Is Ageing a Drag on Productivity Growth? A Review Article on *Ageing, Health and Productivity: The Economics of Increased Life Expectancy*

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ABSTRACT

This review article discusses the volume *Ageing, Health and Productivity: The Economics of Increased Life Expectancy,* which provides a detailed examination of the relationship between ageing and productivity. While the authors find some evidence of a negative effect of ageing on productivity, they conclude that at the aggregate level the effect is small. The review argues that this finding provides support for efforts to boost the employment rate of older persons, especially those aged 55-69, both to benefit these persons themselves and to increase tax revenues to cover the rising health and pension costs of the growing senior population.

RÉSUMÉ

Ce compte rendu critique porte sur l'ouvrage *Ageing, Health and Productivity: The Economics The Economics of Increased Life Expectancy,* qui examine en détail les relations entre vieillissement de la population et productivité. Les auteurs relèvent des éléments qui attestent de l'effet négatif du vieillissement sur la productivité, mais concluent en rappelant que ces effets restent globalement limités. Il ressort que leurs constatations appuient les efforts en faveur de l'emploi des personnes âgées surtout ceux entre 55 et 69. Ces derniers relèvent de l'intérêt des travailleurs même et gonflent les recettes fiscales qui peuvent alors être utilisées pour couvrir les coûts de la santé et des pensions pour une population grandissante de personnes âgées.

TWO STYLIZED FACTS DOMINATE the economic landscape. First, productivity growth in Canada has slowed down since 2000 and is well below that in the United States. Second, the population is ageing, both in the sense that the average age of the workforce is rising and that an increasing share of the population is 55 and over. Many observers see these trends as a threat to the future standard of living of Canadians. They also see the trends re-enforcing one another, as it is believed that older workers are less productive than younger workers so

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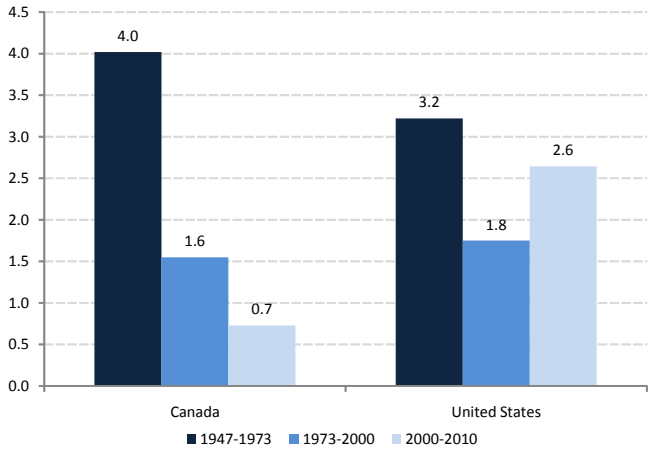
their growing share of the workforce will be a drag on productivity growth. In the past, more heat than light has been shed on this issue. What has been missing in the literature is a rigorous empirically-based analysis of the ageing-productivity nexus. The volume under review fills this hole or gap.

The book *Ageing, Health, and Productivity: The Economics of Increased life Expectancy*, published in 2010 by Oxford University Press and edited by Pietro Garibaldi from the University of Torino, Joaquim Oliveira Martins from the OECD, and Jan van Ours from Tilburg University, contains two reports prepared by two teams of researchers for the Italian Rodolfo DeBenedetti Foundation. The first report on health expenditures, longevity and growth, examines such issues as the relative importance of ageing and technological progress for the growth in health expenditures, whether health is a luxury good, and the impact of health on productivity and growth. The second report on age and productivity discusses the topics of age and absenteeism, age and working capacity and presents an empirical analysis of the relationship between age and productivity. It is this second report that is the focus of this review article.[2]

The objective of this review article is to address the evidence of the effect of ageing on productivity and to set this issue in the wider context of weak productivity growth and the ageing and increased life expectancy of the population. This review article contains three parts. The first section sets the context for the discussion by presenting basic information or data on productivity, aging and longevity trends in Canada. The second section provides a synthesis of the volume's key findings, which are largely based on European experience. The third and final section discusses the implications of the findings for Canada.

Chart 1
Real Output per Hour, Business Sector, Canada and the United States, 1947-2010
(compound annual growth rates, per cent)



Source: CSLS, Aggregate Income and Productivity Trends: Canada vs United States, Table 7a. Available: http://www.csls.ca/data/ipt1.asp

The Context

An understanding of the basic statistical reality should be the starting point of any analysis. This section presents a brief overview of trends in productivity, and aging in Canada.

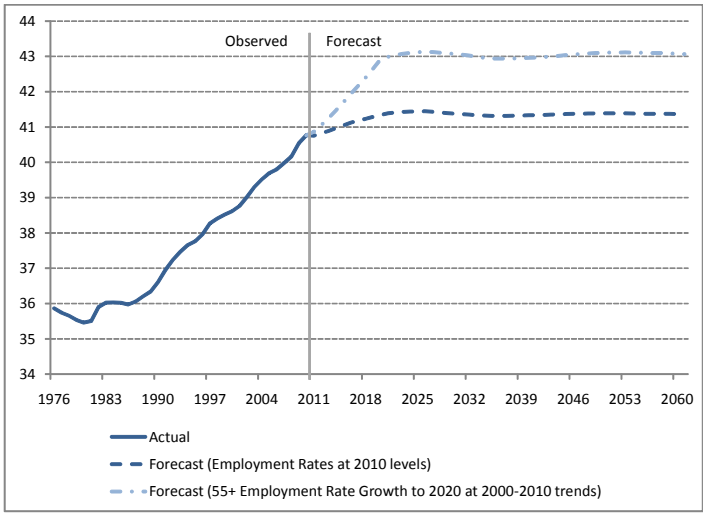
The most relevant measure of the aggregate labour productivity performance of the Canadian economy is trends in business sector output per hour.[3] According to official estimates released by Statistics Canada, output per hour in the Canadian business sector grew at the meagre average annual rate of 0.7 per cent from 2000 to 2010, less than one half the rate of advance of 1.6 per cent experienced in the 1973-2000 period (Chart 1).[4] Even more disconcerting, labour

2 The authors of this report are Pekka Ilmakunnas, Jan van Ours, Vegard Skirbekk, and Matthias Weiss.

3 The business sector is preferred to the total economy as productivity growth is difficult to measure in the non-business sector industries (public administration, education, health) and assumed to be zero.

4 Data for all charts are found in a statistical Appendix to this article posted at http://www.csls.ca/ipm/21/IPM-21-Sharpe-Appendix.xlsx.

Chart 2
Average Age of Employed Canadians, 1976-2061



Source: Statistics Canada CANSIM Tables 282-0002 (LFS Statistics by Detailed Age-Group), 051-0001 (Population Estimates), and 052-0005 (Projected Population)

Notes: 1. Employment rates are top-coded for the 70+ age-group and thus their employment rate was used for higher age groups. 2. In order to calculate the average age of employed Canadians we take age-specific total employment for 5 year age groups and multiply them by the mid-point age of each age-group and divide by the share of total employed. For the 70 and over age-group we assume the mid-point is 73 years. 3. In order to make projections after 2010 we use the Statistics Canada medium growth scenario population projections and multiply them by age-specific employment rates. Average age is then calculated by taking these age-specific employment projections and multiplying them by the mid-point of each age-group divided by the share of total employment as before. 5. For the base-case forecast, employment rates in 2010 are assumed to be constant after 2010. 6. For the forecast with employment rate growth to 2020, we assume that the compound annual rate of growth for employment rates from 2000 to 2010 continue until 2020 for age-specific groups starting at 55 years and above while other age-groups are held at 2010 levels. 7. In order to account for the definitional difference between the LFS-based population estimates and census-based estimates, we assume that the 2010 ratio between them remains constant after 2010 (97.7 per cent).

productivity growth picked up in the United States since 2000 and grew at a 2.6 per cent average annual rate, more than triple that of Canada. This growth differential has resulted in Canada's relative level of output per hour falling from 84 per cent of the U.S. level in 2000 to 70 per cent in 2010. Canada definitely has a productivity problem.

The very large baby boom cohorts born between 1947 and 1966 have driven, and will continue to drive, the age composition of the Canadian population throughout their life course. When the baby boom generation entered the labour market in the 1960s, 1970s, and 1980s the average age of the employed persons or the workforce fell to a low of 35.4 years in 1980 (Chart 2). Given the much smaller size of the post-baby boom cohorts and the aging of the baby boomers, the average age of the workforce has progressively grown since 1980 and by 2010 had reached 40.7 years. Given that the leading edge of the baby boom reaches 65 in 2012 and baby boomers have started to retire in large numbers, futher increases in average workforce age are likely to be small. Based on Statistics Canada medium growth population projections, and assuming the five-year age brackets participation rates remain at 2010 levels, the continued ageing of the population results in the average age of employed persons rising to 41.5 years in 2027 and then stabilizing. In this scenario over 80 per cent (5.3 points of the 6.1 point rise) of the aging of the workforce had taken place by 2010.

Of course, if employment rates for older age groups were to increase significantly, there would be a larger future rise in the average age.[5] For example, if the employment rates for the 55-59, 60-64, 65-69, and 70 and over age groups continued to increase in the 2010-2020 period at the same rates as they did between 2000 and 2010, a very aggressive assumption, the average age of the workforce would peak at 43.1 years in 2025, 1.6 years above the no-growth scenario for the age-specific employment rates (Chart 2). But even in this scenario, two thirds of the increase in the average age of the workforce (5.3

5 Such a development seems increasingly likely. A recent study by Sun Life Financial Inc. reported in the *Globe and Mail* (Grant, 2011) found that the age at which the average Canadian now expects to retire is 68, up from 65 in 2010.

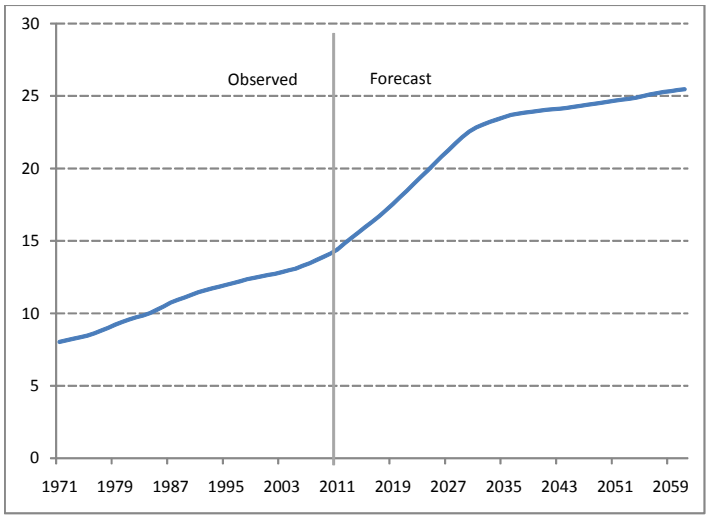
of 7.6 points) would still have taken place by 2010.[6]

In addition to its effect on the average age of the workforce, the aging of the baby boom cohorts starting in 2012 will increase sharply the proportion of the population 65 and over. Statistics Canada population estimates show that the share of the population 65 and over is forecast to increase from its current level of 14.1 per cent in 2010 (up from 8.0 per cent in 1971) to a peak of 22.0 per cent in 2030, and 25.5 per cent in 2061 (Chart 3). Statistics Canada projects that the senior population dependency ratio, defined as the population 65 and over divided by the population 20-64, will increase from 22.5 per 100 in 2010 (up from 15.2 per 100 in 1971) to 40.7 in 2030 and 47.6 in 2061.

It should be noted that growing share of the 65 and over population reflects not only the relative size of the baby boom cohorts, but also the increased life expectancy of the population. According to Statistics Canada estimates, average life expectancy has increased from 74.4 years in 1979 to 80.4 in 2006, the most recent year for which estimates are available (Chart 4, panel A). Half of this increase in average life expectancy at birth is because of lower age-specific mortality rates for the 65 and over population (the other half is reduced mortality rates for the population under 65). Life expectancy at 65 has increased from 15 years in 1979 to 18 years in 2006 (Chart 4, panel B).

It is expected that the trends in life expectancy over the past quarter century (1979-2006) will likely continue for the next quarter century, although possibly at a slightly lower rate.[7] On the assumption that the 0.22 years annual average increase in life expectancy at birth observed over the 1979-2006 period continues from 2006 to 2033, life expectancy will reach 86 years that year. If the same rate of growth is experienced for the life expectancy at age 65 (0.11 years increase per year) over the next quarter century, it will increase an additional 3 years to 21 years (Chart 4, panel C). This means that the average person at age 65 in 2033 can expect to live to 86, nearly one quarter of their life span.

Chart 3
Proportion of the Canadian Population Age 65 and Over, 1971-2061



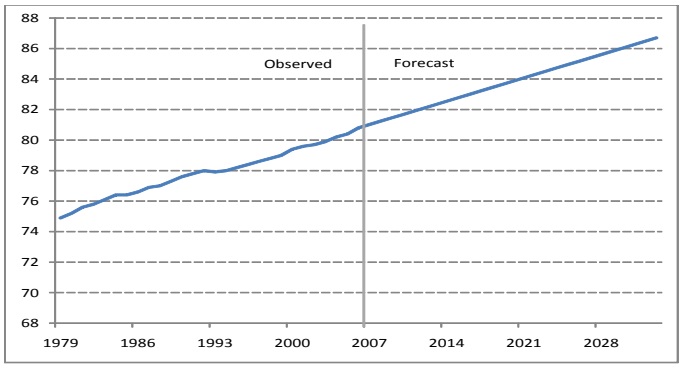
Source: Statistics Canada CANSIM Tables 051-0001 (Population Estimates) and 052-0005 (Projected Population, Medium Growth at Historical 1981-2008 trends).

6 Between 2000 and 2010 the employment rate of the 55-59 age group increased at a 1.38 average annual rate from 59.3 per cent to 68.0 per cent. If this growth continues for the next decade, the employment rate in 2020 would be 78.0 per cent. For the 60-64 age group the employment rate increased from 34.2 per cent in 2000 to 47.7 in 2010, a 3.25 per cent average annual rate of advance. At this rate, the employment rate for this group would be 64.8 per cent in 2020. For the 65-69 age group the employment rate increased from 11.0 per cent in 2020 to 22.5 in 2010, a 7.41 per cent average annual rate of increase. If this trend continued, the employment rate for this group would be 46.0 per cent in 2020. For the 70 and over age group (the Labour Force Survey does not provide a more detailed age disaggregation for this group), the employment rate rose from 3.4 per cent in 2000 to 5.5 per cent in 2010, a 4.48 per cent average annual rate of increase. At this rate of advance, the employment rate for this group would be 8.5 per cent in 2020. See Appendix Table 3 posted at http://www.csls.ca/ipm/21/IPM-21-Sharpe-Appendix.xlsx

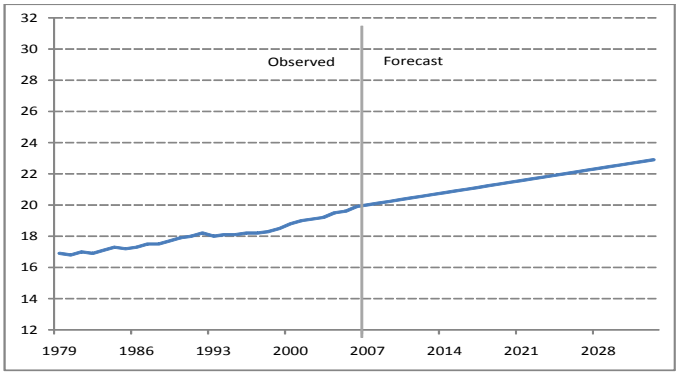
7 It should be noted however that there was no fall-off in life expectancy growth rates over five-year intervals from 1976 to 2006.

Chart 4
Life Expectancy and Changes in Life Expectancy for Canadians at Birth and at Age 65, 1979-2006, Linear Forecasts for 2007-2033

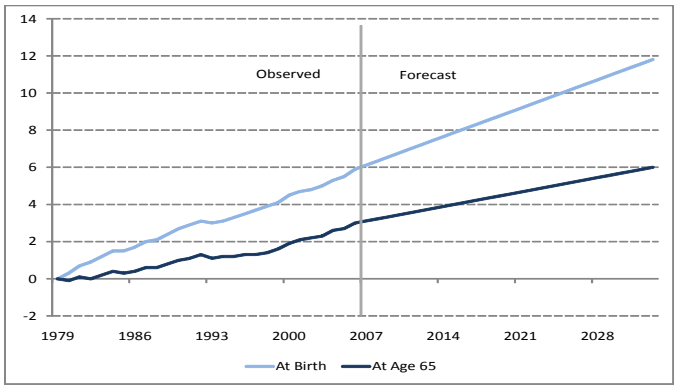
(a) at Birth



(b) at Age 65



(c) Changes in Life Expectancy Relative to 1979



Source: CSLS Calculations based on Statistics Canada CANSIM Tables 102-0025 (1979-1999) and 102-0511 (1990-2006).

Notes: 1. The changes in life expectancy are estimated relative to life expectancy for each category in 1979 (74.9 years for at birth and 16.9 years for at age 65). 2. Life expectancies are forecasted beyond 2006 by taking the absolute increase in life expectancy from 1979 to 2006 and assuming that over the next 27 years the same absolute increase is realized in each life expectancy.

Research Findings of the Volume

The volume stresses that it is not easy to establish the relationship between age and productivity for a number of reasons. First, this relationship is complex and multidimensional. Second, the relationship between age and productivity can change over time. Third, it is difficult to measure productivity at the individual level. This section is organized around these three points.

Evidence on the Relationship between Age and Productivity

A key finding of the volume is that "the productivity effects of ageing depend on the extent to which age-induced changes in cognitive and non-cognitive abilities are relevant for work performance" (page 135). There is no doubt that one's physical attributes decline with age. If job performance depends on attributes such as physical strength, energy, and dexterity, then individual productivity can decrease with the decline of these non-cognitive abilities as a result of aging. On the other hand, there is much less evidence that cognitive abilities fall with age.

The authors stress the importance of identifying and investigating the causes of productivity variation across individuals that can allow a better understanding of how ages relates to work performance. They list the following characteristics that may vary by age group: communication skills, information-processing speed, strength and endurance, health, self-discipline, flexibility, administrative and strategic capacity, mathematical proficiency, vocabulary size, education, motivation, energy, and job experience.

Surveying the literature, the authors provide a review of the empirical evidence of the relationship between productivity and age. Some of the most interesting findings are highlighted below.

- Skirbekk (2007) found an inverse-U shaped pattern where productivity peaks in the 35-

44 age group when gains from experience are outweighted by deteriorating cognitive and physical abilities. Numerical ability, clerical perception, finger dexterity, and manual dexterity were found to decline after 45, but managerial ability showed no decline with age.

- Lehman (1953) showed that output was 40-70 per cent higher at ages 30-39 than at ages 50-59 in a variety of disciplines, including mathematics, chemistry, medicine, genetics, entomology, psychology, and physics. But for professions where communication skills, social networks, and management capabilities are important, such as political leaders, judges, university presidents, top performing individuals were often in their fifties or sixties, or even later.
- Miller (1999) determined that peak ages for the creative output of writers, painters and musicians was their thirties and forties.
- Park *et al.* (2002) found that in the United States working memory, short-term memory, long-term memory, and speed of processing fell continually over time from one's twenties to the eighties, but that verbal knowledge actually increased from the twenties to the seventies.
- Based on a survey conducted in Europe by Borsch-Supan and Jurges, 2005) cognitive ability based on memory, verbal fluency, numeracy, and recall was found to fall from an index of 100 for persons in the 50-54 age group to 95 in the 60-64 age group, to 80 in the 70-74 age group.
- Average muscle strength decreases by roughly 10 per cent per decade from the ages of 20 to 60, 15 per cent per decade from 60 to 80 and 30 per cent per decade after age 80.

It is noted that if the way work tasks are carried out remains constant, accumulated work experience continues to benefit employee performance throughout the working life. But when new technologies are introduced, acquired experience can be less relevant, and indeed can be become a barrier to productivity advance if it results in resistance to change.

The authors summarize the relationship between ageing and productivity well when they state (page 161):

> Individual productivity relates to a number of characteristics of the individual and the work environment. Individual characteristics such as experience, motivation, mental abilities differ between age groups. Accumulated experience benefits employees' performance throughout the working life. However, physical strength and health are reduced over the life cycle. The net effect of the age-specific productivity determinants depends on how individual skills are used in the work process, how the work is organized, and how the individual interacts with other workers and firm-level factors such as technology and capital levels.

Changes in the Age-Productivity Relationship over Time

The authors point out that the negative relationship between age and productivity is likely weakening over time. New technologies have led to decreased demand for manual labour and increased demand for highly skilled workers. Physical strength and bodily coordination have become less important and cognitive abilities, in particular analytical, numerical and communications skills, more important. In addition, both physical and mental health levels are improving in adult and older ages, with a positive effect on work potential.

In support of the above point of the changing relationship between age and cognitive functioning, Romeu Gordo (2005) found that every subsequent cohort in the United States had higher cognitive performance at ages 50-59, 60-69, and 70-79. This better mental performance is a key determinant of labour market success

and means individuals can maintain productivity until later ages. Increased levels of formal education is likely the key cause of this rising cognitive ability.

Costa (2000) found that there was a decrease of 66 per cent in chronic disease rates from the early 1900s to the 1970s and 1980s among men aged 50-74. Romeu Gordo (2005) identified a continued decrease in the 1990s.

Developed economies have experienced a long-term shift in the workforce from blue collar occupations requiring non-cognitive abilities to white collar occupations emphasizing cognitive abilities. This will reduce the magnitude of the negative effect of aging on productivity.

A key finding the volume is that a variety of actions and policies such as investments in human capital investments can offset individual deterioration in productivity. The following quote provides a concise summary role of choice in affecting the way productivity is influenced by age.

> The main lesson from our study is that labour market behavior is more important than demographic changes. And labour market behaviour can be influenced through flexibility in mandatory retirement ages, human resource management, employment protection legislation, and wage policies. All in all, we think that the potential negative effects of ageing on productivity should not be underestimated. Nevertheless, they should not be exaggerated either. The decline of productivity with age is partly endogenous and subject to policy influence. The way productivity is influenced by age is not just an exogenous phenomenon but is also influenced by choice (page 1).

Measurement of Individual Productivity

Output is generally a joint product of the labour efforts of many workers. This makes it difficult to measure the contribution, and hence productivity of an individual worker, except in certain production processes (e.g. university research) and under certain remuneration systems like piece work. Economic theory telIs us that wages reflect the marginal productivity of a worker, but institutional factors such as unions can result in a disconnect between wages and productivity.

The volume includes two technical chapters which attempt to measure individual productivity. The first develops an indirect measure of productivity defined as a self-assessed measure of working capacity based on data from the Finnish Quality of Working Life Survey. The authors argue that the measure, which varies from 1 (total inability to work) to 10 (top working capacity), can shed light on how the subjective assessment of individual work capacity is related to age. Indeed, they find that employees' own assessment of their working capacity falls with age, without a corresponding decline in wages. However, the fall in working capacity is not dramatic, with mean self-assessed working capacity declining from 9.2 in the 20 and under age group to 8.0 for age groups 61 and over. Based on econometric results, the authors find that one additional year of age, relative to the 20 and below age group, reduces the working capacity index by 0.03 points, or 0.3 points in a decade.[8]

A worker's perception of his working capacity is related to the tasks assigned. The authors point out that the rotation of older workers to tasks that are less physically demanding may improve perceived working capacity and even improve actual productivity. They also note that technological change away from blue collar

8 An interesting finding from the econometric results is that teamwork has a significant positive effect on working capacity, supporting the view that "high performance" work practices can improve productivity.

occupations will result in aging having less effect on productivity.

A second chapter uses linked employer-employee data sets to analyze the impact of workforce characteristics (e.g. average age) on productivity at the plant and team level. The authors use a unique dataset compiled for a DaimlerChrysler assembly plant. They find that while productivity decreases with age, the effect of job tenure has the opposite sign and similar magnitude. In other words, if workers remain in the same plant they can compensate for the negative age effect by accumulating job-specific experience. Interestingly, they also find no evidence that age diversity in work teams is good for performance because younger and older workers complement each other's skill sets.[9]

Assessment of the Volume

This is an extremely stimulating volume and highly recommended to persons interested in the relationship between ageing, health and productivity. In particular, it represents a source of ideas and inspiration for future research on the age-productivity nexus.

An important finding of the volume is that the age-productivity relationship is dynamic, not static and that this relationship can be affected by both private sector interventions and public policy. Transferring older workers out of physically demanding jobs is an obvious way to offset the lower productivity of these workers arising from their declining physical skills. Fortunately, with mechanization, the relative importance of physically demanding jobs are falling in number so this issue is less relevant. Equally the upgrading of human capital can offset individual productivity deterioration due to aging. The most effective types of investment in this regard should be identified.

In terms of a commentary on the volume, I have four major points. First, a useful analytical distinction can be made between the ageing of the workforce and the ageing of the population and both these developments can have implications for productivity growth. The volume focuses on workforce aging, but it would have been useful to at least mention the potential effect of population aging for productivity.[10]

Second, it is widely believed that older workers are less productive because they are less able and, more importantly, less willing to acquire new skills. Older workers are felt to be reluctant to learn new technologies and ways of doing things. In my view, the volume pays inadequate attention to this issue. It would have been useful if the authors had assessed the validity of this resistance to change hypothesis through case studies, and if the hypothesis is true, estimated how much this phenomenon reduces productivity.

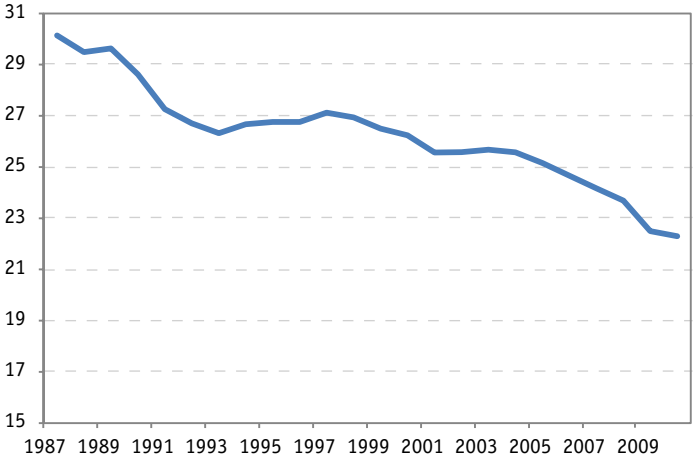
Third, while the authors recognize that the measurement of individual productivity is very difficult, and indeed develop innovative approaches to overcome this problem, one avenue they do not pursue is to look at workers who are paid on a piece work basis. For these workers individual productivity data are available and can be compared to the age of the workers. It would have been useful for the authors to have included in the survey studies on the piecework-productivity to tease out the age dimension, if it exists.

Fourth, the discussion on the relationship between age and absenteeism is confusing. The authors note that younger persons have a greater

9 The more age-diverse the work teams, the more errors were made. The authors attribute this to communications difficulties across generations and the possible prejudices on the part of younger workers about the "useless old."

10 For example, Scarth (2008) has identified two macro channels whereby population aging can effect productivity growth. First, ageing can lead to greater saving for retirement, increasing the capital stock and labour productivity. Second, increased taxes to finance higher health and pension costs of the older population can have a negative effect on investment and hence productivity. These two effects may be offsetting.

Chart 5
Blue Collar Jobs as a Share of Total Employed in Canada, 1986-2010



Source: CSLS Calculations based on Statistics Canada CANSIM Table 282-0010

Notes: 1. Blue collar jobs include: trades, transport and equipment operators and related occupations, occupations unique to primary industry, occupations unique to processing, manufacturing and utilities. 2. White collar occupations include all non-blue collar occupations.

number of absences while older persons have a longer duration of absences when they are away. But what is most of interest is the total number of days absent per year, not the average duration nor frequency of absences. It is unclear from the volume which age group is absence more often. But evidence for Canada shows that it is in fact older workers by a significant margin.[11] Of course, absenteeism only affects productivity at the extensive margin (output per worker), not at the intensive margin (output per hour worked).

Implications for Canada

This section first reviews the relationship between ageing and productivity in the Canadian context. It then discusses the implications of rising employment rates for older age groups on dependency rates.

Ageing and productivity

A definitive answer to the question of the impact of ageing on productivity is unlikely. It depends on too many factors. Studies will find different results depending on the types of tasks examined, the age group targeted (negative ageing effects are likely greater for age groups 70 and over than under 70), and the methodology used. Despite this lack of precision, the conclusion of the volume that the effect of ageing on productivity at the aggregate level is small seems reasonable and is consistent with the results of Canadian studies on the age-productivity relationship finding.[12] Yes, ageing may represent a drag on labour productivity growth. But the key take-away point from this review article is that the magnitude of this phenomenon represents a small proportion of productivity growth.

In addition to being small, the effect of ageing on productivity is declining over time. At least five factors contribute to this trend. First, the proportion of the workforce engaged in manual labour (blue collar occupations), where productivity is based on the physical condition of the worker, has fallen significantly over time, from 30 per cent in 1987 to 22 per cent in 2010 (Chart 5) and is expected to continue to decline.

Second, and related to the first factor, cognitive skills are becoming increasingly important in the workplace. These skills decline less with age than non-cognitive skills.

Third, the state of the physical and mental health of workers 55 and over is improving

11 Data from the Labour Force Survey show that on average, older workers miss considerably more days due to illness or disability than young and prime-age workers. Workers aged 55 and over missed an average of 10.5 days of work in 2009, compared to 7.6 days among workers aged 25-54 and 5.3 days among workers aged 15-24. Average days missed increased for the two youngest age groups between 1987 and 2009. The increases were 1.1 days for workers aged 15-24 and 1.3 days for prime-age workers. Among workers 55 and older, average missed days declined by 0.9 days over the period (Murray, 2011).

12 For example, Tang and MacLeod (2006) find that aging reduces labour productivity growth in Canada during the peak period 2001-2010 by only 0.13 to 0.23 percentage points per year. Kuhn (2005) concludes that once education is taken into account, there is little evidence that productivity actually declines with age. For a survey of the Canadian literature on this issue, see Beach (2008)

thanks to medical advances and healthier lifestyles.[13] This reduces any decline in the productivity of older workers due to poor health.

Fourth, the level of educational attainment of older workers is rising rapidly. The average level of educational attainment for workers 55 and over increased from 11.9 years in 1990 to 13.8 years in 2010 and expected to continue to rise.[14] More educated workers are better able to adapt to offset any negative effect of ageing on productivity.

Fifth, workplaces are becoming increasingly flexible, with growing opportunities for part-time work, contract work, and telecommuting. This environment better meets the needs of individual workers, allowing them to compensate at least somewhat for any age-related productivity disadvantage.

It is also important to reiterate, as seen in Chart 2, that most of aging of the Canadian workforce associated with the ageing of the baby boom cohorts has already taken place so that the lion's share of any negative impact of aging on productivity, albeit minor, has already occurred (and is hence incorporated in the productivity numbers).

In addition to being small and declining, as noted earlier in the review, the negative effects of ageing on productivity can be offset through interventions. Rotations of older workers out of physically demanding tasks and training programs that assist older workers make effective use of new technologies are two examples of actions that can compensate for potential productivity-reducing effects of workforce aging.

Employment rates and dependency ratios

The ageing of the population, and more specifically the increase in the share of population 65 and over (Chart 3), represents a fiscal challenge for Canada. These demographic pressures increase pension and health care costs.[15] But these negative fiscal implications can be offset somewhat by the older persons remaining employed, as the employed pay taxes on their employment income.

It is sometimes argued that the declining productivity of older workers makes their continued labour force participation not particularly desirable. But the finding of this review article that the negative impact of aging on productivity is small, declining, and can be somewhat offset through interventions provides a new perspective on the standard dependency ratio analysis that ignores the employment status of older workers.

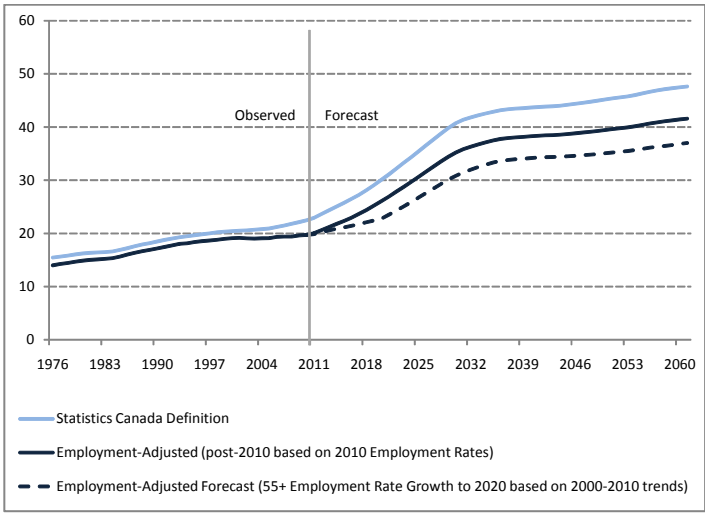
Since dependency ratios or rates are conventionally defined in terms of the population 65 and over, the implications of an increased employment rate for this age group is first discussed. But as most older workers (55 and over) are in the 55-64 age group (83 per cent in 2010), and as the finding that aging has only a small

13 Data from the Canadian Community Health Survey indicates that 67.8 per cent of individuals 65 and over reported their mental health status as very good or excellent in 2003. By 2009, 69.8 per cent of this group indicated that their mental health status was either very good or excellent. The per cent of individuals 45 to 64 with very good or excellent perceived mental health was basically unchanged from 72.2 per cent in 2003 to 72.0 per cent by 2009. Perceived physical health status increased for individuals 65 and over the proportion with very good or excellent health increased from 36.7 to 40.9 per cent as well as for individuals 45 to 64 from 53.4 to 56.9 per cent.

14 Average years of education were estimated using the LFS assuming the following years of education for each category: 8 years for 0 to 8 years, 11 years for Some High School, 12 years for High School Graduate, 13 years for Some Post Secondary, 14.5 years for Post Secondary Certificate or Diploma, 16 years for Bachelors Degree and 18 years for Above Bachelors Degree

15 Dodge and Dion (2011) project that total health care spending will rise nearly 7 percentage points of GDP over the next two decades, and that governments will have to find revenue increases or spending reductions equivalent to nearly 5 percentage points of GDP if they continue to finance about 70 per cent of health care spending. It is important to note that with rising productivity, even with a continuation of the 0.7 per cent annual growth rate of the 2000s, the tax base will be expanding and increased tax rates will not necessarily mean lower post-tax income.

Chart 6
Senior Dependency Ratios for Canada, Statistics Canada Definition and Employment-Adjusted, 1976-2061
(persons per 100 potential workers)



Source: CSLS Calculations based on Statistics Canada CANSIM Tables 282-0002 (LFS Statistics), 051-0001 (Population Estimates) and 052-0005 (Projected Population)

Notes: 1. The senior demographic dependency ratio used by Statistics Canada is calculated as the ratio of persons age 65+ per 100 persons between the age of 20 and 64. This measure does not correct for persons unemployed or not in the labour force and assumes that people aged 20 to 64 represent "workers" in Canada. 2. The employment-adjusted dependency ratio tries to account for those persons aged 65+ who are still working when making the senior dependency ratio calculation, i.e. DR= (Pop 65 and over - 65 and over Employed)/(Pop 20 to 64 + Workers 65 and over). 3. Two different employment forecasts are used. The first assumes that age-specific employment rates observed for all workers in 2010 persist until 2061. The second assumes that employment rates for workers under 55 remain constant at 2010 rates and for age-groups 55+ they continue growing at 2000-2010 trends until 2020 and then level off.

impact on productivity is most applicable for this group, an analysis of the impact of increased employment rates for this group on dependency ratios, defined as the employed versus the non-employed, is also provided.

Subtracting employed persons 65 and over from the dependent senior population, and including them in the denominator of the dependency rate, that is the population that potentially can pay income tax based on employment income, provides a better indication of trends in this population. Chart 6 shows that the standard Statistics Canada dependency rate and two employment-adjusted senior dependency rates from 1976 to 2061. The Statistics Canada senior dependency ratio is defined at the ratio of the population 65 and over to the population 20-64. In 2010, this ratio was 22.5 per 100 persons aged 20-64, defined as the potential workforce. The ratio is expected to increase to 40.7 in 2030 and 47.6 in 2061. The next two scenarios both adjust the dependency ratio by removing employed seniors from the dependent population and adding them to the population 20-64. Going forward, the number of employed seniors will depend on their employment rate (as well as the absolute size of the seniors population).

Scenario one assumes that the 2010 age-specific employment rates for all age groups remain constant while scenario two assumes that employment rates for the 55 and over age-groups increase (it remains constant for under 55 age-groups) over the 2010-2020 period at the same rate as experienced between 2000 and 2010. In 2010, the senior dependency ratio is 19.7 per 100 potential workers aged 20 and over when this adjustment is made for the employed seniors population compared to 22.5 for the standard dependency ratio. Going forward, one sees a smaller increase in the dependency ratio when adjusted for employment rates of the seniors population. In scenario one the dependency ratio rises 15.5 points to 35.2 in 2030, compared to 18.2 points in the base case. In scenario two, the dependency ratio rises less only 11.1 points to 30.8. While increasing employment rates for older workers will likely never offset the increase in the dependency ratio driven by the rise in the relative size of the 65 and over population, it can make a significant contribution. This has important positive implications for tax revenues and fiscal balances.

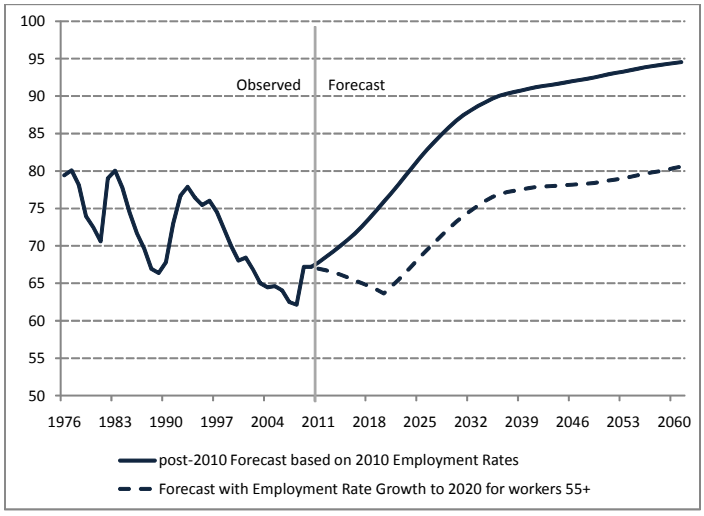
The implications are even greater if dependency ratios are defined in terms of the employed and non-employed population 15 and above, not the population 20-64. The increased

employment rates of the 55-64 population will reduce the dependency rate significantly. For example, in 2010 the ratio of the non-employed to the employment population 15 and over was 67.2 per 100 workers. With age-specific employment rates for all age groups held constant population aging raises this ratio to 86.7 per 100 by 2030 (Chart 7). But if employment rates for the 55 and over population over the 2010-2020 increase at the rate experienced over the 2000-2010 period, the ratio in 2030 would be only 73.2 per 100. In other words, increased employment rates for older workers would offset 69 per cent (13.5 of the 19.5 percentage points) of the rise in the non-employed/employed dependency ratio.

The above discussion illustrates the importance of increased employment rates of older workers, particularly those 55-64, to offset rising dependency ratios, and for raising tax revenues to pay for increased government spending on health care and pensions as the senior share of grows. Fear that older workers are less productive than younger workers should not be considered a barrier to this increased labour force participation. Even if older workers are slightly less productive, the output gains for the economy and tax revenues for governments from their employment completely swamp any drag on aggregate productivity growth.

From the perspective of maintaining sound public finances, society has a strong interest in increasing employment rates for older workers. Governments of course are increasingly recognizing this and taking measures to encourage workers to stay in the labour force until 65 or later. For example, the March 2011 Quebec budget (Quebec Ministry of Finance, 2011) introduced measures that reduced QPP benefits for persons opting to take the pension before 65 and increased benefits for persons delaying receipt of benefits until after 65. It also introduced an innovative tax credit for employment income for persons 65 and over to promote continued labour market participation after 65.

Chart 7
Employment-Based Dependency Ratio for Canada, 1976-2061
(persons 15 and over not working per 100 workers)



Notes: 1. The employment-based dependency ratio measures the proportion of the population 15+ that are not working relative to total employment, i.e. DR= (Pop 15 and over - Total Employed)/(Total Employed). In order to account for the definitional difference between the LFS-based and census-based population estimates, we assume that the 2010 ratio between these two estimates remains constant after 2010. 2. Employment forecasts are made assuming employment rates remain at 2010 levels in scenario one. 3. In scenario two, employment forecasts are made assuming that employment rates for age-groups 55+ continue growing at 2000-2010 trends until 2020 and then level off.

But it is not just governments that benefit from increased employment of older workers. The older workers benefit themselves not just financially, but in terms of well-being. Research shows that work-related activity for older persons has positive effects on their well-being, fostering a sense of purpose and promoting social interaction (Friedman and Martin, 2011). Jacoby quoted in Yoffe (2011) writes, "Being forced to work longer, or to think about developing new skills to augment an inadequate retirement income, might turn out to be an invigorating kick in the pants for boomers rather than a life sentence at hard labor."

Conclusion

The book *Ageing, Health, and Productivity: The Economics of Increased life Expectancy*, sheds much light on the ageing-productivity relationship. It demonstrates that while there is some evidence that ageing can have negative effects on individual productivity, at the aggregate level the effect is small. Less productive older workers should not be considered a reason not to promote the increased participation in the labour force of this population.

From this perspective, the major issues associated with the ageing-productivity nexus are the importance of making workplaces more older-worker friendly and developing public policies (both carrots and sticks) to encourage older workers to remain in the workforce given both their increased life expectancy and the positive effect of work itself on life expectancy. And of course, increased employment of older workers will reduce senior dependency rates and provide additional tax revenues to pay for increased health care costs arising from an ageing population.

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