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ECONOMIC COSTS OF POPULATION AGING

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Abstract

In just over three decades all those born during the post-war baby boom will be 65 and older, and the fraction of the population 'old' will be far greater than previously experienced in Canada, or indeed in any modern industrial nation. That prospect has given rise to major concerns about our ability as a society to meet the large anticipated additions to health care, pension, and other costs associated with the increase in the older population. However, a balanced view requires that attention be given to *all* publicly provided services, not only to those services used in large measure by the elderly, and also to privately provided goods and services, since the costs must be charged against the same national income in both cases. Beyond that, it is important to recognize that population change affects not only the demand side of the economy, but also the *supply* side, the nation's productive capacity. This paper reviews the literature to assess the magnitude of the prospective cost increases associated with the aging of the Canadian population and considers the practical implications for government programs and policies.

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Objective

The baby boom is now in middle age. In the next decade its oldest members will be taking early retirement, and by 2011 they will have reached the age of 65. By 2031 all those born during the post-war baby boom will have passed that milestone and (barring an unlikely return to very high levels of fertility) the fraction of the population 65 and over will be far greater than previously experienced in Canada, or indeed in any modern industrial nation.

That prospect has given rise to major concerns about our ability as a society to meet the large anticipated additions to health care, pension, and other costs associated with the increase in the older population. A recent editorial in the *Calgary Herald* is typical in stating that “Unless the next generation is prepared for an astonishing increase in the tax burden -- we doubt they are -- fundamental reforms are needed to the contribution requirements for social programs and pensions, as well as the level of benefits provided” (July 28, 1998). Even well-informed observers sometimes lapse into hyperbole and speak of such things as “the colossal challenges of our rapidly aging society” (Siegel, 1994, p. 425).

The purpose of this paper is to review the literature that bears on this topic with an eye to assessing, as best we can, the magnitude of the prospective cost increases associated with the aging of the Canadian population. A balanced assessment requires that attention be given to *all* publicly provided services -- not only to those services used in large measure by the elderly (such as health care), but also those associated with other ages (education, employment insurance, correctional services). Moreover, a balanced assessment requires also that privately provided goods and services be considered, since whether provision is mostly through public or private

channels is, in large measure, a matter of social preference and public policy, and the costs must be charged against the same national income in both cases. Beyond that, it is important to recognize that population change affects not only the demand side of the economy, but also the *supply* side. That is, it affects the nation's productive capacity as well as the ways in which its product is used. Our objective here is to provide a balanced account of the relevant literature pertaining to such matters and to draw such conclusions as seem appropriate.

Search Strategy

Our search of the literature started with a review of the electronic resources of the McMaster University Libraries. Included in those resources are all the major electronic search engines. We quickly narrowed the search to *EconLit*, *Index to United Nations Documents and Publications*, and the *Social Sciences Index*. (Among the other indexes considered were *Canadian Periodical Index*, *Canadian Research Index*, *First Search*, *Science Citation Index*, and *Sociofile*.) *EconLit* is "a comprehensive, indexed bibliography with selected abstracts of the world's economic literature appearing in more than 400 major economic journals, as well as in articles in collected volumes, books, book reviews, and dissertations"; the *Index to United Nations Documents and Publications* "contains references to the official records, documents, mimeographed items and periodicals published by the United Nations"; and the *Social Science Index* gives access "to more than 300 English language periodicals and book reviews in the fields of anthropology, area studies, economics, environmental science, geography, law and criminology, medical sciences, political science, psychology, public administration, sociology, and related subjects". In addition, we checked the electronic index (over the Internet) to the Metropolitan Toronto Reference

Library.

Moving beyond the formal, electronic search, we made contact with a number of researchers, both in Canada and abroad, with known interest in the topic, and asked them to tell us of their most recent relevant work. We also made contact with a number of people in the Canadian public service to ask them to identify work that was taking place within government that might not yet be in the public domain. Needless to say (but important) we drew on our own knowledge of the relevant literature, including our own contributions.

The electronic searches can be described as follows:

1. No language restriction was imposed, beyond the coverage of each individual index.
2. With few exceptions, documents with publication dates before 1986 were ignored.
3. The initial search was for documents in which the keywords “population” and “aging” both appeared. Subsequent electronic searches were for “population” but not “aging” in combination with other key words or combinations of words (these searches excluded those with “aging” since they had already been identified in the first search); the other key words or combinations of words were: “fiscal”; “expenditure”; “health”; “pension”; “govern*”; “education”; “budget”; “taxes”; “social” and “security”; “old” and “age” and “security”; “financial”; “econ*”; and “generation*” and “account” (the asterisk, *, indicates a “wildcard” that includes all extensions; for example, “govern*” would include government, governance, etc.).

As expected, the electronic search procedure turned up a very large number of publications, most of which were of no direct relevance for our purpose. However, no satisfactory way of limiting

that search was found and, in the end, we worked from the full listings that resulted, and made decisions based on the titles of publications and such other information as was provided (e.g., abstracts, key words) as to whether to obtain copies for further review.

In total, a very large number of listings was obtained, and many thousands of documents were identified. With inspection, it soon became evident that there was a lot of redundancy -- the same publications were turning up repeatedly in the various searches, and seldom was anything new being added. In the end, we considered it unlikely that we had missed documents of importance for our purpose; at least we were satisfied that all the major ideas that have appeared in the literature would be properly represented.

Summary of Sources

Our selection includes the following (with the numbers selected noted in parentheses):

- articles in journals (44)
- books and monographs (7)
- chapters in books (9)
- working papers and research reports (15)
- Canadian government documents (8)
- international agency and foreign government documents (8)

Synthesis of the Evidence

1. The Underlying Demographic Situation

Demographic prospects, in particular future changes in age distribution, are obviously at the core of any discussion of the economic costs of population aging. Some major aspects of the unfolding demographic situation in Canada are summarized in Figure 1. The figure shows the percentage age distribution of the population in 1966, when the baby boom had just ended, and again in 1996, 30 years later, when those born during the boom were (as a close approximation) between the ages of 30 and 50. The change in the age distribution over the three decades is striking. In 1966 more than 42 percent of the population were ‘young’ (under the age of 20); in 1996, only 27 percent were ‘young’, while the proportion in ‘middle age’ (20 to 64) had increased from 50 to 61 percent. By 2011 those born at the beginning of the baby boom will just have reached their 65th birthdays and, if present trends continue, the proportion ‘old’ (65 and over) will have risen to 14 percent, up from less than 8 percent in 1966 and 12 percent in 1996.² Twenty years later,

² The projection numbers reported here and subsequently draw on the ‘medium’ projection, as reported in Denton, Feaver, and Spencer (1998); however, that projection, which assumes a continuation of recent trends, has been updated to reflect additional information available at the time of writing. The projection is based on the following assumptions: the total fertility rate will remain at its recent level of about 1.64 children per woman, the declines in age-sex-specific mortality rates will continue in accordance with recent historical patterns, but at progressively slower rates; immigration will remain at about 225,000 per year and emigration at about 0.17 percent of the population. A range of official projections is provided by Statistics Canada; the set found in Statistics Canada (1994) relates to the period 1993-2016 for Canada, the provinces and territories, and to the period 1993-2041 for Canada alone. It is the latest published set of projections from Statistics Canada that extends that far. Updated versions of its ‘medium-growth’ projection are provided annually by Statistics Canada, but the projection published in the latest annual update, Statistics Canada (1998), goes only to 2001; the assumptions underlying our ‘medium’ projection for that period are similar to those underlying Statistics Canada’s latest

in 2031 (also shown in the figure), all of the boom generation will be in old age, and it is projected that those 65 and over will account for roughly one out of every four members of the population, or about twice the current proportion³.

Increases in the fraction 'old' are one indicator of population aging. Another is the median age of the population; it was 25 in 1966, at the end of the boom, but had increased to 35 by 1996; by 2031 it is projected to be about 44. As a further indicator, in 1996 there were about 46 'old' people for every 100 'young'; by 2031 it is projected that there will be 114 for every 100, so that the 'old' will outnumber the 'young'. Referring to broadly similar developments in Europe, Stolnitz (1994, p.1) observed that such "a comparison [is] without remote precedent in human history".

There can be little doubt that the *number* of people aged 65 and over will increase very sharply as the baby boomers move into old age; those people are already with us. It is virtually certain that the *proportion* of the population in old age will increase also. By 2031, our medium projection has the proportion 'old' reaching 23.4 percent of the population, or almost double the 12.2 percent observed in 1996. The proportion will be somewhat lower if immigration is increased and somewhat higher if it is decreased; similarly it will be somewhat higher if mortality rates fall more rapidly than anticipated in the projection, and somewhat lower if they fall more slowly. But such factors can have only rather minor effects. A return to much higher fertility rates

projection.

³ The definition of 'old' (65 and over) is conventional but arbitrary. Argument for revising it upward is given in Denton and Spencer (1998b).

would have a more substantial effect, but even then the proportion would still be markedly higher than it is today⁴. As one example, even if the total fertility rate were to increase to three births per woman by 2006 (something that appears very unlikely) and then to remain at that level, the fraction old would still rise by about 50 percent by 2031. The apparently inevitable increases in the proportion of elderly people has become part of the public consciousness, and has given rise to considerable anxiety about the long-term sustainability of programs of social support, most notably the Canada and Quebec Pension Plans and the publicly funded health care system. We consider such issues later.

Age-specific mortality rates have been trending down for many decades, and are expected to continue to do so. The extent of further decrease is a matter of active debate⁵, however, and recent work by Ronald Lee and others has drawn attention to the importance of mortality assumptions, at least over the very long term. For example, Lee and Tuljapurkar (1997) note that in the 1995 report in which the Board of Trustees of the United States Social Security Administration projects the balance in the Trust Fund 75 years into the future (the year 2070),

⁴ Adopting the traditional approach, Denton, Feaver, and Spencer (1998) provide several projections based on alternative assumptions about fertility, mortality, and immigration. An alternative strategy has been introduced by Ronald Lee and his colleagues in the form of stochastic forecasting. It deals more effectively with the inherent uncertainty of projections or forecasts than does the traditional approach. An application to the long-run projection of US social security costs can be found in Lee and Tuljapurkar (1997, 1998), Lee and Skinner (1998), and Lee, Tuljapurkar, and Edwards (1998). See also other references in those publications.

⁵ At one extreme, Fries (1980) and Olshansky, Carnes, and Cassel (1990) claim an upper limit of life expectancy (at birth) of 85 years; at the other, Ahlburg and Vaupel (1990) and Manton, Stallard, and Tolley (1991) think that 100 is attainable within another five or so decades. Vaupel (1998, p. 246) states that “the widely held position that mortality at older ages is intractable is untenable”.

a much greater role is given to the uncertainty associated with the projections of mortality than to either fertility or immigration. However, that is because of the narrow range of fertility rates considered in the Board's projections (their alternatives range from 1.6 to 2.2 births per woman). In the Canadian context, projections have rarely been concerned with such distant futures; Statistics Canada (1994) publishes projections that extend only to 2041, as do Denton and Spencer (1998a)⁶. Denton and Spencer (1998a) and Denton, Feaver, and Spencer (1998) report on the sensitivity of their projections to the underlying assumptions; in particular, they note the relatively great importance of future fertility rates in determining the extent of future population aging⁷.

Some international comparisons are helpful, since population aging is a widespread phenomenon among developed countries. A few comparisons with OECD nations are provided in Figure 2. The "elderly dependency ratios" shown in the figure are taken from OECD (1996), and are calculated as the ratios of the population 65 and over to the population 15-64. The Canadian series, both historical and projected, resembles that of the US, which experienced a baby boom with magnitude and timing similar to the one in Canada. In contrast, the post-war increase in the fertility rate was much more modest in the countries of the European Community as a whole (more a 'blip' than a 'boom') and their populations were already older; hence the EC elderly

⁶ The Demographic Review (1989) was an exception, in that it provided illustrative projections to 2786 in its final report. Also, the OECD has provided projections extending to 2070 (OECD, 1996).

⁷ We note also Lee and Tuljapurkar's (1998) finding, in their stochastic forecasts, that fertility contributes more uncertainty than does mortality to the tax increase that would be required to sustain the long-term actuarial balance of the US Social Security Fund.

dependency ratio is noticeably higher than Canada's, both historically and until almost to the end of the projection period. Indeed, the EC ratio at the end of the 1990s is higher than Canada is likely to experience until after 2010. The situation in Japan provides another sharp contrast: its elderly dependency ratio was very low in the early post-war period, largely because its birth rate had declined sharply⁸. However, the Japanese ratio has been rising rapidly: it was higher than the Canadian ratio by 1980, higher than the US ratio by the early 1990s, and higher than the EC ratio by the late 1990s, and it is projected to be the highest among the OECD countries for the next three decades. The elderly dependency ratio in Canada is likely to increase rather little until after 2010, and then to continue to be lower than that of Japan and the EC, and slightly above that of the US. To the extent that this ratio is an indicator of prospective difficulties, we in Canada are relatively well positioned, by international standards.

It is of interest to note also the differences within Canada. The elderly dependency ratio is projected to be relatively high in the Atlantic Region and Quebec, relatively low in Ontario and the western provinces (Denton and Spencer, 1997). With their jurisdictional responsibilities for health care, those provinces with relatively high ratios may anticipate greater pressures in areas of public budgetary expenditure related to the older population.

We turn now to the effects of demographic change on the labour force. The rapid population growth from the mid-1940s through the mid-1960s was reflected in rapid labour force growth,

⁸ There was no post-war baby boom in Japan. Its total fertility rate fell from about 4 children per woman in 1940 to just over 2 in 1950, and has remained at or below the replacement rate (which is about 2.1) in most years since then.

with a lag of some two decades to allow for the children of the baby boom to reach working age. There was a similar lag following the baby bust, the children of which first reached working age in the latter part of the 1980s, and that played an important role in the slowing down of labour force growth in recent years.

The labour force is, of course, affected also by immigration. Most immigrants are of working age, and hence higher levels of immigration (unlike higher levels of fertility) can increase the size of the labour force immediately. In recent years immigration has come to be the predominant source of labour force growth, and that will almost certainly continue to be the case far into the future. Indeed, if immigration were reduced to zero, labour force growth would soon cease entirely, and would turn negative in the second decade of the next century. With immigration maintained at recent levels, the labour force is expected to grow more rapidly than the population for another decade or so before much slower growth sets in; based on our medium projection, labour force growth will pretty much come to an end by the middle of the second decade of the next century.

Changes in labour force participation rates are important too. In particular, strong and sustained increases in female participation rates were a major contributor to labour force growth from the early 1950s through to the end of the 1980s; the higher female rates more than offset the declines in rates among older males that have been a prominent feature since the late 1960s. But growth from net increases in participation, it appears, has now come to an end also: female participation rates are unlikely to increase much further⁹. As a further indicator of population aging, by 2031

⁹ Denton and Spencer (1998a) review the sources of labour force growth, both past and prospective.

our medium projection shows one person aged 65 and over for every two in the labour force, up from one for every four in 1996. As Stolnitz (1994, p.1) remarked, again in speaking of broadly similar developments in Europe, that is “a prospect whose economic sustainability has never been tested”.

All things considered, the labour force, like the population, is likely to experience a considerable amount of aging in the decades ahead. The range of projections provided in Denton and Spencer (1998a) suggest that aging of the Canadian population and labour force, and associated reductions in their rates of growth, are all but inevitable. Figures 3 and 4 show the five-year rates of population and labour force growth from 1951-56 through to 2036-41, based on our medium projection.

2. Dependency Ratios

Some of the discussion in the previous section was based on “elderly dependency ratios”. However, the “dependency ratio” concept is more general, and sufficiently important in analyses of the effects of population aging to warrant special attention.

The “dependency ratio” is a simple but time-honoured measure of the (broadly speaking) economic implications of the structure of a population. The idea is that the population can be divided into two groups, one representing “dependents”, the other representing “providers” or “working-age population”. The ratio of the number of people in the first group to the number in the second is then taken to be an indicator of how many “unproductive” or “dependent”

members of the population must be provided for by each “productive” member, and hence the degree of difficulty that a population has in supporting itself. The ratio begs many questions and is surely no more than a rough indicator, but it is used frequently, and it has its merits. Among them are its simplicity and its ease of calculation.

The dependency ratio has a long history as a summary measure in demography. Shryock and Siegel (1975) provide two conventional definitions: they define the age dependency ratio as the ratio of the combined population 0-14 years of age and 65 and over to the population 15-64, and the economic dependency ratio as the ratio of the non-labour-force population to the labour force. Other definitions are possible, their appropriateness being defined by the context. Ahlburg and Vaupel (1993) define the working-age population as 18-64, for example; instead of using the labour force as a denominator one could use the number of people employed (thus excluding unemployed members of the labour force); or one could calculate the ratio of the total population to the working-age population or the labour force. (The latter type of ratio is one that we prefer, on the grounds that the total population represents the total number of people to be supported, whether by themselves or by others.) There are many possible variations on the basic theme.

The notion of a dependency ratio (however defined) implies a sort of pay-as-you-go economy. Within any year, those in the population who are the producers of wealth support those who are not. Absent is any concept of saving and capital accumulation, so that people who are “active” in one period of their lives might provide support for themselves in a later period, when they are old. Nor is there any allowance for productivity differences, so that the ability to provide economic support might increase through time, or might vary from country to country or region

to region, even if the dependency ratio were the same. The dependency ratio idea does not fit neatly into an economist's way of thinking. Nevertheless, it is a useful measure for summarizing some of the implications of an age distribution. Moreover, it would seem to be implicit in much of the popular discussion of population aging -- of the future ability of the economy to support a large and increasing proportion of old people, and hence the implications for age-related government programs.

We and others have used conventional-type dependency ratio calculations of various kinds in analysing the historical and prospective implications of population aging in Canada. Such calculations can be found, for example, in Denton, Feaver, and Spencer (1987, 1997, 1998), Fellegi (1988), and Foot (1989). The calculations invariably reflect the high ratios attained in the 1950s and 1960s as a result of the large numbers of children born during the baby boom, the sharp declines during the subsequent baby bust, and the low levels of the 1990s. The projected ratios, based on alternative plausible demographic assumptions, maintain the current low levels for another decade or two, and then start to increase as the proportion of people 65 and over rises steadily. In spite of the increases, though, the ratios never reach the levels attained during the 1950s and 1960s, according to the conventional-type calculations.

There are, then, two points to be emphasized, based on conventional types of dependency-ratio calculations. The first is that the current ratios are at very low levels, by historical standards. The second is that, in spite of what appear to be inevitable increases after another decade or two, the ratios projected over the next half-century are never as high as those of the postwar baby-boom period. A sharp rise in fertility rates in future decades could, of course, alter the situation; it

could produce a combination of large numbers of children and large numbers of older people, and hence much higher dependency ratios. Surprises are always possible, but at the present time we know of no credible argument for thinking that a major increase in fertility rates is likely to occur in Canada -- a modest increase, perhaps, but a major one seems unlikely.

A criticism of conventional-type dependency ratios is that dependents of different ages all have the same weight in the calculations: a child and an old person each count as one dependent; there is no allowance for possible differences in consumption or support requirements. Another criticism is that each member of the working-age population, or of the labour force, if that is used as the denominator of the ratio, is treated equally: in the case of the working-age population, whether or not a person is actually in the labour force is ignored; in the case of the labour force, whether or not a person is employed or unemployed is ignored. David Foot (1989) calculated a number of “non-standard” dependency ratios in which differential weights were employed. The focus in his paper was the effect of population aging on government expenditure, and he assigned weights accordingly. Drawing on earlier studies by McDonald (1977) and Clark, Kreps, and Spengler (1978), he set the weight for the old population much higher than the weight for the young population. He also made provision for labour force participation and unemployment rates that vary by age group. His calculations went back to 1921 and as far forward as 2021, and they are interesting. Taking account of labour force participation rates had some effects on his calculated ratios, both historical and projected, but the largest effects on the projected ratios were those introduced by the expenditure weights assigned to different age groups. Assigning a much higher weight to the older age group (65 and over) than to the youngest (under 15) produced dependency ratios projected to be considerably higher than any historical ones by the year 2021.

Foot's weights were based on estimated differences in government expenditures directed toward different age groups. In two recent studies of our own we have taken account of age differences in total expenditure or consumption. That is to say, our concern has been with the effects of population aging on the total amount of consumption required by the population, whether the consumption is financed privately (food, shelter, etc.) or by one or another level of government (publicly funded health services, police services, etc.). In one study (Denton, Feaver, and Spencer, 1998) we arbitrarily assigned alternative sets of weights to different age groups and calculated dependency ratios using both working-age population and labour force as denominators, and the age-weighted total population as numerator (the total number of consumers in the economy, weighted by their assumed per capita consumption levels). We found in that study (as in others) that the dependency ratios were all low in the 1990s, by historical standards, and all started to rise sharply after a decade or so into the next century. However, in order to obtain ratios that eventually (about half a century from now) exceeded those of the 1950s and 1960s it was necessary to assign to the old population a per capita consumption weight three times greater than that assigned to the young population. We argued that it was unlikely that the difference in per capita consumption would be so great, and therefore concluded that ratios that high would be unlikely to occur.

In a second study (Denton, Feaver, and Spencer, 1997), we also focussed on the effects of population aging on total consumption (as indicated by historical and projected dependency ratios). However, this time we attempted to measure actual per capita levels by age group for a large number of individual consumption categories, privately and publicly funded combined. We also did various calculations using working-age population, labour force, and employment

in the denominator. The ratios so calculated all were again low in the 1990s and changed very little for a decade and a half or two decades into the next century. They all started to rise thereafter, based on our population projections, and moved up substantially in the ensuing decades. But they did not reach the levels of the 1950s and 1960s.

We had the benefit of more recent data and we had a different focus from that of Foot's study. Nevertheless, it is of interest to pool his results and ours, and see what general conclusions can be drawn. A dependency ratio, however calculated, is a convenient summary measure, but a crude one. Allowing for that, the evidence indicates clearly that dependency ratios are very low in the 1990s, by historical standards, and that they are likely to change rather little for another fifteen or twenty years. It indicates also that they will rise substantially thereafter as the proportion of elderly people in the population rises. The evidence differs somewhat with respect to how fast and how high the ratio will then increase, depending on how the calculation is done, but that much is clear.

Weighted dependency ratios differ to some extent from unweighted ones in their projected time paths. Weights based on per capita government expenditure produce higher future ratios than weights based on a more comprehensive approach in which total per capita consumption levels are used. That is what a comparison of Foot's results and ours suggests, but differences in the data available and the assumptions on which the population projections were based should be recognized. We are satisfied, from our projections, that consumption-based ratios as far into the future as the middle of the next century are unlikely to go as high as they did in the 1950s and 1960s. That, plus the fact that the ratios are likely to remain quite low for another two decades

or so, should help to assuage fears about the impending “aging crisis”. However, the specific effects on government expenditure require further attention. We take that matter up below.

3. Points of Impact of Population Aging on the Economy

We move now from purely demographic considerations to identification of the major relationships between the population and the economy. Our concern, broadly speaking, is with two aspects: *demand*, the ways in which the aging of the population might affect patterns of expenditure (including the demands for publicly provided services); and *supply*, the ways in which it might affect the productive capacity of the economy.

Expressions of apprehension that appear from time to time in the popular press and elsewhere typically relate to the demand side, and specifically to the costs of maintaining the public health care and old age security systems. The older population is projected to increase rapidly: it will be two and one-half times as large in 2031 as in 1996, based on our medium projection. Roughly speaking, then, if the same amount is spent per older person in the future as at present, the cost of simply maintaining public programs for them would also increase two and one-half times, in real (constant price) terms. Only by cutting the per capita expenditure by sixty percent would the total outlay not increase.

Concerns with the effects of population aging frequently ignore some matters of considerable importance. One is that as population aging will put pressure on some categories of government expenditure it will reduce the pressure on others. If recent fertility levels are maintained, while

the older proportion of the population will increase the proportion of young people will decline. With proportionately fewer children one might expect less pressure (from demographic sources) on education expenditures; with proportionately fewer in the work force one might expect a reduction in expenditures associated with employment programs; and so on. In general terms, one might expect that the same demographic forces that will give rise to population aging will lead to expenditure decreases in some areas of public budgets that will at least partially offset the increases in others. It makes little sense to consider in isolation only those expenditure categories (such as health care and old age security) that might be expected to increase, and then to claim that there is a crisis. (This matter is discussed in more detail below.)

One might anticipate that changes in the age structure of the population would have far-reaching effects on the demand for goods and services provided by the private sector as well as those provided by the public sector. Broadly speaking, population aging might be expected to cause production to shift somewhat from goods and services associated primarily with children to those associated with people in middle or old age. By way of example, young adults move away from home, marry, and require new living accommodations, thus creating a demand for houses or apartments. They also require household equipment and furnishings, and so stimulate the demand for durable consumer goods of various kinds (stoves, refrigerators, furniture, etc.). As they start to have children they require a new range of consumer goods, and the patterns of expenditure continue to evolve. To the extent that population growth alters the level and composition of consumer expenditure it is likely also to influence investment of various kinds, thereby increasing its impact. Such shifts will take place mostly through market forces: producers will respond by producing more of what consumers want (and are willing to pay for) and less of what they do not

want. (Such forces, and the market price signals that accompany them, are typically not at work in the case of publicly provided goods and services; the signals and processes there are of a different kind.) The types of goods that people consume, and which businesses therefore produce, thus vary with age, and so we expect the age distribution of the population to have an important bearing on expenditure patterns and the composition of national output.

Another matter that is ignored in much of the public debate relates to the impact of population change on the productive capacity of the economy. Government budgetary cost increases associated with population aging are projected to take place over a period of several decades, and hence should be measured not in dollar terms but relative to the productive potential of the economy, as measured by its national income, gross national product (GNP), or gross domestic product (GDP).

In addressing the matter of how population aging is likely to affect the longer term productive capacity of the economy, it is helpful to draw on the simple relation $q = a + b l + c k$ which states that q , the rate of growth of the nation's output, is the sum of three factors: a , which can be interpreted roughly as the rate of productivity growth, l , the rate of growth of the labour force (assuming a constant rate of unemployment), weighted by labour's relative contribution to output, b , and k , the rate of growth of capital (the composite of machinery, equipment, and productive physical structures of all kinds), weighted by capital's relative contribution to output, c . The relative contribution weights sum to 1.0.

We start by considering the rate of labour force growth. The labour force is drawn from the

population, of course, and so this is the most obvious point of impact of population aging on the economy. One would expect the slower growth that comes with population aging to be reflected also in slower growth of the labour force. However, that takes time since people do not become full-time members of the labour force until they are in their late teens or twenties. Hence, as we have seen, the growth path of the labour force can differ considerably from that of the population (see Figures 3 and 4). For example, those born in the latter part of the 1960s, at the beginning of the baby bust, reached labour force age in the latter part of the 1980s, and that played an important role in the relatively slow growth of the labour force at that time and subsequently. The continuing small numbers of births are a major source of the anticipated future slow growth of the labour force.

We turn now to capital. The stock of capital grows as the result of investment. Investment, in turn, is related to the amount of saving, which conventional economic thought regards as reflecting life cycle considerations. Briefly put, people are assumed to accumulate assets (that is, save) during their working years and decumulate (dissave) during retirement. Thus one might expect that at present the baby boom would be in a phase of relatively high accumulation rates, and that high rates of aggregate saving would continue for another decade or so, but then start to fall. Based on conventional economic argument there is the prospect of a decline in the saving rate as the population ages, and hence in the rate of growth of the capital stock, and that would coincide with the slowing rate of labour force growth. That combination could, then, result in a slower rate of growth of the national income and product. All of this is based on more or less standard economic theory, and there are many ifs and buts attached to it. The argument does demonstrate, though, how population aging may affect the capacity to produce goods and

services as well as the demand or requirements for those goods and services.

Consider, finally, the rate of productivity growth, a . This factor has usually been treated as exogenous -- that is, unrelated to other factors, including population change. (Whether it is, in fact, exogenous is open to question.) In effect, the historical rates have usually been estimated residually (after accounting statistically for the contributions of labour and capital). On that basis, productivity growth has been very slow for the past two decades or more, well below the rates of the earlier postwar period. In the face of slower future rates of labour force (and possibly capital) growth, more rapid gains in productivity will be needed to maintain even modest increases in overall output per capita in the Canadian economy¹⁰.

4. Possible Offsets to the Effects of Population Aging

Population aging has major implications for the supply side of the economy, the most direct and obvious of which is on the labour force, and through that, on the productive capacity of the economy: the low birth rates of recent decades mean smaller numbers of new labour force entrants from within the population, and consequently fewer young, better and more recently trained, more adaptable (though less experienced) workers. That situation will probably continue for many

¹⁰ The growth of average *labour* productivity (output per worker) in Canada was less than one percent per year for the decades 1976-86 and 1986-96, down from more than two percent in the two preceding decades. The causes of the slower productivity growth remain a matter of debate, but its importance for future increases in output per capita (and for coping with the costs of population aging) is apparent. We have calculated that one percent growth in per capita output could be achieved in the decade 1996-2006, even with a continuation of low productivity gains, but that to sustain one percent growth thereafter would require gains in productivity much greater than have been observed in the past two decades (Denton and Spencer, 1998a).

decades to come. The rate of labour force growth is likely to decline, and the average age of the working population to rise. A question remains as to what will happen to overall productivity as a result of changes in the proportions of younger and older workers. In any event, though, to the extent that it reflects population aging, productive capacity is likely to grow more slowly in the future.

Can anything be done to offset this slower growth? More rapid productivity growth would certainly help, as we have noted¹¹. There are other possibilities too. The first is an increase in the level of immigration. The appeal of that idea stems from two considerations: immigrants are relatively young, and hence their arrival reduces the average age of both the population and the labour force; and they can be expected to add more to the national product than they use up as consumers, and thus to provide net support for the rising numbers of elderly dependents in the population¹². On closer inspection, however, there is a problem: immigrants get older, like

¹¹ That an increased rate of productivity growth (or “technical change”) may in fact occur as the rate of labour force growth slows in the coming decades is suggested by results reported by Cutler, Poterba, Sheiner, and Summers (1990). They found a negative correlation between productivity growth and labour force growth in a cross-section study of a large number of countries in the period 1960-85: countries with lower rates of labour force growth in that period tended to have higher rates of productivity growth; countries with higher rates of labour force growth (such as Canada and the United States) tended to have lower rates of productivity growth. Looking to the future, they argue that “any effects of demography on the rate of technical change are likely to dwarf its other consequences” (p. 70).

¹² In a related context, Foot (1991) argued that “an age-directed immigration program could alleviate the problem of a ‘bulge’ in the age profile” (p. 71). Those who have argued in favour of more immigration into the US to offset low fertility rates include Simon (1989), Keely and Tran (1989), and Holzmann (1987). Serow, Sly, and Wrigley (1990), looking beyond the year 2030, are more cautious in identifying “the possible encouragement and facilitation of additional immigration as a means of mitigating the potentially adverse economic consequences of population decline” (p. 188).

everyone else, and a sustained policy of higher immigration has little long-run impact on either the median age or the age composition of the population¹³. As Espenshade (1994, p.766) noted, “immigration is a clumsy and unrealistic policy alternative to offset a shortage of domestic labor or to correct a perceived imbalance in the pensioner/worker ratio in the United States and, by implication, in other countries with low fertility... [I]n the short run only substantially larger volumes of immigration than the United States has ever experienced have the potential to dampen current aging trends”. That is consistent with our own findings for Canada.

An increase in fertility is a second possibility. Fertility is obviously less amenable than immigration to policy control. However, some have advocated pronatalist policies to counterbalance the effects of population aging, and the Government of Quebec has such a policy in place¹⁴. Unless such policies have far greater effects on fertility levels than appear likely to us, though, their effect on population aging will be slight, at best, and possibly quite costly. We note that an early return to fertility rates substantially higher than those experienced for the last quarter century would reduce somewhat the pace of aging, but not by much (Denton, Feaver, and Spencer, 1998; see also previous observations above). And while higher fertility rates would lead to faster labour force growth, that would not happen until some two decades after a new boom was under way. In the meantime the overall dependency ratio would be *higher*, not lower.

¹³ It can, of course, have a major impact on the *size* of the population. Denton, Feaver, and Spencer (1997) illustrate the demographic impacts of a wide range of immigration levels in the Canadian context.

¹⁴ Henripin (1994) carried out some calculations to investigate, among other things, the results of a policy to raise future fertility. He recognized the uncertainty as to whether such a policy would be effective, and the possible costs of it, but did not rule it out. We provide further discussion of Henripin’s paper below.

A third possibility has to do with participation in the labour force. The strong trend towards earlier retirement that has been evident among Canadian men since the late 1960s means both more dependents per person working and less productive potential, and hence (if the trend continues) more difficulty in supporting an aging population. That raises two questions: (1) have the lower rates been, at least in part, an unintended result of social support programs and perhaps also of legislation relating to private pensions, in which case the underlying policies might be reviewed; and (2) have older workers who became unemployed tended to 'retire' early because they were not successful in obtaining other employment? Related to the second question, have older workers been persuaded to accept offers of early retirement, and hence effectively forced out of the labour force?

Such questions have received little research attention in Canada and definitive answers are elusive. Economic theory conceives of individuals making lifetime plans for their consumption, labour force participation, and retirement. If capital markets were perfect (so that individuals could borrow against all future income at the going rate of interest) the age-patterns of consumption (and saving) would be independent of the age-patterns of earnings, and thus independent of the age-patterns of work and retirement. In that context, the introduction of a public pension plan might have no impact on labour force participation: the contributions while the individuals were working would be reflected in the expected future receipt of benefits in retirement, so they might reduce private saving, but labour force participation would be unaffected. Similarly, the introduction of an (actuarially fair) early retirement provision under such a plan need not have any effect on contributors. In practice, however, the situation is quite complex and the provisions of plans are very likely to affect retirement planning. For one thing, the Canadian public old-age income

security system is multilayered¹⁵, and will affect people in different income positions differently, in part because there is no earnings test on CPP/QPP benefits but there is an income test on OAS/GIS benefits. As one example, even if the early retirement provisions of the CPP/QPP were actuarially fair, Baker and Benjamin (1997a) show that the reduction in benefits that goes with early retirement are partly offset by higher GIS benefits after 65, at least for low income people¹⁶. Beyond that, of course, capital markets are not perfect, and it is difficult to borrow against future pension benefits. Thus individuals with relatively high rates of time preference may opt to choose the reduced benefits that go with early retirement. The provisions of private plans, including especially the earliest age at which retirement benefits are available, may be an important consideration too.

In Canada, two “natural experiments” have resulted from the separate but parallel existence of the CPP and QPP: the provisions of the two plans have been virtually identical in other respects, but (1) the retirement test for receipt of benefits was removed from the CPP in 1975 and from the QPP in 1977, and (2) the receipt of reduced early retirement benefits before age 65 (in fact, as young as 60) became possible under the QPP in 1984 and under the CPP in 1987. Baker and Benjamin (1997a, 1998) exploited these two differences in an effort to assess whether key parameters of these plans could affect labour force attachment and, in particular, whether the parameters of the plans could “be set to compensate for the effects of demographic shifts, or to influence trends in

¹⁵ Burbidge (1996) provides a good account of the system.

¹⁶ They conclude also that the expected present value of benefits is higher at age 60 and declines thereafter, thereby indicating a slight subsidy to early retirement (based on average mortality rates). We note that continued reductions in mortality (this year’s 60-year-olds can expect to live slightly longer than last year’s) would cause the subsidy to increase year by year.

labour market participation” (1997b, p. 8). With regard to the removal of the retirement test, they found sizable changes in retirement behaviour: fewer “retired” completely by withdrawing from the labour force. That suggests that high taxes on earnings for those in receipt of benefits (for example, through the reintroduction of a retirement test) might discourage labour force participation. With regard to the provision of early benefits, they did find an acceleration in the relative growth of those in receipt of retirement benefits in Quebec after 1984 and in Canada after 1987; however, there were no corresponding changes in the labour force behaviour of 60-64-year-old males, whose participation rates continued to fall to a similar extent in both jurisdictions. They concluded that “secular trends in retirement behaviour were driven more by fundamental factors than early retirement provisions of the public pension scheme” (1997b, p. 15).

An important possibility is that those “fundamental factors” include the difficulties that older workers, once displaced, have in finding alternative employment. The problem may stem from a deficiency in aggregate demand, perhaps combined with an element of “ageism” (if employers would prefer to hire younger workers). In the Canadian context, Osberg (1993) emphasises that poor labour market opportunities appear to be associated with retirement, a condition that he describes as constrained labour supply behaviour. Referring to the US context, Perachi and Welch (1994) argue that increases in Social Security benefits alone do not account for the trend in male labour supply; one candidate they identify is increased wage dispersion, and the associated declines in labour market opportunities for less skilled workers. In a more recent review, Gruber and Wise (1997) summarize the major results from a series of parallel studies, especially commissioned for publication as a volume by the NBER, relating to the impact of social security programs in eleven

industrial countries, including Canada¹⁷. They conclude that the provisions of social security programs themselves typically contribute to labour force withdrawal, and cite as the major reasons generous retirement benefits at young ages, large financial penalties on earnings beyond the early retirement age, and the use of disability and unemployment programs which, in effect, provide early retirement benefits even before the official social security early retirement age. Borsch-Supan and Schnabel (1997), in one of the studies to be published in the volume, express concern about the German social security system and the inducement that it provides for workers to retire: “This tendency towards early retirement is particularly hurting in times of population aging when the German social security contribution rate exceeds the rates in other industrialized countries” (abstract). In another study in the same volume, Gruber (1997) calculates the implicit tax rate on work for those who continue working beyond the age of early retirement eligibility. He finds that the rate depends very much on individual circumstances: for median-income married men with no asset income there is a modest tax on work through age 64, and fairly high levels thereafter, but the taxes are substantially lower for those with asset income and for single workers, and higher for low income workers. How those differences in implicit tax rates have influenced retirement behaviour has not been investigated, as Gruber notes. In the Gruber and Wise (1997) comparison of all the country studies, Canada stands in the middle group, based on a measure of unused labour capacity of males aged 55 to 65, but the fraction of average income replaced by social security benefits at the early retirement age (60 in Canada) is by far the lowest among the countries considered. Furthermore, the three measures that they report relating to the early retirement incentives implicit in the tax-transfer system (accrual in the year after early retirement, the implicit

¹⁷ The other countries are Belgium, France, Germany, Italy, Japan, Netherlands, Spain, Sweden, the United Kingdom, and the United States.

tax on earnings, and the ‘tax force’ from the early retirement age to age 69) all appear to suggest that the Canadian social security system provides little incentive to take up early retirement, at least relative to most of the other countries considered.

It is sometimes suggested that some older workers might like to phase in retirement, for example by working fewer days per week, fewer hours per day, or fewer weeks per year (with a commensurate reduction in earnings)¹⁸. However, private pension plans encourage full rather than partial retirement, since retirement benefits are typically based on annual earnings averaged over the last three or five years of employment, and full retirement may be required for receipt of any retirement benefits. (Hurd, 1996, discusses various features of the labour market that discourage phased-in retirement.)

These matters are of obvious interest and practical importance, in that the failure of the economy to accommodate in one way or another those who are willing and able to continue working when they are in their late 50s, in their 60s, or older, both increases the number of dependents per person working and reduces the productive potential of the economy. With continued aging of the population the problem of supporting a larger fraction in old age will be greater than necessary unless the services that older workers could provide are used. The OECD (1998) has recently proposed the concept of “active aging” to counteract the trend “towards a concentration of leisure

¹⁸ Hurd (1996, p.11), for example, states that “older workers often want to reduce hours of work to make a gradual transition into retirement”, and an article in the *Globe and Mail*, August 20, 1998, p. B9, suggests (based on discussions with financial consultants and others) that many older workers would prefer to work part-time, and discusses some of the difficulties encountered.

in the last third of life and of work in the middle of life”, proposing instead “a more flexible mix of leisure and work (and learning and care-giving) over the course of life” (p. 83). The argument is that the choices available are often constrained in unnecessary ways that harm both individuals and society. Employers, for example, may fail to accommodate family needs (by providing time off to raise children or care for the elderly) or to encourage further education, and public policies may direct educational opportunities only at the young, or encourage early retirement. It is not evident, however, that removing unnecessary constraints would result in a net increase in the annual number of person-years worked, and hence lower the “dependency burden”.

Another issue relates to the level of aggregate saving. As discussed earlier, if saving in the economy is, in significant measure, determined by life cycle behaviour, we might expect the aggregate saving rate to be lower in the future, when a larger fraction of the population is old. That suggests that if more were saved now (and invested productively) the large baby boom generation could share with future and smaller generations the costs of supporting itself in old age; specifically, saving more now would add to the aggregate capital stock, and thereby increase the future productive capacity of the economy. Feldstein (1974), in a famous article, connected a pay-as-you-go national pension scheme with a low national saving rate: current contributors might save less because they expect to receive benefits when they retire, but their contributions are, in fact, not “saved” but simply transferred to those currently retired. Hence there is an “illusion” of saving. Carrying that argument a bit further, the payment of similar retirement benefits in the future, when the boom cohorts retire, would require a significant increase in contribution rates (if the pay-as-you-go system were maintained), diversion of other expenditures, or possibly public sector

dissaving if contribution rate increases were resisted¹⁹.

An additional problem stems from more than two decades of government deficit spending in Canada and many other industrial countries (OECD, 1998): deficit spending represents public dissaving. In combination with the Feldstein effect, then, both the public sector and the private sector were spending “too much” on current consumption and saving “too little” for the future, thereby reducing capital formation and shifting to later generations even more of the burden of supporting the baby boom generation in retirement.

It is a matter of contention whether saving is determined in significant measure by life cycle forces, as standard economic analysis assumes²⁰. That is true too of the important question of whether public transfer systems, such as CPP/QPP, really do reduce the amount that is saved (and invested) and, if they do, by how much. Beyond that, there are questions relating to the effects of other aspects of our retirement income security system, such as the impact of RRSPs on the saving rate.

¹⁹ In a more recent paper, Feldstein (1996, p.8) assesses the evidence as suggesting that “the Social Security program causes each generation to reduce its savings substantially and thereby to incur a substantial loss of real investment income”. He goes on to argue that “even if each extra dollar of Social Security wealth displaces only 50 cents of private wealth accumulation, the loss of national income would exceed 5 percent of GDP”.

²⁰ In its *1997 Annual Report*, the US Council of Economic Advisers concludes that the “evidence ... suggests that demographics may not be as important a determinant of saving patterns as the theory suggests”, and notes, among other things, the failure to document dissaving among the elderly, the low aggregate saving rate during the 1980s “even though the life-cycle model says that it should have risen because the increase in the proportion of the population in its prime saving years swamped the increase in the proportion that was old”. (Relevant sections of the *Annual Report* are reproduced in the “Documents” section of *Population and Development Review*, Vol 23, No. 2, June 1997.) In the Canadian context, there is evidence to suggest that in fact older people continue to save as they grow older, contrary to what the life-cycle model predicts; see Burbidge and Davies (1994) and Lin (1997).

Such questions are difficult to answer convincingly²¹. Nonetheless, there is strong support from many quarters for the early introduction or extension of measures designed to counter the anticipated future effects of population aging²². Such measures include increasing the rate of saving, both by eliminating deficits and reducing the national debt, and by diversifying the sources of retirement income to include less reliance on a public pay-as-you-go tax-transfer system through some combination of encouraging greater provision of private pensions and modifying public plans to put them more on a funded basis²³. Aaron, Bosworth, and Burtless (1989), for example, argue in favour of bringing the US social security and medical hospital insurance programs into actuarial balance, and using resulting surpluses to increase national saving. The Advisory Council on Social Security (1997; see also Gramlich, 1996) accepted the conclusion of the Trustees of the Social Security Funds that the fund disbursements would exceed revenues after 2020, and concluded that “even long-run problems require attention in the near term” (p. 1). However, it was unable to

²¹ Burbidge, Fretz, and Veall (1998) argue that RRSPs do not account for the difference in the aggregate saving rates between Canada and the US, as claimed by Jump and Wilson (1986), Carroll and Summers (1987), Venti and Wise (1995), and Poterba, Venti and Wise (1996), among others.

²² Schieber and Shover (1996) provide a short overview of approaches that several countries have adopted to reform their social security systems.

²³ Two of the principles that are proposed by the OECD (1998, p.19) to guide reform in order to “maintain prosperity in an aging society” (the title of the report) are (1) “fiscal consolidation should be pursued and public debt burdens should be reduced. This could involve phased reductions in public pension benefits and anticipatory hikes in contributions rates”, and (2) “retirement income should be provided by a mix of tax-and-transfer systems, funded systems, private savings, and earnings. The objective is risk diversification, a better balance of burden-sharing between generations, and to give individuals more flexibility over their retirement decision”. Johnson (1996), although relatively optimistic about the likely consequences of aging, argues that “we have to accept that more retired people who live for more years in retirement can only be supported by means of larger transfers from current consumption. These transfers can be through the tax system or by means of private saving, but they have to be made, and they should be occurring on a significantly larger scale...” (p. 269)

arrive at a single recommendation for modifying the US Social Security system, instead identifying three approaches for further consideration, all of which would “seek to achieve more advance funding of Social Security’s long-term obligations” and “would result in a higher level of national saving” (p. 4). The World Bank (1994) would go much further; in what Slater (1995, p. 49) calls its “most startling recommendation”, it would “replace second-tier public pay-as-you-go pension systems (such as the C/QPP) by mandatory retirement savings programs (like Registered Retirement Savings Plans)”. Chand and Jaeger (1996), in a study for the International Monetary Fund, argue that the costs for developed countries of shifting to fully funded systems may be substantially higher than the costs of fixing the pay-as-you-go system. That is consistent with Slater’s (1995, pp. 55-56) view that “the basic structure and scale of Canada’s retirement income system is appropriate” but he too would favour reduced benefits and more “pre-funding” with the fund available for investment purposes, thereby adding to national saving and earning a market rate of return²⁴. Such thinking appears to have been shared by the federal Department of Finance, as reflected in the recent reform of the CPP. Support for debt reduction in anticipation of population aging is provided also by Oreopoulos and Vaillancourt (1998); using a generational accounting approach, they find that “with no further changes to the current path of fiscal policy, the consolidated government budget is on a sustainable track, but *only* if decision makers use projected budget surpluses to pay down the debt” (p. 3)²⁵.

²⁴ Brown (1997) argues in favour of a later retirement age rather than pre-funding; however, as Diamond (1996) notes, increasing the age of pension eligibility amounts to a reduction in benefits.

²⁵ With that proviso, however, we note that Kotlikoff and Leibfritz (1998) argue that Canada, alone among the 17 countries studied using the generational accounting approach, is “essentially in generational balance”; they comment further that “the world’s leading industrial powers -- the US, Japan, and Germany -- all have severe imbalances in their generational policies”

A move towards pre-funding of future pension obligations could be through modifications of existing public plans (as suggested by Slater, 1995) or through partial or full privatization of plans (as suggested by the World Bank, 1994, and in two of the three approaches for reform identified by the US Advisory Council on Social Security, 1997). However, as Mitchell and Zeldes (1996) observe, under a reasonable set of assumptions such a move need not have any impact on national saving. Privatization would make the unfunded liability of public plans an explicit part of the national debt and the associated interest payments would represent “a transfer from young to old which exactly replaces the transfer under the old, unfunded Social Security system. Only if fiscal policy were changed to make the debt shrink over time relative to the old implicit liability would national saving increase (as in Martin Feldstein, 1995)” (p. 366). Alternative assumptions about how the system works could lead to a greater predicted impact on national saving, but they conclude that “[w]e regard the likely effects on national saving ... as modest” (p. 367).

Not all analysts agree that increasing the national saving rate should be a priority. Cutler, Poterba, Sheiner, and Summers (1990) develop a model to explore how the demographic shifts associated with population aging “affect the economy’s sustainable level of consumption, and how society should plan for these changes” (p. 16). They conclude that sustainable consumption *increases* in consequence of such aging, and that “an economy with otherwise optimal national saving would *reduce* (emphasis added) its saving in response to the upcoming demographic changes” (p. 16). Their analysis relates to a theoretical economy in which the consumption path is chosen “in accord with a standard optimal growth model” (p. 27), and they argue, based on their analysis with that

(pp. 19-20).

model, that “for all plausible combinations of parameter values, the effects of reduced labour force growth and reductions in the numbers of children exceed the effects of increases in long-run dependency” (p. 28). Thus, they conclude, that while there may be good reasons for wanting to increase the national saving rate, population aging is *not* one of them.

As discussed earlier, one further possible direction for countering the effects of population aging is by raising the rate of productivity growth. As noted by Cutler et al. (1990, p. 3) with reference to the US, the eventual “decline in living standards caused by the increased dependence would be fully reversed by a 0.15 percent a year increase in productivity growth”. An argument for anticipating such a response is that slower labour force growth means that labour would become relatively scarce, and that might induce more rapid improvements in technology. Using a sample of 29 non-OPEC countries with 1960 incomes per worker above 30 percent of the US level to test this hypothesis, Cutler et al. estimate a regression in which the dependent variable is the average annual rate of growth of labour productivity over the period 1960-85 and the independent variables include, in addition to the rate of growth of the labour force, initial output per labour force member, and the average investment rate. They “find some evidence that nations with slower labor force growth do experience more rapid productivity growth. The estimates suggest that the reduction in labor force growth projected for the next 40 years may raise productivity growth enough to offset fully the consequences of increased dependence. This finding, however, is uncertain. A more definitive finding is the absence of any empirical support for the pessimistic view that aging societies suffer reduced productivity growth” (pp. 3-4). Disney (1996) agrees; after an extensive review of the relevant literature, he concludes (p. 307) that “There is no evidence of

adverse effects of aging on aggregate productivity”²⁶.

In another study, Fougère and Mérette (1998) develop an endogenous growth overlapping-generations model calibrated to the Canadian situation, in which they integrate pension programs (including tax-sheltered private pension plans) as well as programs relating to health and education. They find, among other things, that population aging may create strong incentives for future generations to invest in human capital (that is, to obtain more education). That, in turn, they argue, would help to offset the potentially negative effects associated with reductions in the proportion of population of working age and the national saving rate, and might stimulate economic growth in the long run.

5. Population Aging and Government Expenditure

Having considered a wide range of effects of population aging and some of the suggested remedies for coping with them, we focus our attention now on the specific impact of the aging phenomenon on government expenditures. Social security programs (OAS, GIS, CPP/QPP in Canada) and health care have received the most attention in the context of population aging²⁷. A more general view would add education and family allowances/child tax benefits to the list, inasmuch as an

²⁶ Disney does observe, however, that older workers find difficulty in obtaining employment and suggests that the problem may arise, in part, from a wage structure (including the deferred pay component, pensions) whose incentive effects are reduced by aging. In particular, the trend toward private pension plans with defined contributions (and away from those with defined benefits) may provide a better incentive device for firms with smaller proportions of younger workers covered by their plans (Disney, 1996, Ch. 5).

²⁷ That is true in the US as well as Canada. See, for example, US Council of Economic Advisers (1996, 1997).

aging population implies a declining proportion of children and young adults. But social security, health care, education, and family allowances/child tax benefits account for well under 40 percent of the combined budgets of governments at all levels²⁸. Moreover, transfer expenditures such as OAS and CPP/QPP are taxable, so that a substantial portion is returned to the government treasury, and the net expenditures are thus significantly smaller than the gross or nominal ones. (The so-called “clawback” implies a tax rate of 100 percent for OAS benefits above a certain level, and increasing rates until that level is reached.) While other components of government expenditure are less obviously related to population aging they nevertheless are affected in one degree or another, and a proper assessment of effects on government budgets requires that all of them be considered. We have followed that path in a series of papers in the past two decades (Denton and Spencer, 1978, 1985, 1997; Denton, Feaver, and Spencer, 1986).

Our approach has been to consider each of a large number of expenditure categories individually and then aggregate the results. Each category is scrutinized to establish its likely sensitivity to changes in population size and age structure (health care expenditure is highly sensitive, national defence expenditure is quite insensitive). Choosing some base year, we make judgements about the proportion of expenditure in each category in that year that is population-sensitive and the proportion that is population-insensitive. We allocate the population-sensitive part to male and female age groups, using various indicator series where those are available (labour force by age, school-age population, etc.), and judgement where they are not. We then ask the following question: Given a projection of the population, what level of expenditure (in real terms, i.e., at

²⁸ Social security and publicly funded health care by themselves account for about a quarter of total (consolidated) government expenditure in Canada.

constant prices) would be required in each future year to maintain per capita expenditure in every age-sex group at its base-year level in every category, and by aggregation for all categories combined? We refer to the projected levels of expenditure as “constant quality” levels; they represent the pure effects of population change. In practice, there may be many other factors operating to bring about changes in expenditure in different categories but our calculations abstract from those in order to focus strictly on demographic influences. (The foregoing is a nontechnical summary description; for a complete technical description, see Denton and Spencer, 1978 or 1985. For a purely theoretical model in which the specific age-dependence of different types of government expenditure is recognized, see Echevarria, 1995.)

The calculations just described have been carried out for consolidated expenditures by all levels of government combined and (in Denton and Spencer, 1985) for combined provincial/local government expenditures. Separate projections have been made for expenditures on goods and services (on health care, for example) and for expenditures representing transfers to persons (OAS payments, for example). But projections of population-induced changes in government expenditure tell only half the story. As we have emphasized previously, changes in the size and age structure of the population have effects not only on costs (consumption requirements, government expenditure requirements) but also on the productive capacity of the economy -- the ability of the economy to meet the costs. We have therefore coupled our expenditure projections with projections of national output (gross national product or gross domestic product). That allows us to compare the rates of growth of expenditure with the rates of growth of GNP or GDP. The future burden of population-induced increases in expenditure can be assessed realistically only by making such comparisons.

Denton and Spencer (1997) provide historical estimates of “constant quality” expenditures, expressed in index form with base value 100 in 1986, and projections of the indexes to the year 2031. The projections show social security expenditure (in real terms) increasing three-fold between 1986 and 2031, and publicly funded health care expenditures doubling. Those increases compare with a 50 percent increase in the total population, thus making clear some of the strong effects of the change in age structure. Education expenditures, on the other hand, increase by only 10 percent, a result almost entirely of changes in the age composition of the under-20 population since the total size of that group is projected to change hardly at all. Most of the other categories of expenditure are associated more or less with the population as a whole (e.g., national defence, general government services) or with the population 20-64 (e.g., correction and rehabilitation services, unemployment insurance, workers’ compensation). The net result for all categories combined (both goods and services and transfer payments to persons) is a rate of growth of total expenditure that is just about the same as the overall rate of growth of the population.

Projections of expenditures as percentage ratios to GDP are provided along with the projections of expenditure themselves in Denton and Spencer (1997); see also Denton and Spencer (1995). The projected ratios show the expected increases for health care and social security -- from 6.2 percent of GDP in 1991 to 8.9 percent in 2031 for the former, from 4.6 percent to 8.0 percent for the latter -- and the expected decrease for education, from 5.8 to 5.1 percent. Those three categories taken together rise from 16.6 percent of GDP to 22.0 percent over the forty-year period. However, total expenditure for all budgetary categories combined is projected to represent a smaller percentage of GDP in 2031 than in 1991; their collective share of GDP is projected to fall rather than rise over the forty-year period. (The calculations are on a gross basis: no allowance

is made for taxes on transfer payments, which would make the net expenditure percentages smaller than the gross ones.)²⁹

Summing up, the evidence contained in the publications cited in this section indicates that the government expenditures necessary to maintain social security and health care at current per capita levels will rise in the coming decades (albeit slowly) as a consequence of population aging, as is widely anticipated, and that their rates of increase will exceed both the rate of growth of the population and the rate of growth of GDP³⁰. But the evidence indicates also that those increases will be offset elsewhere in the budgetary framework, especially in education, but in other categories as well, and that the overall increase for all budgetary items combined will be at about the rate of growth of the population, and below the rate of growth of GDP. It seems clear that the main problem of public policy will be not how to deal with increased requirements for overall budgetary expenditure in relation to the nation's GDP, but rather how to effect shifts within budgets to accommodate rising demands of some kinds coupled with falling demands of others. We do not wish to minimize the difficulties in making such adjustments, especially within a federal

²⁹ We note the study and experimental projections of health care costs by Marzouk (1991). Marzouk's projections demonstrate that changes in per capita utilization are far more important than shifts in age proportions in determining future aggregate health care expenditures as percentages of GDP. It is always to be kept in mind that projections of the *demographic* effects of population aging on health care expenditures (or other expenditures) are not predictions of what actual expenditures will turn out to be; there are obviously other influences at work. In a cross-section study of a range of developed countries, Getzen (1992) found virtually no correlation between the percentage of GNP spent on health care and the percentage of the population 65 and over, or between changes in the two percentages.

³⁰ Fougère and Mérette (1998), based on simulation analysis of their overlapping-generations endogenous growth model, note the upward pressure that population aging will place on government expenditures on health care services and public pension plans, but emphasise that government revenues from private tax-sheltered pension plans will compensate for that increase.

framework in which different levels of government have jurisdiction for different categories of expenditure³¹. But the problem to focus on is how to make the adjustments, not how to deal with “huge” overall population-induced expenditure requirements³². As Murphy and Wolfson (1991, p.25) observed, “Contrary to many popularly expressed concerns, demographic aging is not the most important factor in determining future public-sector costs and revenues. Rather, aspects of the design and management of public-sector programmes represent the greatest area of uncertainty. These areas are more amenable to public policy initiatives and gradual adjustments within the half century time-frame of the projections”.

It is perhaps worth noting that concerns about population aging and its effects on government budgets are widespread internationally; Canada is certainly not alone in that regard. See, for example, the United Nations publication edited by Stolnitz (1992) and recent OECD publications by Roseveare et al. (1996) and Turner et al. (1998). The populations of many countries are subject to the general aging phenomenon. However, specific demographic circumstances and outlook vary considerably, and so do institutions (health care, social security, constitutional

³¹ As the National Advisory Council on Aging (1991) put it, “The challenge of population aging is not easy for countries with a unitary system, let alone for a federation. Canadian governments at all three levels thus must display lucidity, flexibility, and collaboration if this challenge is to be met” (p. 17). David Foot (1984) made a similar point in an article that focussed on the 1980s but has relevance for today, and far into the future. He suggested that in the longer term his calculations “might be interpreted to indicate the pressure for fiscal centralization”, because of the division of constitutional responsibilities and the differential effects of population aging on government programs for the old and the young (p. 412).

³² The political aspects of population aging lie outside the scope of this paper, but may in fact be important. The voting power of a large future elderly population may well have an important bearing on the allocation of government expenditures. In a study of US states in the period 1960-90, Poterba (1997) found evidence of the effects of “generational competition”, with increases in the proportion of elderly people in the population tending to be associated with reductions in spending per child on education.

frameworks). Policies designed to deal with the government-expenditure effects of population aging need therefore to be tailored to the individual situations of particular countries.

It is worth noting too, and stressing, that the expenditure effects of population aging are *slow* and that the prospective effects discussed in this section will occur only over a period of several decades. Popular discussions of health care and social security “crises” in Canada, and other countries, often seem to suggest that population aging is the cause of today’s difficulties. That is not so. The proportion of older people will certainly rise, but gradually, and to place the blame on it for perceived current problems is misleading³³.

6. Further Observations on the Expenditure Effects of Population Aging

Attention in the literature has often been focussed largely on government social security and health expenditures in discussions of the effects of population aging, or on social security, health, and education expenditures, when a broader view is taken. But as we have noted, those categories, plus family allowances/child tax benefits, account for well under 40 percent of all government

³³ As Disney (1996, p. 307) states, “There are serious crises in pay-as-you-go social insurance programs and in health care [in many developed countries], but these have little to do with aging”. Also, as Lee and Skinner (1998) note in speaking of the situation with Medicare in the US, “In the shorter term, the Medicare crisis is not because of increasing numbers of old people. The crisis is because of increasing real per capita health care expenditures. Specific diseases are being treated more intensively and with ever greater levels of technology ... The increased cost of treating heart attacks has come from the increased use of surgical intervention, either through angioplasty ... or through bypass surgery. The cost per surgical procedure has actually declined. Nevertheless, surgery is now deemed appropriate for an ever-larger percentage of patients with heart attacks and ischemia.”

expenditure in Canada at the present time, based on consolidated accounts for all levels of government combined. Most of the remaining categories have little or no connection with the young or the old. They include national defence, police and fire protection, general administration, employment insurance, transportation and communications, resource management and environmental protection, and various other categories of expenditure at the national, provincial/territorial, and municipal levels. Social security, health, and education are important, but by no means the whole story. Focussing on them to the exclusion of other categories can therefore be misleading.

Government expenditures are also not the whole story. Studies that assign weights to different age groups based solely, or largely, on government funds directed to those groups run the risk also of being misleading if the results are represented as the overall effects of population aging. Social security payments to the elderly are *transfer* payments designed to put purchasing power in the hands of the recipients so that they may buy food, clothing, shelter, and all the other necessities or enjoyments of life. But funds devoted to public education represent purchases of just that, education, and weights based on them ignore all the other costs associated with the raising of children. Unless care is taken in interpreting results that are based only on government expenditure weights there is a risk that the results will be misunderstood. A broader view, one that takes into account both public and private expenditures, is required if the overall economic effects of population aging are to be assessed properly. We think that a failure to recognize that has led to some confusion and contributed in some degree to unwarranted fears about the future effects of population aging on the economy and the society.

We argue, then, (1) that focussing on social security, health, and education only (or largely) is too restrictive for a proper assessment of the effects of population aging on government expenditure, and (2) that focussing only on government expenditure is too restrictive for a proper assessment of its overall effects.

An interesting paper by Jacques Henripin (1994) deserves special mention in the present context. Henripin's paper is a carefully crafted study of the "financial consequences" of population aging. It focusses on pension benefits, health costs, and education costs, in particular, and concludes that "One can expect large increases in public health costs and pension benefits that taxpayers will bear, and that will be only partially compensated by a reduction in education cost" (p. 78). It further argues that Fellegi (1988) and Denton, Feaver, and Spencer (1989) have got it wrong in their assumptions about the ameliorating effects of productivity increases in the health sector. We have already given our views on the narrowness of a health-pension-education focus so let us turn to the issue of productivity.

Productivity is notoriously difficult to measure, and especially so for the service sector of the economy in general, and for health care in particular. Henripin does not like our assumption that productivity will increase at the same rate in the health care sector as in the economy as a whole over the next several decades. We have, in fact, made various alternative assumptions about productivity growth (Denton and Spencer, 1985, for example) and found that even a modest rate would produce GNP or GDP growth that outweighed considerably the effects of population-induced growth on health care costs. No one can know what in fact will happen to productivity in the health care sector (or any other sector) but we think that assuming the same rate of growth

as in the economy at large is about as reasonable an assumption as one can make. Henripin thinks otherwise, and we respect his opinion. A point to note, perhaps, is that productivity gains can occur in the patient population as well as in the provision of treatment and diagnostic services. It can well be argued that considerable health care productivity growth will occur because of a rising level of general education and an increased awareness of health risks and how to avoid them. Increase public awareness of smoking risks is an important case in point.

Henripin's (1994) paper paints a rather gloomy picture: "I think that population aging will probably be more unpleasant than is generally believed" (p. 92).³⁴ We do not wish to understate the difficulties that will have to be faced and the adjustments that will have to be made as the average age of the population rises in the decades ahead, but our view is more optimistic. As we have said, major adjustments will be required but the future overall burden of population aging does not, we believe, represent an unmanageable problem.

Another paper deserving of special attention is Lee and Skinner (1998). It is concerned specifically with the impact of population aging on the US Social Security and Medicare trust funds. Among other things, it makes use of stochastic forecasts of mortality and fertility rates as well as productivity growth and real interest rates; that permits the authors to assign measures of confidence to the outcomes of simulated policy interventions, and to stress the inevitable

³⁴ A rather pessimistic view of the ability to deal with the effects of population aging on "social expenditures" is found also in Gauthier (1991). Gauthier reviews and expresses doubt about the possibility that the effects can be offset sufficiently by policies relating to economic growth, increased labour force participation, economies of scale, or restructuring of social expenditure. He argues that "we should not take for granted that the effect of aging will be easily absorbed" (p. 103).

uncertainty associated with long-term projections. As they observe, “Any reform, whether an increase in payroll taxes today, or a switch to private or government equity investments, cannot shield the Social Security and Medicare trust funds entirely from going dry”. By way of illustration, they go on to note that “Indeed, even a 4 percentage point increase in the payroll tax leaves a 22 percent chance of the Social Security system going bankrupt by 2070. The same point holds even more forcefully for the Medicare trust funds”.

As Lee and Skinner (1998) argue, the inevitable uncertainty in long-term projections suggests that policy should remain flexible, and able to respond to changing circumstances. In the Canadian setting, for example, one intention of the recently legislated increases in contribution rates is to create a larger CPP fund than has existed in recent years. Inevitably the fund will not accumulate exactly as anticipated. Less rapid accumulation could occur because the outflows were greater than projected (perhaps because beneficiaries live longer than expected), or because inflows were less than projected, and the appropriate policy response might differ in the two cases.

7. Summary of Key Findings

- As the baby boom moves from middle age into old age, the population will grow older, on average: the median age will rise from 35 in 1996 to 44 in 2031, at which time all those born during the baby boom will have passed their 65th birthdays. It is projected that by 2031 a quarter of the population will be 65 or over, and that there will be one person in that age range for every two in the labour force; such ratios are unprecedented, not just in Canada but internationally.
- The prospective aging of the population has given rise to concerns about our ability as a society

to meet the resulting increases in health care, pension, and other costs associated with the elderly.

- It is important to recognize that population aging takes place *slowly*. The ratio of the total population to the population of working age is *low* today, by historical standards, and it will not change much for another fifteen or twenty years. Once the baby boom generation starts to retire in large numbers, the ratio will rise, but it will never go as high as in the 1960s when that generation was in its youth. The ratio of the elderly population to the working age population will likely be the same in Canada as in the United States in the coming decades, and well below the levels reached in the European Community, and more especially Japan.
- The slower growth of the labour force that will accompany future population aging will have a direct and negative effect on the productive capacity of the economy: other things equal, the growth of productive capacity will be slower because of slower labour force growth. Some observers anticipate other negative effects too, resulting from reductions in the aggregate saving rate, and hence in the growth of the stock of physical capital, or from slower productivity growth associated with aging of the work force. Such effects are much more uncertain, though, than the apparently inevitable effects of slower labour force growth.
- What could be done to avoid population aging and its effects?
 - It is clear that immigration would not do the job, even at very high annual rates. Immigration will almost certainly be the most important source of labour force growth in Canada over the next few decades, and higher levels of immigration would certainly increase the size of the population and the labour force. But immigrants age like everyone else, and in the longer run immigration would have only a minor influence on the age distribution.
 - What about fertility? Fertility rates are obviously less amenable than immigration to policy

control, but assuming they could be influenced in an upward direction, would that solve “the problem”? Again, the answer is *no*. Much higher rates than those experienced for the last quarter century (for example, a total fertility rate of 3 births per woman, up from the current 1.6) would certainly affect the age distribution, but the proportion of older people in the population would still rise substantially, and combined with it would be a larger proportion of child dependents.

- The rates of labour force participation have been trending down for older men for several decades, both in Canada and internationally. Observers generally agree that this trend is largely the result of individuals choosing to retire at earlier ages when they have the financial freedom to do so, and in that regard some of the provisions of pension plans may encourage earlier retirement. This is an important matter, and has received considerable research attention internationally. To the extent that the provisions of old age income security plans induce individuals to retire earlier than they would otherwise choose, there will be more pensioners (hence higher costs) and fewer workers (hence reduced national income or product from which to meet those costs). The evidence in this regard as it relates to Canada is not conclusive, however, and further study is warranted.
- What about the aggregate saving rate? The jury is still out as to whether population aging will in fact lower the rate of saving in the Canadian economy. Some have argued that the very nature of public pension systems reduces the national saving rate below what it would otherwise be, but the evidence is mixed, and there appears to be no consensus.
- Finally, what about productivity? Continued growth in productivity is conspicuously important, and it is recognized that a sustained increase in the rate, even a modest one, could outweigh any negative effects associated with aging. On balance, the relevant literature seems to suggest

that there is no reason to anticipate a reduction in productivity growth in consequence of population aging. Furthermore, there is the possibility that slower labour force growth will itself provide an incentive to achieve faster productivity growth, since labour will be more scarce.

- Expressions of apprehension about the effects of population aging typically relate to the *demand* side of the economy, and in particular to public expenditures on health care and old age security systems. Usually ignored is the fact that those same demographic forces will tend to *reduce* expenditures in some areas (such as education, employment insurance, correctional services), and also that CPP/QPP and OAS transfer payments are taxable, and hence that the net cost of them may be significantly less than it appears to be if only the benefit payments are considered. In total, CPP/QPP, OAS, GIS, and health care expenditures account today for about a quarter of total (consolidated) government expenditures in Canada for all levels of government combined. Also largely ignored in the public debate is the impact of population change on the *supply* side or productive capacity of the economy, and hence on the ability of the economy to generate tax revenue to support higher expenditure levels.
- Our projections indicate that when a comprehensive view is taken of the impact of population aging on government expenditures, the *demographically induced* rate of growth of total expenditure is likely to be about the same as the overall rate of growth of the population. Furthermore, when projected expenditures are compared to the projected productive capacity of the economy, it seems likely that the total expenditure for all budgetary categories combined will be a *smaller* percentage of GDP in 2031 than in 1991, even though there will be large increases in expenditures on health care and social security. (Our projections relate to the effects of

population change only; there may well be nondemographic influences that will raise or lower future expenditures, but that is another matter.)

8. Policy, Programming, Practical Implications

It is clear that significant aging of the population will occur in Canada over the next few decades as those born during the baby boom enter their retirement years in the second and third decades of the twenty-first century, and are replaced in the work force by the much smaller cohorts born after them. What are the policy, programming, or practical implications that follow from that observation? What actions should governments take, now or in the future, to accommodate such aging or to offset its negative consequences?

We emphasise again that population aging will take place only gradually, over a period of some decades. Barring an unlikely return to much higher levels of fertility than we have witnessed in the last quarter century, and subject to the policy-controlled level of immigration, the changes in the population that will take place over the medium- to longer-term can be predicted now with some accuracy. There can thus be available an important and more or less reliable base of information which can (and should) be kept up-to-date, and used to support public policy debate and decision.

Population aging means progressively slower growth, not only of the population itself but also of the labour force. Such growth as occurs is likely to become increasingly dependent on immigration. In the five-year period 1991-96, for example, immigration accounted for almost half of the growth in the population and more than 70 percent of the growth in the labour force. The

realization that immigration will be the most important determinant of population and labour force growth in the coming decades suggests to us the need for a carefully thought out immigration policy that takes a long-term view and pays attention to both social and economic considerations.

As a general principal, the planning of government expenditure programs involving the creation and use of specialized physical and/or human capital should be well informed as to prospective demographic changes. Schools, hospitals, and other structures built at public expense will last for decades; teachers, nurses, doctors, and others trained today may be in the labour force for 35 or 40 years. Funding policies and programs will be more solidly based if medium- to longer-term projections of population change and its effects on the economy and government budgets are available routinely, and are taken into account. We note the observation in the 1998 Report of the Auditor General of Canada to the House of Commons that “parliamentarians are left to make annual financial decisions, many of which have lasting consequences, without a macro perspective -- a summing up of the financial impacts that demographic change can potentially have on the government’s long-term financial health” (Auditor General, 1998, p. 6-5). The Economic Council of Canada at one time provided medium- to longer-term economic projections and analysis, but was terminated in the 1980s. We think there is a need today for an agency with somewhat similar terms of reference that will have as its focus the more distant economic future, and in particular the anticipation of the effects of population aging. Basic demographic projections are available at the national and provincial levels from Statistics Canada and other sources, but regular careful study of their economic and government budgetary implications seems to be lacking. At the local level, where decisions about hospitals, schools, housing policies, etc., have immediate impact, there appears to be very little in the way of an organized demographic projection base on which

to make informed judgements.

Population aging will have different impacts on different categories of public expenditure, and hence different impacts on federal, provincial, and municipal budgets; arrangements for appropriate revenue sharing therefore need to be worked out. Moreover, the effects of aging will be uneven across the country: the effects will be more pronounced in some regions than in others. Given the reality (and sometimes misunderstanding) of population aging, we emphasise the importance of planning on the part of governments at all levels to anticipate the program needs of their populations, and to avoid the wastage that comes from having in place surpluses or shortfalls of resources.

The implications of population aging for future government programs and expenditure requirements are especially important. Unfortunately, Statistics Canada's government statistics are in a state of transition at the present time, and it is difficult to get a clear picture of the public accounts on a consistent consolidated basis. We encourage Statistics Canada to deal with this problem as quickly as it can. With so much understandable current concern about the effects of population aging on government budgets we would hope that this area of statistics could be accorded high priority.

An important area for further study is the decline in the labour force participation of older men and the shift toward earlier retirement. The reasons for these trends are still not sufficiently clear, although the trends have been in evidence for a long time. The movement of older men out of the work force and into the "dependent" population is obviously a matter of some importance for

assessment of the effects of population aging: it both increases the number of elderly dependents and reduces the capacity of the economy to support them. We would like to see a well funded program of research to investigate the relevant issues, and in particular the role played by institutional rigidities in public and private pension plans. The tendency for men to retire earlier, in spite of increased life expectancy, seems to us to be a matter of considerable importance for pension policy and policies relating to the elderly generally.

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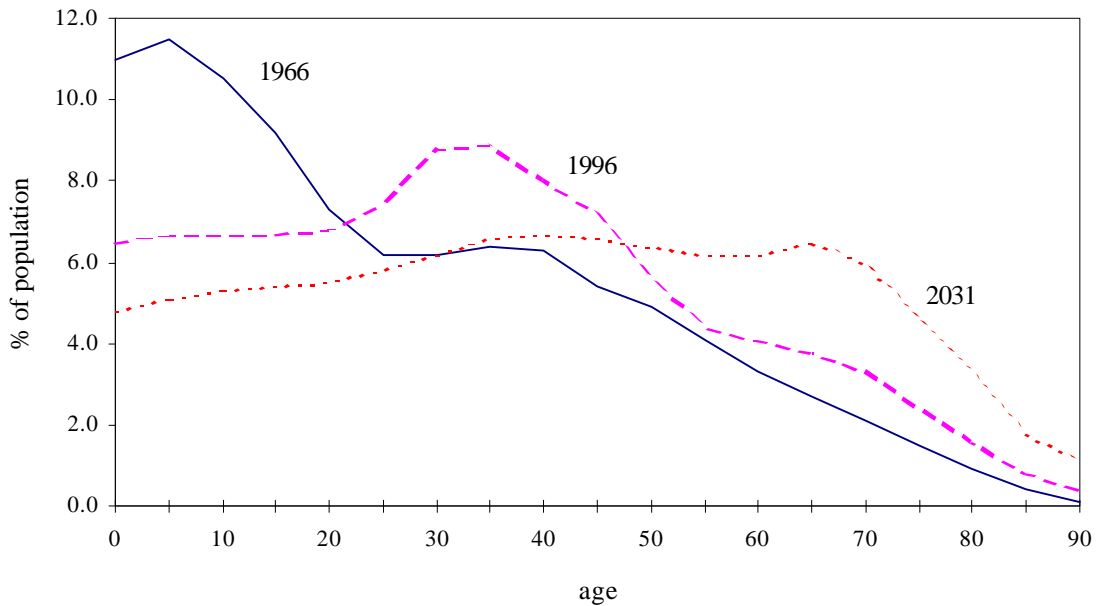
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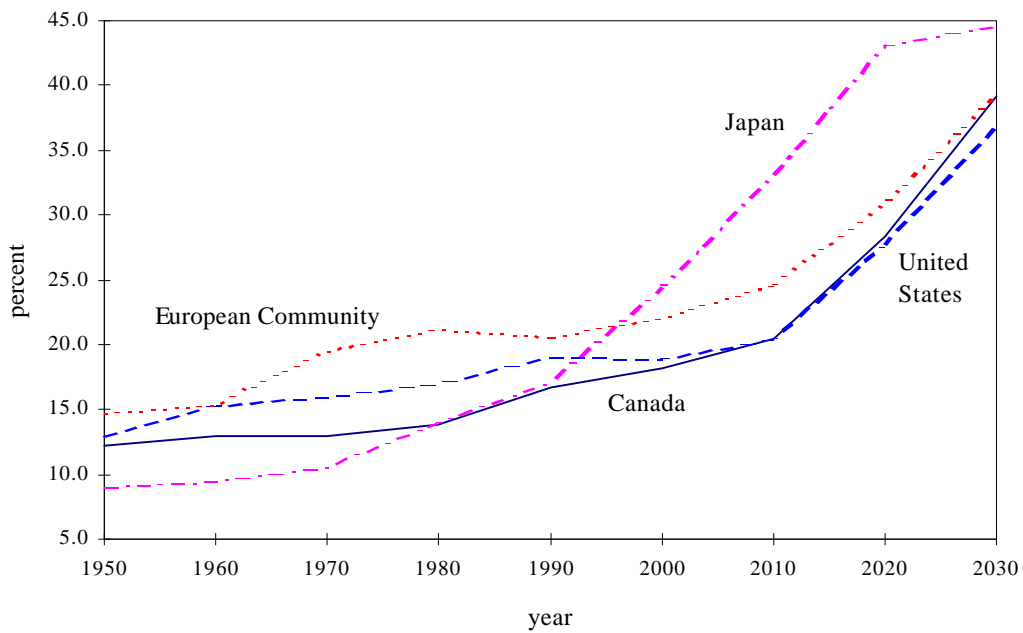
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Figure 1: Age Distribution of the Population, Selected Years



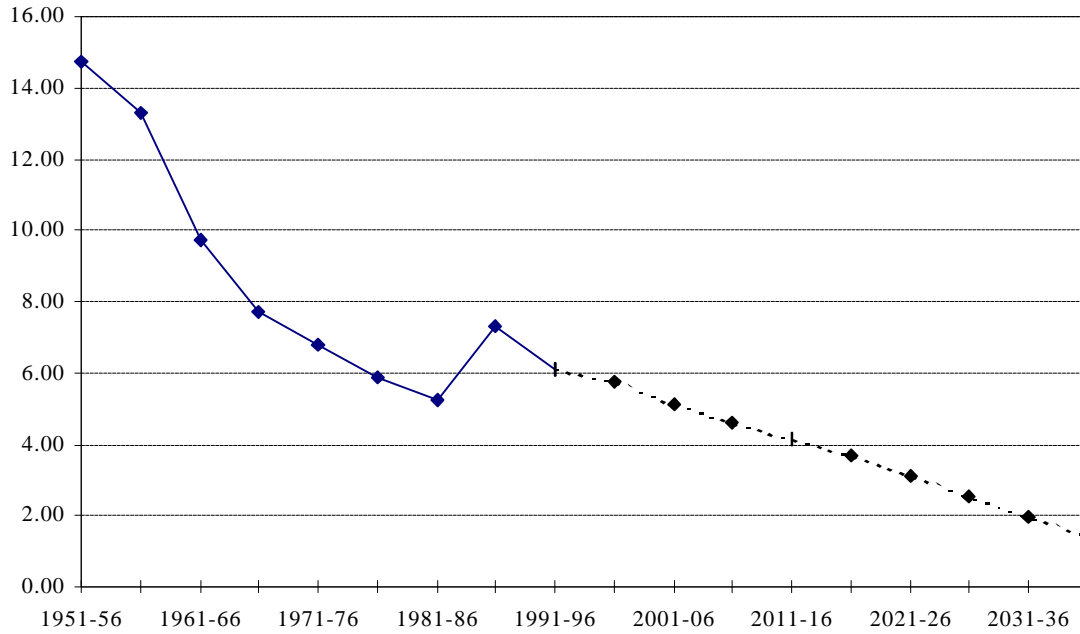
Note: The percentages refer to five-year age groups 0-4 through 85-89 and 90 and over.
Source: Population numbers for 1966 and 1996 from Statistics Canada and those for 2031 from Denton, Feaver, and Spencer (1998).

Figure 2: Actual and Projected Elderly Dependency Ratios, Selected Areas, 1950-2030



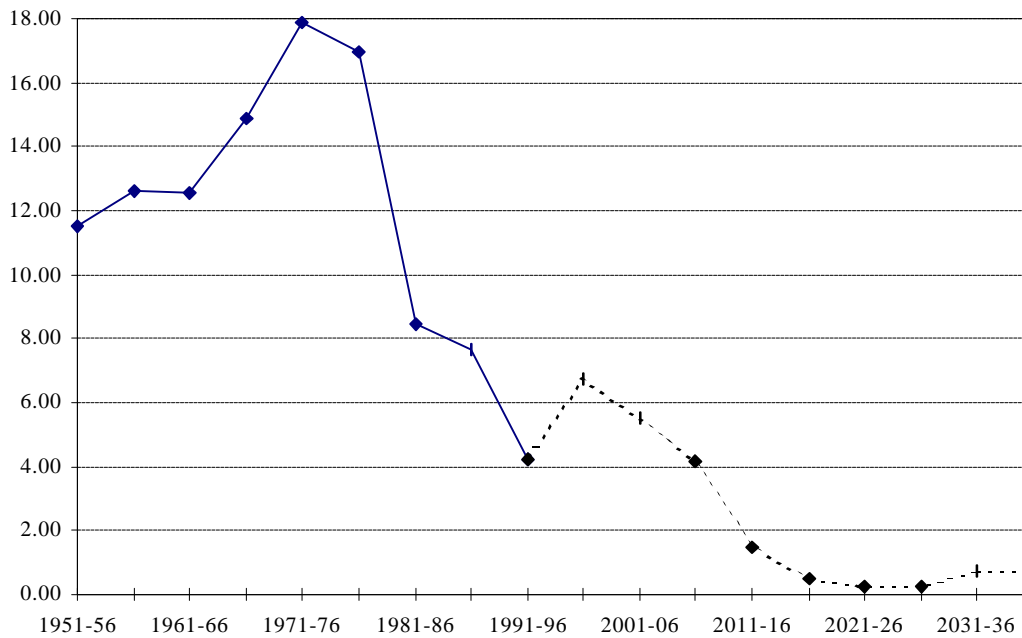
Source: OECD (1996, Table A3). The “elderly dependency ratio” is defined here as the ratio of the population 65 and over to the population 15-64.

Figure 3: Five-year Percentage Growth Rates: Population, 1951-56 to 2036-41



Note: Projected growth rates, represented by the broken line, are based on 'medium' assumptions.

Figure 4: Five-year Percentage Growth Rates: Labour Force, 1951-56 to 2036-41



Note: Projected growth rates, represented by the broken line, are based on 'medium' assumptions.

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