20.2	-14.6	-20.2	-18.0

The implicit tax rate is the difference in pension wealth if retirement occurs at age x and at age x-1, divided by earnings at age x-1. A negative sign means there is a disincentive to continue working.

4. The Model

The analysis is based on a dynamic computable general equilibrium model with an OLG structure. The model is calibrated to represent the Canadian economy. In this section, we present a detailed description of the model.

4.1 Household Behaviour

The population is represented by 16 representative Canadian-born agents and 16 representative immigrants agents, structured in an Allais-Samuelson OLG structure. Consequently, at each period of time, 16 Canadian-born plus 16 foreign-born generations live

side by side. At any period *t*, a new generation is born and the eldest dies. Each native-born agent enters the labour market at the age of 17 and dies at the age of 81. This implies that each period of the model corresponds to four years. Younger individuals are assumed to be dependent on their parents (the representative agents), implying that they play no active role in the model. The population growth rate and immigration are exogenous. The model also distinguishes between four categories of agents in each immigration class: three different skill levels of workers (high, medium and low) and a fourth category of adults who are unattached to the labour market (inactive).

Canadian and foreign-born agents optimize a CES type inter-temporal utility function of consumption and time allocation subject to lifetime income and time constraint. The household (or agent)'s optimisation problem consists of choosing the consumption and savings pattern over the lifecycle, as well as the allocation of time between work, education and leisure. Time spent in education is considered to be human capital investment. Human capital gains also raise effective labour supply and the quality of leisure. For each of the 8 different types of agents, the inter-temporal utility function takes the following form:

$$(1)\ U_{qual,nat} = \frac{1}{1-\sigma}\sum_{g=17}^{80}\left(\frac{1}{1+\rho}\right)^{g}\left(C_{qual,nat,g,t+g-1}^{1-\theta} + \phi_{qual,nat,g}\,\ell_{qual,nat,g,t+g-1}^{1-\theta}\right)^{\frac{1-\sigma}{1-\theta}}, \qquad 0 < \theta < 1.$$

$C_{qual,nat,g,t}$ and $\ell_{qual,nat,g,t}$ are respectively consumption and leisure activity of an agent of qualification *qual*, nationality (Canadian-born or foreign-born) *nat*, age group *g* at time *t*; ρ the pure rate of time preference; σ the inverse of the inter-temporal elasticity of substitution ε ($\varepsilon = 1/\sigma$); θ the inverse of the intra-temporal elasticity of substitution between consumption and leisure activity η ($\eta = 1/\theta$); and $\phi_{qual,\,nat,\,g}$ the leisure activity preference parameter.

Notice that as the 4th category of agents is inactive, their inter-temporal problem is simplified by assuming that they consume what they receive in transfers from the government. Consequently, their wealth (*Ag, t*) remains equal to zero at all times and their time allocation is exogenous. The human capital technology is described by a well-behaved function, linear in the stock of human capital *h*, but strictly concave with respect to educational and training time.

Human capital production is individualized, and total production of new human capital in the economy is simply the sum of all generations' production. The specification chosen is similar to that in Lucas (1988, 1990). The technology for the production of human capital takes the following form:

$$(2) \qquad h_{qual,nat,g+1,t+1} = \frac{h_{qual,nat,g,t}}{1+\delta} + \beta h_{qual,nat,g,t} z^{\gamma}_{qual,nat,g,t} + Exp_{qual,nat,g,t} \ ,$$

$$\beta > 0,\ 0 < \gamma < 1,\ \delta > 0,$$

where z is the fraction of time allocated to the production of human capital, δ the human capital depreciation rate, γ the elasticity of human capital production, β a production parameter and *Exp* an experience variable that evolves exogenously with age. Each agent is endowed with one unit of time for each period of life. As time can be allocated to leisure activity and the production of human capital, what is left for labour market participation (*Lpar*) is:

$$(3) \qquad Lpar_{qual,nat,g,t} = 1 - z_{qual,nat,g,t} - \ell_{qual,nat,g,t}$$

The representative agent of each type optimises equation 1 subject to 2, 3 and to the budget constraint. The representative agent budget constraint in each period of life is:

$$\begin{aligned} & A_{qual,nat,g+1,t+1} - A_{qual,nat,g,t} = w_{qual,t} h_{qual,nat,g,t} Lpar_{qual,nat,g,t} (1 - \tau^{w}_{t} - cr_t - dbcr_t) + \\ (4) \qquad & r_t a_{qual,nat,g,t} (1 - \tau^{k}_{t}) + Tr_{qual,g,t} (1 - \tau^{w}_{t}) + OAS_{qual,g\geq 13,t} (1 - \tau^{w}_{t}) + \\ & GIS_{qual,g\geq 13,t} + C/QPP_{qual,nat,g\geq 12,t} (1 - \tau^{w}_{t}) + RPP_{qual,nat,g\geq 10,t} (1 - \tau^{w}_{t}) - (1 + \tau^{c}_{t}) C_{qual,nat,g,t}, \end{aligned}$$

where $A_{qual,nat,g\ t}$ represents the assets accumulated by skill level, immigration status at age g and time t, cr_t the contribution rate to public pensions, $dbcr_t$ the contribution rate to defined-benefit private pensions, τ^w the tax rate on labour income, τ^k the tax rate on capital income and τ^c the tax rate on consumption expenditures. Government transfers are represented by $Tr_{qual,g,t}$, $OAS_{qual,g,t}$, $GIS_{qual,g,t}$ and $C/QPP_{qual,nat,g,t}$. *Tr* represents government transfers excluding public pensions, *OAS* is Old Age Security, *GIS* includes Guaranteed Income Supplement and Spouse's Allowance (SPA**)**. *C/QPP* is Canada and Quebec Pension Plans' (C/QPP) benefits and $RPP_{qual,nat,g,t}$ is benefits from a defined-benefit registered pension plan (private pension

plan). Both C/QPP and RPP benefits are a fraction of lifetime best labour earnings and are determined respectively by the pension replacement rate *CQPP_rr and RPP_rr*$_{qual,g}$ (see table 4.1*)*. In equations (5) and (6), the left-hand side is total pension benefits to be paid and the right-hand side is workers' contributions.

$$(5)\quad \sum_{qual,nat,g} POP_{qual,nat,g\geq 12,t} C/QPP_{qual,nat,g\geq 12,t} = cr_t \cdot \sum_{qual,nat,g} POP_{qual,nat,g,t} w_{qual,t} h_{qual,nat,g,t} Lpar_{qual,nat,g,t}$$

$$(6)\quad \sum_{qual,nat,g} POP_{qual,nat,g\geq 10,t} RPP_{qual,nat,g\geq 10,t} = dbcr_t \cdot \sum_{qual,nat,g} POP_{qual,nat,g,t} w_{qual,t} h_{qual,nat,g,t} Lpar_{qual,nat,g,t}$$

Also, as discussed in Section 2, the public pension system and defined-benefit pension plans have two types of effects on the individual's retirement decision: a wealth effect and an accrual (substitution) effect. However, they are modeled to capture only the wealth aspect of the incentives to individuals, as it is computationally difficult to include the pension rules that give rise to the accrual effect in the overall model. To circumvent this problem, we develop an external pension calculator to calculate pension accruals, and express these as implicit tax rates which directly affects the price of leisure expressed in forgone wages for older workers.

Differentiating the household (or agent) utility function with respect to its lifetime budget constraint yields a reserve wage, *Wres* for each generation:

$$(7)\quad Wres_{qual,nat,g,t} = w_{qual,t} \cdot h_{qual,nat,g,t} \cdot Lpar_{qual,nat,g,t} \cdot (1 - \tau_t^w - cr_t - dbcr_t - a_{qual,g,t}) + \mu_{qual,nat,g,t}$$

where $\mu_{qual,nat,g,t}$ is a Kuhn-Tucker multiplier and differs from zero if and only if the agent chooses to retire in year *t* and represents the extra money the individual would require to leave retirement and supply labour. The presence of cr_t and $dbcr_t$ in the equation means that workers consider C/QPP and RPP contribution rates as a marginal tax rates on labour. This implies that an increase in payroll taxes to finance income security reduces the price of leisure or the reserve wage. Also, note that $a_{qual,t,g}$ is the implicit tax rate representing the accrual effects of defined-benefit public and private pension plans. For example, for an individual aged 60, if working one more year reduces the discounted sum of future pension benefits, *a* becomes positive and distorts labour-leisure decision in the same manner as a rise in τ^w, *cr* and *dbcr*.

The intra-temporal first-order conditions of the household problem can be written as:

$$(8) \qquad LA_{qual,nat,g,t} = \left[\frac{\phi_{qual,nat,g}(1+\tau_t^C)}{Wres_{qual,nat,g,t}} \right]^{\eta} C_{qual,nat,g,t}$$

As shown in equation 8, an increase in the reserve wage *Wres* causes a decline in leisure relative to consumption. In fact, one unit change in the leisure-consumption ratio following a change in the reserve wage is equal to the intra-temporal elasticity of substitution η. Also, looking at equations 7 and 8, an increase in τ^w, *cr, dbcr,* or *a* reduces the reserve wage, which in turn raises leisure activity relative to consumption.

4.2 The Production Sector

A representative firm produces a unique good. Its production technology is represented by a Cobb-Douglas production function. The national firm hires labour and rents physical capital up to their marginal products. Effective labour is a composite factor of the three skills levels that takes into account both quality and quantity dimensions. It is represented by a constant elasticity of substitution (CES) function. With Y_t representing output at time t, K_t the capital stock, L_t the effective labour force, and A the scaling variable, we have:

$$(9) \qquad Y_t = AK_t^{\alpha} L_t^{1-\alpha}$$

where α is the share of capital in value added. Firms are assumed perfectly competitive and factor demands follow from profit maximization:

$$(10) \qquad re_t = \alpha A \left(\frac{K_t}{L_t} \right)^{\alpha-1}$$

$$(11) \qquad w_t = (1-\alpha) A \left(\frac{K_t}{L_t} \right)^{\alpha}$$

where re_t is the rental rate of capital and w_t the wage rate per unit of effective labour.

The labour force is a CES function of labour by skill level. Consequently, the demand for labour of a given skill level equals:

$$(12) \qquad L_{qual,t} = \varsigma_{qual}\left(\frac{w_t}{w_{qual,t}}\right)^{\sigma^L} L_t$$

where $L_{qual,t}$ is the effective labour force by skill level, $w_{qual,t}$ the wage rate per unit of skilled effective labour, ς_{qual} a constant parameter and σ^L the elasticity of substitution of the CES function for labour demand. Given equation (4), the wage rate per unit of effective labour *wt* becomes a CES function of the wage rate per unit of skilled effective labour $w_{qual,t}$:

$$(13) \qquad w_t^{1-\sigma^L} = \sum_{qual} \varsigma_{qual} w_{qual,t}^{1-\sigma^L}$$

4.3 Investment and Asset Returns

The accumulation of the capital stock (*Kt*) is determined by the following equation:

$$(14) \qquad K_{t+1} = Inv_t + (1-\delta)K_t \quad ,$$

where *Invt* represents investment made at time *t* and δ is the depreciation rate of capital. The rate of return on capital R_t is a function of its rental rate re_t minus the depreciation rate:

$$(15) \qquad 1 + R_t = (1 + re_t - \delta)$$

Since bonds and capital shares are perfect substitutes, expected return on capital also equal the expected returns on bonds:

$$(16) \qquad 1 + R_{t+1} = 1 + ri_t$$

where ri_t is the rate of return on bonds issued at time *t*.

4.4 The Government Sector

The national government issues bonds to finance the public debt and to satisfy its budget constraint. It taxes labour income and taxable transfers, capital income and

consumption expenditures. It spends on public expenditure, health care, education and interest payments on the regional government public debt. It also provides transfers to agents through the social transfers.

The government budget constraint is defined as:

$$
\begin{aligned}
&Bond_{t+1} - Bond_t + \sum_{qual,nat,g} (Pop_{qual,nat,g,t}(\tau_t^w(w_{qual,t} h_{qual,nat,g,t} Lpar_{qual,nat,g,t} + Tr_{qual,nat,g,t} \\
&+OAS_{qual,g\geq 13,t} + C/QPP_{qual,nat,g\geq 12,t} + RPP_{qual,nat,g\geq 10,t})) + \tau_t^c C_{nat,g,t} + \tau_t^k ri_t a_{nat,qual,g,t}) = \\
&(Gov_t + GovH_t + GovE_t) + \sum_{qual,nat,g} Pop_{qual,nat,g,t}(Tr_{g,t} + OAS_{qual,g\geq 13,t} + GIS_{qual,g\geq 13,t}) + ri_t Bond_t
\end{aligned}
\tag{17}
$$

On the left hand side of the above equation, $Bond_t$ is the stock of debt accumulated by the government at time t and $Bond_{t+1} - Bond_t$ is the government deficit. The three remaining terms on the left-hand side are government revenues from taxes levied on labour income (plus taxable transfers), consumption and capital income. On the right-hand side of the equation, Gov_t is public expenditure, $GovH_t$ health care spending, and $GovE_t$ education spending. The remaining terms include total transfer payments (*Tr*, *OAS* and *GIS*), which evolve with demographic changes and interest payments on the public debt.

4.5 Market and Aggregation Conditions

The model assumes perfectly competitive markets and agents with perfect foresight. The equilibrium condition for markets of goods states that total output must be equal to total demand:

$$Y_t = \sum_{qual,nat,g} (Pop_{qual,nat,g,t} C_{qual,nat,g,t}) + InvI_t + Gov_t + GovH_t + GovE_t . \tag{18}$$

There is a demand for labour by level of qualification. The stock of effective skilled labour supplied is the number of workers in each skill category multiplied by their corresponding human capital stocks and labour force participation rates:

$$L_{qual,t} = \sum_{nat,g} (Pop_{qual,nat,g,t} h_{qual,nat,g} Lpar_{qual,nat,g}) \tag{19}$$

Bonds and physical capital ownership are considered perfect substitutes, hence total supply of assets must equal total demand:

$$(20) \qquad \sum_{qual,nat,g} Pop_{qual,nat,g,t} A_{qual,nat,g} = K_t + Bond_t$$

4.6 Behavioural Parameters

Table 4.1 reports key behavioural and government program parameter values. The value of the inter-temporal elasticity of substitution is 0.9 and the value of the intra-temporal elasticity of substitution between consumption and leisure is 0.8. These values are similar to those used by Altig *et al.* (1997), Kotlikoff *et al.* (1999) and Baylor (2005). The C/QPP replacement rate is 0.2. RPP replacement rate varies by age and skill and ranges between 0.02 and 0.14.[5] The elasticity of substitution for labour demand across qualification is set to 1.5. This is based on a survey of recent studies who estimated long-run elasticity of substitution between more educated and less educated workers.[6] The elasticity of human capital technology is equal to 1.7 ($\psi + \gamma$) and is taken from Fougère and Mérette (1999, 2000) and Heckman *et al.* (1998).[7]

Table 4.1
Behavioural and Government Program Parameters

	Symbol	*Value*
Inter-temporal elasticity of substitution	ε	0.9
Intra-temporal elasticity of substitution	η	0.8
CPP/QPP replacement rate	*CQPP_rr*	0.2
RPP replacement rate	*RPP_rr*	0.02 - 0.14
Elasticity of time allocated to the production of human capital	γ	0.7
Elasticity of human capital already acquired to the production of human capital	ψ	1.0

[5] The RPP replacement rate of representative individuals is positively associated with age and skill level. It reflects the fact that the proportion of Canadians who receive benefits from a DB private pension plans increases with age and that average and median benefits from such plans increase with skill levels.

[6] These studies are Ciccone and Peri (2005), Krusell *et al*. (2000), Caselli and Coleman (2000) and Katz and Murphy (1992).

[7] Heckman *et al. (1998*) have estimated the value of γ and ψ to sum to 1.8.

Elasticity of substitution for labour demand across qualification	σ^L	1.5
Production share of physical capital	α	0.3
Rate of interest	ri	0.04
Depreciation rate of physical capital	δ	0.051
Labour income tax rate	τ^w	0.318
Capital income tax rate	τ^k	0.352
Consumption tax rate	τ^c	0.11

4.7 Measuring Lifetime Economic Welfare by Cohort and Level of Qualification

We calculate the impact of population ageing and alternative public pension options on lifetime economic welfare by cohort and level of qualification. The measure is calculated as follows. First, according to equation (1), we calculate the level of utility $U^I_{qual,t}$ before the demographic shock by cohort and level of qualification, which depends on life-time consumption and leisure activity, where *I* indicates the level of utility in the initial steady state, for cohort *t* and level of qualification *qual*. Next, we recalculate utility levels by cohort and level of qualification, $U^F_{qual,t}$ and report the percentage difference, $(U^F_{qual,t}\text{-}U^I_{qual,t})/U^I_{qual,t}$. The same calculation is made to evaluate the economic welfare effect of alternative public pension plan scenarios. Also, we decompose the change in economic welfare in two: lifetime consumption and leisure.

5. Simulation Analysis

As indicated in the introduction, in this section we analyze the impact of eliminating early retirement incentives in public and defined-benefit private pension plans and examine alternative policy options to make the public pension system 'near' incentive neutral. Also, for DB private pension plans, we examine the likely scenario that the recent declining trend in the proportion of DB private pension plans observed since the mid-1980s continues until 2030.

5.1 Impact of Eliminating Early Retirement Incentives in Public and Private Pensions

The simulations of eliminating early retirement incentives in public and private pension plans are undertaken separately. We first discuss the impact on the labour supply of older workers, followed by an analysis of the impact on key economic indicators. Lastly, we discuss the economic-welfare implications.

5.11 Public Pensions

To apply the shock of eliminating early retirement incentives in the current public pension system, we set the implicit tax rates from Table 3.1 to zero in the CGE model. Table 5.1 presents the impact of the shock on the labour supply of older workers by age group and skill level.

Table 5.1
Impact of Removing Early Retirement Incentives in Public Pensions
Change in Weekly Hours by Skill Level
(Level Difference relative to Benchmark Scenario)

High-skilled workers	**2006**	**2010**	**2018**	**2026**	**2034**	**2050**
53-56	-1.3	-1.3	-1.3	-1.4	-1.4	-1.7
57-60	-1.4	-1.4	-1.4	-1.4	-1.5	-1.8
61-64	0.3	0.4	0.4	0.4	0.3	0.3
65-68	2.3	2.2	2.4	2.3	2.4	2.5
69-72	1.9	1.8	1.9	1.9	1.9	2.1
Medium-skilled workers	**2006**	**2010**	**2018**	**2026**	**2034**	**2050**
53-56	-1.5	-1.5	-1.5	-1.5	-1.6	-1.8
57-60	-0.6	-0.6	-0.6	-0.6	-0.7	-0.8
61-64	5.9	5.9	5.9	5.8	5.9	6.4
65-68	-0.1	-0.4	-0.3	-0.3	-0.3	-0.4
69-72	-0.2	-0.1	-0.4	-0.3	-0.4	-0.4
Low-skilled workers	**2006**	**2010**	**2018**	**2026**	**2034**	**2050**
53-56	-1.8	-1.8	-1.8	-1.8	-1.9	-2.1
57-60	-0.9	-0.8	-0.9	-0.9	-0.9	-1.0
61-64	7.6	7.5	7.5	7.5	7.6	8.3
65-68	1.2	0.8	0.9	0.8	0.8	1.0
69-72	1.4	1.3	0.9	1.0	1.0	1.2

As can be seen, for age groups 53-60, the labour supply impact is slightly negative as hours of work fall by one or two weekly hours. Under the current system, before age 60,

workers are encouraged to continue working to obtain more C/QPP benefits. Removing early retirement incentives thus eliminates this effect early on. At age 61-64, the impact on the labour supply of low and medium-skill workers is positive as they increase weekly hours by 6 to 8 hours. However, there is virtually no effect on high-skilled workers.

After age 64, high-skilled workers have somewhat more incentive to work, since the OAS claw-back is eliminated. According to the model-result, the highly skilled would raise their labour supply by about 2 weekly hours. There is no impact on medium-skilled workers, since they are not affected by the OAS claw-back. Finally, low-skilled workers aged 65+ increase their labour supply slightly after age 64 because of the elimination of the work disincentive effect of the GIS.

5.12 Private Pensions

Table 5.2 presents the impact of removing early retirement incentives from DB private pension plans on the labour supply of older workers by age group and skill level. To apply the shock of eliminating early retirement incentives in private pension plans, the implicit tax rates in Table 3.3 for private pensions only are set at zero in the CGE model.

As can be seen, the labour supply impact of removing early retirement incentives in private pensions is several times larger than in public pensions. Across all skill levels, the labour supply of older workers begins to rise at age 57 and continues to increase until they eventually fully retire. High-skilled workers increase their labour supply from 3.5 weekly hours at age 57-60 to about 10 hours at age 69-72. In comparison, changes in weekly hours for medium and low-skilled workers range from 2.2 hours to 10 hours and from 0.8 hours to 9 hours, respectively between age 57 and 72.

Finally, when work disincentives are removed, workers are expected to work longer. Accordingly, they change work behaviour earlier in their life. For example, at age 53-56, there is a small reduction in their labour supply and a corresponding increase in leisure.

Table 5.2
Impact of Removing Early Retirement Incentives in DB Private Pensions
Change in Weekly Hours by Skill Level
Level Difference relative to Benchmark Scenario

High-skilled workers	**2006**	**2010**	**2018**	**2026**	**2034**	**2050**
53-56	-0.6	-0.5	-0.5	-0.4	-0.5	-0.7
57-60	3.5	3.4	3.4	3.4	3.5	3.6
61-64	8.0	7.6	7.4	7.4	7.6	8.1
65-68	10.0	9.3	8.6	8.6	8.8	9.5
69-72	11.5	10.7	9.5	9.3	9.5	10.4
Medium-skilled workers	**2006**	**2010**	**2018**	**2026**	**2034**	**2050**
53-56	-0.1	-0.1	-0.1	-0.1	-0.2	-0.4
57-60	2.4	2.3	2.2	2.2	2.2	2.2
61-64	7.5	7.2	6.9	6.8	6.9	7.5
65-68	10.7	10.1	9.4	9.3	9.4	10.3
69-72	12.1	11.4	10.3	10.0	10.1	11.1
Low-skilled workers	**2006**	**2010**	**2018**	**2026**	**2034**	**2050**
53-56	-1.1	-1.1	-1.1	-1.1	-1.2	-1.5
57-60	0.9	0.8	0.7	0.6	0.6	0.6
61-64	6.8	6.5	6.3	6.2	6.2	6.7
65-68	8.5	7.9	7.4	7.3	7.3	7.9
69-72	10.2	9.6	8.7	8.5	8.5	9.3

5.2 Long-Term Economic Impact of Removing Early Retirement Incentives

We now present the long-term economic impact of removing early retirement incentives in both public and private pension plans. Table 5.3 provides an overview of the results on key economic indicators, including the impact on real GDP per capita, effective labour supply per capita, the capital-labour ratio, national savings per capita and real wages by skill level.

As can be seen, the impact of removing early retirement incentives from public pension plans has a small positive impact on real GDP per capita. By 2050, real GDP per capita is 0.7% higher relative to the benchmark scenario. The real GDP gain comes from both an increase in effective labour supply and physical capital. However, there is a slight decline in physical capital intensity.

Although, households do not have to save as much for retirement since they work longer, national savings per capita increases. The effect on national savings is induced. The

policy change stimulates total income and raises the overall tax base somewhat. If the government chooses to maintain expenditures and tax revenues constant, the government balance improves, thus raising public savings. If on the other hand, the government chooses to lower taxes (in this scenario, we assume taxes on labour are reduced), this stimulates private savings and consumption.

Finally, low-skilled workers are the most affected with a greater labour supply increase than medium and high-skilled workers. As a result, their real wage declines by 0.9% in the long run, while real wages for medium and high-skilled workers do not change much.

Table 5.3
Impact of Eliminating Early Retirement Incentives on Key Economic Indicators
Percentage point difference relative to the benchmark scenario

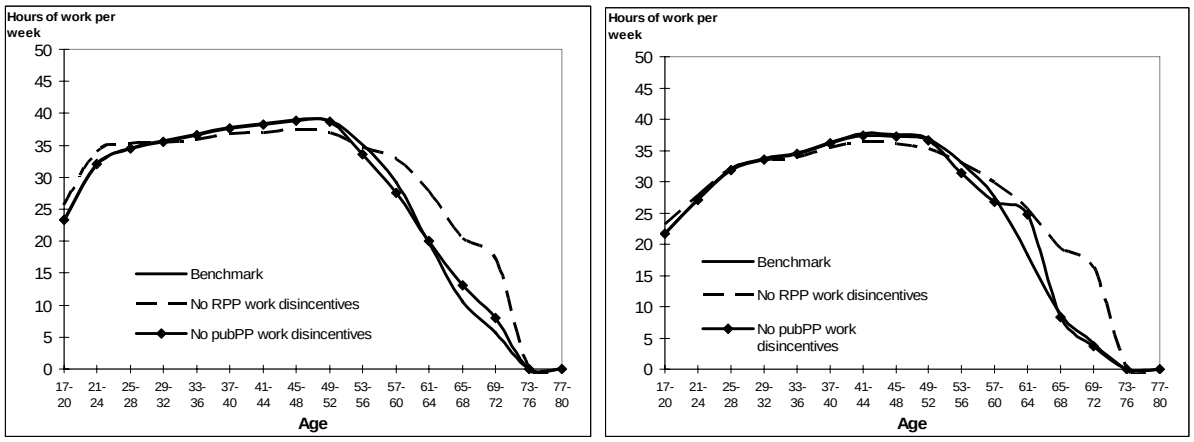
	2006	2010	2018	2026	2034	2050
Real GDP per-capita						
Public pensions	0.3	0.3	0.4	0.5	0.6	0.7
DB private pensions	2.4	2.7	3.4	3.9	4.3	5.2
Effective labour supply per-capita						
Public pensions	0.5	0.5	0.5	0.6	0.6	0.7
DB private pensions	3.9	4.0	4.4	4.8	5.3	6.1
Physical capital per-capita						
Public pensions	-0.1	0.0	0.2	0.3	0.5	0.9
DB private pensions	-1.2	-0.4	0.6	1.1	1.4	2.2
Capital-labour ratio						
Public pensions	-0.6	-0.5	-0.5	-0.4	-0.3	-0.1
DB private pensions	-5.0	-4.5	-4.2	-4.6	-5.3	-6.3
National Savings per-capita						
Public pensions	1.0	0.8	0.7	0.7	0.8	1.2
DB private pensions	7.7	6.6	4.8	3.7	3.2	3.9
Real wages (high-skilled)						
Public pensions	0.0	0.0	0.1	0.1	0.2	0.4
DB private pensions	-3.0	-2.8	-2.8	-3.1	-3.4	-4.1
Real wages (medium-skilled)						
Public pensions	-0.2	-0.2	-0.1	-0.1	0.0	0.1
DB private pensions	-2.3	-2.1	-2.1	-2.2	-2.4	-2.9
Real wages (low-skilled)						
Public pensions	-0.5	-0.5	-0.6	-0.7	-0.7	-0.9
DB private pensions	-2.0	-1.8	-1.6	-1.7	-1.8	-2.1

The economic impact of eliminating early retirement incentives in DB employer pension plans is much larger. As shown in Table 5.3, the increase in effective labour supply

per capita is quite significant and the impact on real GDP per capita is about seven times larger. By 2050, real GDP per capita rises by 5.2%, compared with 0.7% when we eliminate early retirement incentives in public pensions. National savings per capita also increases substantially, but the capital-labour ratio diminishes, compared to the benchmark. The significant rise in the labour supply of older workers across skill levels reduces real wage pressures. For example, high, medium and low-skill real wages fall by 4.1%, 2.9% and 2.1%, respectively in 2050. This in turn encourages firms to substitute away from physical capital toward labour.

Chart 5.1 also illustrates the change in labour market behaviour, over the life cycle for high-skilled and medium-skilled cohorts who enter in the labour market in 2006. For high-skilled workers, the impact of removing early retirement incentives in public pensions has virtually no effect on their labour supply until age 53. Between 53 and 60, they reduce their labour supply somewhat, since the elimination of the accrual no longer encourages them to work more intensively to receive C/QPP benefits. Between 61 and 64, their labour supply remains unchanged because the accrual effect is virtually zero. Finally, after 64, the elimination of the OAS clawback encourages them to work more.

Chart 5.1
Weekly Working Hours of Cohorts Who Enter the Labour Market in 2006



Eliminating early retirement incentives in DB private pension plans has a much larger impact on high-skilled workers over the life-cycle. Under this scenario, high-skilled workers significantly increase their labour supply when they are older. They also expect real wages to

grow more slowly and they adjust their labour supply accordingly, over their working life. For example, the expected return to education is smaller, so they choose to spend less time in school and to work more between age 17 and 24, which has a small negative impact on human capital investment. During middle age, they also reduce their labour supply and choose to spend more time in leisure. Finally, after age 57, they significantly increase their labour supply.

For medium-skilled workers, removing work-disincentives in public pensions has no impact on their labour supply until age 57. Between age 57 and 61, they reduce weekly hours just like high-skilled workers. The elimination of accruals between age 61 and 64 encourages them to work more during those years, while at 65 and over, their labour supply remains virtually unchanged. When RPP work disincentives are eliminated, medium-skilled workers reduce their labour supply during middle age and spend more time in leisure. However, around age 57, they significantly increase their labour supply, just like high-skilled workers, until they fully retire.

5.3 Impact on Economic Welfare

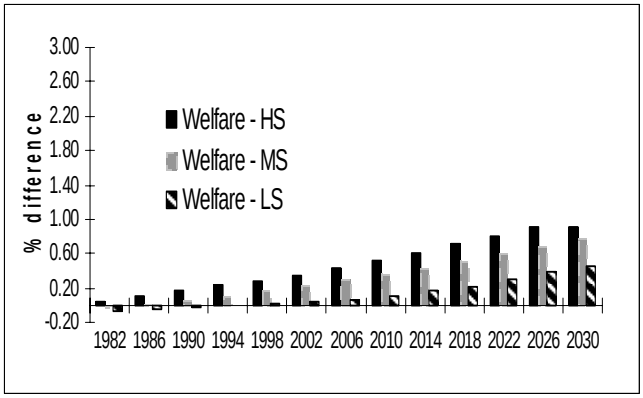
Chart 5.2 presents the impact of removing early retirement incentives in public and private pension plans. As can be seen, the elimination of early retirement incentives in both public and private pension plans raises economic welfare. Not surprisingly, the positive impact is much greater when we eliminate early retirement incentives in private pensions than in public pensions.

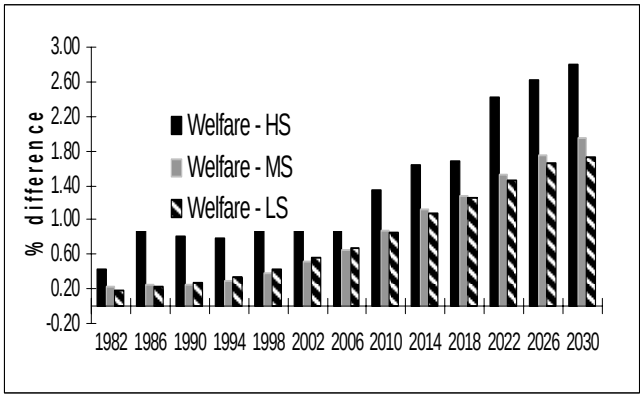
Eliminating early retirement incentives in public pensions has a marginally small negative impact for existing cohorts of low-skilled workers. Even though lifetime consumption increases, it is more than compensated by a fall in lifetime leisure. For future cohorts of low-skilled workers, the effect is slightly positive and is dominated by a rise in lifetime consumption. In comparison, both medium and high-skilled workers enjoy a greater increase in economic welfare. Both groups of workers do not increase their lifetime labour supply as much and do not suffer from real wage decrease.

In comparison with public pensions, all three types of workers across cohorts benefit from an economic welfare increase, when we eliminate early retirement incentives in private

pensions. However, for both low- and medium-skilled workers, the economic welfare increase is explained mainly by an increase in lifetime consumption, while lifetime leisure decreases. Finally, high-skilled workers benefit the most from the removal of early retirement incentives in private pension plans. For high-skilled workers, the economic-welfare increase comes from both increases in consumption and leisure. Overall, high-skilled workers increase leisure activities when they are younger, and reduce leisure when they are much older. However, since they discount leisure over their working life, the present-value of leisure when young is worth more in lifetime utility than the present-value of leisure when older.

Chart 5.2
Change in Lifetime Economic Welfare and Lifetime Consumption by Cohort
Eliminating Early Retirement Incentives in:
Public Pensions **DB Private Pensions**





5.4 Impact of Alternative Policy Options to Make Public Pensions Incentive-Neutral

We now examine the impact of alternative policy scenarios seeking to make the Canadian public pension system incentive neutral. Five scenarios are examined:

- Raising the actuarial adjustment in C/QPP from 0.5% per month to 0.8%.
- Eliminate early eligibility age to C/QPP.
- Use unadjusted value of C/QPP benefits to determine GIS payments.
- Remove the OAS clawback.
- Move the statutory retirement age in OAS/GIS and C/QPP from 65 to 66.

The economic impact of each scenario is summarized in Table 5.4. As shown in the table, of all five scenarios, raising the actuarial adjustment in C/QPP from 0.5% to 0.8% has

the largest positive impact on real GDP per capita, which rises by 1.1% in 2050. However, this scenario is somewhat more than incentive neutral, since high-skilled workers now have a net positive incentive to work more between age 60 and 64. Recall that under the current regime, the accrual effect on high-skilled workers is near zero.

Eliminating the early eligibility age in C/QPP and using the unadjusted value of C/QPP benefits to determine GIS payments have virtually the same economic impact (0.8% versus 0.7% in 2050) on real GDP per capita. These two options would also bring the program much closer to being incentive-neutral for retirement decisions and have little impact on high-skilled workers.

Removing the OAS claw back on high-income earners has a small positive impact on real GDP per capita (0.2% by 2050) and mainly affects the labour supply of high-skilled workers aged 65+. It is also interesting to see that removing the OAS clawback accounts for nearly one-third of early retirement incentives in public pensions. One important drawback, however, is that this policy change would raise OAS payments to individuals and would need to be financed through a tax increase or an expenditure cut, although this remains a small expenditure amount.

Finally, raising the statutory retirement age in OAS/GIS and C/QPP pushes early retirement incentives by one year, but the change in accrual is very small. Moreover, negative accruals become larger when they are delayed. This happens for two reasons: first, by delaying retirement, older workers receive more C/QPP benefits when they retire; second, past a certain age, wages start to decrease, and thus raise negative accruals. Therefore, the overall macroeconomic impact is negligible and could even be negative, according to model results.

5.5 Further Decline in the Proportion of Defined-Benefit Private Plans

As indicated in Section 2.2, between 1984 and 2006, the proportion of members in defined-benefit private pension plans as a proportion of total employer pension plans declined from 95% to about 84%. In this last scenario, we simulate a continued decline in the proportion of members in defined-benefit private plans and a gradual shift towards defined-

contribution plans until 2030. This would represent a 14 percentage point reduction in the share of DB plans to about 69% by 2030.

Table 5.4
Impact of Alternative Policy Options to Make the Public Pension System Incentive-Neutral on Key Economic Indicators
Percentage point difference relative to the benchmark scenario

	2006	2010	2018	2026	2034	2050
Real GDP per-capita						
Raise actuarial adjustment on C/QPP from 0.5% to 0.8%	0.5	0.6	0.8	0.9	1.0	1.1
Eliminate early eligibility age to C/QPP	0.3	0.4	0.5	0.5	0.6	0.8
Use unadjusted value of C/QPP benefits to determine GIS payment	0.3	0.4	0.5	0.5	0.6	0.7
No OAS clawback effect	0.1	0.1	0.1	0.1	0.1	0.2
Moving the statutory retirement age in OAS/GIS and C/QPP from 65 to 66	0.0	0.0	0.0	-0.1	-0.1	-0.1
Effective labour supply per-capita						
Raise actuarial adjustment on C/QPP from 0.5% to 0.8%	0.9	0.9	1.0	1.0	1.1	1.2
Eliminate early eligibility age to C/QPP	0.6	0.6	0.6	0.5	0.6	0.7
Use unadjusted value of C/QPP benefits to determine GIS payment	0.5	0.5	0.6	0.6	0.7	0.7
No OAS clawback effect	0.1	0.1	0.1	0.2	0.2	0.2
Moving the statutory retirement age in OAS/GIS and C/QPP from 65 to 66	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2
Physical capital per-capita						
Raise actuarial adjustment on C/QPP from 0.5% to 0.8%	-0.3	0.0	0.3	0.5	0.7	1.0
Eliminate early eligibility age to C/QPP	-0.2	0.0	0.1	0.5	0.6	0.9
Use unadjusted value of C/QPP benefits to determine GIS payment	-0.2	0.0	0.2	0.3	0.3	0.5
No OAS clawback effect	0.0	0.0	0.0	0.0	0.0	0.1
Moving the statutory retirement age in OAS/GIS and C/QPP from 65 to 66	0.0	0.0	0.0	0.1	0.1	0.1
Capital-labour ratio						
Raise actuarial adjustment on C/QPP from 0.5% to 0.8%	-1.1	-1.0	-0.8	-0.8	-0.8	-0.7
Eliminate early eligibility age to C/QPP	-0.7	-0.6	-0.5	-0.1	-0.2	0.0
Use unadjusted value of C/QPP benefits to determine GIS payment	-0.7	-0.6	-0.5	-0.5	-0.6	-0.6
No OAS clawback effect	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
Move statutory retirement age in OAS and C/QPP from 65 to 66	0.1	0.1	0.1	0.2	0.3	0.4
National Savings per-capita						
Raise actuarial adjustment on C/QPP from 0.5% to 0.8%	1.7	1.5	1.1	1.0	1.0	1.1
Eliminate early eligibility age to C/QPP	1.1	1.0	0.8	0.4	0.6	1.1
Use unadjusted value of C/QPP benefits to determine GIS payment	1.0	0.9	0.7	0.6	0.5	0.6
No OAS clawback effect	0.2	0.2	0.1	0.1	0.1	0.1
Moving the statutory retirement age in OAS/GIS and C/QPP from 65 to 66	-0.1	-0.1	0.0	0.0	0.0	0.0

As shown in Table 5.5, the impact on real GDP per-capita is small but positive. By 2050, real GDP per capita rises by 0.6% relative to the benchmark and is explained entirely by an increase in effective labour supply per capita, but is partly offset by a small decline in physical capital per capita. The rise in the labour supply of older workers leads to some real wage reduction for high-skilled, medium-skilled and low-skilled workers. This in turn encourages firms to substitute away from physical capital into labour.

Table 5.5
Impact of a Continued Decline in the Share of Defined-Benefit Private Pension plans on Key Economic Indicators
Percentage point difference relative to the benchmark scenario

	2006	2010	2018	2026	2034	2050
Real GDP per-capita	0.0	-0.1	0.1	0.3	0.5	0.6
Effective labour supply per-capita	0.0	0.0	0.2	0.6	0.8	1.0
Physical capital per-capita	-0.1	-0.2	-0.4	-0.5	-0.4	-0.1
Capital-labour ratio	0.0	-0.2	-0.7	-1.2	-1.5	-1.5
National Savings per-capita	-0.2	-0.4	-0.3	0.0	0.2	0.3

6. Sensitivity Analysis

As discussed in Section 4, the value of the intra-temporal elasticity of substitution determines the sensitivity of changes in the leisure to consumption ratio. This implies that the magnitude of the impact of a change in accruals or implicit tax rate on labour supply and productive capacity is dependent on this value. The greater the value of the elasticity, the more sensitive the leisure decision will be to a change in the implicit tax rate. As given in Section 4, the value used in this paper (0.8) is well accepted in the literature. For example, Altig *et al.* (1997) and Kotlikoff *et al.* (1999) use an intra-temporal elasticity of substitution of 0.8 in their dynamic OLG models of the U.S. economy. For Canada, Baylor (2005) also uses an elasticity of substitution between consumption and leisure for Canada of 0.8, while Baylor and Beauséjour (2004) use 0.7.

This section presents two alternative scenarios to evaluate the sensitivity of the results of eliminating early retirement incentives in public and private pension plans to the value imposed on the intra-temporal elasticity of substitution. One scenario imposes an intra-

temporal elasticity of substitution of 0.6, while the other imposes a value of 1.0.[8] Along with the original scenarios shown in Section 5, Table 6.1 presents the impact of the accrual shock on real GDP per capita under alternative values of elasticity of substitution.

As can be seen, a difference of ± 0.2 on the elasticity of substitution changes the impact of eliminating early retirement incentives in public pension plans on real GDP per-capita by ±0.1% to ±0.2%. Accordingly, the sensitivity of the impact on real GDP per-capita for private pension plans would range between ±0.5% and ±0.8%. For example, using an elasticity of substitution of 0.6 (1.0), for public pensions the real GDP per-capita impact would reach 0.5% (1.1%) by 2050, compared with 0.9% using a value of 0.8. For private pensions the real GDP impact would reach 4.4% (6%), compared with 5.4% using a value of 0.8.

Accordingly, we feel confident to say that reforming the Canadian public pension system would have a small positive impact on retirement decisions, and that the potential gains to be achieved with private pension plans are far greater.

Table 6.1
Sensitivity Analysis
Impact of Removing Early Retirement Incentives in Public and Private Pension plans on Real GDP per-capita, Under Alternative Values of Intra-temporal Elasticity of Substitution (η)
Percent difference relative to the benchmark scenario

		2006	2010	2018	2026	2034	2050
Public Pensions	***η=0.6***	0.2	0.2	0.3	0.4	0.5	0.5
	η=0.8	0.3	0.3	0.4	0.5	0.6	0.7
	η=1.0	0.3	0.4	0.5	0.6	0.7	0.9
DB private pensions	***η=0.6***	2.2	2.3	3.0	3.3	3.9	4.4
	η=0.8	2.4	2.7	3.4	3.9	4.3	5.2
	η=1.0	2.6	3.1	3.8	4.5	5.1	6.0

[8] These alternative scenarios are performed by creating first a new benchmark scenario with the new elasticity of substitution and then applying the accrual shock.

7. Conclusion

As indicated in the introduction, early retirement incentives from the Canadian public pension system are small compared to most OECD countries. Using a dynamic CGE model we estimate that the cost of early retirement associated with public pension plans likely represent less than 1% of GDP.

We have also examined alternative policy options to make the program near incentive-neutral to retirement behaviour. Among those, raising the actuarial adjustment, eliminating early eligibility age to C/QPP and using unadjusted C/QPP benefits to calculate GIS payments would make the regime near incentive-neutral. However, delaying the statutory retirement age in OAS/GIS and C/QPP has no significant economic impact, which could even be slightly negative. This is therefore not a viable option.

We also clearly demonstrate that there are much greater work disincentive effects present in DB private pension plans than in public pensions. According to our model calculation, the loss in productive capacity could be as much as 7 times larger than in public pension plans. The good news is that the recent decline in the proportion of DB plans since 1984 has likely contributed somewhat to reduce early retirement incentives, over the past two decades. A continued downward trend decline over the next several years, if it materializes should bring some additional gains.

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