Research Institute for Quantitative Studies in Economics and Population
Faculty of Social Sciences, McMaster University
Hamilton, Ontario, Canada
L8S 4M4

Baby-Boom Aging and Average Living Standards

William Scarth and Malick Souare

QSEP Research Report No. 368

February 2002

William Scarth is a QSEP Research Associate and a faculty member of the McMaster Department of Economics. Malick Souare is a doctoral student in the Department of Economics and a SEDAP Research Fellow.

This report is cross-listed as No. 68 in the McMaster University SEDAP Research Paper Series.

The Research Institute for Quantitative Studies in Economics and Population (QSEP) is an interdisciplinary institute established at McMaster University to encourage and facilitate theoretical and empirical studies in economics, population, and related fields. For further information about QSEP and other reports in this series, see our web site *http://socserv2.mcmaster.ca/~qsep*. The Research Report series provides a vehicle for distributing the results of studies undertaken by QSEP associates. Authors take full responsibility for all expressions of opinion.

Baby-Boom Aging and Average Living Standards

William Scarth and Malick Souare[1]

McMaster University

December 2001

Abstract

A calibrated overlapping generations model is used to investigate the effect on living standards of the aging baby boom. The relative scarcity of labor when baby boomers are old raises the wage-rental ratio by an amount that is sufficient to ensure that the post-baby-boom generation can enjoy a modest increase in living standards - despite facing higher taxes. Nevertheless, the baby-boom cohort itself suffers a drop in consumption, and when the two generations are considered as a group, overall living standards fall by a modest amount. These results are robust to several changes in specification: the existence of liquidity constraints, alternative assumptions regarding individuals' expectations concerning future interest rates, and different fiscal policies concerning the tax treatment of private saving for retirement. Policy initiatives that bring significant hardship today to avoid a future "crisis" are not supported by the standard overlapping generations model.

1. Introduction

There is widespread concern about the living standards that will be available for the generation that follows the baby-boom cohort. According to conventional wisdom, when the baby-boomers are old, the much smaller number of workers in the next generation will face high tax rates (and consequently lower living standards) if the pay-as-we-go public pension and public health care programs are to be maintained. 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 bankrupt the world's wealthiest nations.[2]

The seriousness of the aging population has been challenged (see, for example, Denton and Spencer (2000), Emery and Rongve (1999) and Merette (2001)). Denton and Spencer note that the *overall* dependency ratio that will prevail when baby boomers are retired will not reach the level observed when the baby boom was young in the 1950s. Even though health-care costs for old dependents are higher than education costs for young dependents, western economies may not have to cope with any bigger challenge than was faced earlier. Emery and Rongve argue that, with labor becoming relatively scarce when the baby-boomers are retired, factor price adjustments should provide a cushion for the living standards of the next generation. Indeed, if wages rise enough, it may be possible for that next generation to pay the higher payroll taxes necessary to finance the baby-boomers' pension and public health care, and still enjoy higher living standards themselves. To illustrate this possibility in a bold way, Emery and Rongve use a calibrated version of the simplest two-period overlapping generations model (very

similar to Burbidge (1983)) to examine this possibility. Since they find that the post-baby-boom generation's living standard *is* higher than the steady-state outcome, they conclude that the concern expressed on behalf of this generation is "much ado about nothing." They go on to stress that imposing taxes on the lower-income members of the baby-boom cohort to avoid what they predict to be a non-existent crisis for the next generation is not recommended.

Merette stresses two additional considerations. First, a rising wage-rental ratio should stimulate investment in human capital, with the result that the post-baby-boom generation can enjoy higher living standards. Second, Merette draws attention to the existence of tax-sheltered private savings plans. Now, when baby boomers are working and contributing to these plans, they represent a drain on government revenues. In the future, when baby boomers are retired and withdrawing funds from these accounts, these programs will become net revenue-raisers for governments. This turnaround will limit the extent to which governments will have to raise taxes on the post-baby-boom generation while they are working. Merette concludes that –far from there being a crisis for the post baby boomers – this generation should "welcome" the aging of the population.

It is an unsatisfactory state of affairs that economists have such disparate views on a central topic of public debate. Why has there not been a convergence of views on this broad topic? One reason is that most analyses involve quite complicated calibrated models – involving dozens of overlapping generations and an extensive disaggregation of government spending on many different age-specific categories. It is essentially impossible for one researcher to perform sensitivity tests with another's model. Since so many different assumptions are made – from one analysis to another – it is very difficult

for researchers to ascertain the relative importance of each specification change in generating the different results.

Given this limited ability to discriminate between alternative studies, it seems appropriate to return to the basic analytical framework that underlies the overall approach to this policy question. As a result, in this paper, we start with the textbook version of the overlapping generations model, and we apply it to the North American economy. This model involves bold assumptions – such as the absence of any liquidity constraints for all individuals, and perfect foresight over a time interval of an entire generation concerning future interest rates. The sensitivity of the results concerning the aging population to these very basic issues is virtually never assessed. We provide this assessment, in addition to examining the role of tax-sheltered savings plans. We are reassured to find that the results are robust across such boldly different alternative specifications: no liquidity constraints vs. 50% of the population living "hand to mouth;" perfect foresight vs. static expectations concerning future interest rates; and no tax-sheltered savings vs. a program that allows unlimited contributions.

A limitation of our analysis is that we do not explore the possibility that aging may stimulate investment in human capital. Such an investment can be expected since the pay-off from acquiring additional skills will be higher when the wage-rental ratio rises. Our defense for omitting this extension is based on our interpretation of the endogenous growth literature. Many studies, such as Devereux and Love (1994), reach the following two conclusions. First, changes in the wage-rental ratio have significant one-time *level* effects on living standards; and second, changes in the factor price ratio have extremely modest effects on the growth *rate*. These results suggest that policy-oriented

macroeconomists may lose little by focusing exclusively on the levels effects in this context. As a result, our sorting out the importance of the several other issues in a simplified setting, that avoids being a "black box" for other participants in the debate, remains useful.

Our starting point is Emery and Rongve's focus on the core model that underlies this entire literature. Unfortunately, there are inconsistencies in the calibration of their model. After repairing these problems we report our several some sensitivity tests – how the overall conclusion on aging is affected by three central model-specification issues: Are some individuals liquidity constrained? Can individuals accurately forecast interest rates a generation into the future? and Does the government allow taxes on saving to be postponed until retirement? In addition to reporting the effects on the living standards of each generation, we focus on the average outcome for all those alive at each point in time.

2. The Model

In the standard two-period model, each cohort proceeds through a "young" period (when individuals work, consume, pay the taxes that support the public pension and save), and through an "old" period (when they consume their savings and public pension benefits). The length of a "period" is one generation – often taken to be 30 years (see Barro and Sala-i-Martin (1995) p. 131). One drawback of this framework – as noted by Barro and Sala-i-Martin – is that it involves the assumption that there is a 30-year lag between the act of abstaining from consumption and the actual use of the newly produced output as capital. Nevertheless, there is an analytical convenience that accompanies this

specification. The order of the dynamics can be reduced since it is a reasonable approximation to assume 100 percent depreciation of capital during one period of 30 years. It is unfortunate that some applications of this framework involve calibrations that are inconsistent with this 30-year time frame. For example, in Emery and Rongve, the length of the period is one generation for some parameters (such as the depreciation rate), while the length of the period is one year for others (such as the interest rate, the steady-state capital-output ratio, and the rate of time preference).

Concerning the rate of time preference, it is plausible to assume this parameter to be zero for a short time interval. But over a 30-year period, such a calibration is not appropriate. Indeed, we have found it to be impossible to calibrate the two-period overlapping-generations model – in a way that respects both the need to have all parameters "reasonable" for a 30-year period, and the need to be consistent with all the model's steady-state restrictions – without allowing a positive rate of time preference.

As just noted, in this overlapping generations framework, agents born at time t, live for only two periods: t and t+1. At any time t, the population consists of N_t young agents born at time t, and N_{t-1} old agents who were born in the previous period, t-1. One good is produced, and consumers derive utility from consuming this good in both their young period and their old period. Following Mankiw (2000), we consider two sorts of consumers. One group is forward looking; these individuals have a rate of time preference low enough to cause them to plan for the future, and they smooth consumption over their lifetimes. A second group has such a high rate of time preference that these individuals spend their entire after-tax income every period, and are, therefore, liquidity constrained. The two types of consumers represent proportions p and $1-p$ of both the

young and old portions of the population. We examine two polar-case assumptions regarding the expectations of private agents. Initially, we follow convention and assume perfect foresight – that agents correctly anticipate future interest rates (since they correctly forecast all demographic events). As a sensitivity test, we assume static expectations, and in this case agents are surprised by demographic developments and any change in the general level of interest rates from one generation to another.

All agents work in their first period, retire in the second period, and then die. Young consumers supply one unit of labor inelastically in period t for which they receive a wage of w_t. Since they pay a social security contribution, $\boldsymbol{q}_t w_t$ ($0<\boldsymbol{q}_t<1$), their after-tax income in time t equals $(1-\boldsymbol{q}_t)w_t$. At time t+1, they supply no labor. During this retirement period, the forward-looking consumers have both private savings and the public pension, but the public pension is all that the liquidity-constrained consumers have in old age.

The behavior of forward-looking consumers follows from standard intertemporal optimization. We define the consumption of each member of this group (born at time t) in period t as $C_{ft}(t)$, and in period t+1 as $C_{ft}(t+1)$, and their savings while young as $S_t(t)$. In the case without any tax-sheltered retirement savings plans, a young agent's budget constraint at time t is:

$$C_{ft}(t) + S_t(t) = (1-\boldsymbol{q}_t)w_t \qquad (1)$$

Old consumers in this group have two sources of income for financing consumption in the second period of life. The first is their savings. In the second period, this capital earns a return equal to (r_{t+1} – 1). Their second source of income is the social

security payment denoted as τ_{t+1}. Thus, without a tax-sheltered private savings plan, the second period budget constraint for a consumer of generation t is:

$$C_{ft}(t+1) = \tau_{t+1} + r_{t+1}S_t(t) \tag{2}$$

Taking w_t and r_{t+1} as given, each consumer chooses $C_{ft}(t)$ and $S_t(t)$ (and, hence, $C_{ft}(t+1)$) to maximize lifetime utility given by:

$$U(C_{ft}(t), C_{ft}(t+1)) = \log(C_{ft}(t)) + \beta \log(C_{ft}(t+1)) \tag{3}$$

where $\beta = \dfrac{1}{1+\rho}$ and ρ is the rate of time preference.

The first-order condition for this problem is:

$$\frac{C_{ft}(t+1)}{C_{ft}(t)} = \beta r_{t+1} \tag{4}$$

which can be solved to yield:

$$S_t(t) = \frac{\beta}{1+\beta}(1-\theta_t)w_t - \frac{\tau_{t+1}}{(1+\beta)r_{t+1}} \tag{5}$$

Consumption in either period can be determined by the budget constraints.

For the liquidity-constrained consumers, consumption in the two periods of life are given by:

$$C_{lt}(t) = (1-\theta_t)w_t \tag{6}$$

$$C_{lt}(t+1) = \tau_{t+1} \tag{7}$$

Considering both groups together, the average consumption (in period t) of all individuals born at time t, and the average consumption (in period t+1) of these same individuals are:

$$C_t(t) = \pi[(1-\theta_t)w_t - S_t(t)] + (1-\pi)[(1-\theta_t)w_t] \tag{8}$$

$$C_t(t+1) = \boldsymbol{p}[\boldsymbol{t}_{t+1} + r_{t+1}S_t(t)] + (1-\boldsymbol{p})[\boldsymbol{t}_{t+1}] \tag{9}$$

On the supply side, firms operate with a standard production function:

$$y_t = \boldsymbol{g} l_t^{\boldsymbol{a}} k_t^{1-\boldsymbol{a}} \tag{10}$$

where y_t is total production at time *t*, l_t is the labor used at time *t*, and k_t is the total capital stock at time *t*. Since all factor markets clear, employment equals the total number of young people:

$$l_t = N_t \tag{11}$$

and since there is 100% depreciation of capital during one full generation of time, period *t*'s capital stock must equal period *t*-1's total saving:

$$k_t = \boldsymbol{p} N_{t-1} S_{t-1}(t-1) \tag{12}$$

(Recall that $\boldsymbol{p}$ is the proportion of young people that save.)

Capital and labor are paid their marginal products:

$$w_t = \boldsymbol{g}\boldsymbol{a} l_t^{\boldsymbol{a}-1} k_t^{1-\boldsymbol{a}} \tag{13}$$

and

$$r_t = \boldsymbol{g}(1-\boldsymbol{a}) l_t^{\boldsymbol{a}} k_t^{-\boldsymbol{a}} \tag{14}$$

Substituting the factor market equilibrium conditions into these two relationships, we have:

$$w_t = \boldsymbol{g}\boldsymbol{a}[(\boldsymbol{p} N_{t-1} / N_t) S_{t-1}(t-1)]^{1-\boldsymbol{a}} \tag{15}$$

and

$$r_t = \boldsymbol{g}(1-\boldsymbol{a})[(\boldsymbol{p} N_{t-1} / N_t) S_{t-1}(t-1)]^{-\boldsymbol{a}} \tag{16}$$

Equations (15) and (16) describe how factor prices vary with both demographic changes and households' savings plans (as derived in equation (5)). As specified, equation (5)

implies that young forward-looking consumers know the future return, r_{t+1}, when setting the amount to save in period t. To appreciate what must be known for this to be true, consider equation (16) – written one period forward in time. This relationship indicates that, to know the future interest rate, the pre-baby-boom generation must be aware that the baby boom is coming – before it occurs. Since some may regard this property of the model as unappealing, we also derive simulation results that do not involve agents having such foresight. In particular, in the simulations referred to as the "static expectations" cases, we replace the N_t / N_{t+1} term in equation (16) – written one period ahead – by unity.

There is a pay-as-you-go social security system. Each young worker at time t pays taxes $\boldsymbol{q}_t w_t$. These tax revenues are distributed to old consumers at time t as a lump sum pension benefit $\boldsymbol{t}_t$. The balanced budget condition is:

$$N_t \boldsymbol{q}_t w_t = N_{t-1} \boldsymbol{t}_t \tag{17}$$

Since we assume that the pension payment is an exogenous constant, the tax rate $\boldsymbol{q}_t$ adjusts to satisfy equation (17) in each period.

The government's budget constraint is more complicated if tax-sheltered private saving for retirement is allowed. In this case, the government receives less revenue while the baby-boom generation is young (since the majority of the population is taking advantage of the tax break). For the same reason, the government receives more revenue while baby-boomers are old (since, by that time, the majority of the population is withdrawing funds from these plans). To examine the importance of this variation in

government revenue, we present results for two polar cases: one with no tax-sheltered private saving, and one with *no limit* on contributions to such a plan.

The detailed assumptions we make in this regard are as follows. Individuals are allowed to deduct their entire savings from their wage earnings, when calculating taxable income while young. Then when they are old, they pay tax on both that amount of saving and the interest earned thereon. This specification allows us to examine the implications of IRAs and 401(K) accounts (as in the United States) or RRSPs (as in Canada) – with the simplification that there is no limit on contributions. Also, for simplicity, we have assumed just one tax rate – that is involved in both the funding of the public pension and this private savings plan. As a result, the variations in the household and government budget constraints that are appropriate in this setting are:

$$C_{ft}(t) + (1-\theta_t)S_t(t) = (1-\theta_t)w_t \qquad \text{(1a)}$$

$$C_{ft}(t+1) = \tau_{t+1} + (1-\theta_{t+1})r_{t+1}S_t(t) \qquad \text{(2a)}$$

$$N_t\theta_t w_t + \rho N_{t-1}\theta_t r_t S_{t-1}(t-1) = N_{t-1}\tau_t + \rho N_t \theta_t S_t(t) \qquad \text{(17a)}$$

When these revised constraints are involved, the first-order conditions for the forward-looking agents are affected. These changes have been incorporated in the simulations reported below.

3. Calibration and Results

We have assumed the following parameter values: labor's share, α, 0.67; the constant term in the Cobb-Douglas production function, γ, 10; and steady-state values of labor and capital equal to 100. These values make the steady-state *annual* capital-output ratio equal to 3. Given that factors are paid their marginal products, these values make the

steady-state wage equal to 6.67 and r (one plus the 30-year interest rate) equal to 3.33 (and this implies an annual interest rate of 4.1%). We assume that the public pension provides an amount equal to one-quarter of the steady-state wage (so J equals 1.67). The pension budget constraint then implies that the payroll tax rate, 2, is one-quarter in the steady state. Finally, we consider two distributions of the population between the hand-to-mouth and the forward-looking planner groups: $\pi = 1$ (all agents are consumption smoothers) and $\pi = 0.5$ (only half of the agents are forward-looking). Concerning the forward-looking planners, the rate of time preference must be determined residually to ensure that the model's two expressions for saving generate exactly the same value in the steady state. One expression for saving is the market clearing condition – that one period's saving is the next period's capital stock (equation (12)). The second expression is the first-order condition that follows from (forward-looking) household utility maximization (equation (5)). To have this consistency with the other parameter values already assumed (with $\pi = 1$ and ignoring tax-sheltered private savings plans), we require $ = 0.375. This value implies an *annual* rate of time preference equal to just under 3.3 %. Since this rate of impatience is less than the annual interest rate of 4.1 percent, consumption rises as agents age. A similar outcome occurs in the cases with $\pi = 0.5$ and tax-sheltered private savings.

The calibrations discussed in the previous paragraph involve two desirable features. They are consistent with the steady-state restrictions of the model, and they are "realistic" in the sense that each individual parameter value accords well with observations over a 30-year time interval. We now use these calibrations to examine how

the initial steady state is disturbed by a demographic event that is intended to simulate the existence of the baby boom.

We introduce a cohort that is 10 percent larger than both the generations that precede and follow this group. This demographic development makes the overall dependency ratio rise by 10 percent as the baby-boom cohort moves from its working period to its retirement period, and this is what is expected by demographers in North America over the next 30 years.[3]

There is one aspect of the calibration that we find worrisome – but it is a problem for *any* application of this class of models. In the real world, it is the *overall* ratio of dependents to the population – not the ratio of the old-age component of dependents – that is approximately 50 percent. But in overlapping generations models of this sort (without population growth), the steady state requires that the ratio of old-age dependents to the population, $(N_{t-1}/(N_t + N_{t-1}))$, be equal to 0.5. This mismatch stems from the fact that this standard overlapping generations framework assumes that there is no truly "young" period when individuals do not work. Instead of assuming that agents live for some time without work while young, the model assumes that agents live just as long when they are retired (as they do when they are working). Relative to the real world, then, the model involves a retirement period that is "too long," and a pre-work youth period that is "too short." We find it helpful to think of the extra length of the retirement period as a proxy for a pre-work youth period. This interpretation (which is equivalent to Barro's (1974) portrayal of an infinitely lived agent as a family dynasty) can be rationalized by thinking of retirees being the ones who take care of the children. The retirees plan their own life as if they will be retired for a long time. In fact, they die

earlier, and it is their grandchildren that will take their place for the latter part of their "retirement" period. As long as the grandparents and the grandchildren have the same utility function, this interpretation can be defended. This application of the family dynasty concept implies that – to calibrate the "pension" – we should think of both social security and public health payments for the old, and public support for schooling the young, and (as noted above) we have assumed that this total is one-quarter of the working wage.

Tables 1 – 4 summarize the results; they show the percentage increase or decrease in consumption (compared to the steady state) that is available to several cohorts as the baby-boom phenomenon occurs. Table 1 involves the following assumptions – that no one is liquidity constrained, everyone correctly anticipates all changes in interest rates, and there are no tax-sheltered private savings plans. The first line in Table 1 refers to the period during which the baby-boom cohort is young. The larger labor supply pushes both the pre-tax wage rate and the per-person payroll-tax levy down. These competing effects are of approximately equal strength, so consumption rises by just over one-tenth of one percent relative to the consumption of young agents in the steady state. The pre-baby-boom generation (the old in period 1) enjoys a big rise in consumption – almost 5 percent increase compared to the consumption of retired agents in the steady state. Once again, the reason is the change in the wage-rental ratio. With capital now relatively scarce, its marginal product – and hence the interest rate that the retired earn on their savings – is high.

The second line in Table 1 refers to the period during which the baby-boomers are retired. Interest rates have come back down, so this group receives a level of consumption

that is 4.6 percent below what retirees normally receive in the steady state. There is a very small reduction in the living standards of the post-baby-boom generation when these individuals are young. The reason is that there are competing effects that almost exactly cancel off. With labor now more scarce, pre-tax wages are correspondingly higher. But this group is now paying higher payroll taxes to finance the pensions of the baby boomers, so *after-tax* wages are not increased.

The third line in Table 1 refers to the period when the baby-boomers have died and the post-baby-boom generation is retired. Again, during this later period of life, this group is affected very little by the baby-boom phenomenon. There is still some effect, nevertheless, on the generation that follows even this group. Since the post-baby-boom cohort has saved a little less, the generation that follows them has less capital to work with. (This is why there is a negative entry in the first column of the third row.)

Table 1 suggests that – contrary to much public discussion – the post-baby-boom generation is *not* affected significantly by this demographic event. Before concluding that all is well, however, we draw attention to an assumption which underlies the analysis. It is assumed that the level of benefits received by each pensioner is an exogenous constant. The model ignores the fact that baby-boomers may try to avoid the cut in living standards that is indicated for their old-age period by voting for an increase in the pension benefit. This group has the numbers to win such a vote, and if they exercised this political power, it would be the post-baby-boom generation that loses out after all.[4]

Rather than presenting an entire set of specifications concerning different political outcomes, we find it appealing to focus on the living standards of the average person who is alive in each period. The final column in Table 1 provides this information. We see

that, no matter how the burden is shared at the time, the living standard for the average person alive when the baby-boomers are retired is estimated to be about 2.2 percentage points below the consumption enjoyed by individuals who populate the model's steady state. This estimate includes the increase in pre-tax wages enjoyed by those who will be young at that time.

Should a drop in average living standards of 2.2 percent for 30 years be regarded as significant? To answer this question, we must have some base for comparison. To provide this, we consider the debate in Canada surrounding the free-trade agreement with the United States, during the 1980s. The steady-state effect of free trade on the average living standards (of Canadians) was estimated to be about 3 percent.[5] Assuming a discount rate of 5 percent and a GDP growth rate of 3 percent, a drop in living standards of 2.2 percent for 30 years is equivalent to a one-time loss of 51 percent of one year's GDP. Similarly, an annual drop of 3 percent forever is equivalent to a one-time loss of 158 percent of one year's GDP. So the model predicts that the aging economy affects living standards by about one-third of the amount that was the object of the fierce debates on free trade in the 1980s. This comparison suggests that we regard the effect of aging as important, but modest.[6]

How do the conclusions hold up in the face of sensitivity tests? Table 2 reports how things change when 50% of the households are liquidity constrained. Since there is less saving in this economy, the capital/labor ratio is smaller. This makes the bulge in the labor force causes a bigger deviation from the steady-state capital/labor ratio. As a result, the fall in the baby boomers' living standards while young (line 1 in Table 2) is bigger in this case. For a similar reason, wages rise more (than in the Table 1 scenario) for the

post-baby-boom generation when labor is scarce in their youth period. As a result, as seen in line 2 of Table 2, this group's living standard goes up (by one-fifth of one percent), not down, as they support the aging baby boomers. Thus, the existence of liquidity constraints brings a more pronounced variation in the wage-rental ratio, and so it makes the model a little more supportive of those who view the aging population as a benign development. Nevertheless, our overall assessment is still appropriate: the average person living when the baby boomers are retired is worse off by a full 2 percentage points.

Tables 3 and 4 report how the results are affected by the assumption that the pre-baby-boom generation does not anticipate the changes in interest rates that are caused by the baby boom. We compare Table 3 to Table 2, since we continue to assume that 50% of the households live "hand to mouth." Because agents do not see the baby boom coming in the Table 3 simulations, the pre-baby-boom generation does not predict the same rise in the interest rate as before, and so these individuals do less saving. The result for them is that – despite the "surprising" rise in the interest rate – they earn less in retirement. The result for the baby boomers is that they have less capital to work with when they are young, and their wages (and living standards) take a bigger hit in this case. A second reason for the baby boomers to suffer more during their work period follows from the fact that – like their predecessors – they make a forecast error concerning interest rates. With static expectations, they anticipate the same high interest rate that the previous generation had found surprising. Thus, compared to the Table 2 simulations, these baby boomers save more in their youth. This is the second reason why their consumption is lower. Once they retire, they find that the interest rate is lower than expected. Nevertheless, since they saved more when young, they are still better off during

retirement (compared to the baby boomers who live in a perfect foresight world). The interest rate falls as baby boomers move into retirement – whether there is perfect foresight or static expectations. But since these individuals save more when they have static expectations, this mitigates the fall in living standards for their retirement period. What about the post-baby-boom generation? As just explained, the baby boomers save more in the static expectations case. This gives the next generation more capital to work with. Compared to the perfect foresight case, therefore, labour is more scarce. The resulting rise in wages makes the post baby boomers better off (than they were in the Table 2 simulations).

Our final simulations are reported in Table 4. We continue to assume that half the population lives hand to mouth and that all individuals have static expectations. The new feature is that there is a tax-sheltered private saving plan for retirement. This plan induces the forward-looking individuals to save more during their working stage of life. As a result, the pre-baby-boom generation has more interest income during retirement (and this is one reason why their living standard in old age is higher in Table 4 than it is in Table 3). The other reason follows from the fact that the large number of workers in the baby-boom generation allows the government to lower the economy's tax rate. This benefits both the baby boomers, and the preceding generation – since the pre-baby-boomers pay less tax as they cash in their savings. For the baby boom generation, there are competing effects. On the one hand, the previous generation is now paying tax during their old age, and this means that baby boomers face a lower tax rate during their youth. On the other hand, the existence of the tax shelter induces baby boomers to save more while working, and this lowers their consumption. By comparing the top left entries in

Tables 3 and 4, we see that the second effect dominates. The possibility of tax-sheltered saving lowers the living standards of baby boomers in this first period of their lives. This generation suffers the same fate in old age. They save more (than in the Table 3 simulations), so they have higher pre-tax interest income. However, since the generation that is working when they themselves are old is smaller, the economy's tax rate has increased, and this lowers the after-tax income that baby boomers receive from their saving (while old). By comparing the middle entries in Tables 3 and 4, we can see that this second effect dominates. Finally, we consider the post-baby-boom generation. There is one reason for this cohort to be doing better than in the simulations that do not involve tax-sheltered savings – those that are retired are now paying taxes, and this leaves a smaller burden for the working generation. Nevertheless, there are two reasons for this group to be doing worse. For one thing, since the previous generation saved more, there is a bigger capital stock. This means that the increase in the wage-rental ratio is smaller. The second consideration is that the tax-sheltered savings opportunity induces these individuals to save more (which, other things equal, means lower consumption). Tables 3 and 4 indicate that these latter two effects dominate, so that post-baby-boomers receive a smaller increase in living standards when the tax shelter opportunity exists.

4. Conclusions

There is widespread concern that the aging of the baby boom generation may put strain on our public finances, and that average living standards may suffer as a result. But there is significant disagreement about the possible magnitude of these effects, since studies involve different assumptions, and it is difficult for one researcher to perform

sensitivity tests with another's complicated and disaggregated model. We have used the standard two-period overlapping generations framework to assess this concern – in a way that allows us to provide a series of sensitivity tests on some of the most basic assumptions that underlie all analyses of this topic. Our conclusions are robust across several major changes in specification – concerning whether individuals plan ahead at all, whether they have accurate expectations over the time horizon of two generations, and whether the government allows a tax-free private saving plan for retirement (with no contribution limits) or not.

All versions of the model support the prediction that there will be a fall in the average living standards of all those alive when the baby boomers are retired – of about 2 percent. Compared to what has been at stake in other major policy debates, we regard this predicted reduction in living standards as significant, but certainly manageable. Thus, our analysis suggests that the aging population cannot be dismissed as a trivial phenomenon, but nor should it be regarded as a crisis.

Table 1

Percentage Increase or Decrease in Living Standards
Perfect Foresight - All Households Forward-Looking Planners

Time Period	Living Standards of Young Generation	Living Standards of Old Generation	Living Standards of Average person Alive
1	+0.12 %	+4.80 %	+2.07 %
2	-0.09 %	-4.59 %	-2.18 %
3	-0.05 %	-0.02 %	-0.03 %

Table 2

Percentage Increase or Decrease in Living Standards
Perfect Foresight - 50 % Households Forward-Looking Planners

Time Period	Living Standards of Young Generation	Living Standards of Old Generation	Living Standards of Average person Alive
1	-0.59 %	+4.56 %	+1.61 %
2	+0.20 %	-4.45 %	-1.98 %
3	+0.09 %	+0.05 %	+0.07 %

Table 3

Percentage Increase or Decrease in Living Standards
Static Expectations – 50% Households Forward-Looking Planners

Time Period	Living Standards of Young Generation	Living Standards of Old Generation	Living Standards of Average person Alive
1	-1.30 %	+4.37 %	+1.78 %
2	+0.95 %	-4.20 %	-1.51 %
3	+0.01 %	+0.00 %	+0.00 %

Table 4

Percentage Increase or Decrease in Living Standards
Static Expectations – 50 % Households Forward-Looking Planners
All Savings Sheltered from Tax

Time Period	Living Standards of Young Generation	Living Standards of Old Generation	Living Standards of Average person Alive
1	-1.94 %	+4.98 %	+1.39 %
2	+0.89 %	-5.21 %	-2.35 %
3	+0.66 %	+0.40 %	+0.54 %

References

Barro, R.J., 1974, "Are Government Bonds Net Wealth?" *Journal of Political Economy* 81, 1095-1117.

Barro, R.J., and X. Sala-i-Martin, 1995, *Economic Growth* (New York: McGraw-Hill).

Bohn, H., 1999, "Will Social Security and Medicare Remain Viable as the U.S. Population is Aging?" Carnegie-Rochester Conference Series on Public Policy 50, 1-53.

Burbidge, J.B., 1983, "Social Security and Savings Plans in Overlapping Generations Models," *Journal of Public Economics* 21, 79-92.

Denton, F. and B. Spencer, 2000, "Population Aging and Its Economic Costs: A Survey of the Issues and Evidence," *Canadian Journal on Aging* 19, supplement, 1-31.

Devereux, M. and D. Love, 1994, "The Effects of Factor Taxation in a Two-Sector Model of Endogenous Growth," *Canadian Journal of Economics* 27, 509-536.

Emery, J.C.H, and I. Rongve, 1999, "Much Ado About Nothing? Demographic Bulges, The Productivity Puzzle, and CPP Reform," *Contemporary Economic Policy* 17, 68- 78.

Howitt, P., 1997, "Low Inflation and the Canadian Economy," in D. Laidler (ed.) *Where We Go From Here*, Policy Study 29 (Toronto: C.D. Howe Institute).

Mankiw, N.G., 2000, "The Savers-Spenders Theory of Fiscal Policy," *American Economic Review, Papers and Proceedings* 90, 120-125.

Merette, M., 2001, *An Economic Welcome to the Population Ageing in Canada*, (Montreal: Institute for Research on Public Policy).

OECD, 1998, *Maintaining Prosperity in an Ageing Society*, ISBN 92 64 163131.

Office of the Auditor General of Canada, 1998, "Population Ageing and Information for Parliament: Understanding the Choices," *Report of the Auditor General to the House of Commons-1998*, vol. 1, chapter 6.

Peterson, P., 1999, *Gray Dawn* (Times Books).

Scarth, W.M., 2000, *Economics: The Essentials*, Second Edition (Toronto: Harcourt Canada).

World Bank, 1994, *Averting the Old Age Crisis: Policies to Protect the Old and Promote Growth*, (Oxford: Oxford University Press).

Young, A., 2001, "Demographic Fluctuations, Generational Welfare and Inter-generational Transfers," NBER Working Paper No. W8530.

Endnotes

---

[1] We thank John Burbidge, Herb Emery and Byron Spencer for helpful comments and the SEDAP research program for financial support.

[2] See Merette (2001) for additional related references.

[3] We view the analysis as referring to the entire North American economy. Only by making this assumption, are we justified in applying this closed-economy model. For the analysis to be exclusive to Canada, we would have to consider a small open-economy version. In this case, the assumption of perfectly mobile capital would preclude factor price changes, so there is no mechanism for the scarce labor (that works while the baby-boomers are retired) to receive higher pre-tax wages.

[4] Bohn (1999) and Young (2001) consider these issues. Bohn focuses on whether the baby-boom generation can dominate the political process enough to destroy the viability of existing government programs, while Young considers the intrinsic bias against large cohorts that exists when a social planner maximizes the discounted welfare of an endless stream of generations.

[5] See Scarth (2000, p123).

[6] Other bases of comparison are worth mentioning. Disinflation was also hotly debated in the 1980s, and there has been scant evidence of its favorable effect on steady-state living standards. (Howitt (1997) concludes that the evidence for any net benefits "is certainly not overwhelming.") This comparison suggests that aging is important. On the other hand, it is believed that skill-biased technical change has caused the 20 percent drop in the wages of young, unskilled males in the last quarter century. This base for comparison suggests that aging causes only modest effects.

Number	Title	Author(s)
No. 351:	Describing Disability among High and Low Income Status Older Adults in Canada	P. Raina M. Wong L.W. Chambers M. Denton A. Gafni
No. 352:	Some Demographic Consequences of Revising the Definition of 'Old' to Reflect Future Changes in Life Table Probabilities	F.T. Denton B.G. Spencer
No. 353:	The Correlation Between Husband's and Wife's Education: Canada, 1971-1996	L. Magee J. Burbidge L. Robb
No. 354:	The Effect of Marginal Tax Rates on Taxable Income: A Panel Study of the 1988 Tax Flattening in Canada	M.-A. Sillamaa M.R. Veall
No. 355:	Population Change and the Requirements for Physicians: The Case of Ontario	F.T. Denton A. Gafni B.G. Spencer
No. 356:	2 ½ Proposals to Save Social Security	D. Fretz M.R. Veall
No. 357:	The Consequences of Caregiving: Does Employment Make A Difference?	C.L. Kemp C.J. Rosenthal
No. 358:	Exploring the Effects of Population Change on the Costs of Physician Services	F.T. Denton A. Gafni B.G. Spencer
No. 359:	Reflexive Planning for Later Life: A Conceptual Model and Evidence from Canada	M.A. Denton S. French A. Gafni A. Joshi C. Rosenthal S. Webb
No. 360:	Time Series Properties and Stochastic Forecasts: Some Econometrics of Mortality from The Canadian Laboratory	F.T. Denton C.H. Feaver B.G. Spencer
No. 361:	Linear Public Goods Experiments: A Meta-Analysis	J. Zelmer
No. 362:	The Timing and Duration of Women's Life Course Events: A Study of Mothers With At Least Two Children	K.M. Kobayashi A. Martin-Matthews C.J. Rosenthal S. Matthews

QSEP RESEARCH REPORTS - Recent Releases

Number	Title	Author(s)
No. 363:	Age-Gapped and Age-Condensed Lineages: Patterns of Intergenerational Age Structure among Canadian Families	A. Martin-Matthews K.M. Kobayashi C.J. Rosenthal S.H. Matthews
No. 364:	The Education Premium in Canada and the United States	J.B. Burbidge L. Magee A.L. Robb
No. 365:	Student Enrolment and Faculty Recruitment in Ontario: The Double Cohort, the Baby Boom Echo, and the Aging of University Faculty	B.G. Spencer
No. 366:	The Economic Well-Being of Older Women Who Become Divorced or Separated in Mid and Later Life	S. Davies M. Denton
No. 367:	Alternative Pasts, Possible Futures: A "What If" Study of the Effects of Fertility on the Canadian Population and Labour Force	F.T. Denton C.H. Feaver B.G. Spencer
No. 368:	Baby-Boom Aging and Average Living Standards	W. Scarth M. Souare