AGING, CAPITAL INVESTMENT, AND STANDARDS OF LIVING

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Contents

Executive Summary

While there is some variation in recent Statistics Canada projections of Canada's future population size and age distribution, the projections unequivocally point to a conclusion that Canada's population and its workforce will age over the next few decades.

One aspect of the population aging phenomenon is an increase in the dependency ratio, i.e., the ratio of individuals who are age 65 and older to those aged 15 to 64. The former are assumed to no longer be in the workforce and therefore are dependent on the latter to pay for income support and social services provided by the government to retirees. Clearly the dependency ratio is somewhat simplistic, since a percentage of individuals will remain in the workforce past the age of 65. They may also have savings they can draw on to help support themselves financially. However, if a significant percentage of individuals who were formerly working now draw on financial assistance from those who are working, the disposable income of the latter will decline unless there is an increase in real economic growth and accompanying increased compensation for those in the workforce.

Over the period from 2018 to 2068, the dependency ratio for Canada is projected to double, although the actual ratio in any future year will depend on whether and how the labour force participation rate of older workers changes over time. Nevertheless, the overall message from Statistics Canada's demographic projections is that Canada's labour force growth rate will slow substantially as a consequence of an aging population. Therefore, there will need to be increases in the growth of real economic output from other sources besides the labour force if working Canadians are to enjoy increasing levels of disposable income and associated higher standards of living, given increased fiscal transfers from working Canadians to retirees.

The standard model of economic growth assumes that output depends on three things: 1) the quantity of labour services employed; 2) the quantity of physical capital (such as machinery and equipment) that each employee has to work with (i.e., capital deepening); 3) the creation and utilization of scientific and technical knowledge that is used in the production of goods and services (i.e., technological change).

Assuming that the labour force participation rates of individuals of all ages remain at 2018 levels, the projected percentage increase in Canada's labour supply from 2020 to 2050 will be about half the actual increase from 1990 to 2020. The implication is that unless other determinants of real economic growth improve their contributions to economic growth, Canada's real economic growth rate and the growth rate of the standard of living of Canadians over the next few decades will be substantially slower than their growth rates over the previous few decades.

In this regard, one possible offsetting factor to a slowing labour force growth rate is capital deepening, i.e., increasing the ratio of physical capital to labour. While higher wages associated with slower labour force growth should encourage capital investment,

the financial costs of investing are expected to increase given reduced savings rates associated with an aging population, along with an increased demand for financial capital to fund major infrastructure projects tied to the ongoing switch away from fossil fuels to Green Energy sources.

Canada's performance in attracting physical capital investment has been quite poor over the past decade (see e.g. Globerman and Emes, 2021). Hence, unless policy measures are put in place that help make Canada a more attractive location for capital investment, the likelihood that capital deepening will contribute more to economic growth in the future than it has in the past is questionable.

Perhaps the most important contributor to real economic growth over time is the growth of total factor productivity (TFP). This is a measure of how much more real output can be produced using the available capital and labour inputs. The determinants of TFP are complex, as is the impact of an aging population on TFP growth. On balance, it is likely that an aging population reduces the rate of TFP growth. For one thing, entrepreneurs tend to be relatively young, and new firm start-ups are a major channel for introducing new technology into the economy. For another, older workers are less able than younger workers to learn new skills and adapt to new tasks associated with the introduction of new technology. Older workers are also less inclined to change jobs or relocate geographically in response to changes in the economy tied to technological innovation.

The main policy implication is that an aging population, on balance, is a drag on real economic growth. Government policymakers need to recognize this issue raised by an aging population, and address it by implementing policies that will make Canada a more competitive location for capital investment, as well as a more conducive location for innovative and entrepreneurial activities.

1. Introduction

The prospect of population aging as the baby-boom generation retires has generated much debate. (Scarth, 2009: 1)

Demographic changes can have profound economic impacts. In particular, an aging population can affect the supply of labour and therefore an economy's potential output. [1] It can also affect government budgets through a variety of direct and indirect channels including an increased demand for health care and an expansion of income support programs for retirees. [2] Increased government spending on health care and income support programs for seniors implies a transfer of disposable income from taxpayers to the government to pay for those expenditures. In the absence of increased real economic growth, reductions in disposable income tied to increased taxation imply reductions in the standards of living of many citizens.

Aging can also have important indirect implications for a country's standard of living by influencing capital investments which, in turn, are linked to productivity growth. Since productivity growth is the single most important determinant of a country's long-run standard of living, the linkages between aging, capital investment, and productivity growth are extremely relevant to any assessment of the future standards of living of Canadians and, by extension, to public policies influencing capital investment. [3] Higher real incomes needed to pay for increased transfer payments and social services on the part of retirees require significant improvements in labour productivity to offset a slowing growth of the labour force tied to aging. Hence, research on the linkages between aging and the determinants of a society's standard of living is quite relevant to policymakers.

As suggested by the quote at the top of this essay, there is no firm agreement on the relationship between an economy's aging population, its productivity growth rate, and ultimately its standard of living. As Sharpe (2011) notes, the relationship between age and productivity at the level of the individual worker is complex, multidimensional, and changing over time. Arguably, the relationship between aging across the entire workforce and productivity is even more complex since the overall productivity of different cohorts of workers is unlikely to be a simple average of the productivity of the individual

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[1] See Cross (2021) for a discussion of how Canada's aging population is likely to affect its supply of labour.

[2] Globerman (2021) assesses the impact of an aging population on health care expenditures in Canada, while Eisen (2022) provides estimates of future changes in the ratio of employed Canadians to retirees and the fiscal consequences of changes in that ratio.

[3] The relationship between productivity growth and living standards has been documented in numerous studies. See, for example, Economic Policy Institute (2000).

members of the cohort. In this regard, Sharpe (2011) asserts that a definitive answer to the question of the impact of aging on productivity and, therefore, on standards of living is unlikely. If there is any consensus in the literature, it is that there is a negative effect of aging on productivity, but at the aggregate level the effect is small. While this study offers no new statistical evidence on the relationship between an aging population and a nation's standard of living, it discusses qualitative evidence suggesting that the relationship does raise important public policy challenges for Canada.

This study specifically discusses the direct and indirect linkages between aging and capital investment and, by extension, the likely effect of aging on productivity growth and standards of living with a specific focus on Canada. As noted, it does not offer original empirical evidence bearing on the linkages. Rather, it highlights the key economic factors conditioning the linkages and provides qualitative assessments of how those factors might change in the future, which could modify the consensus conclusion that population aging has only a weak effect on standards of living, particularly as it affects investments in physical capital and innovation.

The study proceeds as follows. Section 2 provides background context by discussing demographic projections for Canada. Section 3 provides a brief discussion of the conceptual impacts that an aging population can have on the main determinants of real output growth and, therefore, on standards of living. Section 4 identifies and assesses empirical evidence on the linkages between an aging population and real economic growth with particular attention to the implications for Canada, and is followed by concluding comments.

2. Demographic Outlook

Statistics Canada provides a set of projections of Canada's total population, as well as the age distribution of the population, based on assumptions about birth and death rates and the number and age distribution of immigrants net of emigrants. More optimistic assumptions about changes in the birth rate, in average longevity, and in immigration levels result in scenarios projecting a larger and slower-aging population. There are certainly differences across the various Statistics Canada scenarios. For example, under the high population growth scenario, Canada's total population is projected to reach 46,560,000 by 2035. The population projections for that year under the slow and medium growth scenarios are 41,281,500 and 43,756,000, respectively. [4]

Figure 1 shows Canada's projected population for selected years from 2020 to 2060 using the M1 (medium growth) scenario. The relatively steady increase in Canada's projected total population largely reflects expected increases in immigration levels over the period, as the childbirth rate is projected to be below population replacement rates. The relatively modest projected increase in Canada's population from 2020 to 2060, i.e., approximately 38 percent, contrasts dramatically with the 175 percent increase from 1950 to 2020. The increase in the latter period reflects the post-WWII Baby Boom phenomenon and the echo effect of that phenomenon. [5]

The post-WWII baby boom is also reflected in changes over time in the median age of Canadians (figure 2). The median age declined over the period 1948 to 1968 coinciding with the emergence of the Baby Boom generation. It then rose consistently to the present and is projected to continue to increase throughout the forecasted period. The time series for median age is reflected, albeit imperfectly, in the time series for the so-called dependency ratio. The latter is conventionally measured as the ratio of persons aged 65 and older to persons aged 15 to 64. The former group is presumed to be no longer in the workforce and is therefore "dependent" on the latter group to generate the income needed to pay for income support and social services provided to retirees. [6]

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[4] After the writing of this essay, Statistics Canada (2022a) issued revised population projections showing upward revisions to earlier projections. The most recent projections show wide ranges in the projected values reinforcing the notion that any projections about the future involve uncertainty, even demographic projections. Most relevant for this essay, the updated population projections show that the aging of the population remains a reality over the next 50 years regardless of the underlying assumptions.

[5] Even assuming the high growth population projection, Canada's future population growth will be well below the growth rate experienced from 1950 to 2020.
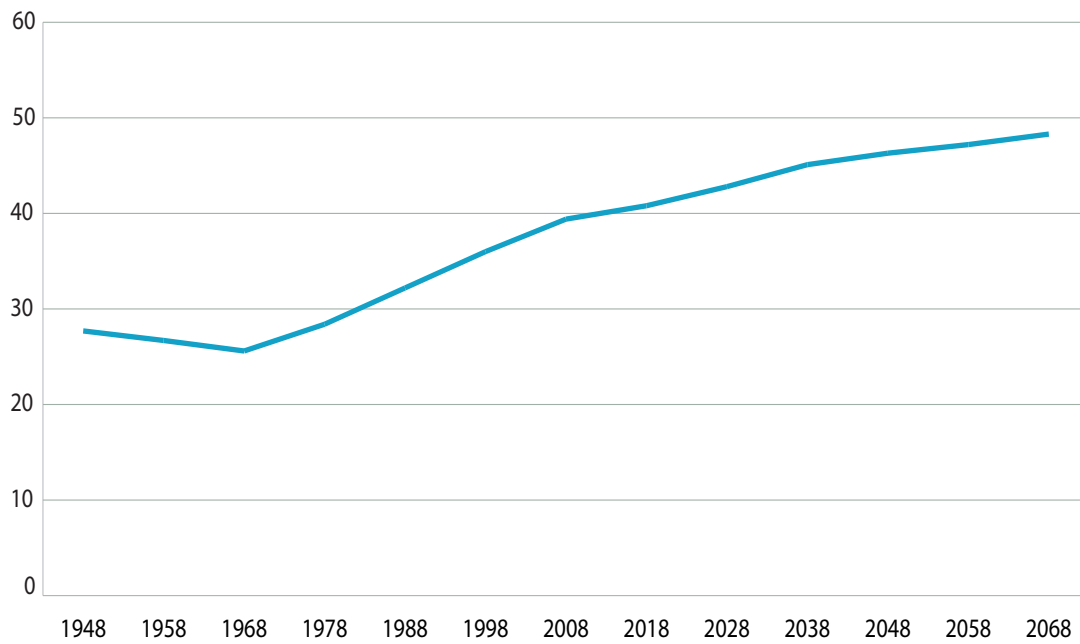
[6] It is obviously an overstatement to say that there are no people aged 65 and older in the workforce, although, as shall be shown later in the essay, the majority of individuals over 65 years of age are not participants in the labour force.

Figure 1: Projected Population, Canada, 2020–2060
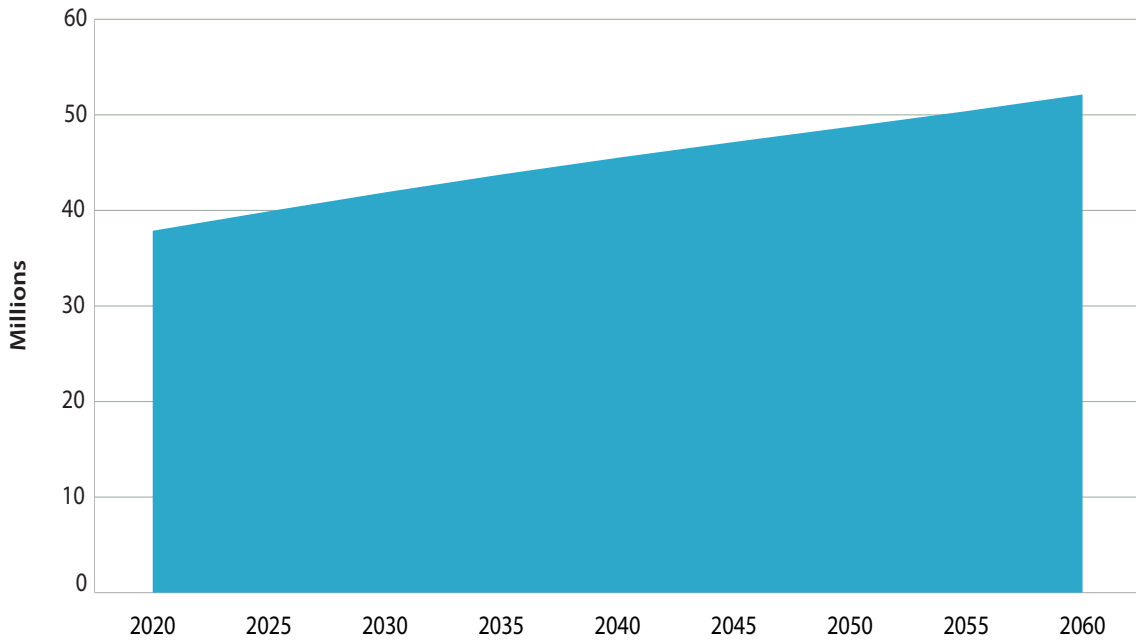
Source: Statistics Canada (2022a).

Figure 2: Median Age of Canadians, 1948–2068

Source: Statistics Canada (2022a): Table 2.4.

Table 1 reports the historical and projected dependency ratio as measured by the number of people aged 65 and older per thousand persons aged 15 to 64. Over the 70 years from 1948 to 2018, the dependency ratio slightly more than doubled, and it is projected to double again over the 50-year period from 2018 to 2068. It should be noted that some percentage of Canadians aged 65 and older will remain in the workforce, and this percentage is influenced by government and private sector actions regarding phenomena such as the generosity and reliability of pensions, training, and education options for older Canadians, and so forth. [7] Hence, it is possible that the dependency ratio reported in table 1 overstates the fiscal burden that will be imposed on participants in the labour force associated with an aging population. Nevertheless, the overall message from the data presented in this section of the essay is that Canada's labour force growth will likely slow substantially as a consequence of an aging population and that increasing the rate of growth of real economic output is an imperative if Canadians are to enjoy increasing levels of real disposable income and higher standards of living broadly defined.

Table 1: Persons 65 Years and Older per 1,000 Persons Aged 15 to 64

1948	11.7
1958	12.8
1968	12.9
1978	13.4
1988	16
1998	18.2
2008	19.7
2018	25.7
2028	35.7
2038	41.3
2048	44.3
2058	48.1
2068	51

Source: Statistics Canada (2019): Table 2.4.

[7] For a discussion of factors influencing the willingness and ability of persons aged 65 and older to remain in the workforce, see Gunderson (2022).

3. Aging, Labour Supply, Capital Investment and Productivity Growth: A Conceptual Overview

Income to buy goods and services, including health care, is created by the output that a society produces. The conventional measure of output is real gross domestic product (real GDP) which is the value of goods and services produced in the domestic economy after adjusting for inflation. The standard model of economic growth assumes that output depends on three things: the quantity of labour services employed; the quantity of physical capital (such as machinery) that each employee has to work with; and the level of scientific and technical knowledge that is used in the production of goods and services. The latter can be embodied in physical capital, for example improved software that programs the operations of physical capital, or it can be embodied in labour in the form of increased knowledge, expertise, and the like gained through formal education, on-the-job learning, or other experiences. [8]

Increases in commercially valuable scientific and technical knowledge when applied to production processes improve the productivity of physical capital and labour inputs. [9] This phenomenon is known as total factor productivity growth. Hence, aging can affect the growth path of real GDP by altering the quantity of labour services, the quantity of physical capital per worker, and the growth of total factor productivity. [10]

Aging and the Supply of Labour

In the absence of a sufficient increase in the percentage of older workers who are willing to remain in the workforce going forward, the projected increase in the percentage of older workers in the population suggests that there will be a slowdown in the growth of labour supply. This is not to say that Canada's labour force will stop growing entirely, as will be discussed further in section four.

To be sure, increases in the labour force participation rates of workers at all ages would increase the labour supply growth rate. As Gunderson (2022) discusses, the labour market decisions of older workers are influenced by numerous factors. Tishman, Van Loo, and Bruyere (2021) review much of the literature bearing upon the decisions of older workers to leave or remain in the workforce. In broad terms, the decision to remain in the

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[8] See Scarth (2009) for a discussion of models relating real GDP to an aging society.

[9] In effect, changes in total factor productivity implicitly reflect improvements in the "quality" of physical and human capital.

[10] Increased physical capital per unit of labour is frequently referred to as capital deepening.

workforce depends on factors such as the individual's accumulated sources of retirement income, the mental and physical capacity of the individual to perform the tasks associated with alternative employment opportunities, the overall state of the labour market, and so forth, and these factors can be expected to change over time.

Aging and the Supply of Physical Capital

Physical capital can be broadly defined to include structures, machinery and equipment, and intellectual property products such as software. More physical capital per unit of labour increases labour productivity since physical capital is typically a complementary input to labour. [11] As a consequence, more real output can be produced using the same amount or even smaller amounts of labour. Increases in the ratio of physical capital to labour can therefore mitigate the adverse effects of a declining workforce in terms of the impact on real output growth.

Investment in physical capital is influenced, in turn, by a variety of factors that, directly or indirectly, affect the expected rate of return on invested capital. The return on invested capital is the expected after-tax net operating profit from an investment divided by the value of the company's debt plus equity. [12] A company creates financial value for its owners if it invests in capital assets whose expected rates of return exceed the company's weighted average cost of capital. The latter is the cost of debt weighted by the share of debt in the company's total amount of debt plus equity plus the cost of equity weighted by equity's share in the total amount of debt plus equity. Hence, organizations will increase their investments in physical capital if the expected return on invested capital increases relative to the weighted average cost of capital.

The cost of labour will affect the expected return on investments in physical capital. The relationship between physical capital investment and the cost of labour is captured in the statistic known as the elasticity of substitution. The latter is measured as the percentage change in the ratio of capital to labour divided by the percentage change in the price of labour to capital. [13] An increase in the price of labour can be expected to encourage substitution at the margin away from using labour as a productive input in favour of using physical capital. At the same time, the labour that continues to be used will involve a larger expenditure, since its price has increased. Which of these effects dominates depends on the elasticity of substitution. When the elasticity of substitution is less than one, the latter effect dominates. When the elasticity of substitution exceeds one, the former dominates. In either case, there will be an increase in the ratio of capital

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[11] Intellectual property products such as software are frequently embodied in machinery and equipment or else indirectly help "manage" the operations of machinery and equipment.

[12] Companies typically use both debt and equity to finance capital investments. See Hayes (2021) for a discussion of this investment decision rule.

[13] The technical definition measures the denominator as the ratio of the marginal product of capital to the marginal product of labour. However, assuming a competitive market, the ratio of the marginal product of capital to the marginal product of labour will equal the price of labour relative to the price of capital.

to labour as long as the elasticity of substitution is positive. The larger the elasticity of substitution, the larger the increase in the capital to labour ratio. Empirical evidence suggests that the elasticity of substitution is around 0.7 percent. This effectively means that a 10 increase in the price of labour relative to capital will lead to a 7 percent increase in the ratio of capital to labour, other things constant. [14] In effect, if a more slowly growing labour force contributes to an increase in real wages, there should be an increase in capital deepening, other things constant, which will mitigate the adverse impact of a slowing labour supply growth on real GDP growth.

Arguably, the most important influence on anticipated increases or decreases in the net operating profits of organizations, and therefore on future business investments in physical capital, are opportunities created by technological change, and the entrepreneurial capabilities of economies to take advantage of technological change. [15] Technological change underlies the introduction of new and more profitable products and services, as well as lower cost methods of production and more efficient organizational structures. The linkages between aging, technological change, and productivity will be discussed in more detail in a later section. However, it should be acknowledged here that public policies regarding effective tax rates, regulation and the provision of infrastructure also condition expected net operating profits, although it is unclear that aging has a significant influence on these policies, as will be discussed later.

Changes in the demand for output across different sectors of the economy can affect expected returns on investments in physical capital across those sectors. If the sectors affected have different capital-to-labour ratios, the overall (economy-wide) capital-to-labour ratio might change depending upon the pattern of demand changes. Sectors that are expected to see strong growth due to aging are health care, packaged tourism, and personal care. Below average growth is expected to be seen in education, transportation, and insurance (R&A Group, undated). Since the ratio of capital to labour differs across these sectors, changes in the mix of industries will affect the overall capital-to-labour ratio. McKinsey Global Institute (2019) argues, with regard to industry mix effects, that the overall capital-to-labour ratio will decrease as sectors characterized by a higher labour share, such as health care and social work, increase with changes in demand patterns associated with an aging population.

Investment in physical capital is also function of the cost of capital, as noted above. The cost of capital to investors itself depends upon various factors. One prominent factor is the supply of savings. An increase in savings will reduce the cost of capital to investors other things constant, while a decrease in savings will increase the cost of capital. The flow of domestic savings is a function of the domestic savings rate, i.e., the share of national income that is saved, and the size of national income. The domestic savings rate in an economy can be expected to decline with an aging population. The life-cycle hypothesis, a well-known theory of how consumption and savings vary over an individual's lifespan,

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[14] See Muck (2017) and Knoblach, Roessler, and Zwerscke (2019).

[15] See McKinsey Global Institute (2019).

predicts that because income tends to rise steeply during working years and decline significantly during retirement, savings will tend to be negative in the early working years (as young households borrow in advance of higher earnings), become positive and relatively large in middle age and then turn negative in retirement. [16]

Empirical evidence suggests that the decline in the savings rate as the population ages is economically significant. For example, a survey of US households shows that savings as a share of income after taxes for those between the ages of 25 and 64 is approximately 22 percent, whereas it is 2.8 percent for those 65 and older (R&A Group, undated).

The cost of capital will also depend upon the demand for physical capital, since planned capital expenditures by businesses, governments and households draw on savings as the source of financing. An increase in the demand for capital will result in a higher cost of capital, other things constant. The magnitude of the increase will depend upon the elasticity of the savings function. The latter is a measure of how responsive savings are to increased rates of return to savings. Hence, an aging population can affect the cost of capital if the elasticities of saving functions differ systematically across age groups. In this regard, there is evidence showing that the elasticity of the savings function declines as the share of the elderly in the population increases. [17]

In summary, an aging population can potentially affect the capital-to-labour ratio in several ways. One is via its impact on labour costs. To the extent that an aging population results in a shrinking labour force, average wages in the economy should increase. This, in turn, should increase the expected return on invested capital to the extent that companies can economize on their use of more expensive labour by increasing their use of physical capital.

A second influence comes through changes in the aggregate savings rate. A decrease in savings increases the financial costs of investment, other things constant, which should reduce the amount of physical capital available per worker. An aging population therefore suggests that the aggregate savings rate will decline, and that the financial cost of capital will rise holding other things constant, which will discourage capital investments.

A third important and broad influence on capital investment is the expected rate of return on investment. Various factors can influence the return on capital investment, particularly technological changes that increase the marginal productivity of capital. Tax and regulatory policies can also influence the expected profitability of capital investments.

Total Factor Productivity Growth

The single most important contributor to improvements in real income and standards of living is the growth of total factor productivity (TFP), i.e., the growth of total real output that is capable of being produced by available amounts of labour and physical capital. The determinants of TFP growth are multidimensional, complex and, in some

[16] Debt and equity capital can also be obtained from foreign investors, which is of particular relevance for small, open economies such as Canada. This caveat will be discussed further in section 4.

[17] See Zuanazzi and Fochezetto (2020).

cases, interactive. [18] The creation, transmission, and absorption of knowledge underlie improvements in TFP. In turn, the creation, transmission, and absorption of knowledge frequently involves physical capital deepening. Improvements in human capital are also implicated in the creation, transmission, and absorption of knowledge. For example, more highly educated workers, including scientific and technical workers, are typically more productive than their less well-educated counterparts at creating and using new knowledge so as to improve overall productivity.

Property rights institutions, developed financial markets, efficient transportation and communications infrastructure, and other economic attributes also condition TFP performance. It is possible for an aging population to affect many, if not all, of these factors determining TFP, and it is beyond the scope of this essay to consider the many potential linkages, however relevant. Hence, we will focus on the relationships that are likely to be of greatest potential importance. One is the relationship between aging and the productivity of scientists, engineers, and other key participants (including managers and skilled workers) in the innovation process. [19] A second is the relationship between aging and entrepreneurship. These latter two phenomena arguably encompass the main effects of aging on the creation and use of new knowledge.

[18] For a detailed review of the relevant literature, see Isakson (2007).

[19] In this context, innovation represents the application of knowledge that is typically created by advancements in science and engineering, although those advancements frequently take place outside of formal research settings.

4. Evidence on the Conceptual Linkages Between Aging and Standards of Living

In this section, evidence on the empirical relevance of factors influencing the linkages between aging and standards of living is considered. One broad factor is how aging affects the labour force participation rate and, therefore, the supply of labour. The second is how aging affects capital deepening. The third is how aging affects total factor productivity.

Aging, Labour Force Participation Rates, and the Supply of Labour

Table 2 reports the projected labour force for 2020, 2030, and 2050 using Statistics Canada's population estimates by age category and the 2018 labour force participation rates for each category. [20] In effect, table 2 reports forecasts of the total labour force assuming the labour force participation rate for each age category remains at 2018 levels. As can be seen from table 2, modest growth in the total labour force is projected from 2020 to 2030 with a pickup in growth from 2030 to 2050. To put table 2's projected labour supply change in perspective, Canada's total labour force increased by approximately 39 percent from 1990 to 2020. [21] The projected increase from 2020 to 2050 equals approximately 21.5 percent, nearly half the rate of growth from 1990 to 2020. An implication is that unless the labour force participation rate for older workers increases substantially in the future, other determinants of real economic growth must improve or Canada's real economic growth rate over the next few decades will be slower than its growth rate over the past few decades.

For all workers, the decision to remain in the workforce depends upon the expected benefits, including financial compensation, relative to the expected costs of continuing to work. For older workers in particular, the expected benefits of continuing to work are conditioned by their ability to be productive using newer technology, as well as continued and reasonably good health and longevity. The ability to adapt to using new technology, as well as the health and longevity of older workers, in turn, are a function of average education levels and the share of work that is cognitive rather than physical (Sharpe, 2011).

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[20] The second column in the table for each year is the percentage of the estimated labour force for each age cohort. The first column is the estimated labour supply for each age cohort. Labour supply is estimated by multiplying the projected number of individuals in each age cohort by the 2018 labour force participation rate for that cohort and adding the product terms over the age cohorts.

[21] See The World Bank (2022).

Table 2: Projected Labour Force (thousands), Canada, 2020–2050

Age	2020	Percent	2030	Percent	2050	Percent
15-19	910	4.5	1,196	5.5	1,362	5.5
20-24	1,828	9	1,988	9.2	2,186	8.8
25-29	2,240	11	2,202	10.1	2,544	10.3
30-34	2,271	11.2	2,345	10.8	2,613	10.6
35-39	2,279	11.2	2,517	11.6	2,720	11
40-44	2,177	10.7	2,532	11.7	2,768	10.6
45-49	2,093	10.3	2,412	11.1	2,618	10.6
50-54	2,082	10.2	2,140	9.9	2,562	10.4
55-59	2,075	10.2	1,803	8.3	2,287	9.3
60-64	1,444	7.1	1,354	6.2	1,626	6.6
65-69	574	2.8	696	3.2	712	2.9
70+	373	1.8	542	2.5	726	2.9
Total	*20,346*		*21,727*		*24,724*	

Source: Author's calculations from data in Statistics Canada Tables 17-10-0057-01 and 14-10-0018-01.

Table 3 reports the labour force participation rates and employment rates for Canadians in three broad age categories for selected years for the month of July of the sample year. [22] The most relevant observation to be drawn from table 3 is the increase in the labour force participation rate and employment rate of individuals 55 years of age and older. The labour force participation rate reports the percentage of individuals in an age category that are actively looking for employment at prevailing wage rates, while the employment rate reports the percentage of individuals in an age category that are currently employed. Both the labour force participation rate and the employment rate increased for the oldest age group from 2002 to 2022.

It is clearly the case that the participation rate and employment rate for individuals 55 years and older are substantially lower than the comparable rates for younger individuals. Hence, the adverse impact of an aging population on labour supply growth is unlikely to be offset by anything other than continued and relatively substantial increases in the participation and employment rates of older individuals. [23]

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[22] The reported data are seasonally adjusted so that the focus on the single month of July should be representative of the annual values for the variables. The data are from Statistics Canada (2022b).
[23] The participation rate and the employment rate give somewhat different perspectives on the labour market status of older workers. Specifically, the participation rate effectively measures the willingness of individuals to accept employment, whereas the employment rate effectively measures the success of willing individuals to obtain employment.

Table 3: Labour Force Participation Rate and Employment Rate

Age	Participation Rate				Employment Rate			
	1992	*2002*	*2012*	*2022*	*1992*	*2002*	*2012*	*2022*
15-34	66.1	66.7	64	69.5	59.2	57.7	55	58.6
25-54	83.4	86.7	86.5	87.9	75	80.4	84.3	81.2
55+	25	27.5	36	36.1	22.8	26.8	33.9	34.4

Source: Statistics Canada Table 14-19-0287-02.

The increase in the labour force participation rate of the oldest group of workers, as reported in table 3, undoubtedly reflects a changing composition of work, whereby the share of workers doing physical labour has decreased substantially relative to the share doing cognitive work of one sort or another. Increasing longevity also undoubtedly has contributed to the relatively small increase in the labour force participation of older workers. As jobs have become physically safer, disability has become a less important influence on the labour force participation decisions of older workers. All of these developments should continue into the future and thereby encourage increased labour force participation rates and higher employment rates for older workers.

Large proportions of today's older workers are being affected by new technology, as it changes the way things are done in the workplace. In particular, new technologies such as Artificial Intelligence (AI) change the tasks associated with different occupations. Little is known specifically about the retraining demands that new technologies may impose on older workers, nor precisely how the marginal products of older workers will be affected by future changes in technology. The relatively slow rate of growth of TFP in Canada in recent years (to be discussed in a later section) mitigates some concern about a rapid future rate of technological obsolescence on the part of older workers. Furthermore, an increasingly higher level of attained education on the part of Canadian workers makes it more likely that forthcoming generations of older workers will be better able to manage new technologies than earlier generations of older workers and thereby remain in the workforce for a longer time period.

The conceptual case for increases in the labour force participation rate of older workers is supported by projections of future labour market conditions. For example, Martel (2019) reports Statistics Canada's projections for future labour force participation rates for Canada. Canada's overall labour force participation rate in 2036 is projected to vary from 61 percent to 63 percent depending upon a set of underlying assumptions. This compares to 66 percent in 2017. One key assumption is that the upward trends in participation rates of older workers noted earlier in this report will continue. The factors underlying the latter assumption include longer periods of education of future cohorts of older workers and continued increases in life expectancy. Still, an ongoing increase in labour force participation rates beyond the age of 50 will not fully offset the effects of an aging labour force as manifested in an overall decline in the labour force participation

rate. Put simply, small increases in participation rates of older workers will not offset the lower average participation rate of older workers compared to younger workers. [24]

Similarly, the US Bureau of Labor Statistics (2021) projects that the overall rate of labour force participation in the US will decline from 61 percent in 2027 to 59.2 percent in 2047. This projection is notwithstanding the assumption that the labour force participation rate for people 75 years and older will increase from 8.9 percent in 2020 to 11.2 percent in 2030.

In summary, while factors such as increasing longevity and a growing emphasis on conceptual workplace skills can be expected to encourage an increased labour force participation rate among the oldest in the workforce, the incremental increase is unlikely to change the overall trajectory of a slowdown in the growth of the supply of labour. [25] Hence, increased capital deepening and a faster rate of TFP growth are required if faster real economic growth and rising standards of living are going to be realized.

Aging and Capital Deepening

As discussed earlier, an aging population can affect capital deepening by directly or indirectly altering the expected returns to investing in physical capital and/or by changing the cost of capital facing organizations in Canada. Addressing the latter consideration first, it was noted earlier that retirees from the workforce have lower savings rates going forward than they did as active members of the workforce. This suggests that Canadian investors will face higher costs of capital as domestic savings rates decline with an aging Canadian population, other things constant, which will reduce the rate of physical capital formation, thereby reducing the overall rate of real economic growth in Canada.

To be sure, Canada is a small, open economy, which suggests that available savings depend upon both domestic and foreign sources. Indeed, foreign savings dwarf domestic savings, so that Canada is essentially a "price taker" when it comes to foreign inflows of financial capital. [26] This means that Canadian public and private sector borrowers can increase borrowings up to large but plausible amounts without driving up the rates they must pay foreign investors. In essence, the cost of capital to Canadian organizations will reflect global supply and demand balances in international capital markets. However, aging is a phenomenon that is occurring across the developed world, as well as in many developing countries, most notably China, which has been a major source of financial capital, particularly for Canada's real estate industry.

The World Health Organization (2021) projects that between 2020 and 2030, the proportion of the world's population over 60 years of age will increase from 12.8 percent

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[24] Martel (2019) reports Statistic Canada's projection that Canada's labour force will total 22.9 million in 2036. This is broadly consistent with estimates reported in table 2.

[25] For a detailed evaluation of the outlook for Canada's labour supply that comes to a similar conclusion, see Cross (2021).

[26] Obviously, to the extent that governments and private borrowers of capital in Canada present unique risks to foreign lenders, Canadian public and private sector borrowers may not be pure price takers.

to 16.7 percent. It projects a near doubling of the share of the world's population 60 years and older over the period 2020 (12.8 percent) to 2050 (22 percent). The aging of the US population is of particular relevance given that US investors are the single largest group of foreign investors in Canada. [27] In this regard, the US will also share in the population aging process. The US Census Bureau projects that the share of the population that is 65 years of age or older will increase from 17 percent in 2020 to 21 percent in 2030 and 22 percent in 2050 (Vespa, Medina, and Armstrong, 2020).

The "world cost of capital" depends on both the supply and demand for savings. The forecast that global savings rates will decline with an aging population is completely plausible. Forecasts of the future demand for savings are more uncertain. Acknowledging the difficulty in forecasting real interest rates, some forecasters believe that the long-run trends in global saving and investing that contributed to low real interest rates in the past will reverse in the decades ahead. [28] The primary reason cited (beyond aging populations in countries with historically high savings rates such as China and Japan) is that countries are embarking on a building boom, especially related to the conversion of the global economy from being carbon-intensive to being "Green". In addition, China's efforts to boost domestic consumption will restrain the growth of global savings.

Barsky and Easton (2021) report that over the period 1992–2019, the real yield on 10-year US Treasury Securities fell by about 350 basis points. [29] Furthermore, the fall in real interest rates was to a substantial extent a worldwide phenomenon. The decline in the real risk-free interest rate reflected both an increase in exogenous savings, as well as a decrease in investment demand. Interestingly, the main beneficiary of this Global Savings Glut (GSG) was the US Treasury, as foreign investors preferred to buy US government debt instruments as the main channel for their investments. Undoubtedly, other government borrowers, including the Canadian government, also benefitted from the GSG in the form of lower costs of borrowing, albeit perhaps not to the same degree as the US Treasury. What is relevant to note in this regard is that Canada was a relatively unattractive destination for investors during the GSG period.

Figure 3 reports over a three-decade decline in the capital-to-labour ratio in Canada, which seems to have plateaued at a new nadir in 2013. This secular decline in the capital-to-labour ratio suggests that there have been long-run forces at work that have discouraged capital deepening in Canada. [30] This decline took place, as noted above, when real interest rates were historically low. The implication is that Canada's investment environment needs to improve relative to those of competitor (for global capital) countries if Canada is going to attract a greater share of global savings and, therefore, if capital deepening is going to accelerate in Canada.

[27] Foreign investors include multinational companies. The latter must access financial capital from savers, primarily domestic financial institutions.

[28] See, for example, McKinsey Global Institute (2010).

[29] A basis point is one hundredth of a percent. So, 350 basis points is 3.5 percent.

[30] Globerman and Emes (2021), among others, document a deteriorating capital investment environment in Canada going back to at least 2014.

Figure 3: Capital-to-Labour Ratio, Canada, 1985–2018
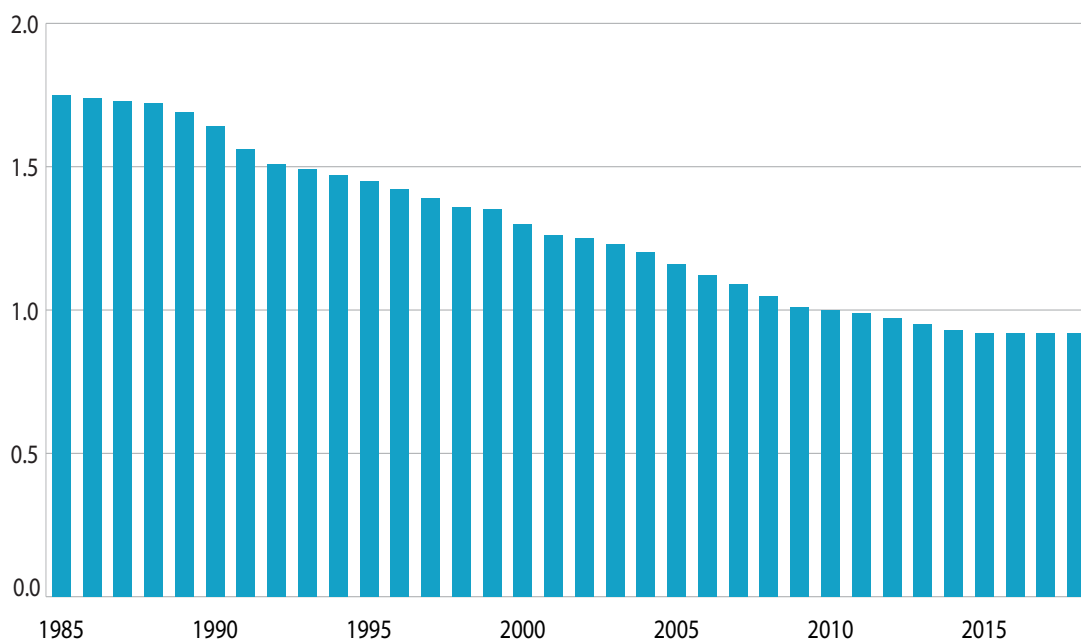
Source: Knoema (2019).

While Canada might well be positioned to participate in the green investment boom, it will also suffer from a transition away from the production of carbon fuels, and the transition will be especially painful to the extent that regulations restrict mining activities that are complements to the production of Green Energy. [31] In sum, population aging combined with a major new source of global investment demand makes it unlikely that the long-run decline in Canada's physical capital-to-labour ratio will be reversed barring major tax and regulatory changes that make Canada's private sector particularly attractive to foreign investors. Specifically, Canadian borrowers will likely face higher real costs of capital than has been the case in recent decades. Furthermore, a major outlet for physical capital investment in Canada in the past, i.e., the energy and natural resource sectors, is facing an increasingly unfavourable domestic regulatory regime, which certainly will not increase Canada's competitiveness when it comes to attracting capital investment.

Aging and TFP Growth

For purposes of considering whether and how TFP growth might be affected by an aging population, it is useful to think of TFP growth as the outcome of generating and applying knowledge to economic activities such that the capital and labour used to carry out those activities are more efficient. This perspective leads to two broad questions: 1) How

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[31] These include rare earth minerals, as well as industrial metals such as copper that are used intensively in the production of physical assets such as electric batteries, wind turbines, and the like.

does aging affect the generation of efficiency-enhancing knowledge? 2) How does aging affect the application of efficiency-enhancing knowledge?

Before assessing available evidence on the linkages between aging and TFP growth, it is useful background to consider Canada's TFP performance. **Figure 4** reports the annual percentage growth rate for TFP for Canada from 2005 to2020. It should be noted that the estimate for 2020 is strongly influenced by pandemic-related business shutdowns in the first half of 2020. In particular, the shutdown in Canada primarily affected service sector operators such as restaurants, movie theatres, and the like. These are relatively labour-intensive, low productivity operations. Hence, notwithstanding disruptions to supply chains, the overall disruptions were selective in favour of maintaining the operations of higher-productivity, goods-producing industries.

Excluding the estimate for 2020, a rather random pattern is observable for TFP growth. Of more relevance, TFP growth has arguably been a modest source of real economic growth for Canada over the period covered by figure 4. Excluding the anomalous 2020 experience, TFP growth averaged 0.4 percent annually over the period 2005–2019. This performance suggests that unless TFP growth accelerates significantly, it will not compensate for a more slowly growing labour force.

Figure 4: TFP Growth, Annual Percentage
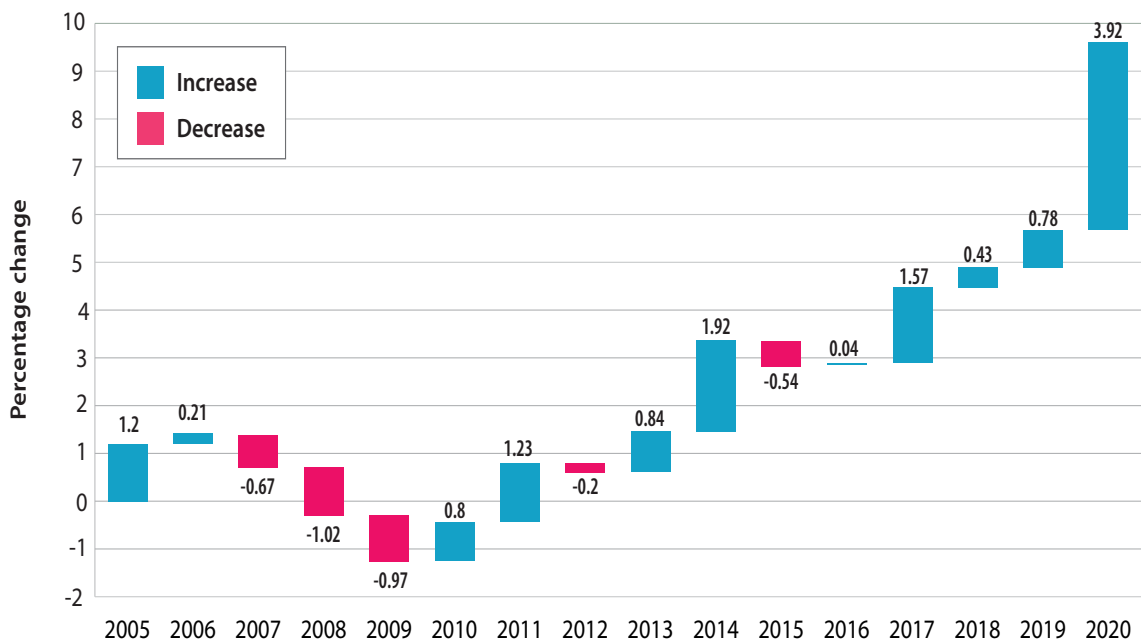
Source: OECD, Multifactor Productivity. <https://data.oecd.org/lprdty/multifactor-productivity.htm>

The literature on aging and knowledge creation tends to focus on research and development activities and the scientists and engineers that are critical inputs to research and development. Put simply, do scientists and engineers become less productive as they get older, and at what point does any productivity slowdown become manifest? There is a fairly robust literature on this issue which focuses on both the individual scientist and scientific teams. While certainly not uniformly agreed upon, the general consensus in the literature is that it is unclear that the aging of the scientific workforce by itself leads to a reduced number of paradigm shifts, breakthroughs, Nobel worthy research, or anything else in that class of outputs. [32]

A Canadian perspective on the relationship between aging and the generation of knowledge is that, as in the case of savings to finance physical capital investment, the flow of knowledge that underlies improvements in the productivity of capital and labour is largely international in nature. Potentially valuable commercial knowledge is transferable through activities such as licensing patents and copyrights, importing goods and services that embody new technology and inward foreign direct investment that brings new technologies into the host country and helps diffuse new technology through the hiring, production, and marketing activities of foreign affiliates. Given that Canada is a small, open economy in the context of knowledge creation, the aging of its population, separately from the aging of populations in economies that are larger contributors to the international pool of knowledge, is unlikely to have any substantive effect on the knowledge available to Canadian organizations.

The more relevant consideration would therefore seem to be the relationship between aging and the capacity of the Canadian economy to absorb and effectively utilize new knowledge to improve the productivity of capital and labour inputs. Critical to the absorption and effective use of new technology are institutions that incentivize such use, as well as human capital skills that are needed for adopting and using new technology.

There are numerous institutions that potentially condition an economy's ability and capacity to absorb and use new knowledge. One is the economy's property rights regime. A country's property rights regime references the legal protection that private property owners enjoy with respect to using and selling their property and internalizing the financial gains or losses from property usage and sale. The more uncertain or insecure the property rights regime, the less likely it is that participants in the economy will make investments in physical and human capital that facilitate the absorption and use of new knowledge. There is no obvious direct linkage between an aging population and a country's property rights regime, although it might be argued that an older population is less inclined to defend private property rights than a younger population to the extent that explicit or implicit transfers of wealth from private owners of property to the government are seen as making transfer payments from government to retirees more secure over the time horizon of retirees.

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[32] For an extensive summary of the relevant literature, see Ricon (2020).

A second institutional feature conditioning an economy's ability and capacity to absorb and use new technology is the domestic tax and regulatory regime. In particular, relatively high personal and corporate income tax rates discourage investments in both physical and human capital embodying new technology, particularly when those investments are associated with above-average risk, as is likely the case with investments involving new technology.

To the extent that an aging population favours government spending financed by borrowing rather than taxes, nominal tax rates may not increase commensurate with increased government spending. The argument in support of a causal relationship between an aging population and deferred taxation is that older individuals prefer to push taxes into the future while benefitting in the present from government transfers and services such as health care. The argument against such a causal relationship is the notion that many taxpayers are not seniors and do not discount higher future taxes associated with increased government debt. That is, they equate deficits to higher future tax rates and anticipate being alive to pay higher future taxes. Furthermore, older taxpayers may also recognize that their children or other relatives will need to pay higher taxes in the future to pay for current government services and transfer payments and may, therefore, oppose increased government deficits. Hence, there is no clear conceptual link between aging and the time profile of taxes. Nor is there conclusive empirical evidence on this issue.

However, there is no doubt that an aging population implies increased government expenditures on health care and transfer payments tied to public pensions and income support programs. Investors and entrepreneurs should recognize that larger government deficits imply an increased future tax burden sooner or later which, in turn, should reduce incentives to invest in physical and human capital. To this extent, an aging population, on balance, could reduce financial incentives to invest in physical and human capital that are conduits for introducing new and improved technological assets and practices.

Increases in the use of new knowledge often require new start-up companies to commercialize that knowledge. Hence, the relationship between an aging population and entrepreneurship is yet another consideration when addressing the linkages between aging and total factor productivity growth. There is no clear consensus regarding the optimal age for entrepreneurship; however, the evidence broadly identifies the age range between 25 and 49 as encompassing the bulk of the population of potential entrepreneurs. [33] Aging affects entrepreneurship in two distinct ways. First, the proclivity to want to be an entrepreneur declines beyond some age limit. [34] Second, business experience is an important asset to becoming an entrepreneur, and an aging population reduces the opportunities for individuals with entrepreneurial proclivities to gain business work experience in senior management positions, since those positions are increasingly populated by those 50 years of age and older in an aging workforce.

[33] See Sobel (2018) for a comprehensive review and evaluation of the relevant literature.
[34] Sobel (2018) posits 30–44 years of age as the range where the odds of choosing to become an entrepreneur are optimized.

In fact, while the population of Canada will age consistently through the year 2050, the "peak" age group of potential entrepreneurs, i.e., ages 30 to 44, will actually increase slightly from 33.1 percent of the workforce (as reported in table 2) to 34.1 percent in 2030. It will then decline to 32.2 percent in 2050. This data suggests that aging, per se, might not be a major hurdle to the potential supply of entrepreneurs, at least for the foreseeable future. Rather, the more important issue is whether aging can influence financial incentives to engage in entrepreneurship. To this extent, the same factors discussed above linking an aging population to government spending and taxation are relevant here. That is, the fiscal burden of caring for an aging population will be linked by potential entrepreneurs to higher future taxes, which is a discouragement to risk-taking.

An aging workforce can indirectly affect incentives for entrepreneurship by conditioning the availability of a workforce that is conducive to working in start-up companies. Over the foreseeable future, new and successful startups will likely draw upon new digital technologies such as Artificial Intelligence, biotechnology and the like. This implies that workers will increasingly be obliged to take on new tasks with the underlying need for retraining and education. It may also oblige workers to move to new organizations and even new geographic locations. It seems likely that older workers have more limited mental capacity to retrain and are also less mobile in terms of job changes and geographical relocation compared to their younger counterparts.

Much has been written about the challenges employers face in training older workers to use new technology, along with suggested initiatives to mitigate the challenges. [35] The suggested initiatives are beyond the scope of this essay. Suffice to say that in the absence of cost-effective initiatives to improve the productivity of older workers, it seems likely that employers will increasingly draw from a less productive pool of workers. For example, Guillemette (2003) reports econometric evidence showing that Canadian workers in their 50s are slightly more productive than workers in their 40s, while those in their 60s are the least productive. His estimates imply that a 5 percent shift from the 40s group to the 50s group translates into a 2.1 percent increase in productivity, while a 5 percent shift from the 50s to the 60s age group results in a 17.1 percent drop in aggregate productivity. [36]

Table 4, drawing on data reported in table 2, shows the projected percentage of Canada's labour force in three age categories in each of three years. Guillemette's econometric estimates suggest an unequivocal average decline in the productivity of Canada's workforce aged 40 and older over the period from 2020 to 2030. Specifically, there is a decrease in the share of workers aged 50–59 and an increase in the share of workers aged 40–49 and 60 and older. Hence, from 2020 to 2030, the changing age distribution of the majority share of Canada's workforce tilts towards an increased representation of less productive workers. Developments are slightly less definitive when comparing 2030

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[35] See, for example, Tishman, Van Looy ,and Bruyere (2012).

[36] It should be noted that this evidence pertains to labour productivity and not total factor productivity. However, since labour productivity is a component of total factor productivity, one can infer that a less productive labour force implies lower total factor productivity.

Table 4: Percentage of Labour Force by Age Group, 2020–2050

Age	2020	2030	2050
40-49	21%	22.8%	21.2%
50-59	20.4%	18.2%	19.7%
60+	11.7%	11.9%	12.4%

Source: Author's calculations from data in table 2.

to 2050. Over this period, the share of workers aged 40–49 years of age is projected to decline, whereas the share of workers aged 50–59 years of age is projected to increase. Guillemette's work suggests that this should increase the average productivity of Canada's workforce. However, the share of workers 60 and older is projected to increase significantly which should lower average productivity.

On balance, the data leads one to conclude that the level of domestic entrepreneurial activity and subsequent improvements in TFP are likely to be hampered by Canada's projected aging population. Presumably, policies can be implemented to enhance the ability of older workers to utilize new technologies more efficiently. However, it is not a conceptual leap to agree with Guillemette that the impact of aging on TFP growth, particularly through its adverse impact on human capital, implies that maintaining Canada's standard of living, let alone improving it, will primarily rely on capital deepening.

5. Concluding Comments

Much has been written about the economic consequences of an aging population. Perhaps no public policy issue is more important than the relationship between an aging population and an economy's standard of living. Since large government-funded programs such as health care and income support can be expected to increase substantially as Canada's population ages, taxes will inevitably increase in order to pay for those programs unless spending on other government programs declines. Faster real economic growth will therefore be needed if the real disposable incomes of tax paying Canadians are to increase.

The aging of the population itself conditions real economic growth through various channels and the overall impact, on balance, adversely affects real economic growth. Most obviously, an aging workforce characterized by a declining labour force participation rate and depreciating levels of human capital contributes to a slowdown in the growth of potential real output. This implies that increased capital deepening and a faster rate of growth of total factor productivity will be needed to compensate for the adverse impacts on economic growth of an aging population. While complex, the relationship between an aging population and these two important channels for faster real economic growth is also likely negative, on balance. In particular, an aging population in most developed countries and particularly in China suggests that the savings glut that helped maintain historically low real interest rates over the past few decades will shrink, contributing to higher real costs of capital. As well, major infrastructure investments, especially those tied to the transition away from carbon-based economies, will increase the demand for financial capital and thereby contribute to higher costs of capital. Higher real interest rates will discourage capital deepening in the absence of government policies to promote investments in physical capital.

The link between aging and total factor productivity growth is particularly complex. The available evidence does not consistently support the notion that older scientists and engineers are less able to create new knowledge that ultimately contributes to improved productivity, although "superstar" scientists are typically relatively young. However, the adoption and commercial use of new knowledge tends to be slower in an economy characterized by an aging population. For one thing, the proclivity and ability to be a successful entrepreneur tend to diminish as individuals age into their fifties and older. For another, older workers are more likely than younger workers to require retraining in order to utilize new technology effectively. Furthermore, older workers are less mobile across occupations and across geographic locations than their younger counterparts, which also contributes to a slower rate of adoption of new technology in an aging workforce.

The policy implications of these phenomena are relatively straightforward if not easy to implement. In particular, the most substantive potential offset to the growth-reducing

consequences of an aging labour force is a pick-up in capital deepening. Unfortunately, barring substantial policy changes in Canada that involve making Canada's tax and regulatory regimes more favourable to private sector investors, it is difficult to be optimistic about prospects for a capital deepening boom in Canada. In particular, tax and regulatory policy regimes in Canada must become more competitive in an international context to promote increased investments in innovative and growth-enhancing economic activities. [37] As well, initiatives to encourage increases in the labour force participation rates of older workers, as discussed in Gunderson (2022), should be prominent items on governments' policy agendas.

[37] For discussions of how Canada's personal income tax and capital gains tax structures might be modified to promote new business start-ups, see Gertz (2018) and Mitchell, Gurst, Lammam, and Jackson (2018).

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